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SECTION VII: KNOWLEDGE AND TECHNOLOGY TRANSFER

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Knowledge Map of Fields and Subfields of Erkowit Conferences (1966-2000)

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Abstract
Sudan as a third world country is facing a lot of development problems. In the middle sixties of the twentieth century the University of Khartoum organized a series of conferences entitled Erkowit Conference. Each conference was dedicated to a major topic of development. The government continuously provided financial and logistical support for holding this annual conference. The governments were supposed to benefit from the findings and recommendations of the conferences. The conference was held 13 times. Although the conference was not regularly held, it was completely stopped after 2000. The objective of this paper is making a knowledge map for Erkowit conferences from 1966 to 2000. Using topic based analysis technique knowledge map was developed. The K map contains 12 fields, 61 subfields and 357 papers. The highest numbers of papers (64) were under economics and foreign aids fields and the fields with low numbers of papers are infrastructure and demography. The most papers in research fields were in agriculture.

Keywords: Knowledge Map, Sudan, Human Development, Conferences

Introduction

Sudan as a third world country is facing a lot of development problems. For studying these problems and coming out with solutions, the University of Khartoum organized a series of conferences entitled Erkowit conference. Erkowit is a summer resort in the red sea cliffs, thus it was selected as a place for holding this conference due to its fine weather and availability of accommodation. However the conference was held in places other than Erkowit but the name was kept. Each conference was dedicated to a major topic of development. The government continuously provided financial and logistical support for holding this annual conference. The governments were supposed to benefit from the findings and recommendations of the conferences. The conference was held 13 times (Appendix1) although the conference was not regularly held; it was completely stopped after 2000.

Objectives

The objectives of this paper are:

- Making a knowledge map for Erkowit conferences from 1966 to 2000.
- This K map will help researchers to reach the papers of importance for them in an easy way. This work gives an example to be followed by Sudanese researchers in order to expose the previous works concealed behind drawers.

Literature Review

A knowledge map is **"a visual display of captured information and relationships, which enables the efficient communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail. The individual items of knowledge included in**

such a map can be text, stories, graphics, models, or numbers. Knowledge mapping is defined as the process of associating items of information or knowledge (preferably visually) in such a way that the mapping itself also creates additional Knowledge". (Eppler, 2008; Vail, 1999)[1].Different researches used knowledge map technique to mapping knowledge. Some researcher used it to tracking research patterns and changes [2, 3, 4, and 5], support e-learning [6] translation process [7] and leading organization [8]. While other focusing on developing and building the knowledge map by classifying it [1] make it searchable [9] and describe the sophisticated process of building it [10] to build the K map they used different techniques e.g. keyword-based network analysis [2] text mining techniques [6],social network analysis technique [8] topic based analysis (core topic sub topic) [4] also the K map of this paper developed on topic based analysis technique (Fields and Sub fields) some of them used text mining software to made K map from conference proceeding [5] The procedure of this paper does not depend on software because all previous research in Sudan and the majority of the recent researches are not computerized, however dependence on modern procedures only will not help us extract the valuable findings based on hard copying. The knowledge map given in this paper tries to list the problems of development as tackled by Erkowit conferences.

Additionally to find if some other development problems were not treated. It is worth mentioning that the majority of Erkowit conferences were held before 1990(see appendix 1) so the concept of development in Erkowit conferences is different form the concept which was adopted by the economist Mahboob Alhaq in Human Development Report HDR 1990. UN coined a new definition to Human Development deviating from relying only on Gross Domestic Product (GDP) measure; UN defined also development as a process of enlarging people's choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living; additional choices include political freedom, guaranteed human rights and self-respect" [11] .

Research Methodology

Topic based analysis technique used to classify treated topic of Erkowit conferences. The steps of this research process were designed as follows:

Step One: Research Questions

Are the problems of human development in Sudan discussed before? Are scientific papers and conferences enough to address these problems? Do some governments of Sudanese deal seriously with development problems? Why we can't solve human development problems? Is it bad government or bad scientist, or both of them? Is there real identification of the problems in Sudan?

Step Two: Take an Example

Erkowit conferences were taken as example, because this conference dealt with human development problems in Sudan.

Step Three: Study and Document Erkowit Conferences

1. Collect most information about Erkowit conferences, the volume of conferences was distributed in two libraries Sudan library and Afro-Asian institute library, both of two libraries in Khartoum University. All volumes of conferences were found on a hard format.
2. The author writes and copied the program conference, steering committee list, and participation list, final recommendations of the conference and the references of each paper.

3. Classified the data of conference as follows:
   conference name, number, location, date, language of papers, number of papers, name of author with his/her organization, number of volumes, the name of organization organized the conference, the recommendations of conference, and the reference of each papers.
   These steps have been done to the all 12 conferences except one because wasn't found.
   Step Four: Literature Review
   Online search's revealed more than 30 papers about K map and its applications.
   Step Five: Classification and Build Knowledge Map Based on Topic.

1. Categorizing, grouping and building a new list of fields, subfields and papers of Erkowit conferences. The classification was done topic based and as the classification of steering committee of conference, also some time as the name of conferences.
2. Re-categorizing, regrouping and rebuilding the list of fields, subfields and papers
3. Categorizing, grouping and building a new Knowledge Map of 12 fields, 61 subfields and 357 papers of Erkowit conferences.

Results and Discussion

The classification of fields was done from papers name, conferences theme and from classification of papers in some Erkowit conferences program, also the classification of each subfield depended on the theme of papers. There is no field named development because all Erkowit conferences concern with development. Table 1 show the developed knowledge map for Erkowit conferences.

Table No (1): Knowledge Map of Fields, Subfields and Numbers of papers of Erkowit Conferences

Fields	Subfields	No of papers
1. Agriculture	General	10
	Agriculture industry	2
	Animal production	12
	Field crops	2
	Irrigated agriculture	2
	rain-fed	4
	Horticulture	3
2. Natural resources	Ground water	9
	Range management	8
	Forestry	5
	Geology and mineral resources	5
	Livestock	7
	Wild life	1
	Soil	1
	Environment	4
3. Human resources	Planning	15
	Training	7
	Qualification	4
	Statistics	4

4. Economics & foreign aids	Food security	4
	Finance	12
	Foreign aids	15
	Planning	13
	Social welfare	10
	Transportation	8
	Holistic economy	2
5. Industry	General	18
	Technical	11
	Economic	10
	Social and human	4
	Manufacturing	4
	Planning	2
6. Government administration	Government administration	10
	Policy	1
	Law	6
	Foreign affairs	10
	Politics	19
7. Infrastructure	Roads , highways and dams	5
8. Services	Education	15
	Railways	1
	Communication	1
	Health	3
	Housing	1
	Drinking water	4
9. Research	Agriculture	11
	Research	1
	Demography	2
	Geology	1
	Technology	1
	Health	1
	Industry	4
	Trade	2
10. Demography	Statistics	1
	Gender	2
	Immigration	2
11. Tourism	Development , rehabilitation and promotion of tourism resources in Sudan	8
	Environmental tourism	4
	Heritage and culture	2
	Archaeology	3
	Tourism security: touristic communication and promotion	2
12. Culture	Sociology	16

It can be noticed from Table (1) that there are 12 fields, 61subfields and 357 papers. The number of papers was 354 papers. This difference appears because some papers belong to more than one field. The objectives of papers are similar because the main topics were about development. Some fields e.g. natural resources and research had 8 subfields. Some fields had one subfields e.g. infrastructure and culture.

Also it's noticed that the most papers in research fields was in agriculture this is natural because the country is agricultural. All the papers in culture fields were in the sociology domain. The technology discussed in one paper belonged to research field in the tenth conference (1985). The paper name was "appropriate technology for developing countries" and the language of the paper was Arabic, and the conference name was "Foreign Aid in Sudan".

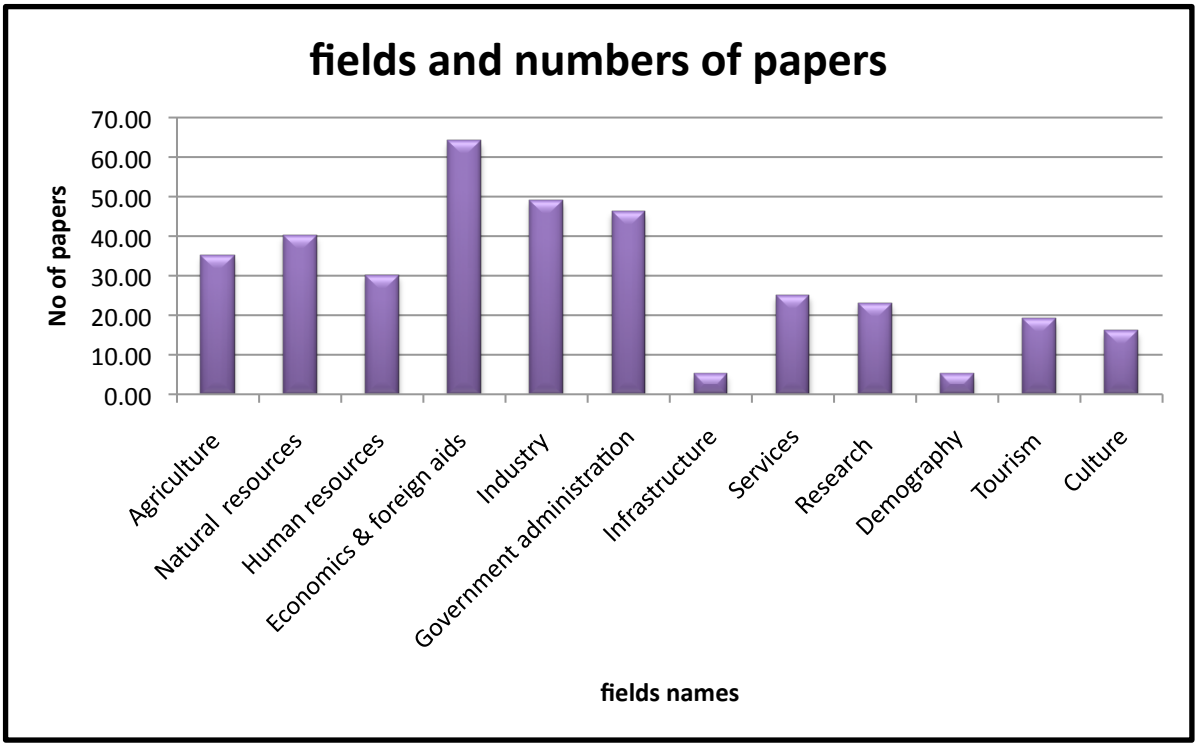

Figure (1): Fields and Numbers of Papers of Erkowit Conferences.

From (Figure 1) it appears that the highest numbers of papers (64) belong to the fields of economics and foreign aid, all these papers were presented before year 1990, this could be explained by the fact that the concept of human development appeared after 1990 by Mahboob Alhaq. Next in frequency come the papers on Industry, 49 papers. It is worth mentioning that the first conference (1966) was on industry in Sudan. This reflects the national ambitions of the elites at that period of their nation's history. There are 46 papers under government administration field, 40 papers in natural resources, agriculture with 35 papers, human resources with 30 papers, services with 25, research with 23 papers, tourism with 19 papers, culture with 16, demography with 5, and infrastructure 5. The lowest fields that have little numbers of papers are infrastructure and demography.

Conclusion

The 12 conferences of Erkowit discussed 345 papers in years (1966 to 2000) the aim of conferences is to discuss development problems and give recommendation to government to solve these problems. From knowledge map it appears 12 fields and 61 subfields with 357 papers, there is no field named development because all fields discussed development. The highest numbers of papers (64) under economics and foreign aids field and the lowest numbers of papers (5) under the demography and infrastructure fields. Most of the papers in research fields were in agriculture. There is one paper discussed appropriate technology with name appropriate technology for developing countries.

Future Work

Only the methodology and the knowledge map of fields and subfields of Erkowit conferences (1966-2000) was reported in this paper. Future research will develop this K map using a computer programing language to mapping Erkowit conferences and use Delphi method with experts to validate topic taxonomy and analysis the knowledge map. After programming the data base of Erkowit Conferences the author intends to see the relationship among Erkowit conferences and, try to find to what extend Erkowit conferences support the government decisions related to development problems? Additionally present the recommendations of Erkowit conferences in order to follow the fate of these recommendations whether used or ignored and to find reasons for that.

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Appendix (1): Name of Erkowit Conferences, the year's, number of papers and conference language

Conference	**Year**	**Conference Name**	**No. of papers**	**Conference Language**
First	1966	Industry in the Sudan	29	English
Second	1967	Sudan path to Self-Sufficiency	56	Arabic
Third	1968	Manpower and education in Sudan	27	Arabic/ English
Fourth	1969	A Model Plan of Development for the Sudan	38	Arabic / English
Fifth	1971	Social and economic development in the Southern Sudan	44	Arabic / English
Sixth	1972	About the organization of the public sector in the stage of socialist transformation	15	Arabic
Seventh	1973	Economic & social development-west Sudan	44	Arabic / English
Eighth	1975	Economic & social development-East Sudan	25	Arabic
Ninth	1976	Economic & social development-North Sudan	Unknown	Unknown
Tenth	1985	Foreign aid in Sudan	19	Arabic / English
Eleventh	1986	National construction proceeds of past and future directions	29	Arabic
Twelfth	1996	Tourism in Sudan	15	Arabic
Thirteenth	2000	Sudan and neighboring countries: factors of stability and development	13	Arabic

Impact of Technology Transfer on Energy Consumption in Industrial Sector

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Abstract
The twin concepts of knowledge and technology transfer are not new to the third world nations. The role of technology in development has attracted increased attention in recent years, particularly around the question of how to bridge the technological gap between countries with different levels of industrial capacity. The industrial sector involves a range of activities, which is significant to energy consumption and a considerable source of both conventional pollutants and greenhouse gas emissions. This paper focuses on technology transfer, how advantageous it is to enhance and promote a green economy with more emphasis on the industrial sector. Technology transfer definition, the need for transfer, methods of transfer and the barriers to overcome, which constitute an overview of technology transfer are addressed. This study shows the various areas in which most of the energy consumed in the industry could be saved through improved technology and technology transfer.

Keywords: Energy Consumption, Technology Transfer, Industrial Sector, Emissions.

Introduction

Knowledge and technology transfer play a major role in international assistance to developing nations (UNCTAD, 2010). These twin concepts are nothing new to many third world nations. Since the middle of the twentieth century, these nations have been engaged in intense efforts to import the developed technologies of the northern industrialized countries and bridge the economic gap between the North and the South (David M. Haug, 1992).
Industry is the part of the economy that transforms raw materials into manufactured goods. This sector uses a large amount of energy to power a diverse range of manufacturing and resource extraction processes. Many industrial processes require large amounts of heat and mechanical power, most of which is delivered as natural gas, petroleum fuels and as electricity (Lawrence B. Evans, 2003).

To cut down on energy consumption, solutions have been implemented. Among them, technology transfer has been introduced. Advanced technologies have the potential to dramatically reduce industrial energy consumption and improve the energy economics for the major industries. International technology transfer has been the focus of attention in the effort to mitigate and adapt to the global climate change. By exploiting existing resources, foreign and domestic technology transfer may directly affect the economic development of the recipient country in many ways. Strategies and improved energy technologies can dramatically reduce industrial energy consumption.

The next section will provide a general overview of the technology transfer process, including technology transfer definition, the need for technology transfer, forms and methods of transferring technology and the barriers to technology transfer. The section after that focuses on

energy consumption in the industrial sector. Finally, the last section deals with the measures implemented to reduce industrial energy consumption in relation to technology transfer.

Overview of the Technology Transfer Process

The definitions and concepts of technology transfer have been discussed in many different ways based on the disciplines of research and according to the purpose of the research (Bozeman, 2000). All the definitions concur that the term technology transfer encompasses all the activities related to flows of applicable knowledge, skill, capability, expertise, equipment or facilities from one location to another within a specific time frame (Ramanathan, 2001). The transfer of technology requires a sustained relationship between two entities over a period of time to enable the receiving entity to produce the product with the desired level of quality standards and cost efficiency (Reddy and Zhoa, 1990).

Hoffman and Girvan (1990) argue that technology transfer needs to be perceived in terms of achieving three core objectives: The generation of new knowledge, the introduction of new techniques by means of investment of new plants, and the improvement of existing techniques. There are many factors to be considered in transferring a technology and different theories and models have been addressing some of these factors. The failure to take these factors into account resulted in many unsatisfactory outcomes of technology transfer. We develop a model below (Figure 1), which considers the technology transfer process as a sequence of steps. These steps are discussed further below:

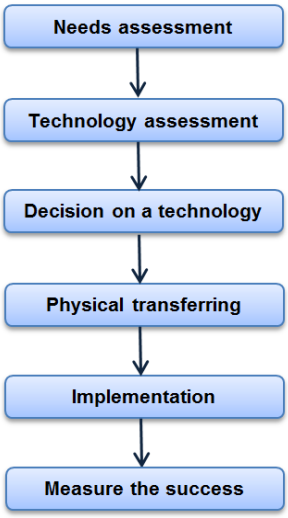

Figure 1. Technology transfer steps

Needs assessment: This is the first and the most crucial step. This involves identifying the needs of the recipient society.

Technology assessment: The aim of technology assessment is to inform decision makers, to provide an early warning signal for unintended consequences, to prepare stakeholders for possible technological changes, or to facilitate the participation of stakeholders in decision making (Smits/Leyten, 1988).

Decision on a technology: After assessing the possible alternative technologies, the most appropriate technology is selected.

Physical transfer: This includes all the procurement and transportation processes of the technology.

Implementation: The final process of technology transfer is implementing the technology. Absorption and further modification of the technology should be taken into account for developing countries as stated by Awny (2005).

Measure the success: Measuring the success or failure of the transfer process helps to learn from mistakes and leads to improving the next transfer processes.

Technological knowledge, experience and equipment can be transferred through various channels such as export, foreign direct investments (FDI), joint ventures, licensing and imitation.

Foreign direct investments: Foreign direct investment (FDI) is a direct investment into production or business in a country by an individual or company of another country (OECD Factbook 2013). Foreign direct investment (FDI) is a key element in international economic integration. FDI creates direct, stable and long-lasting links between economies. It encourages the transfer of technology and know-how between countries, and allows the host economy to promote its products more widely in international markets. FDI is also an additional source of funding for investment and, under the right policy environment, can be an important vehicle for development.

Joint ventures: Joint ventures are long-term relationships involving the pooling of assets, joint management, profit and risk sharing, joint marketing, servicing, and production. In a typical agreement, technology is transferred primarily through technical liaisons, training, and continuing operational support. Foreign investors have become increasingly willing to participate in joint ventures and partnerships with firms in developing countries.

Licensing: Since every patented technology is unique, every license agreement reflects the particular needs and expectations of the licensor and licensee. Technology licensing and transfer of technology are important factors in strategic alliances and international joint ventures in order to maintain a competitive edge in a market economy.

Imitation: As Jovanovic (1997) estimates, the learning cost of new knowledge is huge. Imitative activity has long been identified as a learning activity. Many firms start up by imitating, and they often develop new technology based on the knowledge they learnt from others.

Technology transfer implies the movement of physical structure, knowledge, skills, organization, values, and capital from the site of generation to the receiving site (Mittelman & Pasha, 1997). Although technology transfer is often seen as a private interaction between two companies or trade partners, institutional barriers and policies influence the transaction process, as well as the efficiency of the transfer process.

Market and financial barriers: Market and financial barriers are frequently present due to a shortage of financial resources and a lack of developed markets for the technology. Shortage of financing is very common in developing countries and caused by poor macroeconomic conditions, which can include underdeveloped financial sectors, high import duties, high or uncertain inflation or interest rates, uncertain stability of tax and tariff policies and investment risks. Difficulties in accessing capital due to inadequate financial strength usually pose serious obstacles to the private sector, mainly to small and medium enterprises.

Institutional and informational barriers: These include: lack of supporting policies and frameworks, including codes and standards for the evaluation and implementation of environmentally sound technologies; lack of support for an open and transparent international

banking and trading system; low, often subsidized conventional energy prices resulting in negative incentives to adopt energy-saving measures and renewable energy technologies; inadequate vision about and understanding of local need and demands; shortage of information that can be caused by limited access to media resulting in lack of data, knowledge and awareness, especially about emerging technologies; and lack of access to relevant and credible information on potential partners to allow for the timely formation of effective relationships, which can enhance the penetration of environmentally sound technologies.

Other barriers: Other important barriers are: lack of understanding the role of developed and developing countries and international institutions in the failures and successes of past technology cooperation arrangements; insufficient human and institutional capabilities; inability to access, select, import, develop and adapt appropriate technologies; lack of science, engineering and technical knowledge available to private industry; insufficient R&D because of lack of relevant investments and inadequate science and educational infrastructure (IPCC 2000).

Technology is a passive resource whose effectiveness depends on humans. Consequently, one of the most critical components for effective technology transfer is a person's ability to learn new technology, which can be gained through extended education.

Energy Consumption in the Industrial Sector

The industrial sector is extremely diverse and involves a range of activities. Aggregate energy use and emissions depend on the structure on industry and the energy and carbon intensity of each of the activities. According to EIA Data, industry is the major user of energy in modern society, accounting for roughly 51.7% of final energy use. Coal and oil are heavily used, especially by primary industry and manufacturing and refining. Gas is being used increasingly to replace coal because it is a cleaner fuel producing less impact on the environment. Electricity is only a minor component of industrial energy use, especially in its application in driving electric motors.

In the industrial sector, energy is used primarily to produce heat, to generate steam or as a source of motive power. For example, coal is one of the types of energy used by the cement industry to heat cement ovens. Many other industries use natural gas to fuel boilers for steam generation and electricity to power motors for pumps and fans. The mix and the intensity of fuels consumed in the industrial sector vary across regions and countries, depending on the level and mix of economic activity and technological development. Although electricity is used in virtually the entire sector, it is the pulp and paper and the smelting and refining industries that require the most electricity.

The International Energy Outlook 2013 projected that industrial world energy consumption will grow between 2010 and 2040. Much of the long-term growth in industrial sector delivered energy consumption takes place in countries outside the Organization for Economic Cooperation and Development (OECD). In fact, it can be seen on the diagram below that the non-OECD countries, which accounted for 64% of world total delivered energy in the industrial sector in 2010, will grow to account for 72% of world total delivered energy consumption in the industrial sector in 2040.

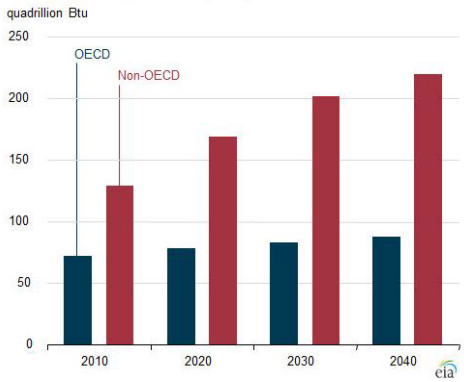

Figure 2. OECD and non-OECD industrial sector delivered energy consumption. ***Source:*** *IEO 2013*

Industrial production is an important engine to increase the economic activity, generate employment, and build up the infrastructure in developing countries. Investment in industry seems to have a stronger relation with economic growth than investments in other sectors (UNIDO, 1997). Since the beginning of the industrial age, the growth in the world economy has been driven by the increased use of energy. Technologies developed for a special industrial infrastructure may not always be the right choice for another. Adaptation and development of technology to suit the needs is an essential step in successful transfer of technology. Technology transfer is a process involving the trade and investment in technology. The globalization of industries will impact technology transfer in such a way that transfer of technology within and between countries will meet similar barriers and challenges.

Technology transfer involves more than hardware supply, it can involve the complex processes of sharing knowledge and adapting technology to meeting local conditions. Domestic technical and managerial capacities, institutions and investments in technological learning all influence the effectiveness with which technology can be absorbed and adapted. These considerations complicate the measurement problem. Human resource and institutional development are crucial to facilitating technology utilization. Institutional development includes capacities for technology and business assessment, incubation, and technology testing and demonstration.

Measures to Reduce Energy Consumption in the Industrial Sector

Industrial motor systems such as pumping systems, fan systems, compressed air systems, and materials processing systems account for 63% of the electricity consumed in the industrial sector. For example, electric motor-driven systems used for production processes consumed 679 billion kWh in 2010 (McKane et al., 2010). As shown on the chart in Fig. 3, pumping, fan, and compressed air systems represent over a half of the motor-driven system electricity consumption.

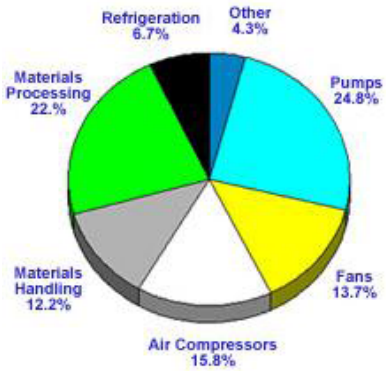

Figure 3. Motor system energy consumption by application. *Source*: A. McKane et al., 2010.

These systems, along with steam systems and process heating equipment, have been a particular focus on strategies to save energy.

Steam: Steam is used for a multitude of purposes in industrial plants. It can provide heat for chemical processing, hot water for cleaning purposes, steam for input to turbines for producing power and so on. Steam is generally produced by boilers.

In addition, a simple maintenance program to ensure that all components of the boiler are operating at peak performance can result in substantial savings. In the absence of a good maintenance system, the burners and condensate return systems can wear or get out of adjustment. These factors can end up costing a steam system up to 20-30% of initial efficiency over 2-3 years. An estimated 10% possible energy savings on average can be achieved through improved maintenance (DOE, 2001a), which may also reduce the emissions of critical air pollutants.

Compressed air systems: Compressed air systems can consume a large component of energy, and offer the potential for large financial savings from reduced energy consumption. The biggest component of a compressed air system is the compressor unit. Compressors can utilise a variety of fuel sources, including diesel, petrol and electricity. According to the US Department of Energy, optimizing compressed air systems by installing variable speed drives, along with preventive maintenance to detect and fix air leaks, can improve energy efficiency 20-50%.

Furnaces: Furnaces are widely used in the manufacturing and mining industries. Although similar to boilers, they are usually used to melt metals for casting. Many of the potential areas for energy savings are the result of high capital cost, or require detailed changes in the current operation of the factory. These include rescheduling to reduce the occurrence of a furnace being heated with less than an optimum load, automatic control of furnaces, insulation of the furnace as well as modifications to the furnace. Although these items require large amounts of capital, consideration should be given to these issues, especially where the furnace is due to be replaced, or where a new furnace is to be purchased. Furnace systems often offer good potential for heat recovery systems where the very high temperatures in the exhaust air can be used to preheat the combustion air entering the system (DOE).

Heat Recovery: In many cases, a heat recovery unit can recover 50-90% of the available thermal energy for space heating, industrial process heating, water heating, makeup air heating, boiler makeup water preheating, industrial drying, industrial cleaning processes, heat pumps, laundries

or preheating aspirated air for oil burners. Implementing this measure recovers up to 20% of the energy used in compressed air systems annually for space heating (Price, A. and M.H. Ross, 1989).

Conclusion

This study looked at technology transfer in relation to reducing energy use in the industrial sector. The various ways of transferring various technologies without leaving out the barriers to be dealt with in seeing to the successful transfer were investigated. Maintenance was identified as a key factor in improving the ways technology can assist in the reduction of industrial energy use. The areas with big industrial energy saving potential were identified, together with the corresponding reduction means.

It is very important for governments, stakeholders and concerned industry managers and operatives to recognise the importance of technology transfer in improving the use of energy. Industrial energy reduction will constitute greener environment and the long-term benefits that come with it. It is advised that breaking the barriers to technology transfer will go a long way in achieving a present and future green environment.

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Integrating Lectures and Labs for Undergraduate Science and Engineering Education through Innovations

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Abstract
The Department of Electrical and Computer Engineering at Howard University has adopted a new curriculum with more emphasis on technical courses with specializations in energy based areas, communications, and digital systems. In keeping up with advances in technology, the department has adopted design based curriculum and computer controlled labs. This paper discusses our lab innovations in relation to the new curriculum in its third year. The Department (and other science and engineering disciplines) has traditionally offered courses and labs separately. This practice has always presented difficulties to the average student bridging the gap between the course and the related lab. Recently, we have introduced the mobile studio approach that combines labs and lectures simultaneously. It is a portable, compact, inexpensive lab equipment that combines instrumentation and other devices to form a lab station. Each student and the instructor has a work station. It consists of: a Tablet-PC with instrumentation and other features, input/output I/O board (with dc power supplies, function generator) and it can be used for analog or digital experiments, (for non electrical signals, transducers need to be used). Our new acquisition is the portable Analog Discovery that is an analog as well as digital circuit design kit. It has similar features like the mobile studio except it is more compact. It consists of dual trace scope, function generators, dual dc power supplies, 16 channel logic analyzer, and it is USB powered. The other acquisition is the energy systems simulator that supplements our energy systems program. It consists of several interchangeable modules used for ac power, wind and solar power studies. These equipments are inexpensive and can be adopted by appropriate technology institutions.

Keywords: Circuits, Digital Electronics, Mobile Studio, Analog Discovery, Simulator

1. Introduction
All science, technology, engineering and mathematics (STEM) universities are continuously upgrading their curricula that can improve the employability of the students through lectures and laboratory improvements, seminars and career fairs. American engineering universities concentrate on design principles and ability to use mathematics and science in solving everyday problems [1,3]. It is well known that the following skills are very important to STEM employers: practical application and understanding of theory to solve real world problems, innovation and creativity, ability to perform in teams, technical breath, ability to communicate (and business skills). Research skills are important for technology and effective in participating in the global community, for developing appropriate infrastructures, and to promote sustainable development initiatives. The Department's undergraduate curriculum has been revised extensively to include more areas of specialization technical electives, design and research components. The department also conducts outreach programs (such as pre-college engineering

systems and smart lighting) for high school students. The students are introduced to electrical engineering principles to under-represented groups who may become future graduate students in the engineering profession [4]. The department is a member of the Engineering Research Center group based in Rensellaer Polytechnic Institute in Troy, New York. The outreach program concentrates on smart lighting communication systems where smart lights can be used for information transfer.

We present new acquired laboratory improvements equipment to complement our new curriculum for electrical and computer engineering students. The acquire equipment are: (a) Renewable Energy Systems simulator for smart grid studies, (b) Analog Discovery, a portable analogy circuit design kit and (c) the Mobile Studio. These are used for mainly undergraduate programs and outreach high school summer programs. We introduce them to how do design in an innovative way under the guidance of the engineering faculty. They learn about the impact of electrical and computer engineering principles with emphasis on smart lighting applications and its role in future living. They do lots of hands on activities coupled with lectures. Other topics covered include communications (report writing, power point preparations, and oral presentation), team work for brainstorming and what to expect in the workplace. In addition to improving our labs the School of Engineering at Howard University has well established several research centers that focus on energy, material science and nanotechnology, signal processing and communications coupled with outreach summer programs for high school students. These programs are designed to motivate participants to pursue careers in the STEM areas.

2. Laboratories

The department has recently upgraded the labs to be in line with our new curriculum. The undergraduate teaching labs are: (i) integrated energy systems and power electronics lab. It supports ergs courses and power electronics, high voltage, renewable energy, smart grid courses, (ii) mobile studio and analog discovery lab support digital systems, circuits, electromagnetics and electronics courses

a. Renewable Energy systems simulator

The renewable energy systems simulator located in the integrated energy systems lab has several functions used to study renewable energy technologies (such as wind and solar power, energy storage coupled with the main grid, data acquisition components, and power electronics). The unit has several interchangeable modules that can be configured for wind energy, solar, storage, main grid systems studies. Figure1 shows the general assembly of the simulator with data acquisition module. Figure 2 shows the simulator next to a traditional energy conversion lab system used for dc and ac machines experiments. The simulator is compact and occupies small space.

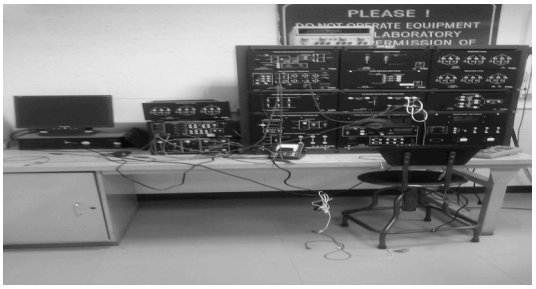


Figure 1. Front view of Renewable Energy

Figure 2. Side view of Simulator

Systems simulator

b. Sample Project: Energy Storage from Solar Panels into Batteries

This project (as an independent study course) was conducted by an international student interested in renewable energy research.

1. Introduction-Energy storage

One of the biggest problems involving electric power produced by photo-voltaic (PV) panels is that the electric energy is only available during sunny periods. Thus it is necessary to find a way to store the excess energy produced to ensure a continuous and reliable supply. This energy can be stored in batteries that can be used later, say, during cloudy periods and at night. Other storage systems include super capacitors and flywheels.

1.1 The battery charge using a PV module

Lead-acid batteries are commonly available with nominal voltage of 12V and this is the type used in this experiment. A battery can be charged when a current is forced into its positive terminal and exiting at the negative. The voltage of the battery increases gradually during charge. In this experiment, the current source used to charge the battery bank is the PV module as shown in Figure 1.1.

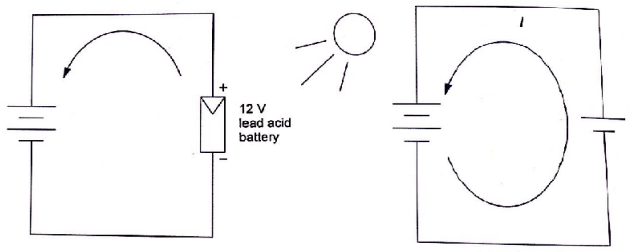


Figure 1.1. Solar charging battery bank system.

The value of the charge current depends on the battery voltage. When the battery is discharged, it's open circuit voltage, E_{OC} is low and, based on the characteristic curve, the charge current is close to the short-circuited current I_{SC}. As the battery charges, the voltage increases and the charge current decreases slightly. It is necessary that the voltage across the 12V battery should be between 12.6V and 14.4V in order to ensure an optimal battery life. As long as the operating point is maintained to the left of the knee of the E-I curve of the PV module, the battery is charged without producing gases or damaged.

1.2 Battery Bank connected to a PV module in the dark

In theory, the PV cell produces no current flow, because the current source in each PV module does not produce current when the battery open-circuit voltage E_{OC} is only able to provide a weak forward bias to each diode. However, in the practice, this is not what happens. Knowing this, we develop a new diagram that includes a resistor in parallel R_P and a resistor in series R_S with the current source and diode as shown in Figure 1.2 below. The parallel resistor explains why the PV cell current decreases with the voltage in the constant-current region of the E-I curve and the series resistor explain why the PV cell voltage decreases a little with current in the constant-voltage region of the E-I curve Figure 1.3.

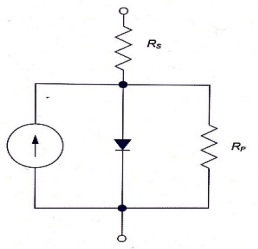
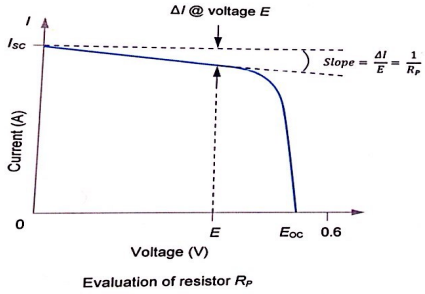


Figure 1.2. PV Model



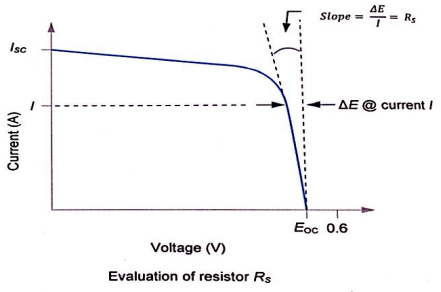


Figure 1.3 PV E-I curves

Using the actual equivalent diagram of the PV cell, we note that in no-light condition current flows in the PV module through the resistors R_P and R_S in each PV cell, discharging the battery. The resistors R_P and R_S are calculated using:

$I_{disch} = E_{oc}/(R_p + R_s)$.Although the discharge current is usually low; it is common to add a blocking diode in series with the PV module to avoid battery discharge at night.

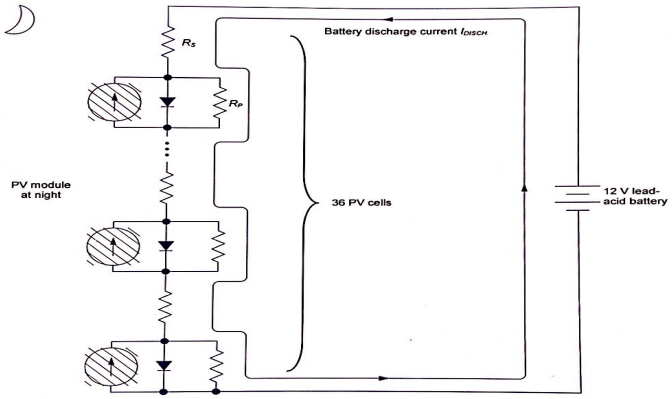


Figure 1.4 PV 36 cells in series circuit

2. Experimental procedures

2.1. Open-circuit voltage E_{OC} and short-circuit current I_{SC} of a 36-cell PV module at room temperature

In this experiment, we use the PV panels in series as a charger. We calculate the open-circuit voltage E_{OC} and the short-circuit current I_{SC}: Results: PV panel temperature: 27°C, Open-circuit voltage E_{OC} = 21V, Short-circuit current I_{SC} = 93.2mA. Single PV panel results are: Open-circuit voltage E_{OC}: = 10.4V, Short-circuit current I_{SC} = 89.6mA. It can be noticed that in this case when the panels are connected in series the Open-circuit voltage E_{OC} value is almost the double when compare with a single panel. However, that the short-circuit current I_{SC} is almost the same.

2.2. Characteristic E-I curve of a 36-cell PV module operating at room temperature

To develop the characteristic E-I curve of a 36-cell PV module, we use the circuit Figure 1.5 below.

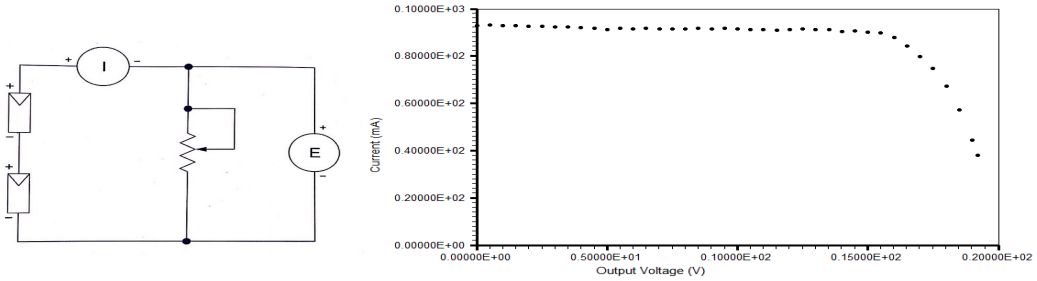


Figure 1.5.PV E-I plot generation

Varying the potentiometer, incrementing the voltage in 0.5V steps and recording the output current, we obtain the typical E-I transfer curve shown above.
Calculating the maximum power point (MPP), MPP=1.4064W. PV module voltage at MPP = 16V, and the current at MPP = 87.9mA.

2.3. Battery charging using a PV module

Measuring the open-circuit voltage E_{OC} of the lead-acid battery, we obtain:
Open-circuit voltage E_{OC} = 12.6V. Using a open-circuit voltage versus state-of-charge curve, it determines the state-of-charge of the battery is100%. It is necessary to maintain a state-of-charge between 40% and 70%. After discharging the battery, the battery parameters are: Open-circuit voltage E_{OC}: 12.410V, state-of-charge: 70%. Using the circuit shown Figure 1.6 it is possible to verify the recharge using the PV panels.

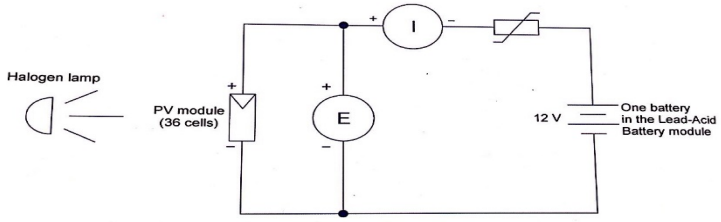


Figure 1.6. PV charging system

Before the experiment, PV module voltage at the beginning of the charge cycle = 13.08V while the charge cycle current = 89.1mA. It is noticed that the operating point of the system is located on the left of the characteristic E-I curve knee. This is important because it ensures that the battery will not be damaged during the charge. After 15 minutes, we take measurements again the output voltage and current: PV module voltage = 13.13V, the current = 90.34mA. We observe that voltage increase and the current are almost the same. This happens because the system operating point moves toward in the constant-current region.

2.4. Battery discharge at night time

Using the same circuit, but this time with the halogen lamp and fan off, it can simulate the night time conditions. Then we get following values: PV module voltage = 12.49V, current = -2.67mA. We notice that the current is flowing from the battery. The polarity of the current confirms that the battery is discharging. To avoid this phenomenon, so we add a blocking diode to prevent it.

2.5. Evaluation of the parallel and series resistances of the PV module

To calculate de resistance of the PV module we use two methods. (i) current and voltage measured during the night time. The total resistance of the 36-cell PV module. $R_P+R_S = R_T$ =module voltage/module current=12.4911/0.00267=4678 ohms. (ii) From the characteristic E-I curve, we find R_P using the inclination of the constant-current region and the R_S using the inclination of the constant-voltage region. Then: $R_T = R_p + R_s$ =PV (module voltage)/(module current) total parallel resistance Rp= $E/\Delta I = 15.5/0.0032 = 4844\Omega$. Total series resistance $R_s = \Delta E / I = 1.3/0.573 = 2.27\Omega$ Thus RT= $R_P + R_S = 4846.\Omega$

2.6. Operation with a blocking diode when the PV module is in the dark

To verify the effect of the blocking diode, we use the circuit Figure 1.7 below:

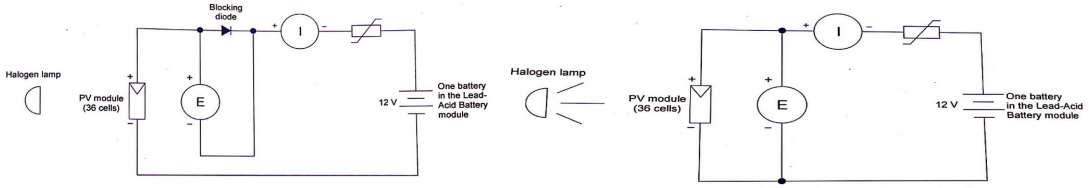


Figure 1.7. Effect of blocking diode

When the halogen lamp is off, it is noticed that the diode blocks the current flows, and the current goes to I = 0A. This means that the battery is not discharging. We also note that the voltage at the diode terminals when the PV panel is dark is: = -12.40V. Thus, the diode is reverse biased when the PV module is dark.

2.7. Operation with a blocking diode when the PV module is illuminated

To find the effect of the daytime (halogen lamp and fan on) conditions with the blocking diode, we use the circuit in Figure 1.7: PV module voltage and current: to be 13.87V, and 89.2mA. The operation point remains on the left of and closer to the knee. This happens because the voltage drop across the blocking diode, causes an increase in the PV module output voltage.

3. Discussions

Knowing that light is necessary for the power generation using PV panels, it is necessary to develop efficient techniques to store the energy produced. In this experiment, we develop techniques (batteries, super capacitors) that can be used to make this technology more reliable.

Analog Discovery

The analog discovery (Figure 2) is a very inexpensive mini portable analog and digital lab device similar to the mobile studio discussed below. It measures 2.5"Wx3"Lx1/2"D. It can fit in the palm. It consists of a dual oscilloscope, function generators (provides variable voltage 0 to 5V+, or 5V-), 16 channel digital logic analyzer, dual dc power supplies (5V+ and 5V-) and it is USB powered. It also has a room for headphones so the user can listen in to the circuit operations. See figure below being used by a student in circuits class. Circuit board connects to the color coded terminals for easy application. (for example the two voltage terminals are 1+, 1-, 2+, 2-. See wires color code in Table 1. The color code is used for proper

connections to the bread board. It can be used for several labs in sciences with a transducer interface.

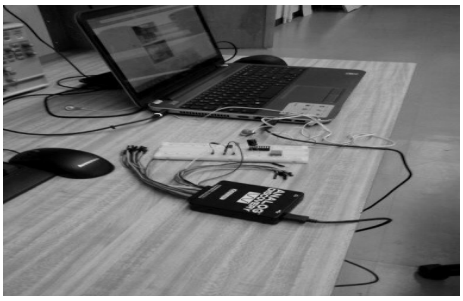


Figure 2a. Analog Discovery set Up

Figure 2b. A Student using Analog Discovery

Table 1. Analog discovery Wire Color Code

Mode	Color	Ground
Scope Channel 1 Positive Negative	 Orange Orange/white	black
Scope Channel 2 Positive negative	 Blue Blue/white	black
Power supply (dc)		
V+ 5V V- -5V	Red White	
Waveform generator 1 **Trigger in**	Yellow Grey	black
Waveform generator 2 Trigger in	Yellow/white Grey/white	black
Digital I/O Signals	Pink, green, brown, purple, all with white stripes	

The Mobile Studio

The mobile studio [5] is a portable inexpensive lab that can be adapted to suit several hands on experiences in several scientific and engineering disciplines. The studio eliminates the need for several bulky expensive classical lab equipment. It consists of: (a) a Tablet-PC (lap top) with special software that mimics instrumentation and other features. (b) input/output I/O board that consists of dc power supplies, function generator and it can be used for analog or digital experiments. (c) A bread board that contains the hardware set up. It is connected to the I/O board that is connected to the Tablet PC via a USB cable. It can be used for analog or digital systems. It is portable and it can fit in a pocket or backpack. See its use in Figure 4. Traditional labs are equipped with bulky work benches and large expensive instruments and other equipment (such as large function generators, oscilloscopes and power supplies) as shown in Figure 3, and sources that consume a lot of electric energy for operation. Due to limitation of space and bulky equipment, students work in large groups. Figure 5 shows mobile studio station.

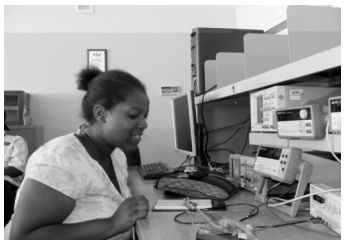


Figure 3. Old Fashion Traditional Lab Concept-Bulky

Figure 4. Compact Mobile Studio- Smart Lighting Demo

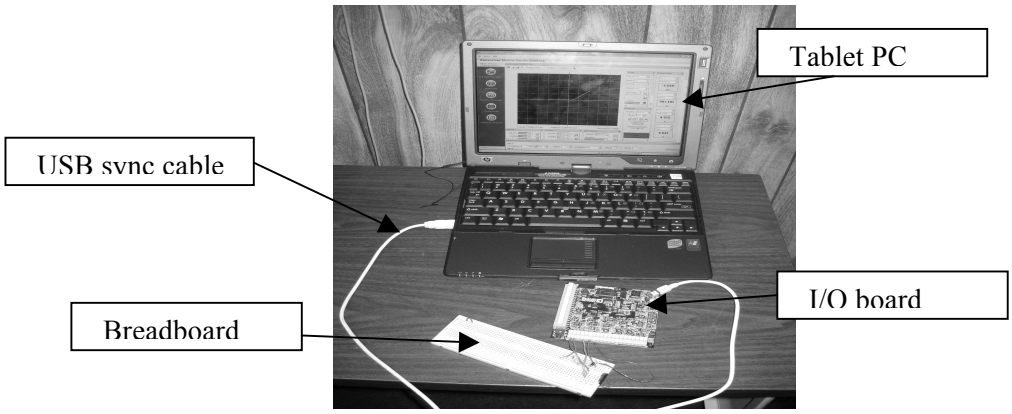


Figure 5. Mobile Studio Station

The Mobile studio is used in several fields scientific using transducers to convert other signals to electrical signals to enable the studio to interpret data.

3. Smart Lighting Institute Outreach Program

The engineering and science communities in the US are trying several methods of introducing high school students (especially under-represented groups) to STEM undergraduate education to motivate them become future researchers and educators. [2]. Howard University, is one of the Historically Black Universities and Colleges (HBCUS) that offer advanced degrees including doctoral (PhDs) in electrical and computer engineering. We have several advanced research centers on campus with outreach programs as part of community engagements. High school students are recruited to attend STEM programs such as the Smart Lighting Institute. The activities of the Smart Lighting Institute include principles of electrical and computer engineering, hands on projects with the use of LEDs and solar panels, use of mobile studio and the analog discovery for their activities, field trips where solar panels are being used, team work, communications and oral presentations of work done. It is a 4-week program in summer. The program ends with a final presentation to parents at a closing ceremony. Program assessment includes: the participants input for strengths and weak points of the program for future upgrades. The aim is to introduce under-represented high school students to pursue STEM areas in their college education and make contribution to the respective profession.

4. Conclusion

This paper has presented modernization of our labs using energy saving, and space saving equipment for renewable energy, electronics, circuits and other hands on labs as well as summer

outreach programs. The Mobile studio and the analog discovery system provide an alternative economical ways of laboratory improvement. They are portable and can also be used in lectures for hands on demonstrations. The renewable energy equipment combines the most common sources (alternator, wind and solar) of energy in a compact space for teaching as well as research. These (inexpensive compact) equipment can be adopted by Appropriate Technology Institutions.

Acknowledgements

We thank students and staff for their contributions in these upgraded labs. We also like to thank the Smart Lighting research group of Rensallear Polytechnic Institute (RPI) and the National Science Foundation (NSF) for their support.

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An Ontology-based Framework for Mobile Learning in Rural Secondary Schools

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Abstract
Mobile phone ownership across rural areas is sky rocketing. Most students and teachers in the rural areas own cell phones. These cell phones are rarely used in the learning processes. Teachers and students normally use them to communication in social networks, short message services and voice calls. In other countries, especially South Africa, it was discovered from literature that mobile learning is becoming an important issue in academic institutions, as students and teachers get connected through smart phones that combine telephony, computing, messaging and multimedia. However, in rural areas the process of designing, communicating and presenting learning resources, content services and learning content for mobile learners poses challenges such as inability to find precise and relevant content and collaborate with each other. This is mainly due to the limited bandwidth of wireless networks, limited resource available on mobile devices, internet connectivity, lack of semantics on content, inaccurate searches and information overload that has rocked the World Wide Web (WWW). This paper proposes a solution to some of the challenges by designing a conceptual ontology-based framework for mobile learning which could be used by both students and teachers/instructors in rural secondary schools in a learning and teaching process. The framework consists of a knowledge base, ontology and software agents, learning resources, learning/teaching content. Agents search for learning objects and extract knowledge according to learner and teacher/instructor profiles. The proposed framework would facilitate collaboration, sharing of ideas, instruction flow and access to learning and teaching content with accuracy, anytime from anywhere.

Keywords: mobile learning, mobile phone, ontology based framework, World Wide Web, ontology, mobile learners, learner profile, teacher profile

Introduction

Mobile learning is defined as learning delivered or supported solely or mainly by handheld and mobile technologies such as personal digital assistants (PDAs), cell phones or wireless laptops (Attewell and Savill-Smith, 2003). Most rural secondary schools if not all require a physical face to face kind of interaction in order to engage in the teaching and learning process in a formalised way. Students and teachers are not taking advantage of their phones in the teaching and learning process so that interaction is anytime from anywhere. Literature has it that mobile phone ownership across the rural areas is sky rocketing. It is estimated that 68% of rural

household own a cell phone (Gallup, 2012) and this includes teachers and students. Teachers and students rarely use these cell phones in the teaching and learning processes in a rural set up kind of a school. They normally use them for communication in social networks, short message services and voice calls. Using the mobile phone one has the potential of accessing the World Wide Web (WWW) to get learning materials and exchange content with each other. Students and teachers can make use of the mobile phones to access content, collaborate, exchange ideas, do homework and assignments in rural secondary schools. This is enhanced by the fact that most computing devices and technologies have become pervasive and ubiquitous (Chen, et al, 2003).

In rural areas the process of designing, communicating and presenting learning resources for mobile learners poses challenges (Gayeski, 2002). This is mainly due to the limited bandwidth of wireless networks, limited resource available on mobile devices, technology costs, information overload that compromises accuracy in information search processes and lack of semantics on content. In this paper, an ontology-based framework that can be adopted by students and teachers in the rural secondary schools is proposed. The framework consists of an ontology component driven by learner and teacher profiles for contextualising learning content, learning resources and content services. Search agents extract the service or content or resource and present these according to user requirements, needs and preferences (Ghaleb, et al, 2006).

Mobile phones in education

A mobile phone also known as a cellular phone or cell phone is a hand held device capable of sending and receiving messages and calls while moving around a wide geographical space (Hackemer and Peterson, 2005). It connects to a cellular network provided by mobile phone operator with access to public telephone networks. In addition to telephony, smart mobile phones offer other services such as text messaging, email, Internet access, short-range wireless communications, business applications, gaming and photography. Mobile phones that offer these services have more general computing capabilities than the old models. Students and teachers in the rural areas are moving with technology as most of them have managed to buy smartphones which have more computing power than the previous ones. Most of the functions and capabilities of these phones have not been exploited due to the kind of set up that exists in rural secondary schools.

In other countries especially South Africa, the usage of mobile communication devices has gone beyond the traditional role of communication. It has been envisaged that these cell phones are capable of supporting teaching and learning processes, a notion that we are now taking to rural secondary schools. Mobile phones have evolved and brought a new paradigm known as mobile learning ((Hackemer and Peterson, 2005). Browsing with cell phones is one convenient way for students and teachers to get online material and exchange educational material. Most of the mobile phones are incorporated with browsing applications such as Opera Mini, Internet explorer, Mozilla fire fox, Opera and Google chrome. It is envisaged that students and teachers can use browsers to check e-mails, read materials and watch lecture from anywhere at any time. Mobile phones have downloading features which can be used by students and teachers to download various kinds of materials. Teachers can download video and present them to students through a TV set available in the classrooms (Kafyulilo, 2012).

The rapid growth of access to mobile phones around the world and in Africa and Middle East regions in particular have a potential (Brown and Green, 2001) of improving teaching, learning and institutional efficiencies to enable national education system transformation.

Mobile learning applications can facilitate access to learning contents conveniently and interaction with others. Hence, the development of an ontology framework comes in as a new strategy for education that has implications in the way students and teachers interact. The components of the proposed framework are as follows, student, teacher, learner profile, teacher profile, learning resources, learning content, content services, intelligent agents, ontology layer, World Wide Web layer and the knowledge base.

Ontology

An ontology is defined as a formal explicit description of concepts in a particular or specific domain with their properties and equivalence relations (Noy and McGuinness, n.d.). These concepts have properties and relations which constitute classes. Properties are features and attributes of concepts in a particular domain and are also called slots or roles. An ontology and its individual instances of classes are referred to as knowledge base. There are different types of ontologies (Ngwenya and Chilumani, 2013), these are; static knowledge ontology which captures static knowledge about a domain. This category identifies four types of Ontologies, namely Domain Ontologies designed to represent knowledge relevant to a specific domain type, Generic Ontologies which are applied to a variety of domain types and Representational Ontologies which formulate representation entities but do not define what is represented and Metadata ontologies that provides a vocabulary for describing the content of on-line information. The second category of ontologies is that which provides reasoning about the domain knowledge, thus a problem solving knowledge. It includes, Task Ontologies that provide terms specific to a particular task and Method Ontologies that provide terms specific to a particular problem solving situations.

In the proposed framework, an ontology is used to add semantics to content, enable better learner modelling, efficient context acquisition and management and reusable customised learning content, learning resources and content services. A standard Ontology Web Language (OWL) for describing the ontology is proposed because OWL offers a set of primitives, mostly derived from description logic (Vaitha, et al, 2013). Ontologies are an important part in mobile learning as they are used to represent terms, their relations and properties so that the content becomes explicit to the user.

Methodology for the development of the framework

Several research works indicate that there is no fixed single methodology or process for ontology development. The methodology depends mainly on the ontology purpose and its application (Noy and McGuinness, n.d.). The only two steps that are fundamental to ontology building process are ontologisation and operationalisation. Ontologisation is the step for designing the conceptual ontology and operationalisation is a step for coding the conceptual ontology. In this case the ontology based framework is designed following a creative design methodology that involves a combination of literature survey for eliciting the design requirements and conceptual design for modelling the proposed ontology based framework.

The creative design methodology is a formal methodology for finding practical solutions to problems immediate to the end users (Lytras, et al, 2003). It is solution based or solution focused. It has found its way and successfully used in the area of Artificial Intelligence (AI). The methodology enables innovation that has user centred models for application development to meet end-user needs. The main technique used is value proposition and contextual design with the purpose of contextualising and appreciating user needs. The methodology is structured

in a manner in which the user insights are placed between the problem and solution. Thus the innovation occurs with the limits of the appreciated user's contextual setting ie learners and teachers in rural secondary schools. The outcome of this methodology is an integrated approach that focused on collecting user insights on mobile learning in secondary schools from literature survey and interviews translating them into an ontology-based framework for teaching and learning.

Conceptual framework

The proposed framework was designed following the SCORM (Sharable, Content, Object, Reference, Model) e-learning standards proposed by Protus as shown in Figure 1. The framework consists of knowledge base with terms, their relations and attributes. The next levels are ontology and software agents representing data and reasoning respectively (Rubens, et al, 2011). The other layer is composed of learning resources which can be in the form of texts, videos, software or any materials that teachers or learners use to acquire knowledge, learning/teaching content as pieces of information delivered to students for knowledge acquisition and content services which enable mobile users to engage with content, work with content, learn from content and create content on mobile devices. In this way, learners and teachers can access content, collaborate, exchange ideas and work on assignments according to user profiles ie learner and teacher profiles. This is facilitated by software agents that reason on the framework to extract objects for users.

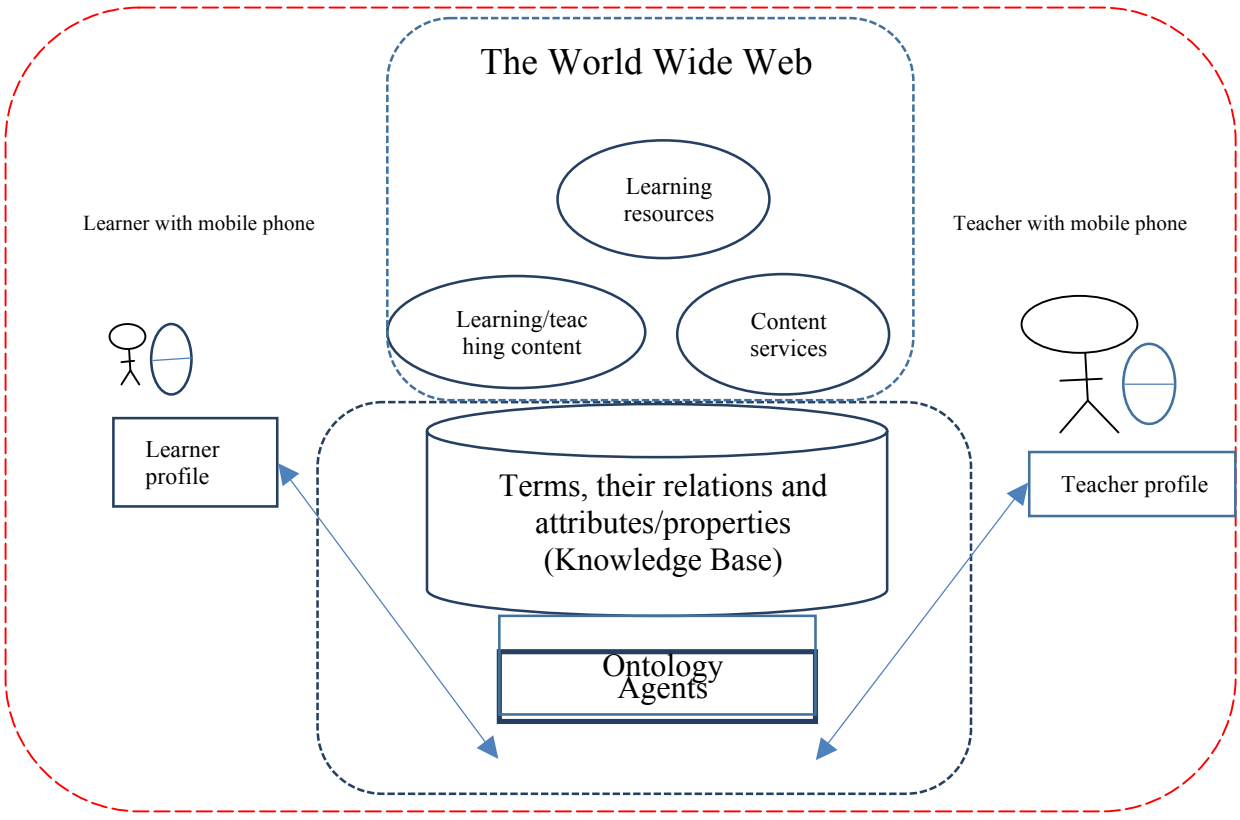

Figure 1: Proposed Ontology-Based framework.

How the Framework works

The teacher and the student interact in the following way. On the side of the teacher profile, students are given assignments, instructions or some initiation of a collaboration. In the case of assignments, students work on them and send back the answers. Thus the developed framework assists students in doing assignments or solving problems. The domain ontology in the framework expresses knowledge and concepts relevance to assignments and problems presented to students. Solution to problems or assignments presented to students are defined in the ontology-OWL files and depending on the learner profile, students are able to semantically search for learner content, learner services and learner resources using software agents. These are then presented to him/her in a precise and relevant manner in accordance with his/her user needs, requirements and preferences. In this way, students give solutions to assignments or problems and results are sent to the teacher profile for assessment and evaluation and in turn feedback is given to the students. The framework gives the opportunity for learners and teachers to improve the teaching and learning process including improvement in performance. It also gives time for analysis of the solutions given and then provide advice on improvement, ie provide learning suggestions based on solutions, course material, domain content and methods used.

Figure 2 shows a learning and teaching scenario with the following components, Student, Ontology-based framework, Student/Teacher initiate session, Presentation of a problem/assignment, Assessment/evaluation of the solution, Send feedback, Send solutions and Solve problems/assignments

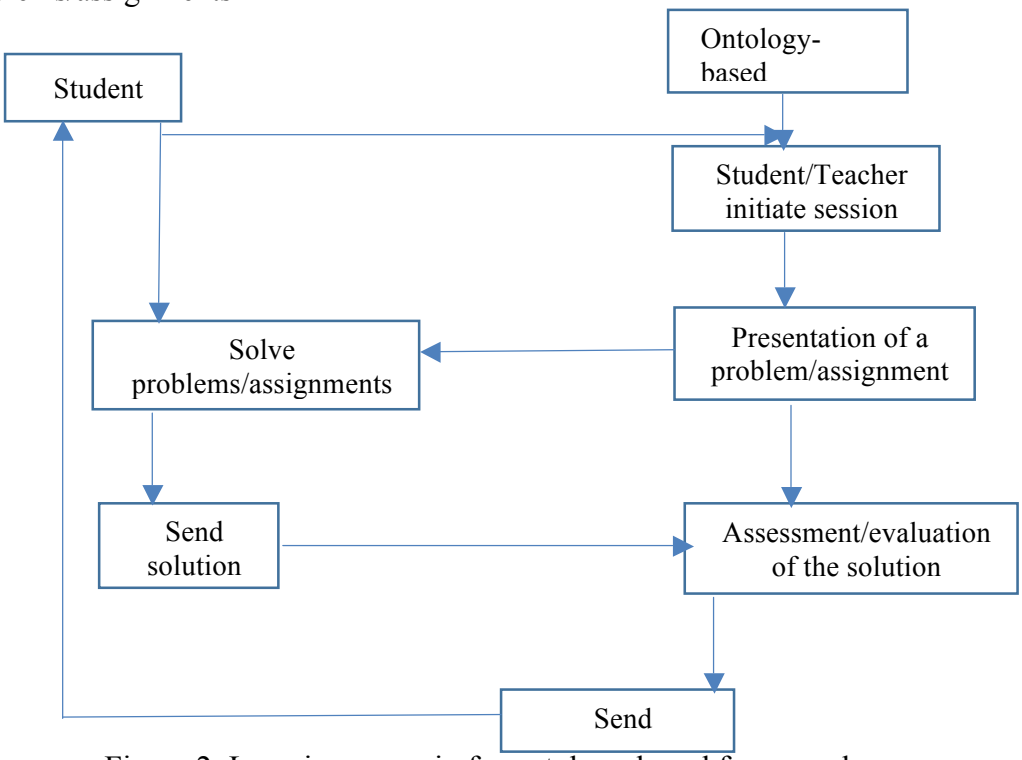

Figure 2: Learning scenario for ontology-based framework.

In this scenario the student or teacher initialises the session from the mobile phone by presentencing a problem/assignment. The role of the student is to solve the problems/assignments. The solution is then sent to the teacher for assessment and evaluation and the feedback is then sent to the student. This scenario is facilitated and handled by an

ontology-based framework which presents knowledge and concepts/terms relevant to the problems and assignments attended to by the student.

Discussion and conclusion

The ontology-based framework presents a unique scenario in which the rural secondary schools benefit by using their mobile phones and the already existing infrastructure in a rural set up. Ontologies allow the presentation of knowledge in the form of a conceptualisation (Ghaleb, et al, 2006) so that information is automatically and semantically processed to allow improvement in the teaching and learning process. Students and teachers are able to work from anywhere and at any time using their mobile phones avoiding a physical face to face scenario which waste a lot of time and other resources. Students and teachers are able to access learning resources, learning content and content services in a precise and relevant manner using intelligent agents deployed in the ontology framework.

In this paper, it has been envisaged that ontologies can improve knowledge presentation and contribute to the teaching and learning processes in rural secondary schools and that they have a potential in the application domain of information processing and retrieval. With increased development and availability of ontology tools, researchers will take up a challenge of developing ontologies in the area of mobile learning. This could make a difference in the subsequent generations to adopt and adapt these ontologies to match needs, requirements and preferences of teachers and students. The number of documents that are machine readable would definitely increase making a big step towards the Semantic Web (SW) and ontology utilisation and their application.

In the novel development of the framework, it important to highlight the fact that more work has to be done in the development of domain ontologies so that they are incorporated into the implementation of the framework. The proposed framework would capture and incorporate learning content, instructions, learner related and metadata aspects so as to support learning technology systems. The framework would also help in structuring and exploring different applications of ontology technologies especially in the area of content development. However, the given approach does not impact directly on the quality of content, though the benefits are noted in extended availability and access to semantically and ontologically developed mobile learning systems with lower educational costs.

Immerging from the discussion is the fact that the relationship between knowledge and content become explicit when using the SW and ontology technology in searching, writing, and gathering, organising and developing content. This would make teachers and students access content, collaborate, exchange ideas, do homework and assignments in a rural set up kind of secondary schools. These technologies come with sharing and reuse of learning resources in different context and environments. Currently, there is not much that has been done in the area of domain ontology development for mobile learning in specific subjects or courses. However, the SW and ontology technology have been exploited successful to some extent, though some promises by these technologies remain unaccomplished in other areas.

Recommendations are that, content developers use available SW and ontology technologies for teaching and learning to improve teaching/learning and research. This would cultivate and bring about the appreciation of the SW for mobile learning systems. The other important future development would be to migrate mobile leaning sites to semantically configured systems to facilitate teaching and content development processes. It is also important to note that this paper did not discuss the geometrical and software requirements for the mobile

phones, a situation that would require further research in the implementation of mobile learning systems.

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Community Centred Postal Service Development

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Abstract
To maintain its relevance, the postal system must look at ways to innovate and optimize. It must optimize its use of resources and delivery of current services. It must employ innovation to develop new opportunities and services. The key will be to leverage its infrastructure and build on its strong community linkage, while taking advantages of emerging trends in information and communication technology. This study uses information gathered from the Zimbabwe and South African postal systems and postal expansion options identified by the Universal Postal Union (UPU) in the areas of e-post, e-commerce, e-government and e-finance, as a basis for a framework oriented to community service in southern Africa. This framework is designed to facilitate the development of a more effective postal research strategy that is well integrated into the overall business strategy of the post office, building on existing services and incorporating new e-postal services. This overall process should encourage regional and continental integration of postal services and foster citizen and community empowerment.

Keywords: simulation, postal service, service optimization, value chain, innovation

1. Introduction

An increase in productivity, due to advances in technology, means fewer people are required in the mining, agricultural and manufacturing sectors. The increased complexity of these sectors has led to more service jobs. Of particular significance is the increase in information systems / information technology service jobs. The trend of increased productivity has led to increased consumption. Much of this consumption is in services. This has led to an increase in service occupations and new services. Also, it has caused significant changes in traditional service industries such as the post office. Postal services in developed, developing and underdeveloped countries are experiencing a reduction in traditional letter mail. This is a result of the global reach of the Internet, which has made electronic mail possible in some of the most remote corners of the world. While populations and literacy are growing exponentially, the traditional letter is seeing a continued decline. Many post offices have responded by providing a range of new e-services. While traditional letters have reduced in numbers, parcel delivery has increased significantly. This is due in large part to the development of e-commerce. Online shopping means many of our purchases now arrive on our doorstep. The Post Office is competing with local delivery services as well as global giants such as United Parcel Services (UPS), Fedex and DHL for these increased deliveries.

This research builds on work (Trimble and Keeling, 2013) that examined best practices of postal services globally and recommended the use of computational intelligence and computational science to 1) make new electronic postal services more effective, and 2) improve the competitiveness of traditional post delivery. Information systems and information technology (IS/IT) must play a significant role in shaping a postal service's business strategy. All organizations are confronted with vast quantities of data and information that must be

processed to make the most effective decisions. The postal service is positioned to effectively use computational intelligence and computational science to convert this information into knowledge constructs. With its well-established global connectivity, postal services are positioned to become more productive.

1.1 Information from Universal Postal Union

Information and communication technology (ICT) has drastically changed the face and operations of public services. Postal service is one of the most entrenched national services with global connectivity. The Universal Postal Union coordinates this global connectivity, with192 member countries. The wide spread use of email and other forms of Internet communication has contributed to a significant decline in the traditional letter-mail business. Globally, postal operators are responding by providing a range of new e-services. UPU refers to postal electronic services (e-services) as "*services, delivered by Posts to their end customers through information and communications technology (ICT) channels*" (Farah and Shakurova, 2012). The UPU has defined 55 postal e-services and studied the extent that they have developed across their diverse member countries. These e-services are divided into four categories: e-post, e-finance, e-commerce, and e-government. Table 1 is a list of the e-post codes and services. Table 2 indicates the e-government codes and services considered in the UPU study.

Table 1: e-Post Codes and Services

Services Code 101 to 110	Services Code 111 to 120	Services Code 121 to 129
Public Internet access point in post offices	E-cards	Electronic notification to Post of letter needing to be collected
Web information on services and tariffs	Online burofax	Electronic notification that letter is to be delivered, to addressee
Postal electronic mailbox	Hybrid mail (electronic to physical)	Electronic notification to sender that letter has been delivered
Online direct mail	Hybrid mail (physical to electronic)	Electronic notification to Post that parcel needs to be collected
Postal registered electronic mail	Postcode lookup	Electronic notification that parcel is to be delivered, to addressee
Electronic stamp	Postal address validation	Electronic notification to sender that parcel has been delivered
Customized electronic stamps	Post office location lookup	Check mailbox contents online
Electronic postal certification mark	Address change online	Web-based customer service and contact
Electronic signature	Holding of mail delivery online	Applications on mobile devices
E-telegram	Track and trace	

Two major findings of the UPU study are 1) "Postal e-services are growing globally, but there is a divide between industrialized and developing countries" and 2) "*Innovation capability influences the development of postal e-services more than wealth does. ... innovation capability as well as the development of regulation and infrastructure related to ICTs are factors supporting the development of postal e-services*" (Farah and Shakurova, 2012).

Table 2: e-government Codes and Services

Code 401 to 406	Code 407 to 411
Digital identity	Management of patients' electronic medical files
Driving license renewal	Electronic medical certificates
Online shopping tickets: cultural and/or sports events	Electronic collection of public medical fees
Electronic university registration	Electronic export documents
Electronic payment of retirement pensions	Electronic customs documents

Online passport application	

1.2 Best practices and best Post Offices

This UPU study [2] represented their first attempt to measure the development of postal e-services in UPU member states. It required the UPU to develop a measurement index. They used principal component analysis (PCA) to develop indices for e-post, e-finance, and e-commerce. Then PCA is used to combine these three indices into one postal electronic services index (PES index). Table 3 ranks the top ten UPU countries based on the PES index. The UPU looked into a range of factors that could possibly influence the development of postal e-services and concluded that the most significant factors were 1) innovation capability of a country, 2) the development of its telecommunication infrastructure and 3) the development of regulations related to e-services.

Table 3: Top 10 countries by PES index

PES rank	Country name	PES index	e-post rank	e-finance rank	e-commerce rank
1	Switzerland	4.32	2	1	2
2	Belarus	4.09	5	2	1
3	Italy	3.45	7	4	9
4	Germany	3.23	8	8	3
5	Qatar	2.98	3	10	3
6	Tunisia	2.85	15	5	8
7	France	2.65	1	19	22
8	Korea (Rep.)	2.43	4	17	23
9	United States	2.36	6	47	5
10	Canada	2.28	14	9	12

UPU did not include online government services as a component of the PES index. However the study does provide the index for online government services for its member countries. The top six countries were Korea (Rep.), USA, Canada, UK, Australia and Spain.

1.3 Zimbabwe Postal Services (Zimpost)

Zimpost is engaged in a number of innovative activities. They have introduced Post-buses with trailers that carry mail and parcels while providing transportation to passengers. Since 2012, Zimpost has been involved in setting up Community Information Centres (CICs) with the aim to reduce the digital divide between the urban and rural communities. Perhaps the most exiting new venture for Zimpost is their money transfer service called Zipcash. It allows Zimbabweans to send and receive money locally and internationally through the global postal network. "Zipcash is a money transfer service that sits on an electronic platform called IFS … The IFS system which the company is using was developed by the Universal Postal Union, the mother body of all post offices in the world. The system has low operating costs compared to other money transfer agencies that operate in the world." (Banda, 2014)

1.4 South African Postal Services

South Africa has a PES rank of 21 and a PES index of 1.26. This is the 2nd highest (behind Tunisia) of African countries in the UPU study. In an effort to extend its online presence, the South African Post Office (SAPO) recently announced the development of the Trust Centre, "a highly secure environment that holds the public key infrastructure (PKI) and Certificate Authorities (CAs) which provide user authentication and ensures trust and legal status in electronic transactions through the use of Trust Centre digital Certificates" (South African Post

Office, 2014). The South African Post has a network of 2600 outlets. The SAPO is the most active postal service in southern Africa. The South African Post Office delivers mail items each workday to almost ten million addresses. With more than 2,400 outlets and 5,500 service points, the SAPO has the largest reach of any organisation in South Africa.

"*Mail Business boasts 25 mail sorting centres for domestic mail and parcels including 3 international sorting centres for international mail and parcels. Between these centres, approximately 6 million mail items are handled daily and 50 tons of parcels are processed per annum*" (South African Post Office, 2014). The SAPO is positioned to play a leading role in advancing postal services across Africa. Innovation and effective information systems strategies are essential to achieving the goal of high quality postal services across Africa.

The South African Post Office has indicated that it will expand along four business lines – logistics, banking, mail movement and retail. Logistics is concerned with parcel movement, legal documents and the handling of other non-mail entities. Banking involves savings banks, check cashing, money transfer and is evolving into a full commercial banking operation. Mail movement is the traditional post office operation and involves individual letters, bulk mail and the emerging hybrid mail operations. Retail operations are the channel for a number of services to handle bill payment through the post office and well as new electronic commerce operations.

2. Results of previous work

Approaches in computational science and computational intelligence that would be useful in advancing postal services are identified in (Trimble and Keeling, 2013) and this section summaries most of this earlier effort. Computational techniques are used to analyse the service operations, as well as the vast amount of data and information collected from observing service operations. Operations research offers a wide variety of techniques that can be used to optimize resource allocation, scheduling and system element location.

2.1 Select Approaches in Computational Sciences

The most effective deployment of Post Office resources can be addressed using mathematical programming techniques such as linear, integer and dynamic programming (Taha, 2010). These can be used to determine the location of postal pickup boxes, post offices, regional distribution centres and vehicle depots (U.S. Postal Service Office of Inspector General, 2012). These techniques can also be used to facilitate scheduling of mail pickup, mail delivery and personnel.

Discrete simulation (Banks et al 2005) is an effective way to study a number of the postal operations. The discrete simulation of proposed post offices, based on data from existing post offices, can be the basis for designing and setting up new post offices and reorganizing existing ones. The information collected from previous postal activities is a reliable source for modelling the distribution functions associated with proposed simulation models. System dynamics focuses on the causal relationships in a system (Forrester, 1968). Critical to the system dynamics approach is the identification of key variables and the patterns the values of these variables form over time (Sterman, 2000) (Morrison et al 2013). The simulation time frame spans past time periods as well as the future. The results of these simulation models are compared with the historical values of the key variables as a check on model validity. This system dynamics approach has proven useful in the study of a number of global and environmental systems (Ford, 1999), (Sterman, 2014). The patterns of the reduction in traditional mail and the increase in e-services can be modelled with a focus on identifying the causal relationships and the feedback loops. An effective closed loop model will allow a study of the policy options available to the Postal Office.

2.2 Select Approaches in Computational Intelligence

Data mining can be employed to get useful information and knowledge patterns from terabytes of information collected over years on mail traffic and other postal activities (Hand et al 2013), (Domingos, 2012). As the Post Office gets more involved in electronic activities a much larger volume of information is collected and data mining techniques become more important. One of the best ways of reducing the digital divide in e-services between different countries is to develop expert systems (Giarratano and Riley, 2005), (Mpofu, 2012) that employ the best practices from the highly PES ranked countries. The expertise of the best postal operators and postal operations will be transferred to software that can easily be duplicated and used in multiple locations.

Early work with 'internet of things' focused on sensors and actuators throughout the home connected through a wireless network and operational both, within the home and remotely (Gershenfeld et al, 2004). Also, referred to as the 'internet of industry', a much wider range of equipment, products and locations can be networked (Hachem et al, 2011). The Post Office can use this technology to track trucks, packages and workers. Data collected in a range of situations over time can be used to adjust schedules, routes and the allocation of resources to increase efficiency. Issues must be addressed concerning employee and customer privacy (Bao and Chen, 2012). Issues of personnel and mail security must also be taken into account. Efficiency must be achieved without the loss of security and privacy.

2.3 Best Practices

Based on the best practices of countries with the highest PES indices, four e-post and four e-government services were identified. They are the focus of expanding the offerings of SAPO. In selecting these eight services, the impact on the broadest population was also considered. The focus e-services are shown in Table 5

Table 5: Focus e-services

Code	E-post service	Code	E-government service
101	Public internet at PO	401	Digital Identity
103	Postal electronic mailbox	405	e-payment of pensions
104	Online direct mail	407	Management of e-medical files
114	Mail (physical to electronic)	411	Electronic customs documents

For the Post Office to increase its role as a service provider, postal workers must leverage their power to influence policies that regulate traditional mail and parcel delivery and determine what new e-services the Post Office can provide. This is an example of indirect relations of production. Post Office workers must organize a larger base of workers and communities to get the government to set policies favourable to Post Office expansion. These policies allocate resources that expand the means of production for the post office. This expansion can be new technology, techniques and training that increase productivity. The expansion can also be a market expansion. The market expansion can be new services or an increase in the customer base using traditional services.

A better understanding of how the value chain of postal services functions will also allow the post office to organize itself to have a greater impact on policy decisions. Value networks are a special type of value chain.

"*Value Networks are businesses that provide exchanges and mediation between buyers and sellers, enabling relationships to be established. They earn revenue from either or both in their use of the firm's network 'everyone's a customer*". The UK's Post Office is an example both in its mail and parcel delivery and its counter services where it is acting as an agency for

government service delivery (DVLC, Social Security, etc.). The services may extend beyond connection to revenue collection, contract management, systems integration, information source, etc., in terms of adding additional value for a customer or customer segment" (Ward and Peppard, 2002).

Value networks consist of four components: 1) a set of customers, 2) some service the customers all use, and enables interaction between the customers, 3) some organization that provides the service and 4) a set of contracts that enables access to the service. The traditional postal services of mail and parcel delivery operate as value networks with a sending and a receiving customer and both should be effectively served. The postal electronic mailbox and physical to electronic hybrid mail operate as value networks. In each case the sender and receiver are customers benefiting from the delivery of mail.

Many of the added services at the Post Office, particularly many of the newer e-services operate as 'value shops'. "Value Shops are businesses that essentially are 'problem solving', delivering value by providing solutions for clients. They are characterized by intense and extensive information exchanges both in setting up the business transaction and delivery of the solution." (Ward and Peppard, 2002) The e-government services of digital identity, electronic payment of retirement pensions, management of patients' electronic medical files, and electronic customs documents all should be considered value shops. The two remaining e-post services from Table 5, public Internet access point in Post Offices and online direct mail, are both value shops.

The use of computational science and computational intelligence to increase postal service efficiency can help empower postal workers. Simulation studies of the operations of post offices and post office competitors, will provide valuable information on bottlenecks and as well as potential scenarios to increase quality. Optimization techniques such as integer programming should be used to improve resource location. Examples are the location of post boxes, postal stations, and distribution centres. Optimization techniques can be used to improve routes for delivery of services, as well as the allocation of resources (people and equipment) to the different postal locations. The demographics of local communities and nations are constantly changing. The Post Office information systems strategy must keep this in account in addressing not only recent demographic changes but planning for projected demographic changes well in advance.

3. Methodology

The methodology is to develop a framework that addresses a comprehensive strategy to promote optimization and innovation of the postal system. Framework development draws on general system theory (Boulding, 1956) in analyzing the situation as components with various relationships. Framework development also draws on dialectical materialism, where we view the situation as forces in tension that are constantly in motion (dynamic). The components in tension can lead to a qualitative change that results in drastic shifts in the forces in tension. This is indicative of innovative change or significant system optimization. The situation considered includes both components within the organization (in our case the post office) as well as external components or forces.

4. Investigation and Results

The backbone for the framework approach is information and communication technology (ICT). The postal services must refine their information systems strategy (ISS) so that it becomes a

driving force in optimization and innovation across the post office. This ISS must have both short-range and long-range components and must address the business goals and objectives of the postal business. One starting point recognized by African postal leadership (Banda, 2014) is the need for state-of-the-art information systems in the front and back office that are connected using wide area networks (WAN), mobile and cloud technologies.

The ICT driven research agenda must address the following areas:

- Data mining: data collection strategy, statistical analysis, advanced analytics using artificial intelligence and machine learning
- Knowledge management: capturing and sharing best practices, strategies, operation guidelines, standards, etc.
- Optimizing traditional postal services through use of techniques to improve logistics and resource allocation (scheduling algorithms, linear and non-linear programming, etc.)
- Modeling and simulation of postal operations for use in short ant long term planning. This would include system dynamics, agent based models and discrete simulation.
- Extending traditional postal services through innovations in e-post operations.
- Extending postal services into the e-finance arena. This would include domestic and international money transfer and other banking services.
- Extending postal services into e-governance. This includes tracking government decisions as well as providing citizens online access to government services.
- Use of ICT to enhance employee involvement and community engagement. This is critical given the historical role and obligation of the post office to the community and the importance of job creation in Africa (Trimble, 2014).

The Post Office research agenda can be advanced best by increasing the role of academic research. The strategy for university engagement represents the second dimension of the postal research framework. The strategy for university engagement must address:

- Establishing and maintaining memorandum of understanding with universities and ministries of higher education (MOUs). They must specify deliverables and committed stakeholders with the authority to implement the plan.
- Involving students as interns through the university attachment process, during school break, special visits or as part time employees to assist in the research agenda.
- Engaging the universities in working with final year students on final year projects that involve postal operations and research.
- Engaging academic staff as researchers as i) part time employees; ii) full time employees on academic leave; iii) consultants; iv) award research grants on competitive basis.
- Having Post Office technical staff enroll in MPhil and PhD programs with collaborating universities to conduct postal related research (part time or on leave from Post Office).
- Participating in related conferences such as the conference on appropriate technology.
- Organizing research track in existing postal conference such as the Durban conference.

- Collaborating with university partners to organize postal research forum, symposia and conferences to further University – Post Office research collaborations (Trimble, 2014).

5. Conclusions and Discussion

The proposed framework combines an ICT driven research agenda with a strategy for university engagement in postal services research. It should extend the footprint of optimization and innovation research within the postal organization and at universities. The framework should take advantage of the latest research developments in ICT, innovation studies and management. Universities should link other disciplines like public policy, political science and economics to this research. Work to improve the quality of service and employ innovation to expand postal operations is by nature multidisciplinary. This research effort will be extended as part of the content of 'modelling and simulation' and 'socially relevant computing' courses taught at Howard University. The simulation material will also be included in a modelling and simulation course taught at the National University of Science and Technology (NUST) in Zimbabwe. The full framework will be addressed in the MIS course on Information Systems Strategy also taught at NUST.

A historical role of the post office has been to enhance communication among a nation's citizens. This communication has been empowering. The mail and parcels, and now electronic communication have connected billions of people globally in one of the broadest sharings of information, knowledge and resources. This historical reality should serve as incentive for the Post Office to embrace innovation to improve quality of service of traditional postal operations and aggressively expand to include other forms of media and service development and delivery. The proposed curriculum and research collaboration between universities and Post Offices will help achieve a continuous innovative environment.

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Appropriate Technology and Media Interaction in India: An Overview

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Abstract
The media plays a crucial role in conveying information on appropriate technology and services that can empower people and improve their lives. This paper looks at the transition in the way print and digital media have dealt with these issues in India over the last 25-30 years. With 22 officially recognised languages, including English, local language reports have been important in creating early awareness of cost-effective innovations. This study, however, gives an overview of the reportage by mainstream English language newspapers, such as *The Hindu, Business Line, The Times of India, The Economic Times, The Indian Express, The Hindustan Times* and *Mint* from the late 1980s to the present. Online archives and digital indices were examined to identify such coverage and it was found that reportage on development issues was infrequent — *vis-a-vis*, say, corporate stories — until the early 2000s, from when traditional and new media interest increased. Serious and accurate reporting on developments benefiting grassroots communities has, in fact, been sporadic in most developing regions of the world. This paper aims to show that sustained development communication by the media could be a game-changer in increasing empowerment among the marginalised, endorsing the work of appropriate technology groups and influencing policy.

Keywords: Appropriate Technology (AT), Indian Print Media, Newspapers, Digital Media, Development Communication, ICT for Development, Mobile Phone Platform, Inclusive Growth

Introduction

The years after India's Independence in 1947 were marked by economic policies that gave primacy to rapid industrialisation. During this industrial resurgence, the economy was hit by the 'oil shock' in 1973-74. As a reaction to the soaring prices of crude oil post 1974, several agencies and scientific organisations, both in the West and in India, began research into renewable energy and other appropriate technologies. Cost-effective, sustainable and environmentally benign technologies found attention in the mainstream newspapers. Much of the coverage of these new applications of science and engineering was through short reports with some form of cost-benefit analysis and, usually, an accompanying photograph.

Social impact assessment

One of the earliest newspapers to pick up on such information was *The Hindu*, published in Madras (now Chennai), India. Its reports usually described the specific equipment, with a picture and gave an idea of the costs (Prabu, 2007). One such news item in *The Hindu* explained the indigenous technology with which Shri AMM Murugappa Chettiar Research Centre (MCRC) produced Spirulina, a nutrient-rich alga valued as a dietary supplement. Under the leadership of Dr C.V. Seshadri, MCRC, a non-profit research centre, was, in the 1970s-1980s,

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engaged in finding sustainable food, fodder and energy solutions for the rural areas through appropriate technology (MCRC website).

There was also a collaborative project between MCRC, Government agencies, their doctors and a private hospital that conducted one of the largest ever feeding trials recorded in India. Involving the inclusion of Spirulina in the diets of 5,000 pre-school children, the study established the alga's significance as an easily cultivable, natural source of Vitamin A, beta carotene, proteins, iron and anti-oxidants (Shambu Prasad, 2005). This celebrated case of *ab initio* research led to commercial success as well as important social and health outcomes.

Like MCRC, many similar groups were also committed to publication programmes that helped evoke media interest. Described below are other instances where communities in rural India gained from such reporting on alternative technologies.

Talking to *The Times of India* some years ago (Ganjapure, 2011), Sameer Kurve, Director, Centre for Science for Villages (CSV), Wardha, said: "The basic concept behind the evolution of CSV was a place which could act as a technology transfer centre and bridge the gap between portals of national laboratories and doors of rural huts." Founded in 1976 by Devendra Kumar, a disciple of Mahatma Gandhi, CSV was well-known for its simple booklets describing inventions that served everyday needs. The Centre continues its active publications programme, in English and Marathi, with special attention to simple manuals in print and electronic form.

Set up even earlier, in 1968, in Phaltan in rural Maharashtra by Dr BV Nimbkar, Nimbkar Agricultural Research Institute (NARI) undertakes research in agriculture, renewable energy, animal husbandry and sustainable development. Its activities received wide attention in the newspapers (NARI website, media coverage). The Institute's work expanded into related areas and its Director, Dr Anil Rajvanshi's articles have featured frequently in both academic journals and the popular press, both mainstream and regional.

Also founded in 1968 was the Appropriate Technology Development Association (ATDA), Lucknow, started by Mansur Hoda, who was inspired by E.F. Schumacher's philosophy. The ATDA worked on improving and inventing rural and renewable technology devices (Wikipedia). When Hoda died in 2001, *The Guardian* wrote "the rural poor of India have lost one of their most effective champions" (McRobie, 2001).

Such achievements were not confined to rural areas. In New Delhi, Anil Agarwal, an environmentalist and mechanical engineer from IIT Kanpur, established the Centre for Science and Environment (CSE) in 1980. Agarwal was founder-editor of *Down to Earth*, a science and environment magazine he started in 1992 that still forms the basis for wide debate among policy-makers and corporations as well as civil society and non-government players in an effort towards corrective action. CSE's campaign to make a soft drinks major accountable for excessive water use affecting farming, groundwater pollution and pesticide residue in the drink itself received sustained coverage in the print and electronic media that forced the corporate concerned to take remedial action (Bhushan, *Business Line*, 2003).

All these initiatives followed paths that were unconventional for their time, upending established notions of the superiority of Western science and the top-down approach of accepted scientific models. An exemplar of such unconventional thinking, Sanjit 'Bunker' Roy set up the Social Work Research Centre (SWRC) in Tilonia, a desert town in the western State of Rajasthan in 1972, initially with the aim of conducting studies on the groundwater and power requirements of the region. Now known as the Barefoot College, it is a school that teaches rural

women and men — many of them illiterate — to become solar engineers, artisans, dentists and doctors in their own villages, as Roy describes in a TED talk (Roy, 2011).

Working towards the same goal at roughly the same time was Anubrotto Kumar 'Dunu' Roy who, after a B-Tech and M-Tech from IIT Bombay in the late 1960s, "spent the better part of the next two decades repairing bicycles, water pumps and tractors in Madhya Pradesh's Shahdol district,' as a 2010 article in *Mint* puts it (Jain, 2010). He adds: "I realised that most development activities in India at that time were micro-experiments, limited to a few sectors like education and healthcare." What was required was what Roy calls "a democratic people's plan". This was created in Shahdol, in Madhya Pradesh, and encompassed a range of activity, from agriculture to industry.

It is interesting that media interest in development institutions often spiked around the time of an award or recognition of some kind, either by the Government or a reputed private entity, as indicated by the spurt in the number of news reports when NARI's Rajvanshi received the Jamnalal Bajaj Award.

Special media focus on appropriate technologies is also evident when a particular technology is in the news for a long time. One instance is the sustained reporting on the importance of rain water harvesting (RWH), following a State government legislation mandating that RWH systems be integrated in all domestic and commercial buildings.

Language

The period from the 1980s onwards saw the Hindi media focus more on grassroots social groups, offering them an "alternative discourse of democratic participation that was more inclusive" and challenged "the dominance of the national elite who depended on the English media." The vernacular media was thus robust and proactive in providing an alternative approach to development (Taberez and Tanabe, 2014). Nevertheless, as the Indian Constitution allows the Central Government to use both Hindi and English in official communication, policies tend to be influenced more by opinion pieces, debates and campaigns in the widely read English media (see Table 1).

Table 1: Daily Readership (in millions) Source: Indian Readership Surveys (IRS) 2012, 2013

English Newspapers	Region	IRS 2013	IRS 2012
The Times of India	Various cities, States	7.25	7.61
The Hindustan Times	Various cities, States	4.33	3.82
The Hindu	Various cities, States	1.47	2.16
Mumbai Mirror	Various cities, States	1.08	.81
The Telegraph	Various cities, States	.93	1.26
The Economic Times	Various cities, States	.72	.73
Mid Day	Mumbai, Pune	.50	--
Deccan Herald	Karnataka, Delhi	.45	--
The Tribune	Various cities, States	.45	.67
Deccan Chronicle	Various cities	.33	1.20

Media preoccupation

One group that was clear in its goal of scaling up to become commercially viable and achieve the widest impact was Development Alternatives (DA). Since it was founded in 1982 by Dr. Ashok Khosla, DA has researched, designed and delivered eco-solutions for the poor and the marginalised in a climate-sensitive environment. In an interview with *Mint* (Sharma, 2010), Khosla said: "Trees and rural women are the two pillars of DA. We try to solve their problems, directly or in a roundabout way."

Asked for his views on media interaction with groups working in appropriate technology, Dr. Khosla said: "DA and peer organisations received hardly any attention from the mainstream media in the early 1980s. There was a feeling that appropriate, or intermediate, technology activity was sub-standard, and was possibly even delaying development in people's lives." This, he said, was despite Mahatma Gandhi himself being an astute and firm believer in practical technology solutions in sanitation, hygiene and water supply as well as rural productivity and nutrition. "More media coverage of actual, working, field-level innovations and devices is what is needed," says Dr. Khosla, "as these directly impact the life of the common man, particularly the disadvantaged and those in the hinterland. But the media tends to be preoccupied with issues related to climate change, environment and forestry as they usually impact big business and government policy and finances." (Khosla, 2014).

Observation

In most cases, media interest in appropriate technology initiatives increased many years after the groups began their work. Such activities were, in the 1970s and 1980s, predominantly carried out by non-governmental organisations (NGOs) in areas where government departments had not carried out any meaningful intervention. The 'non-profit' label could perhaps have worked against many of the NGOs, as the media may not, at the time, have seen any commercial value in the projects.

Information and Communication Technologies for Development (ICT4D)

From the late 1990s, Internet connectivity in the urban and rural areas increased on the back of a policy thrust to promote ICT4D to enhance productivity and inclusive growth among farm and non-farm communities. Such technology was "appropriated" by several agencies to leverage their positions and reach out to the communities they needed to impact. Here's a sample of initiatives where institutions successfully leveraged the power of rural Internet.

An early entrant in this area was ICRISAT, with its Virtual Academy for the Semi-Arid Tropics (VASAT) and Agropedia. VASAT is a coalition for information, communication and capacity building, operating in South Asia and West and Central Africa. It links and mobilises stakeholders for drought mitigation in the semi-arid tropics (VASAT website). Agropedia, an online, open-access repository for information related to agriculture in India (Agropedia website), uses weekly alerts from scientists to send crop-specific text messages to farmers across India.

MS Swaminathan Research Foundation (MSSRF) set up Village Knowledge Centres (VKCs) under its IT for Change programme. It had developed the Community Managed Knowledge System for Sustainable Food Security, for farming and energy management and weather information, and represents one of the earliest instances of computers being used for development work in India (MSSRF website).

A report in *The Hindu* (July 2014) said that MSSRF's Fisher Friend Mobile Application (FFMA), an Android app used by over 1,000 fishermen to identify potential fishing zones and save on fuel, was awarded the mBillionth Award South Asia, 2014.

In an earlier report *The Hindu* (July 2013) described a joint MSSRF-Reliance Foundation initiative to distribute GPS devices to fishermen on the Andhra Pradesh coast, so that they can easily identify potential fishing zones. Reliance Foundation (RF) has, since 2010, been disseminating information to empower rural and urban communities in a philanthropic model. Its teams convey specific and relevant inputs to solve problems in farming, livestock-rearing and health as well as to promote education, micro-enterprises, the arts and cultural heritage. The RF achieves this through various media and modes, including SMS messages, local cable TV and radio programmes, knowledge sharing meetings and providing clarifications through toll-free helplines. The information sources are universities, research institutions, Government departments, hospitals, and educational institutions (reports in *Business Standard*, *The Economic Times*, *The Times of India*). The programme reaches seven States (Andhra Pradesh, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu and Union Territory of Puducherry) and has reached over 5,000 villages with more than 300 partner entities.

In 2012, *The Economic Times* reported that "smart sourcing by e-Choupal's agri-business division also helped the company cut its FMCG losses" (Mukherjee, 2012). e-Choupal was started by tobacco conglomerate ITC Ltd to link directly with rural farmers via the Internet for procurement of agricultural and aquaculture products. e-Choupal tackles the challenges posed by Indian agriculture, characterised by fragmented farms, weak infrastructure and the involvement of intermediaries (e-Choupal website).

That online services in the areas of cultivation, crop disease, education, health and e-governance can crucially impact life in the rural areas, was emphasised by *Business Line* (Warrier, 2002) and Press Trust of India (2002) articles on the n-Logue project. Part of the IIT's Tenet group, n-Logue devised a business model to set up a network of wireless Internet kiosks in villages that offered people living in remote areas unprecedented access to digital resources and opportunities.

New age initiatives

On the back of mobile phone connectivity and expanded reach of data, digital initiatives in the hinterland are, in many areas, going beyond traditional media in ensuring that empowering information is directly accessible by the key stakeholders

Ventures and start-ups over the last decade have ensured access to sophisticated digital technologies in remote areas. One such game-changer is the Digital Empowerment Foundation, set up by Osama Manzar in 2002. Curator of the mBillionth Awards, Manzar is a social entrepreneur with a mission to eliminate the information barrier between India's rural sector and 'developed' society (DEF website). A few years back he initiated a regional movement on "How Mobile can Empower Masses" that recognises and mentors mobile content. He writes a widely followed column in *Mint*. (Manzar, Osama, *Mint* Archives). In the 14 July, 2014 column he wrote of how even the poorest of poor, illiterate and those living in remote areas can use GPS devices to collect documentary proof of their land-use and obtain land titles.

In a globalised economy, where market and media greatly influence people's ideas on food and agriculture, there is a growing need for strong agrarian independence. The Deccan Development Society is a grassroots organisation working in about 75 villages with women's Sanghams (voluntary associations) in Medak District of Andhra Pradesh. Since 1985, the 5,000

Sangham members have worked to revive active cultivation over ten thousand acres, growing organic grains and millets and achieving a high level of food self-sufficiency (DDS website). The DDS women produce videos reflecting dialogues within their Sanghams to inform the outside world of their accomplishments. The women control and operate a community FM radio as well (Balaji, 2012).

Any narrative on empowerment through new media would be incomplete without the success story of CGNet-Swara. Its home page says that many of the estimated 80 million members of India's tribal communities lack access to any mainstream media. This is a key barrier to their socio-economic development, as grievances about government neglect and economic exploitation remain unvoiced. To address this problem, Shubhranshu Choudhary and his team built CGNet Swara, a voice portal that enables ordinary people to report and discuss issues of local interest. Choudhary's effort to tap the mobile phone network to carry the voices of tribals to the outside world caught so much attention that he beat US whistleblower Edward Snowden to win the Digital Activism Award, 2014, says a *Times of India* report (Chatterjee, 2014).

Latter-day digital initiatives have, thus, 'leapfrogged' and, in a sense, even replaced the mainstream print media; such projects have also received almost instant publicity.

Comparison

At this point, it may be useful to draw reference to the situation in several African countries *vis-a-vis* media discourse in the development sector. From the representational literature available, early appropriate technology initiatives, largely carried out by NGOs, seem also to have suffered media neglect, as did their Indian counterparts.

'*Africans themselves readily concede that there continues to be terrible conflict and human suffering on the continent. But what's lacking, say media observers like Sunny Bindra, a Kenyan management consultant, is context and breadth of coverage so that outsiders can see the continent whole — its potential and successes along with its very real challenges. "There are famines; they're not made up*," Bindra says. "*There are arrogant leaders. But most of the journalism that's done doesn't challenge anyone's thinking*." Reinforcing the sense of economic misery, between May and September 2010 the ten most-read US newspapers and magazines carried 245 articles mentioning poverty in Africa, but only five mentioning gross domestic product growth' (Rothmeyer, 2011). On the positive side, with the advent of mobile technologies and the change in communication interfaces, digital and telecom ventures in Africa, too, have received wide publicity. A classic and much-reported case is the mobile money transfer mechanism called m-Pesa, heavily used by people in Tanzania's and South Africa's urban areas to send money to rural regions.

In India, with the legislation mandating that companies spend a portion of profits on corporate social responsibility projects, and the keen interest among venture capital organisations and angel investors in promoting projects with a development slant, many newspapers and websites now have special pages devoted to such entrepreneurship and social enterprises. Among these are *The Hindu Business Line's* 'Emerging Entrepreneurs' section that features articles on start-ups, with a focus on policy matters, and information on rating agencies, banks, angel investors and private equity funds.

Conclusions

From the sample reports on groups working in appropriate technology, it is clear that media interest in these areas is greater now than 30 years ago. Over the last 30-35 years, when 'appropriate technology' groups were at their creative best, more proactive media interest may have created a better awareness of their work. This could have led to wider acceptance of such technologies, and thus their legitimisation, and may have influenced local and central government planners to factor such alternative development into their policy framework. In such a nurturing environment, a far more conducive eco-system could have been created, in which many practitioners of appropriate technology could have become commercially viable, with or without government backing. Though their work and application of science was of the highest quality, the inventors of that time did not have the right means to achieve the widest impact.

More than three decades later, people using appropriate technology to develop products or services have realised that many forms of new media can be deployed as powerful transformational tools. Appropriate technology in the present day is all about creating change in a holistic and sustainable way. Alternative technology initiatives of today are using digital media extensively to bring about exactly this kind of change. The digital platform has thus enabled current groups working with all kinds of sustainable, cost-effective and environment-friendly technologies or services to achieve the kind of reach and impact AT groups of 30 years ago could not have dreamed of.

The message for the innovators of today is that they should leverage digital technologies widely if they want to get their message across most effectively to their target groups. With even those among the most disadvantaged communities owning mobile phones, this reach is now practically unlimited, and achievable at low cost. More importantly, control over what is disseminated does not lie with a few media tycoons but is scattered across hundreds of entities, large and small. Given this reality, it is more feasible, even essential, for both print and digital media to report in an unbiased manner on agencies working in rural development and appropriate technology. It is crucial that more such accurate and far-sighted stories are encouraged by the managements of media houses and promoters of new media platforms if the fruits of a globalising economy are to be shared equitably across society.

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Rural Electrification Pathways to Wellbeing

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Abstract

Considerable amount of effort is dedicated to use engineering and technology for the benefit of society, but there are few studies that consider wellbeing as a measure of success of that effort from a systems perspective. There is also a lack of information about the human and natural systems interactions and the processes to which this wellbeing is attributed. To model such complex systems and interactions various methodologies have been proposed and studied. The main result of the work presented is a conceptual model encapsulating the dynamic processes involved in community perceptions and decision making, in order to better understand the impacts of the adopted technology on wellbeing along with the behavioral dynamics and pathways that prompt those impacts. The focus is on rural electrification in remote farming communities using renewable energy based mini-grids, with Duchity, Haiti as a case-study. The conceptual model is the first stage of an effort to develop complex systems based computational tools to study human wellbeing of those that have the greatest unfulfilled needs. It is expected that technology adoption will have a positive short term impact on human wellbeing, but in the long term it might promote an excess use of natural resources that would limit the ability for the communities to consistently revise the energy policy needed for the betterment of their wellbeing. Four types of central variables were identified to build the conceptual model; 1) rural electrification key areas, 2) drivers of wellbeing, 3) Millennium Development Goals, and 4) wellbeing indicators. A total of 51 relationships among 22 variables were identified, derived from work by two research groups recognized as global leaders in this research area.

Keywords: Agents, Rural Electrification, Sustainable Energy for All, Wellbeing

1. Introduction

Some studies have analyzed the relationship between electric energy consumption and the United Nations Human Development Index (HDI) (Pasternak, 2000). This approach has opened the door to further exploration of a coherent methodology that links engineering activities, such as electric energy supply, to human wellbeing. The main motivation for this work is that access to a minimum of electric energy in remote communities significantly increases the human capabilities for the communities to improve their wellbeing. This is based on previous work that explores connections between electric energy consumption and human wellbeing (Castro-Sitiriche, 2013b). Specifically, the unchallenged work by many researchers reported that for the countries with extremely low levels of consumption, a strong direct correlation between increased consumption and improved wellbeing almost always exists (Pasternak, 2000, Schwartzman 2012, Kubiszewski, 2013, Castro-Sitiriche, 2013a). The main objective of this work is to explore the main pathways for access to electric energy to have an impact on human wellbeing. Some questions that this line of research can address are: How do farmer cooperative

structures act as catalyzers of community owned rural electrification projects? How to estimate the ability of local households to pay for electricity under different circumstances? How to compare the impacts of specific electrification technologies on community wellbeing? How are limited resources best spent?

Responsible Wellbeing

The concept of wellbeing has been studied from Aristotle to Schumacher. The latest research on wellbeing, while diverging in some aspects, is consistent in stating that wellbeing is multidimensional and context specific. This work is primarily based on two reports; one of them is "The Causes of Happiness and Misery" chapter in the World Happiness Report (Layard et al., 2012). While the term "happiness" used in the report is mainly concerned with subjective wellbeing, specifically, *affective happiness* and *evaluative happiness*, the report highlights that "both kinds of happiness have predictable causes that reflect various facets of our human nature and our social life," therefore demonstrating the broad areas that happiness research includes. The second report is the Poor People's Energy Outlook (Practical Action, 2010), which draws connections to the United Nations Millennium Development Goals (MDG). Even though the MDG do not address energy poverty directly, the report provides case studies with data that demonstrate the need to provide universal access to electricity to achieve the MDGs. The report states, "As long as hundreds of millions of people remain deprived of the basic energy services needed to stay fed and healthy, earn a living, and allow the time needed for learning and fulfilment, the MDGs will remain out of reach." Furthermore, Practical Action has adopted the wellbeing model developed at the University of Bath which highlights the crucial importance of subjective wellbeing and also the multidimensional nature of wellbeing (Practical Action, 2012). That model puts subjective wellbeing at the top of the pyramid, but it also includes the material, social and human aspect of wellbeing. Recent research by the same group defines the concept of *inner wellbeing* as the focus of their work on the "Wellbeing and Poverty Pathways" (White, 2013). This new iteration of the wellbeing model is also multidimensional, incorporating subjective and objective layers. Further development of this work will incorporate such models in the future.

Responsible Wellbeing was proposed by Chambers (1997) more than 15 years ago as a way to combine locally defined concepts of wellbeing with personal responsibility. The ultimate end is sustainable wellbeing for all. In Chamber's words, the biggest challenge is "to find more ways in which those with more wealth and power will not just accept having less, but will welcome it as a means to well-being, to a better quality of life." That "certain point of affluence" in which more individual power and wealth doesn't improve but decrease individual human wellbeing was presented as a *threshold hypothesis* by Manfred Max Neef (1995, 2010) and it has been further studied by other scholars (Costanza, 2008b) (Knight, 2009). The positive relation between electric energy consumption or similar measures (energy, GDP, ecological footprint) and quality of life indicators (HDI, life expectancy) for poor countries has been consistently demonstrated in many different studies (Pasternak, 2000, Schwartzman 2012, Kubiszewski, 2013, Castro 2013). Therefore, the relevance of the presented work is not dependent on ongoing debates about the validity of the threshold hypothesis, even though the most radically different perspective is a marginal increase due to diminishing returns, which still contains sufficient weight to make an ethics case to provide sustainable energy access for all (Spierre, 2013). An ethics exploration of different arguments that support the concept of Responsible Wellbeing and the Threshold Hypothesis was recently published (Castro-Sitiriche

& Jimenez-Rodriguez, 2014). Figure 1 shows the different regions associated with the level of consumption using the threshold hypothesis and emphasizing the transition in question, from low levels of consumption (Region 1) due to energy poverty towards a responsible wellbeing level (Region 2). While the presented work is focused on analyzing the transition from energy poverty to responsible wellbeing, represented by the red arrow, it could be crucial to establish public policy in poor countries to prevent an excess of consumption, because a decline of wellbeing in Region 3 of Figure 1 may occur at a much lower consumption level as suggested in a recent study (Lawn, 2010).

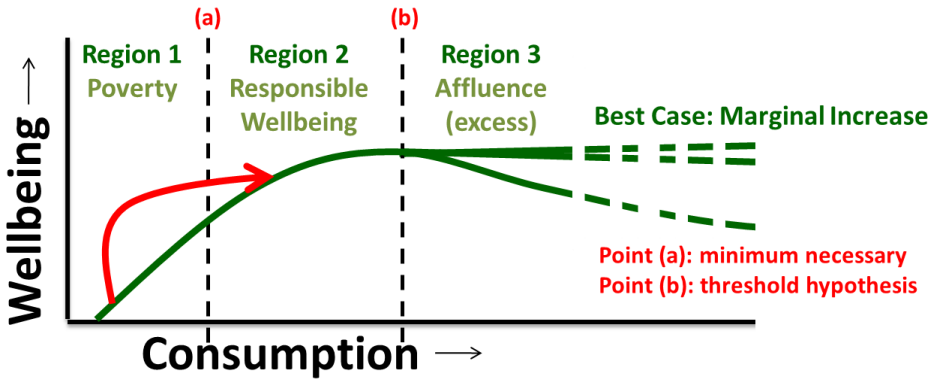

Figure 1. Responsible Wellbeing and the Threshold Hypothesis: Wellbeing vs Consumption

Previous work by one of the authors (Castro-Sitiriche et al., 2013a, 2013b, 2014) proposed a set of levels of electric energy consumption related to Figure 1. The access to a minimum of 60 kWh yearly consumption per capita is suggested as a human right to which people should be provided with (from the case of Madagascar). The minimum necessary to reach the region of *responsible wellbeing* is 400 kWh yearly per capita (from the case of Guatemala). The possible target level is set as 1,870 kWh (or 2,000 kWh) yearly consumption per capita (case of Costa Rica). The threshold hypothesis level is set as 7,372 kWh yearly consumption per capita (case of Switzerland).

A broader exploration of the concept of human flourishing (Abdallah, 2011) will also be useful to provide richness and depth to any study on human progress. Important components of human flourishing were identified as: 1) autonomy, 2) sense of purpose, 3) feelings of happiness and life satisfaction, 4) competence, and 5) social relationships. These include three categories for the components labeled: I) *how people feel*: feelings of happiness, II) *how people function*: autonomy, sense of purpose, competence, social relationships, and III) *how people evaluate their life*: life satisfaction (Michaelson, et al. 2012). The same research team from the New Economics Foundation also made a distinction between wellbeing and the drivers of wellbeing; external aspects such as income, housing, education and social networks, and internal factors such as health, optimism and self-esteem. These concepts are synthetized in their proposed dynamic model of wellbeing (Abdallah et al., 2009, Abdallah et al., 2011, Michaelson, et al. 2012). Recent work established the importance to study in depth the interconnections among the use of natural resources, human systems and the goal of wellbeing for all, while also suggesting five key headline indicators (Abdallah et al., 2012).

2. Methodology

To build the conceptual model, a set of theories and data was used. Two main reports (Practical Action, 2010, Layard et al., 2012) have been used to define the interconnections as shown in

Figure 2, while other research results has been used to establish important aspects of the model. The first report of the Poor People's Energy Outlook series was used to establish the interconnections of the access to electric energy, the drivers of wellbeing and the Millennium Development Goals. The reason for using the MDGs in the model is to enable further improvement of the model using data collected by the United Nations and partners related to such efforts. The chapter in the World Happiness Report that focuses on causes of happiness and misery was selected to define the pathways of the Drivers of Wellbeing to Human Wellbeing. Even though the report uses the term "happiness", it is used in a broad sense, analogous to the concept of "true happiness" as a state of mind in a recent article (Biswas-Diener & Kashdan, 2013) unlike a burst of positive emotions but similar to a well-lived life. New reports have been published (Practical Action, 2014, Heliwell et al., 2013) that expand the theory in which this work is grounded and potentially increase the knowledgebase for similar work.

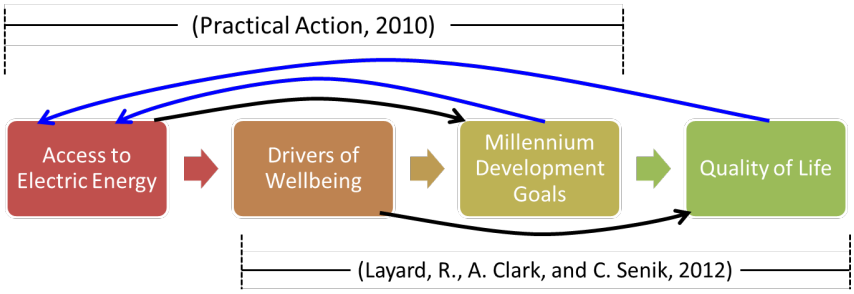

Figure 2. Overall Systems Approach to Energy Access Interconnections with Wellbeing

Conceptual Model

To establish the conceptual model, 22 relevant variables have been identified and categorized into four types: A. Rural Electrification Key Areas, B. Drivers of Wellbeing, C. Millennium Development Goals, and D. Wellbeing Indicators. The selected variables are summarized in Table 1. A total of 51 relationships among the 22 variables have been defined based on information extracted from the two main reports used. The relationships represent the core of the system's conceptual model, providing a first step in developing computational complex system models that encapsulate different types of relationships.

Table 1. Set of Variables used to define the conceptual model

A. Rural Electrification Key Areas	B. Drivers of Wellbeing	C. Millennium Development Goals	D. Wellbeing Indicators
A1. Earning for a Living	B1. Income	C1. Eradicate extreme poverty and hunger	D1. Autonomy
A2. Lighting	B2. Work	C2. Achieve universal primary education	D2. Life Satisfaction
A3. Information & Communication Technologies	B3. Social Capital	C3. Promote gender equality and empower women	D3. Employment and Competence
A4. Cooling	B4. Values	C4. Reduce child mortality	D4. Sense of Purpose
	B5. Education	C5. Improve maternal health	D5. Resilience
	B6. Health (mental and physical)	C6. Combat HIV/AIDS, malaria and other diseases	D6. Social Relationships

A detailed overview of the pathways extracted from the World Happiness Report that include Variables B (Drivers of Wellbeing) and Variables D (Wellbeing Indicators) are represented in the diagram in Figure 3. The blue arrows represent a positive impact while the

black arrows represent a negative impact. A recent study established that there are six key variables that "explain three-quarters of the international differences in average life evaluations: GDP per capita, years of healthy life expectancy, having someone to count on in times of trouble (sometimes referred to as "social support"), perceptions of corruption, prevalence of generosity, and freedom to make life choices" (Heliwell et al., 2013). All six variables were actually included in this study and can be matched with one of the 22 variables presented in the following way: 1) GDP per capita – income; 2) years of healthy life expectancy – health; social support – social relationships; perceived freedom to make life choices – autonomy; freedom from corruption – social capital (trust); and generosity – values (altruism).

Baseline data

Survey results from Duchity (Frey et al., 2012) were used to establish baseline indicators for the population. A modified version of the survey is expected to take place every two years, which would provide further data for model calibration and validation. The survey demonstrated a general strong desire for electricity and willingness to pay for electricity, and a healthy level of happiness for about half of the population with 42.6% very happy, 19.8% somewhat happy, 11.7% somewhat unhappy, 25.9% very unhappy.

The information extracted from a rural participatory investigation conducted by a Canadian development organization is also used to establish some of the baseline data (pcH, 2013). The methodology included focus groups, semi-structured interviews, and historical profiles among others. The total number of participants was 837, of which more than half were women. The study reported a persistent gender inequality, sometimes expressed in gender violence, and rape of young teenage girls often resulting in early pregnancy. It was also reported that the average household buys 15% to 55% of their food needs depending on the number of family members and their farming capacity, while food insecurity due to natural disasters and environmental degradation is a major concern.

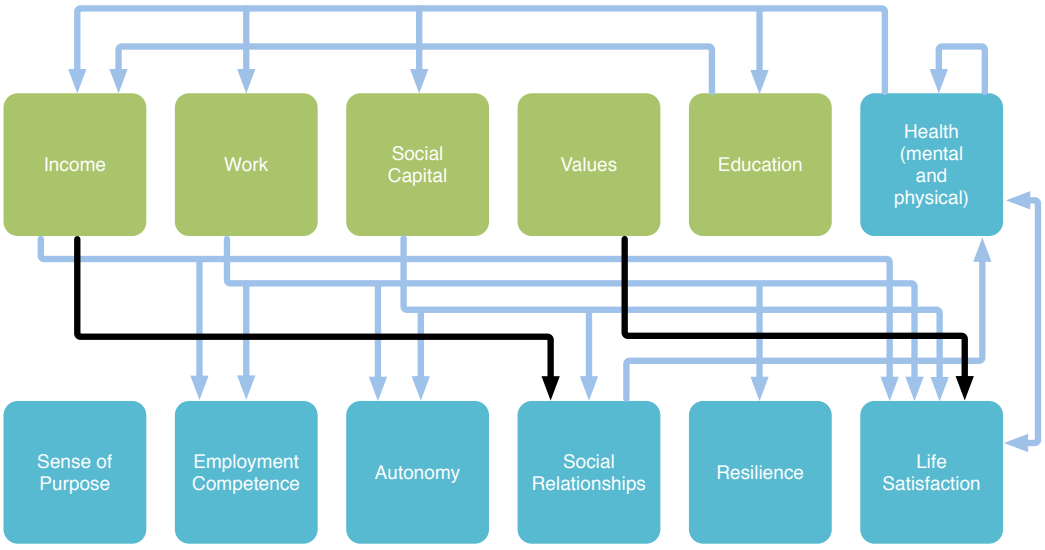

Figure 3. Pathways to Wellbeing: From Key Drivers to Wellbeing Indicators

Geographic and Demographic Information

The population is divided into two regions as shown in Figure 4: the yellow region is close enough to the center of Duchity that could be connected to the mini-grid with an estimated population of 200 households, and the red region in the vicinity of Duchity including where the mini-grid might still not be accessible with an estimated population of an additional 800 households. The resulting population distribution would be 40 households in the yellow region that will be the first to connect to the mini-grid, 160 in the same region that would not be connected to the mini-grid in the short term, and 800 households in the extended red region that would not have access to electric energy through the mini-grid in the near future.

Based on demographic information extracted from survey questions, we will develop the daily activities of each actor in the conceptual model. These include going to school, to work (farming, business, taxi driver, teacher, doctor, carpenter, household work), not working (ill, toddler, elder). The decision making process for the actors are going to affect mainly two types of aspects: the set of 22 variables and the electric energy consumption. They will depend on all 22 variables but mainly on the available income (B1), resource needs (C), and the availability of activities (B2, B3, B6, D1, D3. D6). The decision making process will be refined using the cultural model of household energy consumption proposed by Lutzenhiser (1992, 1993) and more recent rural household energy consumption studies (Davis 1998, Miah, 2010). Other recent studies that will be instrumental to improve this kind of research is the Poor People's Energy Outlook latest report (Practical Action, 2014) and also the Sustainable Energy for All (SE4ALL) Global Tracking Framework (Kennedy, 2013). Particularly, as the Global Tracking Framework measures of universal access evolve, rich global data sets will provide a strong basis to test different hypothesis at a large scale. Also, data from small local projects using the same tracking methodology will bring an important perspective useful to simulate detailed dynamic behavior and also set a potential path to replicate the success of small projects in different contexts.

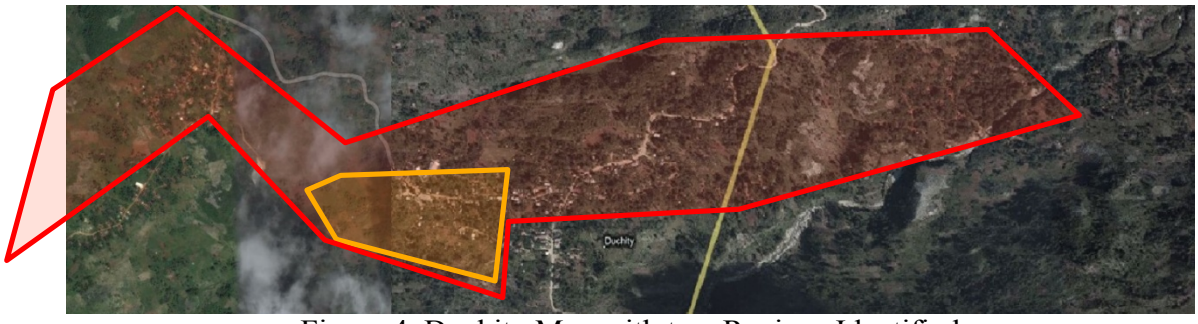

Figure 4. Duchity Map with two Regions Identified

Energy Generation and Household Consumption

Three different scenarios are considered. The current scenario in which there is no broad access to electric energy and only a handful with a personal gasoline generator have access to electric energy on demand while the rest might depend on paying up to $120 per kWh to charge mobile phones. The second scenario is for those households in the Yellow Region (Figure 4) that will now have access to electric energy through a solar based mini-grid rated at 15 KW, and expected to provide 60kWh per day on average. One third (20 kWh) of that daily energy will be utilized for the business sector like for example welding, and mainly post-harvest agribusinesses such as refrigeration, food drying processes. The other two thirds (40 kWh) will go directly into the family households. The estimated daily energy consumption by each business is 17.6 kWh

for the crops refrigeration, a similar amount for a welder that works a total of 3 hours (equivalent full power) on a welding machine that draws approximately 6 kW of power.

3. Results and Discussion –

The conceptual model is presented in graphical form by connecting the potential impact of rural electrification through "Earning a Living" activities (Figure 5). The diagrams for "Lighting", "Information and Communication Technologies", and "Cooling" are not shown for brevity.

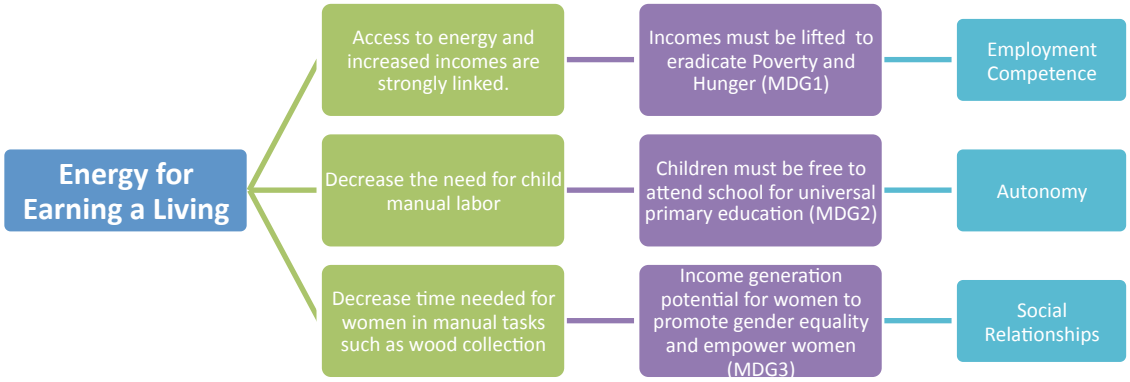

Figure 5. Rural Electrification Pathways to Wellbeing: Impact of Energy for Earning a Living

The pathways to wellbeing identified in Figure 5 were obtained from the two reports mentioned earlier (Practical Action, 2010, Layard et al., 2012). Detailed data from small projects provided by Practical Action helps to clarify these pathways. In relationship to Energy for Earning a Living, the Rural electrification and gender in Chile case (Practical Action, 2010) provides a sense of the data richness that could be available. A graphical representation is provided in Figure 6 with a detail explanation in Box 1. For brevity, similar figures for other key areas of rural electrification are not shown.

4. Conclusions

The conceptual model of the pathways through which renewable energy technology adopted in remote farming communities have an impact on human wellbeing was developed. The focus on rural electrification using renewable energy based mini-grids provides important insight into a global grand challenge of energy poverty that has been broadly documented but not addressed completely. One of the main obstacles to accomplish universal access to energy for all is the necessary funding needed to achieve it, estimated in almost US$1 trillion (IEA, 2012). The work presented has the potential to provide a complementary impact evaluation methodology for rural electrification projects with the double purpose of better utilization of international aid funding and to incentivize the commitment by international organizations to invest in energy access projects. Further work will implement the conceptual model as a computational agent-based model. While the focus is primarily on poor communities, the same methodology could be applied to development projects in wealthy countries or wealthy communities in which many times unforeseen ramifications of big infrastructure projects could be explored in some detail and innovative possibilities could emerge.

Box 1: Rationale for Electrification Pathways to Wellbeing related to Earning a Living

Blue Arrow #1: Impact on Income (B1) - Two-thirds of the population took on additional income-generating activities. For women, this included weaving clothes and dressmaking using electrical appliances; for men, carpentry and welding. **Households generated an additional income of 35% per household** from these activities. This increase is attributed principally to activities undertaken by women.
Blue Arrow #2: Impact on Social Capital (B3) - 40% of women were found to spend less time on household chores mainly due to household electrical appliances.
Blue Arrow #3: Impact on Social Relationships (D6) - Half of the population noted having more time to participate in social and community organizations and activities.
Green Arrows: Impact of Drivers of Wellbeing on MDGs
Grey Arrows: Potential for other Rural Electrification key areas to earn a living activities.
Source: Blue Arrows adapted from Box 1.15 Rural electrification and gender in Chile, Green Arrows adapted from Box 1.17 and Grey Arrows adapted from Table 1.19 (Practical Action, 2010).

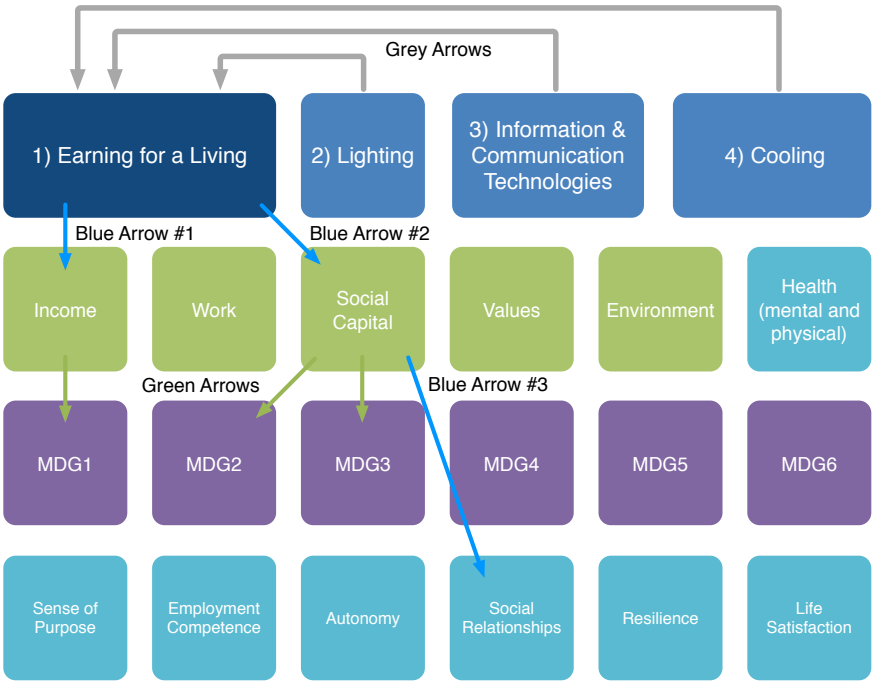

Figure 6. Rural Electrification Pathways to Wellbeing: Impact of Energy for Earning a Living

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Technological Innovation in Nigeria: Using Open Source Electronic Health Recording Systems to Improve Health Management

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Abstract
Nigeria's Healthcare system has failed to become a sense of pride for its descendants. From cut-rate supplies, inadequate education, mediocre waste management to continuous strikes, it comes as no surprise that many have fled its borders in search of more effective facilities and treatment. One questions the authenticity of political uproar, claiming efforts are being made to strengthen Nigeria's global stance, when an area so critical, as healthcare, has gone unresolved for so many years. How then can this country stand in the face of globalizing healthcare and worldwide standardization? This article not only critiques the quality of clinical care received in Nigeria, but advocates for a new means of intervention via an improved educational and management infrastructure, through the use of Open Source Electronic Health Recording Systems (EHRS). As the viability of this method is explored, examples will be drawn from Open Source Software (OSS) Practice Fusion, which will lead to the construction of an algorithm for an OSS EHRS that is more applicable and can be easily implemented in the developing world. The use of an OSS EHRS will not hinge on the Nigeria's limited budgets, rather, aims to take the advantage of resources already in place. Given the speculative nature of the proposal, Millennium Compassionate Care, a community clinic in Imo State Nigeria, has agreed to be the first to employ this new system of management, and over the course of 1 to 5 years, their progression will be tracked and documented, then later reported for effectiveness.

Key Words: Healthcare, Open Source Electronic Health Record System, Quality Clinical Care

Introduction

Nigeria is one of Africa's most populace and buzzing countries, filled with a multiplicity of individuals. Housing over 300 ethnic groups and 170 languages, Nigeria has become a powerhouse in the African continent; however, much of this success has yet to show forth in its citizens. After 51 years of independence, Nigeria is still an adolescent country, with most of its population living in underdeveloped regions. Despite signing their first constitution in 1999 (Abdulraheem et al., 2011), and the formation of centralized government, with thirty six state governments and a federal capital territory, ethnic and religious rivalry still threaten the country's foundation (Smith, 2012).

Despite its ethnic uproar, Nigeria has managed to be counted amongst the important members of the Oil Producing and Exporting Countries (OPEC). Before oil became its largest domestic product, the economy was fueled by agriculture, these included coca, groundnut and palm oil. "Since the production of commercial quantities of crude oil in 1970, its dependence on oil as its sole foreign currency has grown to the extent that diversifying the economy has proven troublesome. (Smith, 2012)

The need for intervention in Nigeria's health system has never been more pressing. The World Health Organization has deemed Nigeria's Primary Health system uncoordinated and unsustainable, despite having joined the International push for primary health in 1979. Primary

health standards and efficacy have since deteriorated. Out of the 191 countries ranked in the year 2000 by the WHO, Nigeria ranked 187, which is reflective of its low budget allocation and expenditure for health. This resource poor country finds itself plagued with inadequately trained staff and undereducated personnel.

Strides have been made to change the face of Nigeria's health system, one, being the decentralization of control, stewardship and financing into 3 tiers, federal, state and local. Even with this organized appearance, great levels of inadequacy still exist. The prominence of cardiovascular disease, hypertension, chronic kidney disease, diabetes, hepatitis A B & E, Thyroid fever, malaria, dengue fever, yellow fever and lassa fever are at an all-time high. Nigeria has one of the highest HIV/AIDS rates amongst its population, and yet health is the least touched area for the federal government (Abdulraheem et al., 2011). According to the World Health Organization, Nigeria, in most cases, is unable to uphold international standards of health, despite housing Africa's largest population.

The public and private sector owe much of this discrepancy to the lack of coordination and resource distribution between them (Health Systems 2020, 2009). Data tracking between them has also proven ineffective and delivery points for goods and services lack, especially in regions outside of the major cities, where the disease burden is greatest. This lack is not a result of a shortage in graduates, rather a lack in an efficient and sustainable infrastructure.

Program Needs

A vast majority of Nigeria's health care facilities still rely on paper based medical records. This has not only stunted effective clinical care, but also nationwide data collection as well as collaborations. Nigeria's health infrastructure needs a means of maintaining an integrated history on individual medical and health status, as well as day to day management needs, at a low cost to the country and partner organizations. To accomplish this, an open source electronic health recording system will be used. This will allow for a large volume of information to be collected, at minimal cost to the facility. It will also allow for constant monitoring both in Nigeria and the United states. It is important to note that constant electricity and internet connection cannot be guaranteed. As much as 35% of Nigeria's installed power supply are nonfunctioning so power outages are very common (Chaplin et al., 2014). As a result, paper based documentation will used alongside the OSS EHR, to ensure functionality of the facility during times of power outage.

Software of Choice

Practice Fusion was chosen due to its ease of implementation and applicability in vast areas of clinical settings. Founded in 2005, it is presently the largest cloud based electronic health recording system in the United States. It works to connect doctors, patients and laboratories. Despite being based in the United States, it offers a plethora of features that can be easily applied to practices across the globe, as a few non-profits in third world countries have employed it to track the patients they see. To effectively deploy electronic health recording systems in Nigeria, it will first be tested in one clinic and then gradually phase to be used by neighboring facilities and hospitals, fostering a national network.

Millennium Compassionate Care is the primary health clinic in Imo state Nigeria that has agreed to be our test site for the effectiveness of this system. Research into the benefits of EHR's in the third world is limited, thus it is necessary that this proposal is transitioned into an

actual experiment. For the next 5 years the results of implementation will be recorded and compiled, and then used as concrete data for legislative action.

Methodology

Practice Fusion was chosen as the software of choice after a series of tests for adaptability in differing clinical settings, user friendliness and navigation, congruency with a wide variety of users and role specification, ease of data management and reporting, collaborations, data portability and training/ training support. Each criteria was tested extensively with simulated patient information. At the conclusion of these tests, it then served as a platform for creating an algorithm for a more applicable open source electronic health recording system.

Results

Adaptability in Differing Clinical Settings

The clinic we are collaborating with has, as part of the primary care clinic, a pharmacy, imaging center, lab, training center and billing center. Practice Fusion offers a simple enough platform that can be used across the board. Accounts were established for each of these settings and the needs of each department was accommodated by the software. It covers the basic necessitates of any health record system:

- Access to patient demographic information and family history
- Access to physical assessments
- Access to new and past test results and immunizations
- Access to Nursing care plan and treatment history
- Medication recording
- SOAP Notes
- Basic order entries
- Scheduling
- Data storage and reporting
- Portable data

User Friendliness and Navigation

The user is met with bold letters and color coordinated icons, which not only give this system a welcoming appearance, but also serves to remove reservations that the system is difficult to use. Many opponents have claimed that EHR's are cumbersome, impractical and technically complex (Baillie et al., 2013) but Practice Fusion's simple layout attests that even technical novices can use it with relative ease. Given it will be implemented in a rural setting, with nurses whose technological exposure may be limited, it is crucial that this system appear to the staff as something they can easily master. Other user friendly features include spell check with data entry and bold labels to locate vital information. The formatting of the system is simple enough that advanced computational skills is not needed. Since it is open source, it does not require the use of a database maintenance personnel, as would trying to host an electronic medical records system in the facility itself. The Harvard school of Public Health and AIDS Prevention Initiative in Nigeria PEPFAR Program used FileMaker Pro in the implementation of their EMR system, but this system required personnel with advanced knowledge of relational databases in order to modify it from facility to facility.

The large navigation bar (figure one), promotes easy navigation from tab to tab. Even after exiting the dashboard, all tabs are located on one screen, which make it very easy to locate specific information about a patient, rather than the paper based system that would require

shuffling between rooms and rustling through files. It also conveniently lists recently seen patients, an asset for physicians and nurses looking to quickly locate a patient, rather than enter the patient search tab.

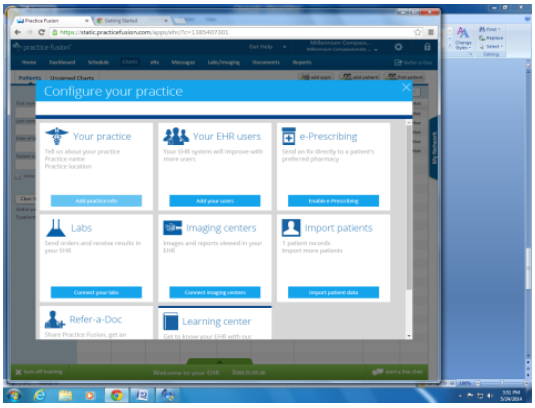

Figure 1. Dashboard

Congruency with a wide variety of users and role specification

A wide variety of users are accommodated given the simplicity of this software's formatting, even those who are accustomed to paper based documentation. Once the employee data has been added, it allows for role specification by the system administrator, which limits the accessibility of some features. This way roles are explicitly defined for monitoring and reporting purposes.

Ease of data management

It is imperative that patient entry (figure two) is analyzed extensively when it comes to data management. Although not located on the opening screen dashboard, it is featured on the very next page. Before any patient can be imputed, the user must perform a system search to prevent data duplication. This section may prove more difficult to learn than others because it requires a greater attention to detail. As the search list is being generated, the user must go through each result and determine if it matches the patient originally entered. Misunderstanding of this may lead to data duplication and mistakes. A more effective OSS will perform data matches with all the information given and only list those who match all three categories, rather than listing matches for each category.

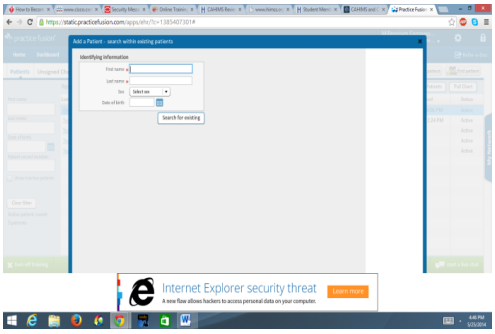

Figure 2 Patient Search Screen

Unlike the patient search screen, the patient data input screen (figure three) can be navigated with relative ease. Sections are labeled "Identifying information", "contact", "address",

"demographics" and "next of kin". This layout allows for onsite imputation, as the patient is being admitted, or inputting once patient has been discharged. The bolded labels make it easy to locate vital information within a short amount of time.

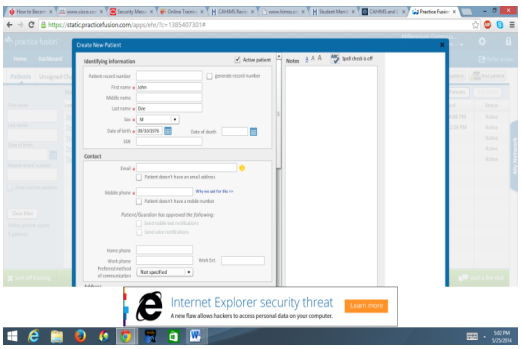

Figure 3 Patient Data Input Screen

The patient profile contains tabs (figure four) which make locating and assessing specific information simple. Rather than read through the whole page, the user can pinpoint what it is they need, and go there specifically. The categories include basic information, Insurance information, profile settings, patient summary, doctor history, prescription history, allergies, etc. On the right hand side of the patient profile is the "patient action" portal, which gives directives as to what action the user wants to take with this particular patient. These include ordering lab tests, printing patient record, create clinical record, send referral and export patient record. Rather than look for a file and flip through numerous pages to perform these actions, they can be done with the click of a button. When looking for another patient, the user can easily navigate to the search patient icon (highlighted in yellow)

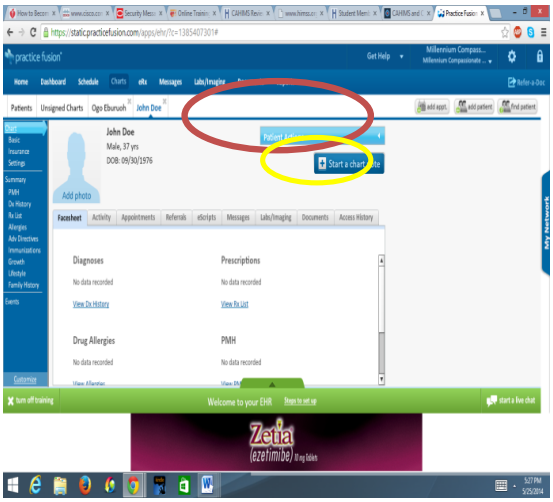

Figure 4 Patient Profile Action Tabs

Collaborations and Data Portability

If used within the United States, Practice Fusion allows for neighboring facilities to connect and transmit data, but that feature is not available once out of the Unites states. However, it does allow for departments to be created. These departments are not required to be within the same facility, therefore, Millennium Compassionate care can collaborate with local pharmacies and

include them as departments under the clinic, which will automatically integrate their information and allow for a network to be created. Another pivotal benefit of this feature is that community centers no longer need to have all medical equipment within their facility. With Practice Fusion, partnerships can be established between facilities that have the equipment, then patients can be referred to them, or a center can be allocated specifically for imaging, and the results uploaded and transmitted where necessary. Additionally, if a facility so chose to go paperless, patient records can still be maintained within the hard drive of the facilities computer by simply backing up the patient information into an excel spread sheet.

Training/ Training support

Despite the ease of usage of this system, another necessary feature, if it is to be implemented in the third world, is training support. Unfortunately, for this software, technical support is not offered outside of the United States, making it absolutely imperative that whoever chooses to take this software to another country, must assign two individuals who will serve as technical support for that region. These individuals must be well trained in computation and the technical aspects of a computer system and the software. One person will remain in the United States for data management and monitoring, while the other will work in the third world region, where they will answer any questions the staff has about the system, as well as train all new employees.

Already, Practice Fusion includes training videos within the program that give an overview of many of the basic capabilities of the program, from inputting users to use of the meaningful use tracking. These videos are short but offer detailed information on the subject matter. This will be combined with in class training and practical demonstrations, in order to ensure that staff adequately understand what is required of them when using this system. There will be a training center that will be open for the duration this system is in use.

Algorithm for more applicable OSS EHR

Problem: Enter Patient Data in OSS EHR for Nigeria

1. Login with appropriate credentials: These credentials will include Student, Nursing Assistant, Physician Assistant, Physician, Pharmacist, lab coordinator, Lab technician, Data Entry Clerk, Receptionist or Other
2. Select language: 5 main languages will be included in first prototype – English, Igbo, Yoruba, Hausa, and French
3. Select “Add New Patient”
4. Enter Patient Search Criteria: First name, Last name and Birthdate
5. If patient information matches search results, pull file, check referring doctor and verify demographics are current
6. If patient information does not match search results, click “enter new information”
7. Enter corresponding patient information which must include profession, village of origin, current medications, previous physician and physician location

Problem: Print Data Reports from OSS EHR for Nigeria

1. Login with appropriate credentials
2. Select language
3. Enter “reports” tab
4. Print corresponding reports
    a. Productivity reports

   b. Disease tracking
   c. Patient satisfaction
   d. Patient flow
   e. Medication reports
   f. Drug interaction reports
   g. Training Center Comprehension Exam Reports
5. Export reports to Excel sheets and send to Data collaboration Centers

Problem: Establish New Partner Organization in OSS EHR for Nigeria

1. Login with appropriate credentials
2. Select language
3. Enter "New Network" tab
4. Enter facility name, address, email and professional information ie. Physician name and specialization
5. Send request to collaborate
6. If request is approved, click "complete collaboration" to sync data

The 5 keys to the usefulness of this algorithm: A simple interface that allows for easy learning, the ability to establish local and global connections to promote referrals, collaborations among neighboring facilities and access to current global health information and trends, incorporation of numerous languages, mainly English, Igbo, Yoruba, Hausa and French, a comprehensive reporting system that allow for easy internal and external data tracking and a self-contained training material with limitless access to staff and trainees

Discussion

The algorithm was created taking into account areas where Practice Fusion failed, but were crucial areas for a health system in a developing country. Amongst these are local and global connections. Granted Practice Fusion allows for the creation of departments, if this system is to be used on a large-scale, facilities need to independent of each other and have separate accounts for security purposes. Secondly, the language barrier must be reduced. Nigeria houses over 170 languages and it cannot be assumed that all health workers will be well versed in English. Adequate training support must be present if there is to be longevity for this system.

In addition, Open source Learning Content Management Systems such as NTER (National Training and Education Resource) will be employed for longer more detailed training videos, lectures, assignments and assessments. NTER is an open source suite of browser based software solutions, made to assist institutions in deploying and managing educational and training courses for audiences of any type. It securely shares information across institutions as well as to the public. Unlike Practice Fusion, NTER can be installed and managed in the United States, with directives sent to trainers oversees. Creation of teaching materials will be done in the United States by an experience Health informatics professional. NTER will also be advertised to other public healthcare providers as a means of offering training to their staff, and with time, it is hoped, Nigeria will incorporate this low cost teaching system.

Conclusion

Practice Fusion has many applications in Nigeria, and may be one of few inexpensive resources available to this struggling country. Using OSS EHR's will allow Physicians to view patient files in real time as well as receive alerts on patients who need adherence counseling. The

information is more legible, more accessible, more accurate and easily retrieved. In addition, it removes the complexity of data management, and doctors can spend more time caring for patients, rather than searching files. Doctors can easily manipulate patient accounts and make adjustments where necessary and administrators can easily perform quality control audits and report to the national census bureau with ease. In light of present global health issues, it is imperative that resources such as these are continuously sought and utilized to improve the health of developing nations.

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Cryptocurrency and Economic Sovereignty

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Abstract
This essay demonstrates how two popular forms of digital money seek to create economic sovereignty for its users, and evaluates which of the two would be the more appropriate technology to adopt for developing economies in Africa and other parts of the Global South. Economic sovereignty defined here means the freedom to manage household affairs using currency as a medium for exchange. The literature on one digital currency in Kenya, M-Pesa, qualitatively shows that its' users experience benefit (Jack and Suri, 2010). Bitcoin, a digital currency based on cryptography has a lower level of adoption as well as less published literature attention. While there are well analyzed critiques of Bitcoin (Courtois, 2014) this paper hypothesizes that Bitcoin provides greater opportunities for economic sovereignty, specifically due its emphasis on decentralization, which is lacking in the M-Pesa system. The methodology to test this hypothesis will be philosophical, utilizing conceptual analysis of the two-systems' 'economic footprint', measuring broad generalizations about experience—though examining few data-sets--since it is the engineering of the users' experience being interrogated, more so than the underlying engineering of either currency-system. The essay proposes development strategies for cryptocurrency based on implementation schemes in Argentina, and with the Lakota-nation.

Keywords: Economics, Bitcoin, M-Pesa, cryptocurrency, Decentralization, Ethics

Introduction

This essay demonstrates how two popular forms of digital money seek to create economic sovereignty for its users, and evaluates which of the two would be the more appropriate technology to adopt for developing economies in Africa and other parts of the Global South. Economic sovereignty defined here means the freedom to manage household affairs using currency as a medium for exchange. M-Pesa and Bitcoin are two digital money technologies that promote increased economic sovereignty amongst their users. The hypothesis of this paper is that Bitcoin offers a higher degree of economic sovereignty, and that despite the barriers to its adoption, is ultimately a more appropriate digital money technology for Africa and other parts of the Global South, specifically since it is engineered with decentralization as a high priority.

When thinking about technological innovation to empower Africa, it is intuitive to assume that the technological innovations will have an impact on the economy. In addition to health, water, energy, and educational technological innovations there are also those innovators that seek to directly improve the economy by innovating how we conceptualize money. In Africa the proliferation of mobile telecommunications has created a network well suited as a carrier for digital money technologies. As an economic region that has never had wide access to banking (see Ngugi, 2006) Africa is now poised for a banking revolution. The question remains to what degree these new technologies will empower humans with a greater degree of economic

sovereignty, here defined as the freedom to manage household affairs using currency as a medium for exchange, with an emphasis on the ability to save and create wealth.

Related Work

To talk about technological innovation within the banking system in Africa one has to talk about mobile technology. There are lots of interesting facts, courtesy of the Praekelit Foundation[2], about mobile use in Africa, such as that smart phones are outselling computers 4 to 1, or that already more than 50% of all internet connections in Africa are exclusively on mobile. When additionally accounting for the fact that more than 50% of the African population is younger than twenty, it reveals how important mobile technology serves as a medium to engineer additional technologies on top of.

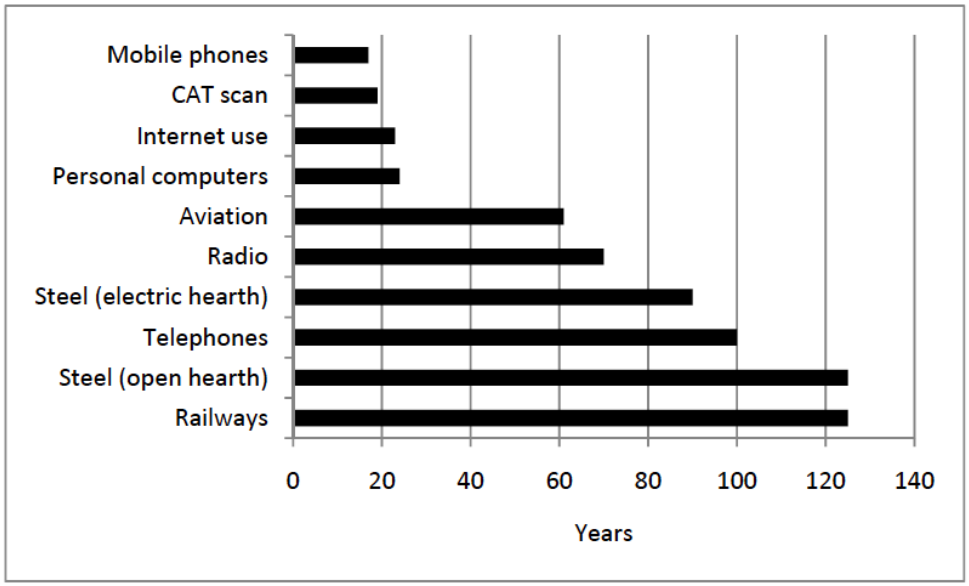

Figure 1: Technological Adoption (numbers of years to reach 80% Coverage) *source: Jack & Suri, (2010: 4)*

The phenomenon of co-opting by which one technology serves as a medium to engineer other technologies utilizing the pre-existing network speaks directly to the fact that 'as technologies are adopted they have direct and indirect effects on the intended purpose of the creation' (Jack & Suri, 2). And this is is basically what users of mobile phone technology quickly figured out—that they could transfer wealth with their phone by sending airtime to another mobile phone user—and thus created a "transfer of purchasing power from the initial sender to the recipient" (Jack and Suri 2). The mobile technology that was originally intended as a tool for communication where there was no landline infrastructure began to be co-opted for use as a banking surrogate.

So in March 2007, the leading cell phone company in Kenya, Safaricom, formalized this procedure with the launch of M-Pesa, an sms-based money transfer system designed within Kenya that allows individuals to deposit, send, and withdraw funds using their cell phone. M-Pesa, according to the World Bank has reached 9 million-users (40% of Kenya's population)

[2] The Praekelt Foundation builds mobile technologies and solutions to improve the health and wellbeing of people living in poverty, and the mobile facts come directly from their website.

who transfer $320 million per month (Mas and Racliffe, 2010: 1), and is 'widely viewed as a success story to be emulated across the developing world' (Jack and Suri 2010: 2).

The original goal of M-PESA was to help individuals send remittances to their families, but it soon became apparent that the innovation could possibly be even more empowering than originally expected. 'The ubiquity of the cell phone across both urban and rural parts of the country, and the lack of penetration of regular banking services, led to hopes that M-PESA accounts could substitute for bank accounts, and reach the unbanked populations' (Jack & Suri 2010: 5-6). While there are promising hopes to link M-Pesa with banks and other institutional partners to offer a full range of financial services (see Mas & Radcliffe 2010: 23-24), there are also reasons for caution due to lacks in its ability to function as a tool for saving, in that users of M-PESA do not receive any of the traditional safeguards or benefits (like earning interests) of having a bank account. '[M-Pesa] deposits are not supervised by the Central Bank. And unlike payments, where trust can be validated experientially in real time, savings requires trust over a longer period of time (Mas and Radcliffe 2010: 24).

M-Pesa is still centralized, being owned by a private corporation, Safaricom (a subsidiary of transnational telecommunications corporation, Vodacom). No one knows exactly how much money Safaricom is earning through M-PESA, though they have recently opened up additional bank accounts to store the deposits. Additionally while M-PESA offers services similar to banks at a reduced fee, Safaricom stresses clearly to the Kenyan government that M-Pesa is not a bank, and so therefore doesn't give the safety of a traditional bank, nor pay interest on deposits. So, if something happens to the money in your account there is no recourse to retrieve it, and while it can be utilized for risk sharing, informally among individuals, it doesn't actively encouraging saving. This is especially important when evaluating a digital currency for its appropriateness towards increasing economic sovereignty since promoting saving is crucial towards generating wealth and eliminating the gap between the rich and the poor.

When tracing the history of M-PESA back to a remote banking experiment with Kenya microfinance institution FAULU we see that the pilot study eliminated 'the need for FAULU customers to travel …to deposit their weekly loan payments…[but] this, however also had the unintended consequences of reducing attendance to FAULU meetings which was against the business interests of FAULU itself (Ngugi et. Al. 2010: 5). It was the Department for International Development, in the United Kingdom that had sponsored the pilot study, and then later picked up by 'market watchers' who repositioned the pilot project from the non-profit sector to the for-profit telecommunications sector. What are the risks involved for a technology that only promotes passive savings while generating income for transnational corporations? Could the economic sovereignty created through the use of M-Pesa give Kenyans greater freedom to manage their households and offset risk at the hands of a global banking crisis?

While M-PESA was created in 2007 before the global banking crisis in 2008, Bitcoin was developed in the aftermath of this crisis. It has only been recently that the crptocurrency movement and the mobile money movement in Africa have begun to cross paths, since there was initially no protocol for a 'sms wallet' (basically a way to store bitcoin on phone and transfer through sms message). Bitcoin was started by 'Satoshi Nakamoto', which is believed to by a pseudonym for either one-person or a group of people, in 2008. Born out of the banking crisis, Bitcoin utilizes peer-2-peer networks to confirm transactions. According to Nakamoto the 'most important part of the bitcoin system is a public ledger that records financial transactions without the intermediation of any single, central authority' (Nakamoto 2008: 4). The way units of money used for the transactions are through a process called mining. In fact, the money is

created as a reward for the miners using their hash power (electricity) to solve the crypotgraphic problems that determine what of the bits count as real money.

So, from the beginning Bitcoin was created in opposition to how so-called *fiat* currencies issued by a central bank function. Instead of there being one source that accounts for the money in circulation, with Bitcoin there are numerous nodes that approve of transactions, and all transactions are recorded in a public ledger, called the *blockchain.* Furthermore instead of the inflation rate being set by a centralized group of individuals (with inherent conflicts of interest) the Bitcoin system was designed to regulate itself through the mining process, specifically the tier-scheduling in rewards as subsequent "blocks" of bitcoin are discovered, levied against the increasing difficulty of mining.

Like M-PESA Bitcoin users have no recourse if their wallet is compromised, or if they send money to the wrong individual. And there have already been high profile attacks of Bitcoin trading platforms subject to DoS attacks and also bankruptcy, namely the Japanese exchange Mt. Gox in February, 2014. However, unlike M-PESA Bitcoin is not centralized, and there is no multi-national corporation to monopolize price increases in fees. Rather the transactions are all processed by individual nodes that comprise the network, and the fee for the transactions is the reward that creates new bitcoin. So, in theory being a part of the network encourages wealth creation, and serving as a node and taking part in maintain the block chain can be viewed as a type of interest accrual-system. The problem is that mining has become increasingly sophisticated. According to Courtois (2014: 4-7) miners have invested millions of dollars in bitcoin infrastructure, and the hashing power has in increased 1000x. These are for-profit miners, who are using sophisticated ASIC mining computers. Whereas when Bitcoin began the mining community was comprised of individuals using PCs and one individual generally counted for one vote in the ledger, today there are guilds of miners that pool there resources together.

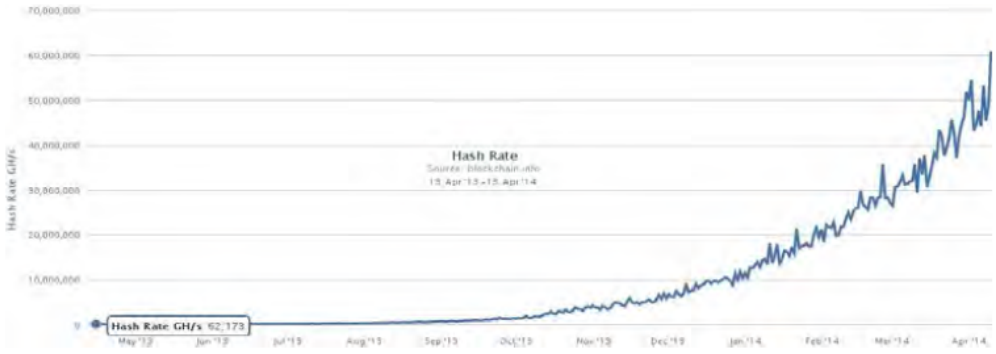

Figure 2: Bitcoin Hashrate. Source: Courtois (2014: 4)

The reason for this arms race in mining hash power is due to the rewards involved. The market capitalization of Bitcoin as of October 21, 2014 was 5.5 billion USD. The infrastructure in mining has limited opportunities for individuals without pricey technology to totally integrate into the mining process. Thus, Bitcoin, even though decentralized, and engineered to a greater degree than M-Pesa to be communitarian, faces some similar 'backend' access limitations.

Cognizant of these limitations, there are many individuals working on designs to proliferate Bitcoin in a more equitable manner. Patrick Dugan, in an interview with *Coin Telegraph* states, 'poor people trading Bitcoin for daily business doesn't makes much more sense than doing so with shavings of gold, but local or foreign currency-pegged tokens are going to enable a billion unbanked people to enter the middle class via System D merchant activity' (Scott, 2014). A currency-pegged token without getting overly complicated is one where a currency, be it paper money or coins, are backed by something else. This was the case when the US's fiat currency was backed by a gold standard. What Dugan is advocating is to initiate a similar type of backing, but with digital cryptocurrency.

With the open source engineering behind Bitcoin there is room for improvement of the system, by consensus, This is important because up until today Bitcoin, though designed to be a currency is functioning more like a payment system or as investment, for those that are speculating on the bitcoin price. Therefore Bitcoin is largely held, and not used in transactions, which make the valuation extremely volatale meaning that the adoption rate is slower than that of M-Pesa, which uses an e-float system where the valuation is pegged on a 1:1 ratio with the Kenyan Schilling.

Methodology

If the literature suggests that Bitcoin may have more potential to increase economic sovereignty, by encouraging savings and decentralizing wealth, then the method to further analyze these claims will be a broad generalization of Bitcoins' 'economic footprint' in those parts of the global where Bitcoin has already been more widely adopted than to the extent it has in Kenya. One such country is Argentina; other nations with 'Alt-coin' digital currencies are Ecuador and the Lakota Nation.

Results

Argentina is a country that has 'long been guilty of fiscal mismanagement' (Rosencheck). The country went from being one of the 10 richest countries in the world in terms of percentage of per capita household earnings to defaulting on its bonds, twice in the last hundred years. (Buera et. Al 2011: 6) Therefore it's natural that the country would become a focal point for Bitcoin in Latin America. So many Argentinians have no trust in the government and hold their savings, outside of banks, in foreign currencies, as a hedge against the inflation rate (Levine 2014). Bitcoin's recent history has exposed issues with volatility and its subsequent valuation, but with the Argentinian national bank fixing the exchange rate for the peso, and preventing its citizens from legally obtaining foreign currency by levying charges against foreign purchases with credit cards at 13% Bitcoin immediately becomes a viable way to transfer cash in-and-out of the country.

The most surprising aspect of the Bitcoin movement in Argentina is that its actually being accepted by some businesses (see Mateu, 2014, Igal 2014 and Urieta, 2014). The is a national Bitcoin foundation that has already hosted an international conference on Bitcoin in December of 2013, and is opening a 'seedcoin' coworking to get startups together that all seek to utilize Bitcoin in their business models. Seedcoin is a incubator project that funds promising Bitcoin startups similar to other silicon valley and technology based incubator projects. Another aspect of the *Fundacion Bitcoin Argentina* is an alliance with Bitcoin films that seeks to make short documentaries about successful Bitcoin projects around the world. One tells the story of an Argentinian farming cooperative that has started to accept Bitcoin has payments. Its saved them

fees that would normally go to credit card and payment processing companies. The next film tells of the remittance market in Uganda and how one student is using Bitcoin to receive cash from his sister in the United States, at a greatly reduced cost to using traditional remittance options like Western Union. The main instructive generalization from the Bitcoin movement in Argentina is that Bitcoin must be circulated if it is to truly function as a currency; to be used as a medium of exchange creates the parameters whereby it may become and instrument of saving and wealth creation. According to Courtois (2014: 17) Bitcoin is largely being used for speculation by investors.

In contrast to a community developing Bitcoin within an existing weak banking system there are several examples of nations taking digital currency into their own hands to try to ensure their economic sovereignty, and sanctioning digital currency as the de facto medium of exchange. The Lakota-nation an autonomous Native America nation in the Midwest of the United States, as adopted 'Mazacoin' a cryptocurrency based on the Bitcoin blockchain. The first 10,000 coins were mined exclusively for the Lakota Nation council and now the movement is attempting to ensure their economic sovereignty the way the Buffalo functioned for their ancestors (Harnill 2014). It remains to be seen in what way the US government may try to intervene with these movements. Another nation state preparing for the introduction of digital currency in December of this year is Ecuador. The history of Ecuador is similar to Argentina in that it was plagued by inflation, which became so bad that in 2000, it had to abandon its' currency, the *sucre* in favor of the US dollar.

When the Ecuadoran economy failed after a series of banking disasters the government attempted to solve the problem in the way that most governments do, i.e. printing money. This and other factors such as fleeing businesses caused inflation to grow out of control. The government was forced to adopt the US dollar as its currency but this meant that the Ecuadorian government had no control over its own money supply. This is a problem faced by several countries in South and Central America. While the adoption of the dollar probably saved the country from complete economic disaster the position of the government in Quito was dependent on decision made in Washington and Wall Street (Carluzo 2014). Ecuador's implementation of a digital currency coincides with the country totally banning Bitcoin (making it one of only 2 countries in the Western Hemisphere to do so). It is clear they wish to utilize digital currency as a way to safeguard their ability to print money and control inflation.

What must be done to move Bitcoin—or some other 2.0 version of a digital currency—into economies that can benefit from the decentralization and sovereignty inherent in the philosophy behind the currency? The Lakota-nation's Maza coin provides a provoking example. As of October 21, 2014 there are over 100 'alt-coins' cryptocurrencies that use the block-chain technology to create a currency. The technology behind Bitcoin enables communities to create a currency as a system of exchange, in the spirit of Benedict Anderson's *Imagined Communities* (2006), to enable more freedom in saving, risk avoidance, ultimately autonomy in decision making for household and community management.

Conclusion

This paper has demonstrated how two digital money systems function to create economic sovereignty for their users, with the hypothesis that Bitcoin, because of its engineering background in decentralized peer-2-peer networks, ultimately exhibits more potential as a technology for empowerment of economic sovereignty. After reviewing the literature and seeing that M-Pesa is (1) owned by a transnational telecommunications corporation and (2) has

only attributed to passive saving mainly for risk avoidance purposes, the methodology was to analytically examine overall generalizations in the 'economic footprint' of Bitcoin in those economies where it is more widely adopted than Kenya, namely Argentina. The paper concluded that while there is a strong seed of pragmatism in place for the M-Pesa system it is ultimately a wolf in sheep's clothing since the power and ownership of the system remains centralized in the hands of outsiders to the community. Bitcoin on the other hand offers a promising alternative, based in the same pragmatic philosophy and utilizing technology that seeks to 'level the playing field' by decentralizing the recording keep (and thus ownership) process. However, Bitcoin is to a large extent still a 'Beta' technology. Despite its massive growth, it has not wide-scale adoption levels in any segment of the global population, let alone the Global South. So any comparison to M-Pesa has in Kenya must take in to account these imbalances. Authors like Courtois (2014) bring up salient points about danger for corruption inherent in the engineering of the Bitcoin system, but in spite of this there are projects globally that provide lots of inspiration for macro and micro economies that can function more sovereignly and more appropriately, by serving the people that utilize them. Further research can be directed at engineers who want to start a '2.0 coin platform' on a small scale, in semi-autonomous or isolated regions. There is furthermore a considerable amount of philosophical and experimental engineering research to be directed at how digital currencies can be integrated into the D-Economy or so called 'Shadow Economy', the unregulated worldwide economy not serviced by banking systems.

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Knowledge Management in Organizations

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Abstract
This paper looked into the knowledge management in organization, and that include definition of knowledge and organization beside that the knowledge management, the role of knowledge within organizations after that we will mention the types of knowledge (tacit and explicit knowledge), and the resources of knowledge (internal and external resource) and how can it be applied in organization. The emphasis will be on discussing How to use knowledge to increase efficiency of work in organization and the benefit of knowledge that gain (both tangible and intangible), also the tools and techniques used to capture knowledge. The study refers to the role of human recourse department to deal with knowledge through motivate employee to share their knowledge. It also explains the challenges that can be face by an organization to establish knowledge management concept. In addition attempts to explain the four modes of knowledge conversation. We will also mention in this study an example of how knowledge could be recorded, documented in organization and how it used. We discussed in recommendation how to establish job of knowledge management in organization and which department can be suitable with this job. According to the above, the main objective of this study is to shed light on the important of knowledge management in organization.

Keywords: Knowledge Management, Organization, Human Resource

1. Introduction

Knowledge appeared with the beginning of humanity, we find its clear presence in humans, predatory animals and pets, which then transfer this gained knowledge for the generations that follow. In the field of Agriculture we observe that the same mechanism operates in knowing the right time for agriculture through the experiences gained from the practice. Obviously, we find that this knowledge needs to be documented so that it can be preserved from loss and in order to benefit future generations. This recording or preservation of knowledge appeared in the ancient Pharaohs who wrote down their knowledge in the walls of the temples. So the important operations were the sources of knowledge, they were captured, documented and shared.

Knowledge considers assets in organization such as buildings, cars and furniture (tangible assets).But actually knowledge has intangible assets which without it could collapse if employees leave the organization that have the knowledge and they are outside the organization without taking their knowledge. Knowledge is an important thing in human life and it is acquired through experiences and learning as an example.

2. Organization

A social unit of people that is structured and managed to meet a need or to pursue collective goals. All organizations have a management structure that determines relationships between the different activities and the members, and subdivides and assigns roles, responsibilities, and

authority to carry out different tasks. Organizations are open systems--they affect and are affected by their environment[1] [http://www.businessdictionary.com/definition/organization.htm]

3. Knowledge Management

The popularity of knowledge management (KM) has increased rapidly, particularly since 1995, and it has become central topic of management philosophy as well as management tool [professor ingi runar edvardsson- December 2004][2].knowledge management aims firstly to facilitate an organization in acting intelligently, in order to secure its viability and success, and secondly to make an organization to realize the best value of its knowledge assets [Wiig k, 1995][3].

Km is a management process to knowledge resources, which the organizations have held. The final objectives is to identify, acquire, develop, analyze, store, disseminate knowledge, and make each staff contribute their knowledge to others at the maximum while they can also share other's knowledge[li sijing][4].

4. There are mainly two types of knowledge

4.1 Explicit knowledge:

A kind of knowledge that can be coded and exists in different forms for example books, reports, maps, videos and records. The organization members can extract explicit knowledge very easy, because is available to take without efforts.

4.2 Tacit Knowledge:

Consider the knowledge embedded in the human mind such as experience, behavior and information. Tacit knowledge is very hard to capture, because it needs special technique and tools such as brainstorming sessions.

5. Resource of Knowledge:

5.1 Internal Knowledge:

Tacit knowledge in organization considers internal knowledge such as experience and culture .also lesson learnt, strategic plan in organization, peoples in organization and Annual report of organization.

5.2 External Knowledge:

There are different ways to acquire external knowledge such as collaborate with other organizations, and employees in other organizations, and participate in conferences that acquire new knowledge for the organization.

6. Tools to Capture Knowledge:

- **SWOT analysis:** Is an Abbreviation of (strength, opportunities, weakness and threats) which is used to capture different perspective of knowledge to solve a determined problem.
- **Brainstorming:** Employees in organization try to solve something such as invent new product in organization.
- **Lessons learned:** Any member in the organization should explain what is learnt and who learns every period, to share knowledge with organization members.
- **Interview:** To capture knowledge and experience from experts to be documented and shared in the organization.

- **Observation:** Is a method of getting a direct and realistic impression of what is happening. It can be done by detached or an involved observer, or by participant observation [Michael Armstrong, 2010:397][5].

7. Examples: How Knowledge is Documented?

- **Database**

Information technology tools which help the organization to save tacit knowledge and retrieve it. So through database the organization can save the knowledge and recovery data then use it without wasting time and effort because knowledge predecessor exist and registered in the database result of accumulated experience in the organization.

- **Books**

Write tacit knowledge that is in members minds in books .All this knowledge will be available in one book (externalization).

- **Other forms of documentation include:** Annual Reports, Magazine and Documentary Film

8. Four Modes of Knowledge Conversation (Nonaka model):

The assumption that knowledge is created through the interaction between tacit and explicit knowledge (Figure 1) allows us to postulate four different modes of knowledge conversation **[**Nonaka and Takeuchi, 1995:62**]**[6].

Socialization: is a process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills. For example Honda Company, which set up "brainstorming camps" informal meeting for detailed discussions to solve difficult problems in development projects **[**Nonaka and Takeuchi ,1995:62][6]

Externalization: is a process of articulating tacit knowledge into explicit concept **[**Nonaka and Takeuchi, 1995:64**]**[6]such as writing book included all information and experience acquire from specific field.

Combination: is a process of systemizing concept into knowledge system **[**Nonaka and Takeuchi, 1995:67**]**[6]such as Wikipedia concept every person could add his/her tacit knowledge in specific subject.

Internalization: is a process of embodying explicit knowledge into tacit knowledge.it is closely related to "learning by doing" **[**Nonaka and Takeuchi, 1995:69**]**[6]such as reading a book**.**

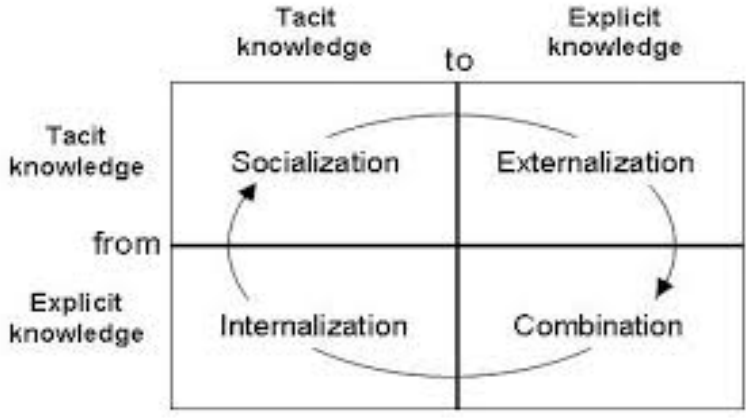

Figure 1. Four modes of knowledge conversation [Nonaka and Takeuchi, 1995:62][6]

9. Example of how knowledge management helps organization

- In (x) organization if we faced a problem we should call an expert to solve it. This costs money and time. But if we write down problems and their solutions daily reports and put them in a database (DB), we will solve problems by ourselves without the need for an expert and this saves money, time and effort for the organization.
- Project managers within organizations need to know the best way to carry out a project at the lowest cost, and a short time is always of high quality. The concept of knowledge management provides the project manager with the knowledge gained through past experiences of the organization, making benefit of the successful experiences and leave out the unsuccessful cases, which reduces the time and also allows him to take advantage of previous efforts at no additional cost and achieve high quality in the project using tools like brainstorming knowledge or SWOT analysis through real evaluation of the project from members of the organization.

10. Knowledge Manager

The main role of the knowledge manager or chief knowledge officer (CKO) is the responsibility for developing and implementing knowledge sharing program [Alexandra Perrin, Pascal Vidal and Jennifer Mc Gill,3][7]. If an organization needs to develop the structure of organization, the organization directly calls the system analysts who collect information about current structure, and try to find problems and solve them through designing a new system for the organization. This is actually the job of the knowledge manager besides researching resources of knowledge in an organization and their use in an optimal way.

To establish Knowledge management concept in organization the members need an Information Technology (IT) department (represents 20% to build KM in organization) and human resource (HR) department (represents 80% to build KM in organization). The role of IT department is to develop good knowledge management system (KMS) through a database as an example besides that HR persuades the members of organization to accept the concept of KM for better efficiency. To sum up we find the role of human resources department is very important to KM concept to do its task effectively, according to the knowledge manager the most related job to HR department.

11. Human recourse and knowledge management:

The core business of HR function is to develop employees in accordance with a business strategy. This also include the selection and hiring of people, the training and developing of staff, evaluating their performance, rewarding them, and creating a culture of learning[Evan,2003][8].Ten ways in which HR can contribute to knowledge management:

1. Help to develop an open culture in which the values and norms emphasize the importance of sharing knowledge.
2. Promote a climate of commitment and trust.
3. Advice on the design and development of organizations that facilitate knowledge sharing through networks, team works and communities of practice (groups of people who share common interests in certain aspects of their work).

4. Advice on resourcing policies and provide resourcing services that ensure that valued employees who can contribute to knowledge creation and sharing are attracted and retained.
5. Advice on method of motivating people to share knowledge and rewording those who do so.
6. Help in the development of performance management processes that focus on the development and sharing of knowledge
7. Develop processes of organizational and individual learning that will generate and assist in disseminating knowledge.
8. Set up and organize workshops, conference, seminars, communities of practice and symposia that enable knowledge to be shared on a person-to-person basis..
9. In conjunction with IT, develop systems for capturing and, as far as possible, codify explicit and tacit knowledge
10. Generally, promote the cause of knowledge management with senior managers to encourage them to exert leadership and support knowledge management initiative[Michael Armstrong,2009:225,226][9]

12. Recommendation

- Raise the awareness of organization members about knowledge management concept and the benefit gained if the organization members use it.
- Encourage employees to share their knowledge through different tools of knowledge management.
- Compare the benefits that the organization gains after use KM concepts to persuade the organization members to support it.
- Human resource department should change culture in the organization through making good environment for knowledge management.

13. Conclusion

Knowledge management is very important in organization and must be a part of the organization culture that will be supported through different managerial levels (strategic, middle and operational) to establish knowledge management concept in organization in an effective way. The concept of knowledge management success depends on accepting the senior management first, and the extent of the members of the organization in response to the idea of knowledge management that will change in the intellectual side and reduce time loss, money, solve problems, increase knowledge assets and help innovation in the organization.

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Knowledge Management to Empower Organizations in Developing Countries

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Abstract
The rapid growth of knowledge, plus increased demands and successive changes in the business environment and other management fields, has led to thinking about new concepts such as globalization, which is the direct result of a worldwide demand of products and services distribution. This has led to the concept of open markets, which has accumulated a huge amount of knowledge for organizations and their stakeholders, including customers. An organization's success depends on its ability to improve and follow up changes and a new concept such as knowledge management, which contributes to advancing an organization's position and insures sustainability regarding available resources. Any organization may have a great deal of information as a result of its work experience, and this information can be formed into valuable knowledge if knowledge management tools are applied. This research aims to address how knowledge management can contribute to the effectiveness of an organization's performance. Also aims to show off the importance of knowledge management and its key elements and the effect of knowledge management in increasing performance. Furthermore presents three proposed projects by Sudanese researchers to get benefits from the application of KM in three organizations.

Keywords: knowledge management, performance, organization, developing countries

Introduction

Business development challenges, the rapid growth of knowledge, increased demands and successive changes in business environment have led to new thinking about concepts previously unknown, such as knowledge management. Knowledge management is one of the most interesting concepts discussed by researchers recently. Knowledge management helps organizations to capture, classify and utilize valuable information to improve the business process by applying knowledge management tools, then analyzing the organization's performance while taking into consideration its internal and external situation.

Organizations in developing countries face many more challenges than those in developed countries, such as limited funding, adapting to new technologies and a lack of management tools. Knowledge management enables organizations in developing countries to use existing resources in an optimal manner, make better decisions, and achieve organizational objectives, while supporting innovation and competition and reducing rates of error. This research aims to address how knowledge management can contribute to the effectiveness of an organization's performance.

Knowledge Management Concept

2.1. Definition

Knowledge management (KM) can be defined as the systematic processes, or range of practices, used by organizations to identify, capture, store, create, update, represent, and

distribute knowledge for use, awareness and learning across the organization [1]. Any organization typically holds a great deal of information as a result of its work experience, and this information can be formed into valuable knowledge if KM tools are applied.

2.2. Why Knowledge Management

Organizations have been highly motivated to apply KM tools for many reasons, including the following [2]:

- KM's effective contribution to an organization's success by reducing cost and maximizing profits
- The importance of KM to set effective plans that support an organization's strategy
- The need to adapt to new technologies
- KM's effect on business competition and helping to meet customer expectations
- KM's support of innovation and competition

2.3. Key Elements for KM for Organizations in Developing Countries [3]

a) Strategy

Using available knowledge to determine strengths and weaknesses is a key factor in defining a good strategy for the organization, and then adopting an appropriate choice regarding the organization's mission and business objectives.

On the other hand, knowledge helps to set priorities in an organization's strategy and determine what should be executed first.

b) Human Resources

Human resources are the basic elements in a KM process because they are responsible for knowledge creation in their daily tasks, which is one way of producing organizational knowledge.

c) Technology

Technology has an important role in knowledge creation, publication and storage. It has many capabilities that can be utilized by human resources for document management, knowledge sharing, a decision support system and expert systems.

d) Operation

Business practices can be developed through the utilization of the knowledge gained, by analyzing previous work experience to get indicators about how to reduce cost and achieve a quick response.

Applications of Knowledge Management in Organizations in Developing Countries

This section presents three projects proposed by Sudanese researchers to apply KM in three organizations.

3.1. University of Khartoum Knowledge Web Portal

The first research is a suggestion of a knowledge web portal for the University of Khartoum. Since the formation of the University of Khartoum, many professors, lecturers, teachers and scientists have come and gone without any documentation for their efforts and achievements. No doubt countless great ideas have been lost and forgotten so that the students who come year after year do not get the most out of their university, and the researchers as well. The culture of knowledge sharing in the organization plays a vital role to ensuring that knowledge is shared among the faculty [4].

3.2. Application Of Knowledge Management Concepts in Archaeology

A Proposal for knowledge Portal on Ancient Sudanese Civilization. The second research aims to attract more attention to ancient Sudanese civilization, spread word of the greatness of this civilization, give access to Sudanese archeologists to present their works on a large scale, and encourage the study of Sudanese civilization while also encouraging tourism to Sudan [5].

3.3. The Impact of Knowledge Management on Kenana Engineering and Technical Services Company (KETS) Projects.

The third research was conducted to highlight the impact of KM on KETS projects; it was designed to explore the benefits of KM on project-oriented companies, with KETS as an example. The study findings demonstrated that KM processes contributed positively and raised the scale of a project's quality, with 49% of respondents agreeing that the impact of KM on the different deliverables of project quality is above average or excellent [6].

Discussion and Results

According to the above researches, we can note the positive impact of applying KM in different types of organizations. Applying KM directly affected organizational efficiency and performance on different aspects, which may be discussed in the following categories:

a) Human Resources

KM provides learning skills to human resources so as to increase their contribution to organizational improvement and enable them to adapt to changes related to market needs and technological development, which could increase flexibility and develop problem-solving skills.

b) Operations

KM improves an organization's operations by setting a plan to execute the most suitable operations according to business objectives, analyzed information and the current situation. KM tools enable human resources to share knowledge and find innovative solutions so they can perform operations with high efficiency.

c) Products

KM is an appropriate process to develop existing products according to market needs and also to innovate new products to meet customer expectations.

Conclusion

In light of the above, KM represent one of the most important concepts that has gained broad interest in recent years. Any organization potentially holds a wealth of information as a result of its work experience, and it is clear that this information can be formed into valuable knowledge if knowledge management tools are applied. Knowledge management contributes to increased performance and efficiency because it enables organizations in developing countries to use existing resources in an optimal manner, to make good decision, achieve the organization's objectives, and it supports innovation and competition while reducing the rate of error. On the other hand, it is very important to get people sharing knowledge and be awareness enough about the importance and using of KM tools.

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Massive Open Online Courses and how it can be helpful to Sudanese Students

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Abstract
The purpose of this study is to present a brief view of the impact of Massive Open Online Courses widely referred to as MOOCs on education and providing equal opportunities for the population of the third world. The paper attempts to determine the difficulties, challenges and obstacles confronting the widespread of MOOCs in Sudan .It then tries to suggest a few ideas for the purpose of addressing these challenges. It discusses how MOOCs can be customized to be adapted to local cultures and ways, and benefit students with different understanding levels and educational backgrounds. Moreover, the paper displays the outcome of a survey regarding this subject is conducted on students, teachers, professors and education community on their perceptions about MOOCs. By submitting this paper, I really wanted to shed light on the importance and benefits of MOOCs under our well known educational conditions and what can be done to capture the advantage of MOOCs and utilize them in favor to solving the big problem of educational gab between the developed and the under developing nations The natural consequence of these facts is being continuously far away from coping with the very big educational progress and advance happening in the developed nations. So, the urgent question is whether MOOCs can be utilized to lessen this gab .If the answer is (Yes) so it proves that it is a great and creative technology that can meet some of our educational needs.

Key words: MOOCs, Infrastructure, Education, Obstacles

Introduction

The Sudan, one of the northeastern African countries with its vast areas once resembling one fourth the size of the U.S.A and with its river Nile tributaries traversing it from south north, such a country which was once considered to be one of the most geographically, socially and culturally diverse country was split into two countries in July 2011 immediately after the application of the comprehensive peace Agreement (C.P.A). The republic of Sudan is now considered to be a young country because 15.7 million of the total population is under the age of 15. In such a country, with such a young population the demand for quality education is very high and crucial .this is because such education positively influences its economical, social, cultural and political aspects. [1]

But what is the actual image as a matter of fact concerning education? Unfortunately, the Sudan badly suffers from a very high illiteracy rate beside the unjust geographical distribution of schools; there is inequality in getting equal education opportunities .as a consequence of such unfair policy, the illiteracy rate has increased.

The Sudanese Council for Literacy and Adult Education has declared that the illiteracy rate has increased from 37% to 57% this increases has been discovered after the stoppage of war in some areas a thing that enable to carry out comprehensive and accurate statistics and senses regarding that exact numbers of illiteracy among females has raised to 27% and 3 million and 125000 schools aged children do not go to school. According to the last statement issued by the

united nation ,there are 50 south of desert African countries will not be able to providing equal elementary and secondary education opportunities for the males when the dead line arrives at the end of this year, A hint is made that the Sudan unluckily one of these countries.[2]

This is the sad image of education in Sudan concerning the traditional education in general whose foundation was very poor and weak not needing to tell about the image of modern technological education in which the country is far away backward and its people are still not knowing and illiterate. This last point is actually my topic of this paper for which I chose the title ***Massive open online courses (MOOCs) and how it can be helpful to Sudanese student.***

The worldwide widespread of MOOCs

A few years ago and following the huge information technology advance that occurred, many universities in different parts of the world directed to the so called Massive Open Online Courses (MOOCs) which formed a high quality educational revolution opening very wide horizons through providing free high quality educational sessions on web sites for millions of learners. MOOCs newspaper has stated that the number of universities providing MOOCs services is 500 universities. The most well known organizations are:

(**Edx**) unprofitable establishment, founded by Harvard University and Massatshots institution for technology in 2012.**Khan Academy**-an electronic educational platform established by Salman khan, an American educational person who produced more than 2200 video tapes on different branches of science and knowledge. The American profitable organization (**Coursera**) founded in 2012 at Stanford universities and college to design electronic courses broadcasted through its electronic platform.

The number of members of (Coursera) exceeded 6.3 million users and its present more than 596 session from 108 participants of international universities. The (**Udacity**) establishment founded at Stanford University this establishment holds contracts with scientists, lecturers and university teachers instead of universities the professionals design electronic courses to be broadcasted through Edacity platform.

Several university principals and administrators think that including MOOCs in the high education institutions will form a big opportunity for the development of knowledge and a good solution for the problems confronting of the high education sector. Thousand of learners can get knowledge through lectures conducted directly online by professors at a given point of time a thing that will save the student time and money.[7]

The situation in the Sudan

Up to now MOOCs has not witnessed a remarkable existence in the Sudan. It has not widespread and has not been popular and well known except for a few people who pay serious attention and care for this modern technological and electronic medium of education. Actually MOOCs is not expected to form a magic solution for the problems facing high education in Sudan. But considering that there is no longer a university in Sudan classified as one of the internationally leading universities and bearing in mind the rising complaints as from the late seventies of the previous century regarding the deterioration of the university graduates standards and academic levels and the bad quality of education in general, I think there is a promising opportunity for MOOCs to play a good role in changing or participating in changing the very bad image of education in Sudan. Below I will try to put forward and discuss the

obstacles and difficulties facing the widespread of MOOCs in Sudan, Then the benefits of MOOCs.

Challenges and Obstacles

The dream of having country- wide MOOCs facilities in Sudan which is a part of the Middle Eastern comparatively backward countries always faces a number of obstacles and difficulties.

Connectivity and Devices

One of the difficulties facing the utilization of MOOCs facilities is the question of connectivity and devices. It is known that the infrastructure in the Middle Eastern countries especially in the Sudan. The internet usage rate is still very low in this area reaching 17.4% [6] according to the estimated made by Marketers co. and independent American marketing co. These figures show a very low number of internet users compared to the total population number as shown below according to ITU reports as:

Table 1. Internet Usage and Population Growth [5]

YEAR	Users	Population	% Pen.	Usage Source
2000	30,000	36,841,500	0.1 %	ITU
2003	300,000	35,035,677	0.9 %	ITU
2009	4,200,000	34,206,710	9.3 %	ITU

Being one of the third world countries the Sudan faces new challenges added to its traditional accumulated problems. These difficulties together are increasing and widening the gap in the fields of education, technology and scientific advances which are the essential bases of development. This actually led to the existing conditions in all developing nations. They have no opportunity to utilize the imported technology or to improve it or to add to it through their own skills and knowledge. So I can conclude that the learning through internet in Sudan is still below what is hoped. To improve the Sudanese ability to get education through internet courses requires appropriate information web site infrastructure and supporting technology which does not exist now in almost all areas in the Sudan.

Another point is that these sessions may reproduce the question of inequality, not all of the areas can find access to these programs or have the ability of owning the devices or have the skills and knowledge to deal with them. Only the rich will be able to have and use them. Almost all the rural areas in Sudan don't know such technology.

The language as an obstacle

English language is not the Sudanese mother tongue it is taught as a foreign language starting from 5grade elementary. So almost of the Sudanese suffer a language barrier when dealing with English.

The teaching language of all subjects in all levels is Arabic knowing that English is the key language for modern education. The problem is that there is no genuine effort being made to overcome this problem. So, considering that MOOCs are mostly designed in English language, most people might be discouraged to make the best of them. But looking at the full half of the cup, MOOCs can help the students if they exert doubled effort. An international company for training has issued a report showing that almost all Middle Eastern and North African countries occupy the last fluency marker (indicator)[6] So the video lectures may be

hard to understand for most of the students. However, some of them tend to use the translator applications while others tend to make translating groups.

Lack of awareness of the E-learning

The people in the Sudan need their awareness of the importance of the online learning to be raised. Even those who use the internet, exclude their interest in surfing Facebook pages, games and chatting. A big change in people's attitudes is needed. The question of offering the certificates without making sure of their really acquired skills and knowledge is another point.

The culture of Education

Academics see that the culture related to education and being educated is another important issue. To them, there is a difference between MOOCs methodology which depends on colleagues discussions while teaching in Sudan mostly depends on teachers.

Professors also say that Sudan is still suffering from a kind of complexity towards the west especially the Europeans as a consequence of the British colonization in the past, people think that everything produced in the west has the priority and superiority. This feeling enforces the good impression about the programs presented by such well known and famous international universities.

Another point is that MOOCs do not actually provide diverse cultures. If such varied and different cultures are to be introduced, the planners and sessions designers of MOOCs have to include individuals who really represent those cultures perfectly. For those who cannot have the access to such cultural diversity, the best way may be in drawing the attention of subscribers and students to establish their own contents.

How MOOCs can be helpful

It is a fact that there are remarkable obstacles, challenges and difficulties which hinder the widespread of the process of MOOCs in the Sudan. However, there is a still the potentiality of making the most of MOOCs, in a way or another, by a creation percentage of Sudanese people. MOOCs being appropriate to the Sudanese communities can be clarified by the fact that this service as discussed below.

In communities whose females are not easily given the chance of getting educated abroad for reasons such as the conservative social attitudes, religious reason, financial reasons or other practical reasons, the electronic education can provide unprecedented opportunities. These courses which are presented to huge number of students for free have the ability to multiply these numbers

As mentioned above, MOOCs free service is of great importance for our poor communities. This is very obvious in the light of what is known about the fact that Sudan is nowadays witnessing the most difficult conditions in all aspects. Deterioration in every field, political and economical instability, the rate of inflation is (45.30%)[3]. These very bad conditions are necessarily and directly reflected on people's life especially on their education. Getting good education is possible only to those who have financial potentialities. So education has become very costly.

In the light of what is stated above, MOOCs can provide good opportunities to whoever needs wherever he is through the best international universities and institution the cost of education in MOOCs will be limited by the cost of subscription fees of the internet. In this way

thousand of Sudanese in the Sudan can be graduated directly from Harvard University wherever these students are even if they are at the most remote parts of the Sudan.

These courses will be of great benefit for females both female workers on long vacation, motherhood and nursing free time and unemployed females who have sincere seriousness and desire to acquire knowledge but they are unable to achieve the dream because of their poverty. The flexibility of MOOCs enable some of the females to make sure of the courses at their convenience, in other words at time they find themselves free of household responsibilities. Some females are so lucky that they can travel abroad, get educated while others have the potentiality of doing the same. but hindered by some unavoidable obligations and responsibilities at home. This second group of females can benefit of MOOCs. But there is still the obstacle of their ability to find easy access to the internet.

In addition to the above stated, and bearing in mind the language barrier , but MOOCs creates a big opportunity to the regional leaders and pioneers by providing a different kind of education which I can call good or high quality education compared to our traditional education compared to our traditional education. This quality education can heal and fill the now existing gap between our education and the advanced education of the developed nations. This will definitely create new kinds of leaders and elites who can drive the nation forward by tackling and coping with the latest and newest advances in sciences and knowledge.

Suggestions addressing challenges and obstacles

When talking about a responsible body or entity that can adapt the MOOCs program, one immediately thinks about universities and educational institutes. Unfortunately, our educational institutes are far away from such Ideas, the ideas of sharing knowledge and providing it to all of the people while preventing their own students from sitting for exams because of their failure to pay some remaining fees. So, I don't think that it is probable that such universities will be able to adopt the MOOCs and include them in their programs and plans. Our Sudanese universities suffer lack of resources weak infrastructure and shortage teaching staff.

The idea which is to be thought about is the idea of establishing training centers in the capital and the states to adapt MOOCs and to launch training the students to develop their skills and to raise their awareness. These centers should established by unprofitable organizations and societies such as the Sudanese Knowledge Society in co-operation with other profitable organizations as a part of their social responsibility towards the community.

These centers responsibility includes the provision of devices, communicating with and contacting the students and active internet, coordinating with them regarding the time table of the courses and announcing them. The trained student can then aquifer needed experience so that he or she can do the job without needing help. This is because educating methods in Sudan completely depends on the teacher and the educational institute a thing that makes it difficult for a student to completely depend on himself in dealing with MOOCs. The existence of training centers will encourage the students and increase their commitment and obligation towards MOOCs.

Another important role played by such centers is that they can solve a problems considered to be a weak point in MOOCs program, that is the question of cheating to get completion certificates regardless of the actual content, use and knowledge he or she actually obtains. This is because the learners will enroll by themselves under the supervision of the centers. Moreover, the centers will pay the completion certificates fees in behalf of the students

because the learners cannot pay them by themselves for the absence of electronic payment tools in Sudan.

To solve the language barrier problem partially, the mentioned centers can adopt the initiation presented by (EDRAK) [4] organization the MOOCs Arabic platform which came as a result of Queen Rania's initiation for education and development.
(Edrak) is the first Arabic electronic platform related to MOOCs shared with (Edx).

Survey results

I carried out survey related to MOOCs and internet usage on 150 student and employee. The **main** selected survey result was as follow:

1. Do you have the desire to study abroad?

		Age			Gender	
	Total	16-20	21-30	31-45	Female	Male
	146	27	92	27	56	90
Yes	88%	93%	91%	70%	93%	84%
No	12%	7%	9%	30%	7%	16%

2. Have you heard of MOOCs?

		Age			Gender	
	Total	16-20	21-30	31-45	Female	Male
	146	27	92	27	56	90
Yes	49%	30%	52%	59%	38%	57%
No	51%	70%	48%	41%	63%	43%

3. Do you wish to get free education through internet?

		Age			Gender	
	Total	16-20	21-30	31-45	Female	Male
	146	27	92	27	56	90
Yes	90%	89%	89%	93%	88%	91%
No	10%	11%	11%	7%	13%	9%

4. Will you abide by the courses timetable?

		Age			Gender	
	Total	16-20	21-30	31-45	Female	Male
	146	27	92	27	56	90
Yes	86%	81%	87%	85%	84%	87%
No	14%	19%	13%	15%	16%	13%

Conclusion

In the light of what is mentioned above it clearly seems that the problem is not in MOOCs in Sudan but it is in the weak infrastructure of education and the information sector. The issue of the information society is basically process of changes resulting in fundamental changes in the pattern and behavior related to all activities at all levels. The big change will not occur merely by sending mottos calling for coping with what is going on in the world, or doing inconstant treatments to achieve the goal of such a big change including the establishment of monitoring MOOCs centers because such a solution in a short-term solution and not a final radical one. What we aim at in here is to lift the whole car and put it on the correct track of modern society of information along with developing its mobility and charging it with its surrounding environment. In this case, the role played by the official state authorities to adopt this trend will be essential.

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Project proposal: Bringing Raspberry PI computing to Sudan

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Abstract
Technology education in developing countries needs revolutionary methods in setting curriculums and education systems. These methods should exploit affordable technologies to solve one of the major educational challenges, which is providing practical training in a real computing environment with appropriate computing platform and required supporting peripherals. This research aims to view the possibility of using the Raspberry Pi platform for educational purposes in Sudan; to develop education techniques that used by establishing Raspberry PI Innovation labs in Sudan which will let student more interest in education process.

Keywords: Raspberry PI, RPI, Technology Education, Raspberry pi platform

1. Introduction
Educational Technology is the use of Technology to support student learning and instruction, and includes all the electronic tools, both hardware and software, that assist individuals in their ability to acquire and communicate information developing challenging curriculum while increasing state supported opportunities for professional development [1].

Education has taken a new road away from old fashioned pedagogy. Old fashioned pedagogy techniques that depends on lecturing or being the sage on the stage is no longer valid. Instead new pedagogy that has high technical learning involvement and gets the learners more involved, encourages creativity, develops problem solving skills and helps learners to think for themselves with teachers guidance of course are more appealing. Yet this concept and its techniques is not really new to many countries around the world, but it has not been introduced to the Sudanese educational system so far. Many challenges might be the reasons why it has not yet been adopted by the country officials, and more likely the number one challenge is the financial status. Here comes the Raspberry Pi presenting a low cost, high efficiency solution. This research aims to prove for fact that using Raspberry Pi in education can close the gaps between education and technology in Sudan due to lack of technology infrastructure, as well as it facilitate transmission in no time with the least financial resources possible. Not only that but by coaching teachers and providing them the tools needed for a better and more open education this will guarantee a generation of leaders who are tough to functioning their maximum capacity, sustainable educational system, knowledge sharing society and a ground for development of all areas and future endeavors.

The research is idea to instructional program required of all students. Students work individually and in teams as they learn how to use and interact with raspberry pi platform to solve problems and extend human capabilities. Another motivation behind this research is to explore the possibility of using this device in high schools to get students more excited about programming and computer science.

What is the Raspberry Pi?

The Raspberry Pi was born in response to fears about a decline in computer literacy. In 2006, Eben Upton and his colleagues at the University of Cambridge's Computer Laboratory were concerned about the number of children developing programming skills. Instead of controlling a computer, children were being taught to use software or simple web design. In particular, A-level students applying to study computer science at the Lab were demonstrating less and less experience of actual programming. Upton's solution was to create a computer that was cheap and helped hone programming skills. The same size as a credit card, the device plugged directly into a keyboard and television. This allows it to function in much the same way as a home PC at a fraction of the price. The basic and accessible design also means it can be adapted to a range of different uses: from making robots to simply connecting to the internet. The aim of the charitable Raspberry Pi Foundation is to distribute to as many schools as possible to create a new generation of computer programmers. This UK technology is helping to reunite children's' creativity with coding and computers. [2]

From using the Pi, the device boots like a normal computer only on a different operating system (Linux) and works pretty much the same. It has a few limitations where you are required to use command line instead of a flashy Graphical User Interface at login, however once support log in switch from the command line to the GUI,surf the Internet through the Ethernet port or through WIFI (wifi dongle). The programming language you can use on the Pi is Python. Google Coder allows you to turn the pi into a mini web server. [3]

Why Raspberry pi?

Raspberry Pi has shown that it is a very useful device and is capable of replacing a number of more expensive devices in the academic like OLPC (one laptop per child)machines 200$ per computer here are the reasons why:

1. ***Low cost***

   Starting from as low as $25 for a 512MB of RAM and 700GHz processor power of a foundation computer kit and a paltry $50 for supplementary peripherals (or even usage of existing hardware such as monitors and keyboards)[4]

2. ***Education should be fun***

   RPI comes With a capability of building a media playback device, a NAS box, an FTP, print server, a torrent Sniffer, a time lapse camera, a dedicated firewall box, a 3D printer, an internet radio, a nanny cam, a robot, a Rube Goldberg machine …what can't you build with raspberry pi? [4]

3. ***Open source system***

   Raspberry pi's open source nature and friendly development environment of third party apps and frameworks that create chances of wide spread adoption especially in Africa also kids can be into development of projects that will change communities.

4. ***Building for the future***

   Raspberry pi is geared at enticing as many children as possible in coding with languages such as kids Ruby, python, PHP, which create a better learning experience hence better thinkers That make students are trained to be innovators rather than just being job seekers in future. [4]

2. Relevant work:

Relevant to this research, an experiment of introducing technical education has been implemented in school in Rwanda and Ghana. Even over a short period of time, under less than ideal conditions, these schools achieved significantly higher scores than the typical schools, over several measures of literacy. There is every reason to believe that the Open Learning System will also inspire comparable improvement in learning subjects such as math, science and health. In this research the same approach will be experimented using the Raspberry Pi and more aspects along with the academia will be put to test and observed. [5]

In 2013 successful story of UNICEF innovation to help educate displaced Syrian children in Lebanon whose lives have been so drastically disrupted, back into learning. [6]

In Sudan there is another experience in innovation labs; the approach is technology for development but not in RASPBERY PI, field it is based on UNICEF's innovation lab model with collaboration with faculty of mathematics sciences (university of Khartoum) that concerned with telecommunication and rapid uptake of mobile technologies to support development work. [7]

3. Methodology of research

The question is how can you identify the requirement for developing and sustaining high quality education system via raspberry pi platform through establishing innovation class or labs we want to seek to partner with other organizations such UNICEF to support with open learning system. Labs are bridging the innovation gap between technology development and the uptake of new educational services involving all relevant players of the value network via partnerships between teachers, researchers, research organization, innovation agency; that are allowing for early assessment of the education methods implications of new technological solutions [8].

Figure 1. RPI labs partnership [1]

3.1 Tools for highly innovative environments [9]

- Strong leadership.
- Classroom coaching.
- Open Education Resources
- Basic e-Learning Library
- Open Learning Network

3.2 Phases for suggestion RPI labs:

- Stakeholder involvement
- Vision building with workshops
- Innovative scenario
- Requirement analysis and definition of utilization for raspberry pi platform.

- Bringing Raspberry pi devices. and equipments
- RPI configuration and programming coach

- Full scale software/ hardware development
- Integration of tools and services
- Field trial

- Field lap trial extended full profession teachers
- Evaluation for living labs as innovation environment and evaluate impact on student

Figure 2. RPI Labs Framework [10]

3.3 Between theory and practice raspberry pi labs

Threats that faces RPI labs:

- Funding: this project need financial support to deal with all cost begins form buying the devices to programmers' salary.
- Change management from teachers their selves and adaptation to new technologies.
- Convincing authorities' example ministry of education to use this updated education technique in school rather than exist traditional ones.
- Sustainability for projects.
- Transferring project idea for rural and far areas: will be difficult because of least technology background in those areas.
- Teachers and organization involvement: this project need flexible teacher to accept deal with it and collaborate organization to supervise on it.

4. Future work

RPI labs will open many opportunities for kids through skill based learning modules that include online and face to face teaching unit that also provides opportunity to acquire and master core skills and basic electronic-technology knowledge from early age that guide student to gain skills and confidence, and advance through the curriculum. This project can be study from other side by explores the possibility of using the RPI in high schools to get students more interested in programming and computer science topics.

5. Summary

This paper discusses the possibility of Applying RPI platform in education system. and RPI labs as a way to constitute a new a approach of enabling user driven ICT-based innovation initiatives geared towards education , Several methodologies development and innovation practice of such RPI labs in Africa and one case study about innovation labs focusing on higher education in two Sudanese universities where tools were proposed to facilitate .The key conclusion of this paper is that RPI platform labs methodologies and strategies must be tailored to higher education as one of the applied curriculums. It is relatively easy to envisage a toolbox of concepts, methods and strategies. However, the crucial challenge is to intelligently adapt such authorities in Sudan and make them really work in Sudanese schools. This approach can contribute to initiate a technical style of education. This work requires a strong partnership and commitment at the educational field.

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The Role of ICTs Affecting Climate Changes

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Abstract
This abstract gives a brief review about Information and Communication Technologies (ICTs) how can it be effective in tackling many problems and dire consequences resulting from climate change. ICTs can provide practical solutions to problems such as greenhouse gas emissions, global warming, floods, hurricanes and other natural disasters. ICTs can provide means of predicting the future of the planet as it can foresee the negative impact of climate change on social trends and behavior, such as migration ,homelessness etc. he impact of human activities on the environment and climate change, which has become a growing concern for everyone, it becomes clear to all of us to put the issues of environmental degradation and climate change as a priority and to take all measures and precautions required to make environmental improvements that are directly related to the development of information technology and communication, production, use and safe disposal of waste, especially since this sector has become responsible for approximately 2-3% of greenhouse gas emissions on a high level. To sum up, there will be some precautious solutions related to ICTs' obstacles that will be discussed in the upcoming paragraphs. Those ones will enable us to create and find other energy alternatives.

Key word: ICTs, climate change, impact, natural disasters, global warming, gas emissions, social trends.

1. INTRODUCTION

The impact of human activities on the environment and climate change, has become a growing concern for everyone, it may become clear that it is essential to all of us to put the issues of environmental degradation and climate change as a priority and to carry out all required measures and precautions to make environmental improvements that are directly related to the development of information technology and communication, production, use and safe disposal of waste, especially since this sector has become responsible for approximately2-3% of greenhouse gas emissions in such a high level.

"*We all know that information and communication technology has revolutionized the world,, information and communication technology are also very important to address the problems faced by our planet: the risks posed by climate change...In fact, Constitute the ICT part of the solution. The use of these technologies to reduce emissions and help countries to adapt With the effects of climate change...and that governments and industries that adopt Strategy for pro-growth environment will occupy a central- stage in the environmental field and will be Serving as leaders in the economic sphere, in the twenty-century atheist*. " [Ban Ki-moon ,5 October 2009][1]

"*ICTs are part of the solution, not part of the problem, and there are enormous gains to be made through the smart use of ICTs virtually in every single sector. Forward-thinking leaders already recognize the powerful role ICTs play in helping address climate change issues across the world. The importance of ICTs now needs to be recognized globally- and the vital role of ICTs as we move forward in dealing with climate change issues are further promoted*" [Dr Hamadoun I.Touré , 5 October 2009][2]

1.1 Climate change

Is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years . It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events). [http: en.wikipedia.org wiki Climate_change][3]

1.2 ICTs

Information and communication technologies is a collection of devices and services You capture data and information sent and displayed electronically .It Include personal computers and peripheral devices and networks ,broadband communications and its data centers.

Proven information and communications technology that have an essential role in helping to mitigate climate change and adaptation, in spite of the existence of different views on climate change and how to act according to it, the scientific materials demonstrate that the impact of human activity on the Earth's climate is almost a fact that cannot be refuted ,It seems that the emissions of greenhouse gases behind climate change and then there is a need to reduce carbon dioxide and other greenhouse gas emissions.

2. Waste management using information and smart communication technology

Industry is experiencing ICT rapid progress by Moore's Law as the number of transistors that can be integrated at no cost in an integrated circuit doubles every two years and lead to the obsolescence of premature hardware and waste generation can achieve considerable savings in energy consumption through recycling equipment information and communication technology, which leads to avoid the need to extract raw materials, particularly materials-intensive high-energy, such as rare earths, so the increased use of recycling and safe disposal of information and communication technology can help in the mitigation of climate change and greenhouse gas emissions, and the introduction of the principle of sustainability of supply in the industry information and Communication Technology Standard universal charger-uniform size fits all solution Mobile phones aimed at reducing waste and greenhouse gas Global Warming.

The International Telecommunication Union recently collaborated With the information technology industries sector and communications, the development of a global standard for charger Effective global in terms of energy use phone Mobile that would allow the use of the same Charger for all mobile phones in the future36 It can lead to save tons of Chargers excess annually, which helps to Reduce wastes and carbon dioxide. [ITU , study Group 5 February 2011][4]

3. Use of information and communication technology to reduce travel or replacing it

It can reduce the need to travel by holding virtual meetings which can facilitate this process, and the most common are the services Web-based that requires access to the Internet and software Web-based permit to hold virtual meetings from different locations, including sharing of

documents and exchange, and can lead this to reduce the travel or replacing it and thus to reduce emissions. In addition to working through the house and also cut emissions of carbon dioxide resulting from the movement and the movement of cargo or other modes of transport.

4. Use of information and communication technology to increase efficiency in energy supply and to maximize the use of renewable sources

It can use information and communication technology to maximize the efficiency of energy systems and their capacities in terms of computing and communications are essential in the energy of harnessed power resulting from the resources of renewable such as geothermal, solar, wind, wave and tidal effective and incorporated into the electric grid in a smart way.

The information and communication technology are necessary to monitor the load in the network by maximizing the use of solar energy and tidal energy available, for example. using and information and communication technology to develop a model for the case of systems of renewable energy in real time taking into account the local air monitoring stations so that the transmission losses are reduced to a minimum level through the selection of the shortest path from the source to the load.

4.1 How can ICTs help in mitigating climate change?

As a scientific evidence of climate change continues to emerge and awareness to increase over the rapid accumulation of greenhouse gases (primarily CO2), interest in the impact of ICTs on the environment has escalated, and along with it, research on their potential role in both contributing to and mitigating climate change. A lot of international conferences and international organizations and most importantly the International Union of Telecommunications mostly focused on encouraging the development of devices, applications and networks to be more consumer efficient, as well as to encourage the design pro-environment, especially information technology tools and communication in order to reduce greenhouse gas emissions significantly and reduce the impact of carbon industry.

4.1.1 Case Study

The GSMA and 23 leading mobile operators and manufacturers have committed to implementing a cross-industry standard for a Universal Charging Solution for new mobile phones. This will enable the mobile industry to adopt a common format for mobile phone charger connections and energy-efficient chargers, resulting in an estimated 50% reduction in standby energy consumption, the potential elimination of up to 51,000 tonnes of duplicate chargers25 every year, and the enhancement and simplification of the end-user experience. A universal charger will also make life much simpler for the consumer, who will be able to use the same charger for future handsets, as well as being able to charge their mobile phone anywhere from any available charger. [GSMA , February 2009_Mobile's Green Manifesto][5]

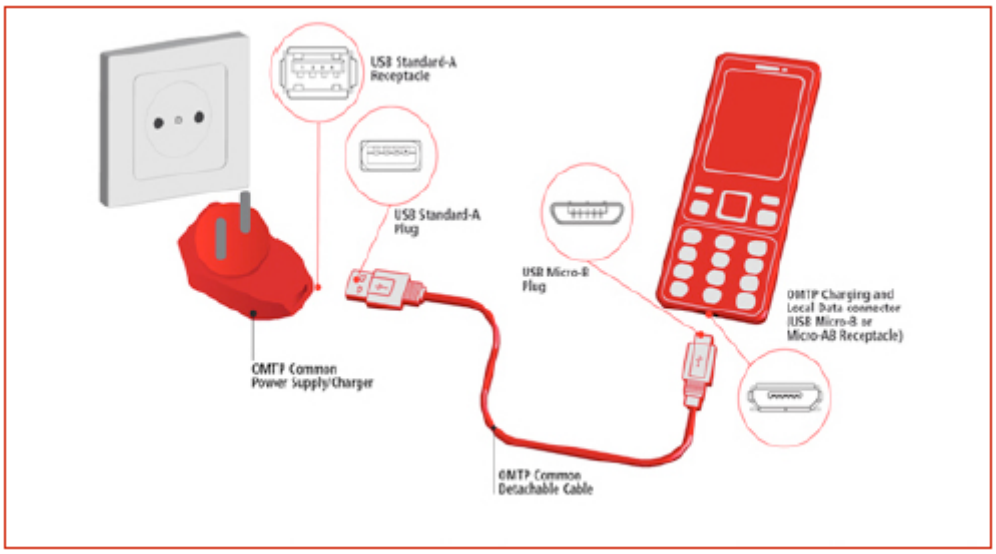

Figure 1. Universal Charging Solution

4.2 Use of information and communication technology for environmental monitoring

The systems include information and communication technology used for environmental monitoring, climate and dissemination of data and early warning as follows:

- Meteorological satellites that track the progress of the storms and hurricanes
- Meteorological radars that track the progress of the tornadoes and thunderstorms, fluid flowing from volcanoes and forest fires Home.
- Assistance systems Meteorological Liston the radio to collect data on weather conditions and treatment, and without which the current and planned precision of weather forecasts threatened dramatically.

Satellite systems for earth observation allows access to environmental information such as the composition Atmosphere (for example, carbon dioxide, steam, and ozone concentration), and standards relating to the oceans (temperature change at ground level), including monitoring of forests and data Agricultural and many others. These systems are all global monitoring system, GMP is the primary source of technical information on the global atmosphere, a system composed of complicated methods, techniques and facilities standards for measuring meteorological and environmental uses in most countries Source: Hand book joint venture between the International Telecommunication Union Organization World Meteorological under the title "Use of Radio Spectrum for Meteorology: weather, water and climate monitoring and prediction[ITU][6].

4.3. Use of ICTs To monitor deforestation and forest degradation

It can be a key component of the protection of forests to mitigate climate change which could lead to increase in temperature two degrees More details to eliminate one-third of the trees over the next hundred years Can ICTs can also contribute to this issue through technological development paths of sustainability and the protection of tropical forests as well as enhancing the collection of data on forest conditions. The satellites are now able to capture

images through clouds at night and remote sensing applications, are of great importance to monitor the health of the trees of tropical forests in the world.

5. Recommendations

- Develop and use ICTs for disaster prediction, detection monitoring, and response.
- Design and Develop Early Warning Systems.
- Establish collaboration platforms to share information for a better response.
- Strengthen Institutional Capacities through training/
- Link the Development and Disaster Management Agendas to optimize the use of resources.

Develop a program based on real figures showing the effect of reduced energy consumption and the benefit of ICT;. As ICTs may need to operate in difficult meteorological conditions (hot weather, high humidity), it becomes urgent to help countries develop more affordable green ICTs, as well as more robust and reliable; and most importantly, because of the developing world is particularly vulnerable to changing climatic conditions and suffer from poor service in the field of Internet and voice communications. Bridging the digital divide is necessary to help the developing world to develop a plan to adapt to the conditions.

6. Conclusion

Nowadays Become ICTs exist everywhere in the community and ensure that telecommunications networks and the Internet to make information available in one touch of the keyboard, and I've stated in this paper how to assess the risks posed by climate change or the adaptation with the help of Information and communication.

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A New approach for eliciting Non-Functional Requirements in Sudan: collected and analyzed data

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Abstract
Requirements engineering are now widely recognized as crucial part of software engineering and has established itself as distinct research area. Those are commonly classified to Functional requirements: These are statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. In some cases, the functional requirements may also explicitly state what the system should not do and Non-functional requirements (NFRs): These are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process and standards. Non-functional requirements often apply to the system as a whole. They do not usually just apply to individual system features or services. The elicitation requirement process is the process of gathering requirements and based upon the success or failure of the project, although the researchers demand, however, it have a many problems, the most famous problem is the communication gaps exists between customers and developers. During the last years several approaches dealing specifically with NFRs but until now there are no clear cut definition about NFRs. This paper presents guidelines aid to elicit the requirements especially the NFRs, increase the knowledge of customer about NFRs, and help the developer to elicit the requirements properly and quickly. This guidelines result from real data analyzed and collected from software companies with different sizes and specializations in Sudan.

Keywords: Requirement engineering, Non-function requirement, Function requirement, Requirement elicitation.

Introduction
Many systems development methodologies have been proposed to address the problem of identifying user requirements adequately but their focus leans towards the analysis of user requirements rather than the elicitation of those requirements from the users. However, errors in requirements elicitation are the most serious in software development and the hardest to repair. In a study by Beichter found that 70% of the systems errors are due to inadequate system specification and 30% of the system errors are due to design issues (Vijayan and Raju, 2011: 9-16), (Prasad and Roger et al, 2005:1-2).

The elicitations of NFRs are more difficult than Functional Requirements (FRs) because it appear in any time in the system lifecycle. There are many challenges of NFRs that make it hard to identify and evaluate. Some of these challenges include the difficulty in defining an NFR clearly because the description is often subjective and lack a common methodology or odd (rarely appear). Also, it is challenging to examine how NFRs influence on each other (Singh

and Kumar, 2012:2).

Theoretical Background

The services provided by the system, the system's operational constraints, and the customer's needs. All these things called the requirements. Requirement engineering it is the first, and most critical activity of the software development process as it affects the entire software development process because it provides the basis for the rest of the software development phases such as design, coding, etc. The requirements engineering process comprises five steps that include elicitation, analysis, specification, validation and management (Vijayan and Raju, 2011: 9-16), (Tousif and Muhammad et al, 2013:2).

Several names used in the software industry for the term requirement is a high-level, abstract statement of service that the system should provide or a constraint on the system (Sommerville, 2009:83). Software requirements are classified as functional requirements, non-functional requirements or domain requirements (Martin, 2005:1), (Singh and Kumar, 2012:1), (Armin, 2006:5), (Samuel and Atif et al, 2008:9).

Functional requirements: These are statements of services system should provide, how the system should react to particular inputs and how the system should behave in particular situations. In some cases, the functional requirements may also explicitly state what the system should not do.

Non-functional requirements: These are constraints on the services or functions offered by the system. They include timing constraints, constraints on the development process and standards. Non-functional requirements often apply to the system as a whole. They do not usually just apply to individual system features or services (Summerville, 2009:83).

The main goal of requirement elicitation is to understand the problem. A Savant Institute study found that "56% of errors in installed systems were due to poor communication between user and analyst in defining requirements and that these types of errors were the most expensive to correct using up to 82% of available staff time" (Prasad and Roger et al, 2005:1-2). One of the key challenges facing software engineering researchers is the infamous gap between analysts and users in terms of awareness, acceptance, and adoption (Didar and Chad, 2005:22).
They are a lot of quality models to involve the NFRs of the software. The Models of software quality can be classified to hierarchical models and non-hierarchical models. The hierarchical models involve McCall's, Boehm's, FURPS, ISO 9126 and Dromey's models, also the non-hierarchical models can be Bayesian belief networks and Star model (Samuel and Atif et al, 2008:5-11).

Data collection and analysis

There are a number of elaborate classifications for the NFRs where each of these classifications covers set of NFRs by some way. The following table (1) calculates the NFRs in all models to determine the most commonly used and to determine the number of the NFRs in each model:

Table (1) occurrences of NFRs in models

NFR name	McCall	Boehm	FURPS	ISO	IEEE-Std 830	Summerville	Jacobson	Total
Reliability	√	√	√	√	√	√	√	**7**
Maintainability	√	√		√	√			**4**
Usability	√	√	√	√		√	√	**6**

NFR name	McCall	Boehm	FURPS	ISO	IEEE-Std 830	Summerville	Jacobson	Total
Testability	√	√						**2**
Portability	√	√		√	√	√		**5**
Efficiency	√	√		√		√		**4**
Integrity	√							**1**
Correctness	√							**1**
Flexibility	√							**1**
Interoperability	√					√		**2**
Understandability		√						**1**
Modifiability		√						**1**
Functionality				√				**1**
Performance			√		√	√	√	**4**
Supportability			√				√	**2**
Safety					√	√		**2**
Quality					√			**1**
Security					√			**1**
Interface					√		√	**2**
Operational					√			**1**
Resource					√			**1**
Verification					√			**1**
Acceptance					√			**1**
Documentation					√			**1**
Delivery						√		**1**
Implementation						√	√	**2**
Standards						√		**1**
Capacity						√		**1**
Legal						√	√	**2**
Economic						√		**1**
Operations							√	**1**
Packaging							√	**1**
Human engineering		√						**1**
Reference	(Martin, 2005)	(Martin, 2005)	(Martin, 2005)	(Martin, 2005)	(Singh and Kumar, 2012)	(Singh and Kumar, 2012)	(Singh and Kumar, 2012)	

The data collected from developers working in Sudanese software development companies. The companies surveyed differ in terms of the size of developers, size of revenues,

number and type of project produced in company, as well as the ways they elicit the requirements from the users or stakeholders.

In interviews with participants, information was obtained on the techniques adopted by the company for eliciting the requirements, the challenges developers face and the strategies the company uses when discovering that the project produced is not satisfying the customers need. In addition to that, the interviews obtained information on tools used by different developers to narrow the communication gaps with customers, when the NFRs appear in the system lifecycle, and the common NFRs.

These data was collecting from software companies Sudanese different in terms of size, specialization, and type of systems that being built and we have analyzed and reached the following points:

- Most of these companies size are small or very small.
- There is no standard or known method followed, most of them use semi agile methods.
- The existence of communication gaps in most companies.
- There is no traceability on these companies.
- The customers have no idea about NFRs.
- The common NFRs are often appearing in final stage (deployment).
- The common NFRs are: performance, usability, security, and availability.
- The most important thing for all companies the quality of product.

Proposed guideline:

From the review of literature we found that a major problem in requirements is the gap communication exists between the customer and analyst for the elicitation process especially NFRs which is the focus of this research paper because the customer cannot define the NFRs. The framework supports the elicitation process in three perspectives:

1- Customer perspective:

- **Maturity test:** it is the test to evaluate the understanding of customers about the software concepts, by the result of this test, we can divide the customer to two levels depend on his knowledge about software requirement concepts:
  Level one: customer aware about software requirements concepts and aware about his company needs.
  Level two: customer aware about his company needs only.
- **Mediator:** there is no problem with the customer in level one because he/she knows about the company needs and how can arrives these needs to the developer (but this type of customer is very rarely in this country depend on survey result) . When the customer in level two needs someone arrive the requirements of customer to the developer this someone called mediator.
- **Customer awareness rising:** Make a list contain all of the NFRs that exist in the Sudanese company and describe it to the customers to help them to know it. For example the next list in Table (2).

Table 2. Description of NFRs

NFR	Description
Performance	High speed in response to any order

NFR	Description
Usability	Ease of handling system interfaces for any client
Security	Not to allow any unauthorized person to skip his/her powers in the system
Availability	Being able to access the system and deal with it at any time within working hours
Stability	Degree of system security risks and ensure there are no errors in it

2- Developer perspective:

- **Training:** before the beginning of any project the developer team must take training in the domain of Customer Company, this will reduce the gaps of communication exist between the developer and customers.
- **Field of specialization:** the developer team is divided into different sub-teams, each have experience in a specific domain of the software project. This sub-team can enhance the experience of developer team in elicitation process and increase the quality of product.
- **Early NFR identification:** Every type of systems has specific set of NFRs. According to the results obtained from the sample of local software companies in this paper, Table (3) lists NFRs by type of system. The set of NFRs represent the common NFRs that was highlighted (performance, usability, security, and availability).

Table 3. Common NFRs in systems

Type of system	Common NFRs
Security systems	Performance – security – stability
Banking systems	Performance – usability – availability – security
ERP systems	Performance – usability
Accounting & health systems	Performance – usability

3- Software product perspective:

- **Customer involve:** to ensure the right way of software product the customer must involve in any iteration of the system so can extract the right requirements for right domain.
- **Agile methods use:** In addition, the testing process is important in agile methods such as acceptance test, integration test, and unit test, as well as maintenance.

Conclusions

The objectives of this paper are concerned with non-functional requirements in (considered as more elusive than functional requirements and presenting a challenge to local software developers) and ways of improving their elicitation process. The paper used document review to investigate classification and models of NFRs and ways of defining them. An analysis was conducted on the communication gap and NFRs models found from literature as well used by local software companies, to develop a framework to aid NFRs specification.

This paper started with theoretical review about the elicitation process and especially NFRs and their types, models and challenges. Those data backed by data collected from

software companies to know about how deals with the NFRs in Sudan, this data try to cover all information about NFRs in these companies as possible.

After analyzing all these data reach to the following: The most appropriate methods to deal with the NFRs (identified by local developers as well as from literature) are agile methods because of their focus on the customer to be involved in all stages and facilitate early feedback on the product and start of the testing process. The paper produced a list that contains the type of systems and recommendations of a set of NFRs that are applicable to them that developers can use during the elicitation process, and a second list that contain the NFRs and their description to help customers in selecting NFRs that are relevant in their system. One of the main challenges for this research work was the trend that was highlighted in the data collected from local companies. Those NFRs can show at any time of the system. Although this poses a challenge to developing a systematic process that this paper aimed to produce, further evaluation of the recommendations produced by this work can contribute to bringing NFRs to the front of developers' and customers' minds alike, because of the difficulty in dealing with them and their critical importance to software quality.

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Software Development Challenges in Developing Countries

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Abstract
Software became one of the most important tools that contribute to facilitate and achieve tasks effectively and easily in different fields, so it became one of the most important appropriate technologies. This led to increase the demand of software products that has an important impact on the rapid growth of software industry. Software development restricted by numerous challenges such as requirements changes, limited budget, limited resources, unapproved customer decisions, limited project time and not accurate cost estimation. These challenges must highly considered because it affects the development process and quality. Also addressing of software challenges has a great impact on customer satisfaction and business welfare. In the third world countries, software challenges is always a struggle in software companies. Probably is because of the limited resources. This research aims to investigate the most important challenges faced in business environment of developing countries in order to develop software that realizes needs of the system environment and its users. On the other hand, this research concern about reducing the risks, reasonable resources consumption and guarantee quality of software products.

Keywords: Software Development, Developing Countries, Open Source Software

1. Introduction

The computer software production continues to grow rapidly. This growth had a number of important implications both for the industry and more generally in terms of economic development. Software consists of the set of instructions that enable different hardware to perform the required operations. In this sense, it constitutes the "brain" of ICT devices (Sophie, 2012).

Software production has different levels: data entry, software/ IT services for domestic market, software/ IT services for exports, software products for domestic market and software products for exports. Due to the limited resources in developing countries, software development faces many challenges more than existing challenges in developed countries. These challenges must be highly considered because it affects the development process and quality. Also addressing of software challenges has a great impact on customer satisfaction and business welfare.

This research aims to investigate the most important challenges in business environment of developing countries in order to develop software that realizes the needs of the system environment and its users.

2. Software Trends in Developing Countries

Based on literature, software development in developing countries recently has greater emphasis on mobile applications, cloud computing and Free and open source software.

2.1 Mobile Applications

According to International Telecommunication Union (ITU) Reports, numbers of

mobiles subscribers in developing countries are extremely increased. This is represent a potential base of demand for mobile applications (Zeljka and Jeremy, 2002).

2.2 Cloud Computing

Cloud computing provides computer processing and storage over a network as an alternative to purchasing packaged or customized software (Sophie, 2012). So cloud computing is necessary to reduce the cost of hardware.

2.3 Free and Open Source

Free and open source refers to the source code of a program, usually written in a high level programming language, is necessary to be able to understand its functionality, to modify it and to improve it (Carlo and Jesus, 2000). "Free" refers to users' freedom of use and redistribution (Carlo and Jesus, 2000). Free and open source provides new business opportunities in developing countries and can help to empower communities to be less technologically dependent. Recent technological trends, especially with regard to cloud computing and mobile applications are set to further accentuate the reliance on free and open source.

3. Software Challenges in Developing Countries

Software sector has grown significantly in recent years in some developing countries, such as India, Argentina, Brazil, China, Costa Rica and South Africa. This is generating new job opportunities, innovation and export revenue (Sophie, 2012). Software production faces many challenges in developing countries and it is very important to address these challenges in order to get software with a high quality. This paper discussed two levels of challenges: framework challenges and development process challenges.

This paper discussed framework challenges based on a literature while development process challenges was discussed based on a previous study conducted on a sample of software companies in Sudan as a case study for one of developing countries (Elamin, 2014).

3.1 Framework Challenges

Framework challenges related to overall challenges that hinder software production in developing countries. The most obvious obstacle to establish a successful computer software and services industry in developing countries is the lack of financial capital. This is could be noted obviously in the unavailability of hardware and advanced telecommunication services (Oshikoya and Nureldin, 2005).

Policies of software development in developing countries not gained the required concentration, this can led to raise conflicts between different organizations due to unclear laws of intellectual property right protection (Marin, Tomislav and Mario, 2003). Supporting research activities contribute to update and spread knowledge over software developers. Unfortunately, research activity is limited in developing countries; this caused to loss the benefits of knowledge sharing (Oshikoya and Nureldin, 2005).

Efficient training represents one of challenges that faces developing countries in software production. Specialized professional training services for further qualification of local IT experts are frequently insufficient or not available (Marin, Tomislav and Mario, 2003). Nonetheless, in many developing countries most software companies are small and may lack the necessary resources to invest in training and developing the capacity of their employees. Although developing countries need outsourcing to improve electronic services provided by software, but the existing obstacles such as: Communication problems, incomplete project

specifications and poor project management could limit dependence of outsourcing to improve software services (Friday, 2011).

3.2 Development Process Challenges

Development process challenges indicates challenges faced by software engineers in developing countries throughout the development process. Software development affected by two main challenges: project set-up and project complexity. Firstly, software developers in developing countries do not comply with the practices of the used software development methodology, they only apply the practices that suite their business environment and projects context. Secondly, Lack of full documentation for the development process represents a great challenge in the software production since it limits to benefit from the previous experiences and sharing lessons learned. Finally, software developers in developing countries prefer to use one methodology with all types of products unless the project context requires the use of a different methodology. This may not be the right behavior to get software with a high quality.

4. Discussion

Although education system in most of developing countries is capable to provide knowledge for software engineering students to be graduated with an acceptable level of software development skills, but training is required to improve these skills. Free and open source has various implications, including the reduction of the market power of proprietary software manufacturers and greater reliance on collaborative software development.

It is obvious that countries with well-developed capabilities are better equipped to implement their own customized solutions and less dependent on outside expertise.

The ability of a country to adopt, adapt and develop appropriate technological solutions and applications depends on the strength of its domestic capabilities (Sophie, 2012). Local software expertise is more able to understand local needs and therefore to develop relevant and innovative applications and content. Also close interaction between local developers and users generates learning opportunities and potential development. Moreover, low levels of software intellectual property rights protection represent a great challenge for developing country firms. The cost of intellectual property rights legislation enforcement, however, remains a major problem for developing countries.

5. Conclusion and Recommendations

While new trends such as, mobile applications, cloud computing and open source imply better opportunities for developing countries, their ability to meet domestic needs for software and to supply software services or products to international markets depends on the strength of their domestic capabilities. Governments have a key role to set software development policies. However, developing countries need to be flexible in their policies in order to pursue development paths suited to their own specific requirements and capacities. Hence, intellectual property protection represents an important factor influencing the development of the computer software and services in the developed and developing world.

The main way of fostering skills is through the regular education system, particularly secondary and tertiary schools. A key challenge is to produce human resources that the market is actually requires. Some of developing countries moving towards in software production. It is obvious that India and Sri Lanka are highly export-oriented while Brazil, the Republic of Korea, China and the Russian Federation are predominantly driven by the domestic market (Sophie,

2012). Consequently, to support software production in developing countries, it is important to concern about the following point:

- Promotion of local learning.
- It is better to perform software projects with lower costs and local value creation.
- Creation of local independent market led to less dependence on specific technologies and vendors.
- Enable adaptation of software to local needs.

In the light of the above, recommendations of this paper are summarized as follows: it is very important to support research activities and create a strong basic for research development, adapt education and training schemes to the new ICT landscape, setting a good level of intellectual property protection laws, encourage technological upgrading, improve communication skills to benefit outsourcing and give adequate attention to free and open source, especially in public procurement.

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