INNOVATION IN ENGINEERING EDUCATION: THE MOBILE STUDIO

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Abstract

Most departments of electrical and computer engineering traditionally offer courses in several areas by separating the courses and the accompanied required labs. This approach always presents difficulties to the average student bridging the gap between the course and the related lab even though the objectives and Accreditation Board for Engineering and Technology (ABET) requirements are met. Lectures and labs become difficult to follow. Concerns about labs related to the theory may not be readily available. The lab instructor may be different from the course instructor. Thus further chaos is created for the student. These labs are equipped with bulky expensive equipment. Thus few stations will be available to a group of students. Each station may accommodate 5 or 4 students per group creating calamines since very few of the students can actually conduct the experiment due to the limitation of space. The rest are mere observers or reporters just recording the data. Recently, the Department of Electrical and Computer Engineering at Howard University together with participating universities has introduced the mobile studio approach. It combines hands on and lectures simultaneously.

The mobile studio is a lab on "wheels". Each student has his/her own work station that 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 for the hands on approach. It is connected to the I/O board that is connected to the Tablet PC via a USB cable. The instructor also has a similar set-up for demonstration. It combines lectures, labs and demos in one package. Presently, the mobile studio approach is being implemented in circuits, digital and electronics courses with success. In future, the mobile studio concept will be extended to other courses. The studio has motivated students' interest in the courses and performance have improved immensely. Examples are provided using the mobile studio. A survey is conducted at the end of each semester. It covers use of the I/O boards, course content, format setting, and perceptions of engineering and ABET assessment. The department uses the mobile studio in conducting high school outreach programs as a motivation to do engineering.

INTRODUCTION

Generally, medium of instruction of courses with accompanied labs are offered separately. This approach creates problems for students as well as the instructors. Lectures and labs are taught at different times, on different days and even sometimes both are taken in different semesters, and also sometimes by different instructors. Thus students find it difficult to understand theory as well as the lab hands on. In order for students to fully understand the lectures material and labs as proof of theories, there is a great need to offer „hybrid „courses that consist of lectures and labs at the same time.

Additionally, traditional labs are equipped with bulky work benches and large expensive instruments and other equipment (such as large function generators, oscilloscopes and power

supplies) sources that consume appreciable amount of electric energy for operation at this time of the world‟s dwindling energy sources. Due to limitation of space and bulky equipment students work areas are limited and thus they are forced to work in overcrowded groups. It contributes to a few number of students in a group that can actually participate in performing hands on the tasks required for the lab under investigation. The rest only act as recorders. They hardly participate or contribute to the success of the lab.

Due to recent advances in technology (nanotech) and miniaturization, a great deal of work for miniature devices have been developed. Large size instrumentations have been reduced to palm sized computer notebooks. The miniature instruments (Tablet PC) is interfaced with input out I/O boards that series as source of power supply and function generators for analog and digital labs. The circuit under test is on a bread board is connected to I/O board. This unit (tablet PC, I/O board, bread board system) is known as the mobile studio. It occupies rather a small portable space (much less than a cubic foot). The cost is rather low, less than $1000 per station. There is available mobile studio for each student in a course as well as one for the instructors.. The mobile studio provides the functionality of a regular lab in a portable package. The instructor, as well as students, work in synchronism to provide lecture and hands on experience at the same time. Data collection at the PC is made easy. The PC acts as instrumentation (ammeter, voltmeter, oscilloscope with basic two-channels) as well as the control panel for the labs.

The mobile studio-based classes have been used in courses in the department for over four years now. Initially, the department started with a few stations on experimental basis with networks (circuits) courses. Students enthusiasm motivates the department to get more and expand the concept to several courses at different levels from freshman through senior levels. The concept has also been introduced in our “Smart Lighting‟ high school outreach programs with great success.

The “Smart Lighting” program provides students motivation to pursue engineering profession. The program consists of lecture series and it is coupled with hands on approach since engineering involves data collection and analysis leading to evaluation.

THE MOBILE STUDIO CONCEPT

The mobile studio teaching concept that is a normal practice of other departments (such as architecture, arts) has been adopted by engineering departments due to advances in technology and miniaturization. It consists of a Tablet-PC that acts as instrumentation and input/output I/O board that serves as computer interface via USB cable [1, 2]. Thus, the usual old fashioned laboratory setup (as shown figure 2) that

Figure 1.Compact Mobile studio lab Equipment

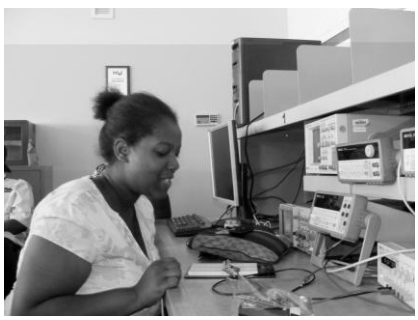


Figure 2. Old Fashion Traditional Lab Concept-Bulky

includes separate oscilloscope, multi-meter, power supply, function generator and others has been replaced with the „portable" mobile studio (shown in figures 1 and 3) setup that consists of a breadboard, Tablet PC and an I/O board that is a small hardware platform. The entire setup occupies small space. It can fit in a backpack and carried home. .

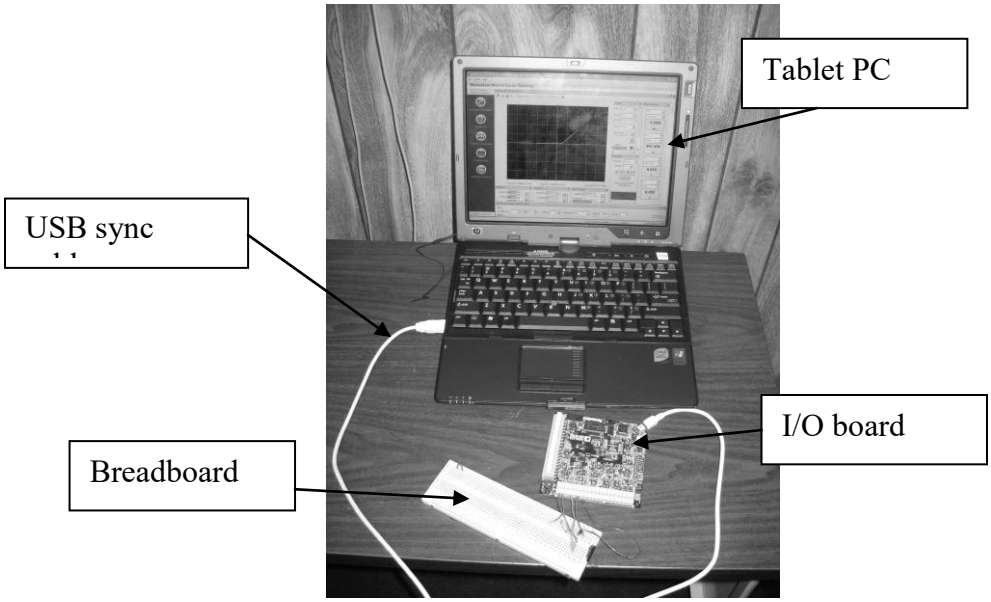


Figure 3. MOBILE STUDIO STATION

Figure. 4 below shows the I/O board instrumentation panel displayed on the tablet PC screen. The I/O board emulates a function generator, oscilloscope, voltmeter, Spectrum analyzer, ±4.5V DC power supply and is capable of digital operations.

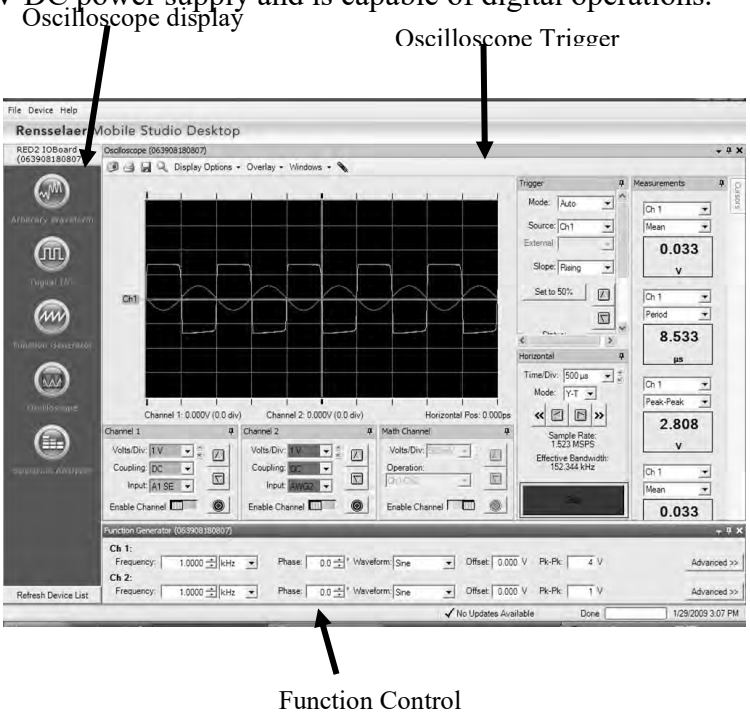


Figure 4. THE I/O BOARD INSTRUMENTATION PANEL ON THE TABLET-PC

The portable nature of the mobile studio setup means that there is far greater student interaction with the equipment since there is a workstation for each student. The instructor and the teaching graduate assistants also have a similar set up. The students are encouraged to individually explore the characteristics of the demonstrated circuit under several conditions. Occasionally, a graduate teaching assistant may contribute to monitoring the students‟ progress and offer assistance to ensure that all of them understand the topic before resuming the lecture. They also use the mobile studio for projects, homework, labs, and designs.

MOBILE STUDIO-BASED COURSES

The mobile studio concept has been in use for the past four years. The Department initially started with a small scale tablet-pcs (as a test bed) with circuits courses by combining lectures with labs at the sophomore level [1]. It became a great success and students interest in electrical/computer engineering increased. Students could save data gathering time using the mobile studio. They could obtain plots instantly (instead of traditional write down data, and plot graphs on paper by hand or other means later.

Additional tablet pcs have been obtained with improved voltage supply and more features. Thus the concept has been extended to electronics and digital courses as well as to capstone design projects. It has also be introduced in freshman introduction to engineering courses.

EXPERIENCE WITH THE MOBILE STUDIO

Unlike separate classes and labs, combining both lectures and labs has greatly improved the attention of our students through hands on approach. They are able to discuss results with other students instantaneously. They correct each other. Our students work on assignments with the mobile studio. One can observe them with serious concentration and overall enthusiasm. Their mobile studio work coupled on the spot with comments from the instructor, enhances the individual‟s understanding of the subject both theory and practice (through experimentation).

SAMPLE OF STUDENTS MOBILE STUDIO APPLICATIONS

Samples of students use of the mobile studio are presented below.

Compound Amplifiers: Students study characteristics of compound differential, Darlington and cascode amplifiers using PSPICE simulation and comparison with experimental results using the mobile studio

Problem Statement

a. Differential Amplifier: Set up Circuit as shown in Figure 3, obtain waveform and determine: the common mode voltage gain, the differential mode gain, and the common mode rejection ratio, (CMMR)

b. Darlington Pair: connect the circuit as shown in Figure 4, add the Darlington pair to the output and measure the gains.

c. Cascode Amplifier: Connect the circuit as shown Fig. 3 right, determine the upper half frequency of the cascade amplifier, Find the upper half frequency of the resulting common emitter amplifier

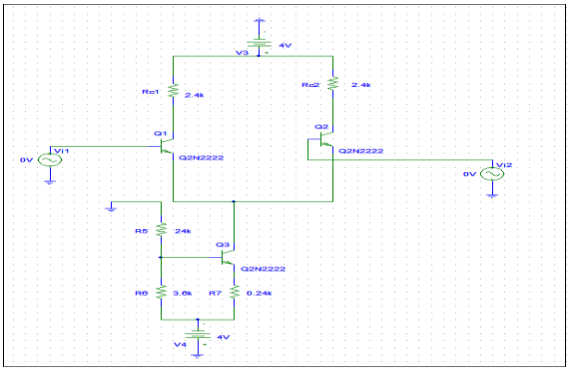
Differential Amplifier: The differential amplifier amplifies the difference between the two input signals V1 and V2 by some the differential gain, Ad. Thus its output is proportional to the difference between its input voltages. $V_{out=}A_d(V_1 - V_2)$. They are often used when it is

desired to null out noise or bias-voltages that appear at both inputs, a low common-mode gain is usually considered good. This is because they are less sensitive to noise and interference than the single ended amplifiers. It consists of two transistors whose emitters are connected together. The output can be taken either as a single ended or double ended with a dc bias current source, I. The differential mode voltage gain, A_d, and the common mode voltage gain A_{cm} are determined from small signal analysis. The common mode rejection ratio (CMMR) is a measure of how well the amplifier amplifies differential mode and common mode signals.

$CMMR = 20\ log\left|\frac{A_d}{A_{cm}}\right|$. Ideally, this value is infinite (∞).

Darlington Pair: The Darlington pair is an extremely useful direct coupled amplifier configuration. It is often found in the output stages of power amplifiers so as to reduce the required base drive. It can be thought of as a variation of the CC-CE circuit with the collector Q1 connected to that of a Q2. It is used to implement a high performance voltage follower. Its current gain of $\beta = \beta_1\beta_2$, where β_1, and β_2 are the current gain of the two transistors.

Cascode Amplifier: A common-base amplifier stage is in cascode with a common–emitter amplifier stage to form a very useful and versatile amplifier circuit. This configuration is known as the cascode. It combines the high input resistance and large trans-conductance achieved in a common-emitter with the current-buffering property and the superior high-frequency response of the common-base circuit. It can be designed to obtain a wider bandwidth and also increase the dc gain while leaving the bandwidth product unchanged. The BJT cascade has high input resistance and it improves input-output isolation (or reverse transmission) as there is no direct coupling from the output to input [3-5]



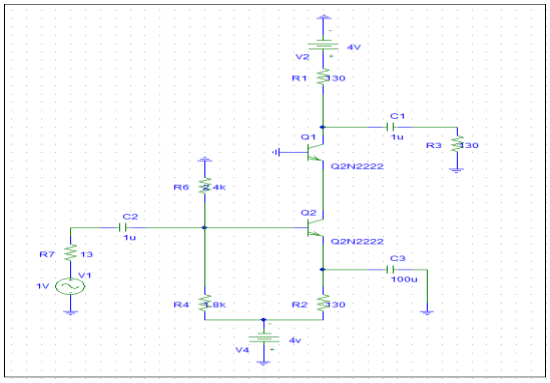


Figure 5. a. Differenetial amplifier:- b. Cascode amplifier circuit

A. Differential Amplifier

Experimental Results (from figure 5a)

1. Set Vi1 = Vi2 = 0, results: Bias currents, $I_{c1} = 2\mu A$, $I_{c2} = 2\mu A$, $I_{c3} = 2\mu A$

2. Set Vi1 = Vi2 = 1V at 1 KHz. Determine the common mode gain

$$A_{vcm} = \frac{1.05}{-0.4} = -0.26nV/V$$

3. Set Vi1 to 50mV peak to peak at 1khz, ground Vi2,results in mV

In decibels, CMMR = 20 log $\left|\frac{0.0156}{-0.38 \times 10^{-3}}\right|$ = 32.3db

B. ***Comments:*** Both the experimental and PSPICE simulation results did not produce accurate results because of the lack of a potentiometer.***The Darlington Pair Effect***

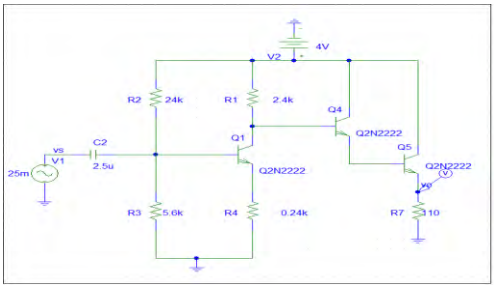


Figure 6a. Circuit with Darlington Pair

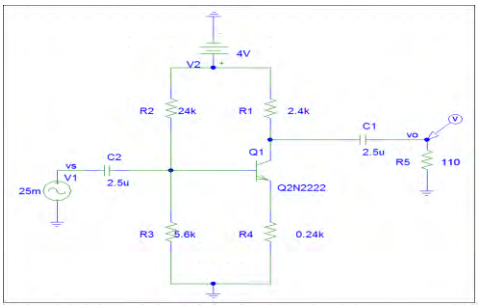


Figure 6b. Circuit Without Darlington Pair

Experimental Results

Table 1. Connect circuit without the Darlington pair (from figure 6a, b)

Amplifier	Load	Vs	Vo	Voltage gain Av
Without Darlington pair	$R_L = 110\Omega$	$50mV_{pp}$	$19.5mV_{pp}$	0.39V/V
With Darlington pair	RL=110 Ω	50 Vpp	2.89 Vpp	57.8 V/V

Simulation Results

Gives, RL = gain = .36V/V, RL= 110, gain = 62.3 V/V, similar results

Comments: The results from the experiment differ from that of the simulation because the limitation of the IO board makes it impossible to produce a 4V at Vdd.

C. Cascode Amplifier

Results

Table 2. Connect the circuit as shown and measure the collector current and voltage across collect

Results	Ic1	Ic2	Vceq1	Vceq2
Experimental	7.4mA	7.4mA	3.7V	2.1V
Simulation	7.38 mA	7.438 mA	3.736 V	2.33

1. Cut-off (lower and the upper half) frequencies of the cascade amplifier

Lower 3-db frequency fl = 1.07 KHz, mid-band gain 18.8 V/V, upper 3-db frequency, fh = 75 MHz

2. Cut-off (lower and upper half) frequencies of the common emitter amplifier.

Fl= 1.07 KHz, midband gain = 18 V/V, fh = 75 MHz

Comments: The Cascode amplifier increased the bandwidth of the amplifier the mid band gain same.

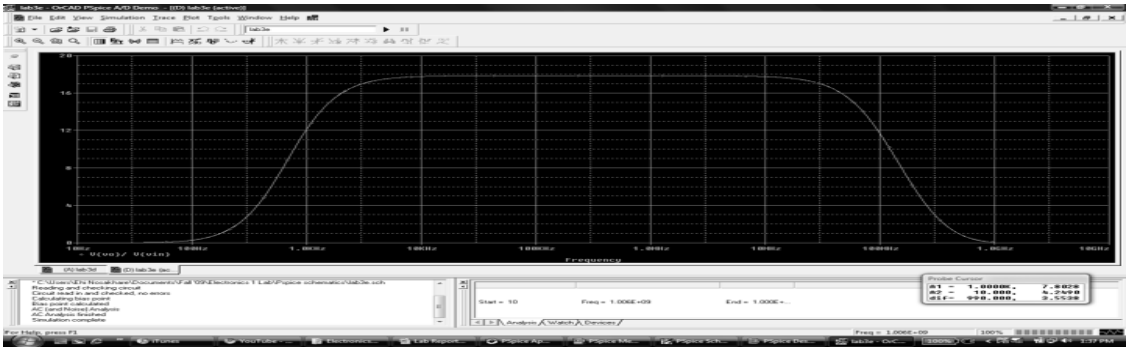


Figure 7. Simulation of cascode amplifier

Conclusion: The experiments give properties of several configurations of amplifiers. The errors in the experiment are due to the limitation of the I/O board to supply a voltage of 4v.
Reference: Sedra S. A., Smith, K. C. Microelectronic Circuits. Fifth Ed. New York. 2004

THE OUTREACH SUMMER PROGRAM

The program emphasizes electrical and computer engineering and it is designed to provide an exciting, hands-on, design-centered introduction to engineering design using smart lighting projects and the mobile studio. Howard University is committed to providing an education environment that is accessible to all students. The School of Engineering consists of the following departments: chemical, civil, mechanical, electrical and computer engineering, and systems and computer science options. We explain the role of each area. Such as: electrical engineering that involves: devices generating, control or using electricity, communications, radio, television, cell phones, video games. Computer engineering also encompasses several areas including digital systems (hardware and software).

SAMPLE PROJECT: The design of optical-emitter

Design: Smart Lighting: A team is asked to build an optical emitter (transmitter) and a receiver. The systems is demonstrated with a music source to be received by an amplifier and converted into sound using a loudspeaker. It works.

Figure 8 a. Optical receiver project b. Nanotechnology lecture by Prof Gary Harris

SURVEY ON USE OF THE MOBILE STUDIO

A survey of the students‟ reaction to the use of the mobile studio that combines lectures and labs is conducted every semester based on the outline below.

- Frequent use of I/O boards in class, lab and homework, I/O board usage in course content, instructor and teaching assistant, format setting, supplementary material

- Use of I/O boards integration-development of students confidence

Students approve the use of the mobile studio. However, they want to see the I/O board with improvements in increase of voltage supply above the available 4.5 volts.

CONCLUSION

The department has successfully implemented the mobile studio approach (while satisfying ABET requirements) in teaching the courses circuits, electronics and digital courses and laboratory hands on by combining lecture, labs, recitation and homework projects. Students participating in the High school summer engineering outreach programs show great interest and appreciation in the use of the studio. Typical students‟ examples using the mobile studio have been discussed. Their confidence levels have increased unlike the earlier traditional methods (class lectures separate from labs). The survey for assessment of the mobile studio concept by the students is very overwhelming and encouraging. We hope colleges in appropriate technology adopt the mobile studio concept. It saves money and space. In the high school „Smart Lighting‟ outreach program, we demonstrate how students can be exposed to several areas of engineering profession and practice through hands on approach..

Acknowledgement

Thanks to the high school students participants, and to the students and faculty who have contributed to the continuous improvement of the studio based courses.

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Using Business Rules Standards to Advance E-Governance

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Abstract

The business community has played a leading role in establishing standards for sharing knowledge across computing platforms. Developments in e-commerce have led to developments in e-governance and e-government. One of the latest efforts to standardize electronic communication in the business community is the development of international business rule management standards. This study focuses on an examination of one of the most popular business rules standard – Semantics of Business Vocabulary and Business Rules (SBVR). Standards in the e-governance arena will not only facilitate the expansion of e-governance within nations, but also greatly facilitate e-governance in the international arena. Standards across national boundaries are of particular importance to Africa as the African Union (AU) seeks to implement continental unity. E-governance is viewed as a particularly effective approach to using information and communication technology (ICT) to empower the general citizenry. This makes the expansion of e-governance a key concern of appropriate computing. This effort concludes with suggestions for further research efforts in standardizing and advancing the utilization of e-governance across national boundaries.

INTRODUCTION

"In poll after poll, citizens want their governments not only to fix economic problems, but also to be active in almost every domain". A 2008 survey involving 50,000 people across 60% of the world indicated that over 87% of people want governments to provide food to the hungry, health care and public education to all citizens [1]. As populations become more literate, countries become more economically and industrially developed and communication technology advances the expectations of government increase. The ability for governments to use technology to both assist its citizens and involve its citizens has greatly increased for both developed and developing countries. This sets the stage for advances in e-government and e-governance.

Advances in the ICT sector in Africa have set the climate for the private sector, civil society and government sector to improve service delivery. "Africa"s telecoms sector is the most rapidly growing of any in the world. With many markets globally at saturation point, the opportunities for expansion in the continent are plentiful. But only those investors who understand the complex dynamics of Africa and the unique challenges it throws up will succeed in realizing the immense potential. With three submarine cables now installed, the availability of cheaper broadband connections and the Internet could transform communications in Africa. Mobile banking is already doing so in the financial sphere" [2]. With the connection of submarine cables to fiber cables across Africa, broadband speed has greatly increased while reducing in cost significantly. Fiber is replacing the slower and more costly satellite connections. The global reach and financial potential of telecom advances in Africa is apparent in the following report: "Safaricom, in Kenya, has a service called M-Pesa that lets the cell work as an ATM; … Cellphone minutes are traded by phone as a cash substitute. Credit card payments are mad by cellphone. Remittances from relatives overseas come by cellphone. (Amounting to about $350 billion a year these days, remittances are expected to reach $1 trillion soon; in some developing countries, the remittance total is already higher than foreign aid and foreign investment combined.)" [3]

African e-government

African countries have embraced the utilization of information and communication technologies to reduce disparities among its citizens. Some such as Rwanda [4] have been very aggressive in planning and implementing ICT based projects. Earlier initiatives dated back to 2000 initiated government backed national internet access projects, Government website, computerization of ministries, a national GIS applications project, as well as a effort to establish a comprehensive computer-based information system to deliver government services. In 2005, Rwanda extended on these efforts with twenty new initiatives outlined in Table 1 below.

Project	Purpose
Document Tracking & Workflow Management	To provide a system that can be used in any Ministry, agency, or large organization to track the progress of documents through their life cycles.
The Citizen‟s Guide to Governmental Procedures	To define and document all procedures that the citizen or the private sector needs to interact with the public sector.
Rwanda National Portal	To develop an official Rwandan gateway to all governmental and non-governmental information and procedures.
Budget Management System	To allow preparation of detailed Government budget lines and to manage budget execution.
Tax Management System	To provide a tax management system integrated with other public accounting applications.
External Finance Inflow Management System	Management of development projects, integrated definition of public projects and development budget, and financial execution of projects as development budget execution.
Public Accounting	To establish a Public Accounting Planned Action that collects financial data from revenue collection, budget execution and central bank data, and presents them in accounting terminology, running various financial reports on the State finances.
Border Control and Visas	To support the Immigration and Emigration Departments.
National ID and Smartcard System	To provide every citizen with a Smartcard based on a national ID. It will include additional information that is useful to various entities such as health, traffic, etc.
Automation of Postal Services	To modernize the Post Office in order to provide a more efficient service to the people of Rwanda. This is to be achieved through a widespread automation of the postal services.
Information Decision Support Center (IDSC)	To provide valid and robust information for use in decision-making by key central authorities.
Ministry and Agency ICT	To develop strategic plans for ICT in each Ministry and Agency.
Donor Coordination Network	To provide information for planning, monitoring and evaluation of donor projects across Rwanda.
The Citizen‟s Guide to Parliamentary Operations	To introduce the citizen to the ways in which their representatives work in Parliament.
Parliament Management Automation	To assist the management of Parliament in all administrative procedures as well as to provide other services such as web casting of sessions and scheduling of meetings.
Transport Management Information System	To automate all procedures and systems related to transportation and which are currently under the Ministry of Infrastructure.
The National Computer Center (NCC)	To establish a National Computer Center that has the responsibility of providing technical support to all Ministries and public institutions.
Establish the National Information Center (NIC)	The unit that processes national data. It will be in the responsible position of collecting national data, analyzing it and disseminating it.
MIS in RITA	Introduce a Management Information System in RITA.
Automate Street Names	This project assigns clear, usable street names in all towns and cities in Rwanda.

Table 1: Rwanda's NICI 2010 E-Government Projects (source [4])

These projects illustrate the potential of e-government. They range from projects focused on enhancing the information technology capacity of individual agencies (MIS in RITA) to those

that will impact the country‟s whole population (National ID and Smartcard system). The broad coverage of these projects can serve as a model for other countries as well as a starting point for an Africa-wide initiative.

E-government as Appropriate Technology

The core concept of appropriate technology is „technology to empower people“ [5]. Electronic governance and electronic government can be designed to empower people by structuring greater involvement in the governing process. E-government enables users to take advantage of automated government administration processes accessible on-line. E-government involves government to citizen, government to government, and government to business interactions. All three types of interaction can empower the individuals involved. Government to business interaction enables greater business productivity, contributing to the country‟s economic productivity. Government to government interaction should result in greater governmental efficiency, consistency and transparency. It is the 3rd type of interaction – government to citizen – that most empowers the individual. It reaches out to the total citizenship of a country. This e-government effort is most pervasive when it maximizes the number of citizens involved and addresses the populations most in need of assistance.

[6] points out that "The public awareness, in general, of the potentials of the advances in ICT has led to increased expectations of government efficiency and access. This will serve to increase pressure on policy makers to make e-governance more people-centered." With that in mind [6] recommends a framework that emphasizes decision support processes involving knowledge development and sharing from the highest leadership to the common citizen. These decision support processes must build on the knowledge repositories from the local to global levels.

Knowledge management and Decision support

Electronic government projects build on existing information systems and government communication processes. Knowledge management is a valuable concern of government. The identification of „best practices“ across different government agencies is a starting point. The capture of these „best practices“ in a knowledge representation standard and placement in a knowledge management system widely assessable is the next step. The potential users of this knowledge management system must be properly educated on usage of the system, particularly accessing knowledge relevant to their responsibilities and needs. The knowledge management system should be complemented with decision support tools that allow for effective manipulation and alteration of the stored knowledge artifacts as well as information stored by the government. This decision support tool set should consist of standard popular software (with a focus on open source software) as well as customized software developed to address particular needs of the particular communities and circumstances. These computer-based tools must be well integrated with a broader set of decision support techniques that are people-centered.

Need for multi-national approach to e-government

Globalization has created a reality where citizens and businesses have a need to conduct varied and regular interactions across national boundaries. Governments can facilitate these interactions by extending e-government operations beyond their national borders. This can best be achieved by multi-government web-based efforts. Multi-national e-government broadens the opportunities of citizens and businesses. This larger e-government effort requires standards that address the decision processes and knowledge representation that is critical.

Semantic web and Pan-European e-government

The European Union recognized the need for a multinational approach to e-government and launched a program to deliver pan-European e-Government services in 2005. This five-year program was to deliver services to public administrations, businesses and citizens. "Overall the evaluation (after 5 years) concludes that the programme is in line with the e-Government Policy priorities of the European Commission, plays a unique role within the European instruments to foster the integration of Europe through interoperable public administrations and is on track in the implementation of actions [7].

"When moving the focus from national to Pan-European e-Government Services (PEGS), additional challenges appear mainly due to the existing inconsistencies amongst the administrative systems. Apart from problems of multilingualism, the clients have to overcome a series of difficulties such as different names for the same services provided by different administrative levels, and providers; different titles, names of documents and their structure; extensive use of different administrative and legal terms; different communication patterns must be followed when interacting with different PAs". To solve this a conceptual model is developed that depicts infrastructure levels such as service requestors, front-office applications, application layer and service providers where the underlying transport network is facilitated by the Trans-European Services for Telematics between Administrations network [8]. This addresses some of the ontology needs of e-government system standardization. However, addressing the decision process standardization requires rule standardization. Production Rule standardization is particularly important. Production rules allow the representation of a wide variety of decision processes that reflect the following structure: (conditions + constraints imply actions).

Business Modeling Knowledge standards

In most cases the business sector is more advanced than the government and civil society sector in developing international standards. This naturally follows since the internationalization of commerce has been a driving economic force for centuries. Political or governmental cooperation has largely served to facilitate economic forces. In recent years e-commerce has played an important role in this global economic drive. This is the situation with regards to establishing standards for knowledge representation and decision-making. Rule based systems have flourished for years and the business community has dominating in their utilization. Three of the most prominent business modeling knowledge representation standards are analyzed and compared [9].

Howard University (HU) researchers devoted significant effort to survey three major business knowledge representation standards, SWRL (Semantic Web Rule Language), SBVR (Semantics of Business Vocabulary and Business Rules), and XBRL (eXtensive Business Reporting Language). "These are standards and mechanisms used by industry organizations, such as Object Management Group (OMG), World Wide Web Consortium (W3C), as well as various business rule management system (BRMS) vendors. Semantic Web Rule Language, or SWRL, was developed by the W3C to be the rules language for the semantic web. It is essentially a combination of OWL and RuleML and thus supports both a sophisticated ontology and a strong system of rules. Semantics of Business Vocabulary and Business Rules, or SBVR, is a standards product of the OMG. The standards group started work on SBVR in 2005 and the first public release was Version 1.0 in January 2008. The eXtensible Business Reporting Language, or XBRL, is an open standard approved by XBRL

International that is now widely adopted by over 400 organizations in 11 global jurisdictions, including 19 stock exchanges and 10 country-wide taxing authorities." [9]

The table below Table 2 compares the strengths and weaknesses of the three standards. This is based on a study done to determine which standard is most appropriate for a particular business environment. However the results are very helpful in establishing suitability in the e-government setting.

STANDARDS	SWRL	SBVR	XBRL
Advantages	--It is very expressive, essentially being able to express all of first order logic. --It has facilities to allow easy calling of external programs (e.g. querying databases). --It has extensive academic interest and there are a number of open source rule engines.	Flexibility of expressing rules in: -Natural language (such as English, German, Dutch) -Specialized terminology (such as that used by lawyers or engineers) -Constructed language (such as the UML)	--SEC approved and recommended --Addresses financial knowledge representations
Disadvantages	--The standard is so expressive and powerful, that only a subset can be used. Otherwise inference will be undecidable. --Does not natively support natural language statements.	--Does not directly address linking to other knowledge sources such as Oracle or SQL databases. --The absence of a traditional object-attribute representation can be a shortcoming.	--Lack of a flexible, comprehensive rule representation --Limited ontological knowledge representation capabilities --No consideration by industry leading vendors

Table 2: Comparing SWRL, SBVR and XBRL (source [9])

SBVR

"SBVR is appropriate to be used by business experts, since it allows the representation of business vocabulary and rules using controlled natural language" [10]. SBVR may prove the best standard to pursue in a broader e-government effort. SBVR presents the strongest case of knowledge representation flexibility. Users do not have to be skilled programmer analysts to express their domain knowledge. This opens the development process to a wider community. This is important with e-government and e-governance. The potential pace for development and the involvement of stakeholders, decision-makers and citizens is important.

The basic components of SBVR constructs are the Noun and Verb concepts. They are used to construct simple as well as complex facts. Noun and verb concepts are used to build the fact knowledge base for the domain, instead of less readable object-attribute constructs. There are two types of rules in SBVR: structured rules and operative rules. Structured rules are logic rules that are unbreakable. They are used to present complex relationships in the domain that help define both static and dynamic structural realities in the domain. Operational rules are action-oriented and are breakable (i.e. they need to be enforced) [11].

Pan-African e-government

The African Union has established processes that are designed to lead to the full integration of African states politically and economically. A continental electronic governance system would both facilitate the integration of government processes across borders. It would allow for greater shared administrative resources. This is particularly important given the limited expertise in information and communication technologies. The best practices of the stronger

and more developed states in Africa such as South Africa and Egypt can be used to accelerate development in smaller less developed states. The potentials for citizen users are even greater. Best governmental practices will be made available to citizens in their local communities at a much quick pace given the standardization facilitated by user-friendly international standards such as SBVR. Citizens will have much better access to opportunities on a continental scale through a well-planned Pan-African e-government structure. This ranges from improved access to visas and travel opportunities to access to jobs across Africa.

Conclusion and future research

This initial study concludes that a nexus of conditions exist for the advancement of a Pan-African e-government and e-governance initiative. This effort can link not only the 53 independent African countries but also the various African communities in the Diaspora. Technology advances in telecommunications and computing have set the stage for a wide range of advances in global connectivity for business and government. Initially information and communication technology was strictly the domain of the most developed countries. Technology transfer to the developing countries has accelerated in recent years. The projected impact on Africa will lead to advances in commerce as well as democratization. The business community is taking the lead in developing standards for knowledge representation and the exchange of knowledge artifacts. These are international standards that can apply not only to the business communities but are well suited for government efforts. SBVR has emerged as a leading candidate in the standards development efforts. The strength of SBVR is its flexibility for expressing rules, particularly its use of natural language constructs. This can open doors to rapid development of internet-based knowledge management decision support systems across national boundaries. The authors plan to extend this research in two directions: 1) expand the examination of rules standards and rule development tools; and 2) engage researchers from different countries in this effort.

1) Identify best projects for empowering people. These should be projects that have the broadest impact on the most disadvantaged communities and effect the largest populations.
2) Identify cross-national linkages. These may be sister agencies in difference countries such as: social security agency or motor vehicle authority.
3) Replicate projects across national boundaries. This may be as simple as utilizing the same website templates or may involve complex linkage of knowledge structures across national boundaries
4) Further investigation of SBVR as a standard for e-government efforts. Several issues must be addressed including the role of UML models and how will Production Rule Representation (PRR) and Rule Interchange Format (RIF) be used in development efforts
5) Planning for the human resources needed to implement a comprehensive Pan-African e-government effort in terms of immediate needs and long term development.
6) Address the required network infrastructure development needed. This must particularly address end delivery points such as: mobile, portable PC-based, telecenters (public, private, and PPP), home based access
7) Address connecting Pan-African e-government to Asia, Europe and the Americas.
8) Develop a process of continuous assessment. Measuring effectiveness across boundaries and over time and making the necessary adjustment is key.

Table 3: Starting points for comprehensive plan of action

Initial multi-national efforts at e-government have been initiated by the European Union. They focus on using Semantic Web Service (SWS) specifications [8]. This study finds SBVR to be a more expressive and powerful candidate for extensive e-government

development. The application of this e-government development process across Africa can have an even greater human impact because it addressed the most disadvantaged populations and the structurally weaker government. This can be a truly effective approach to reducing the „digital divide". One key to implementing these ideas is how completely the African Union and its member states embrace this effort. A comprehensive plan of action is needed. Table 3 above outlines points that should be addressed in such a comprehensive plan. This will be the starting point of our continued research effort.

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Is COTS[1] an appropriate technology?

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Key words: COTS-Based System Development, Software Acquisition, Software Development

Abstract

This paper is based on a case study on software procurement guidelines that is supported by the National Information Centre (NIC) in Sudan as part of their efforts to regulate information technologies development and purchase in the public sector. The approach to software acquisition in government has traditionally been building software components and their implementations. More recent IT policies show increased interest and commitment to exploiting the market place of software products because of their functional and economical advantages. This, by and large, is a global move that brings anticipation as well as concern for governments in particular such as change to established processes and the adoption of standard interfaces. I discuss in this paper a number of concerns that must be considered in examining the appropriateness of a COTS-based solution in the context of a developing country.

1. INTRODUCTION

The approaches to acquiring software can be broadly grouped into developing a tailored-to-need or procuring an off-the-shelf product. The IEEE further classifies off-the-shelf into COTS which is defined as *"a software product that is driven by market-need and commercially available and whose fitness have been demonstrated by a broad spectrum of commercial user*" and MOTS[3] which is *"..already developed or available, usable either "as is" or with modifications*" [6]. The spectrum of COTS-based systems ranges from COTS-solution systems (single product from one vendor that can be tailored to need e.g. CRM); to COTS-aggregate systems in which many disparate products (from different and sometimes competing vendors) are integrated to provide a system's functionality [5].

This paper is based on a case study (that is built on a previous project [1]) on software procurement guidelines. The project is supported by the National Information Centre (NIC) in Sudan as part of their efforts to regulate information technologies development and purchase in the public sector; as well as a response to recent changes in government IT policies that aim at exploiting the market place of software products because of their functional and economical advantages. I discuss in this paper a number of concerns that must be considered in examining the appropriateness of a COTS-based solution in the context of a developing country.

In the following two sections, I give a background to the case study in (2) and the components of the guidelines proposed for inclusion in government practice in their purchase of software products in (3). Sections (4) and (5), respectively, highlight some of the implications of adopting a COTS-based system development approach; and the areas that require policy making at a national level for adopting the approach – argued in this paper as critical to COTS being *the* appropriate solution. The final section concludes with a set of broader issues on COTS-based development from a developing country perspective.

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1 Commercially-off-the-shelf Software Products.

2 Member of the Software Engineering Committee at the NIC. She conducted this project as a consultant for the NIC.

3 Modified-Off-The-Shelf Software Products.

2. Background to Case Study

The main objective of the study is to recommend a set of best practices that can be used by government agencies in their procurement of software products. The NIC requires that these recommended practices be based on current international standards and best practice as well as allow for the incorporation of government purchase procedures and regulations. At the onset of the case study, the scope of the work was established to focus on COTS and MOTS products and to distinguish between procurement and acquisition that are sometimes used interchangeably to name the process of software purchase. The case study adopted the broader view of acquisition suggested by Meyers and Oberndorf in [13] where they defined acquisition as the "*set of activities performed to procure, develop and maintain the system*" that involves issues of software product development and maintenance and covers technical (e.g. requirements specification, testing) and management activities (e.g. project planning, contracting).

The case study was carried out during the period of March – July, 2010, and conducted as a research project that involved an extensive literature review on issues pertaining to software acquisition and related international standards, and interviews with key informants from the NIC, IT Units at Federal Ministries and IT Management in the Banking sector. A committee – that included members of the Software Engineering group at the NIC and one member from the Ministry of Finance – acted as peer reviewers of progress reports that were produced in the course of the case study. The group consensus process that was followed included review meetings and written evaluations by committee members, and feedback was incorporated in the final set of recommended practice.

In the next section, an overview of the recommended practices is given and the rationale used to select the set. While many organisations do attempt to undertake the development of processes under the best practices frameworks described in section (3), many organisations do not succeed in this goal either due to deliberate divergence from the best practice in order to accommodate organisational realities or because of inability to reach the best practices condition for another reason – managerial or technical such as lack of standardised procedures, business strategy or resources. According to information obtained from interviews, in extreme scenarios of software acquisition project failure, the reasons behind the divergence is due to lack of domain knowledge or malicious intentions (corruption). A number of examples of costly failures was cited by Professor Ali[4] in the consultative meeting held at the NIC to review the output of the case study. These challenges by and large remain to be addressed by implementers of the recommended practices to yield their anticipated benefits and those of the commercial market of software products.

3. The Proposed Set of Best Practices

The acquisition process consists of technical (e.g. requirements specification, testing) and managerial activities (e.g. scheduling, budgeting) that must be accounted for by the acquisition strategy adopted to achieve the goals of a project. The management aspects of the proposed set are based on the IEEE 1062 (Recommended Practice for Software Acquisition) which describes a generic nine-step process recommended for use in acquiring COTS and MOTS, in addition to fully-developed or custom-built software. Technical aspects focused on off-the-shelf products and incorporated best practices from areas of project initiation and planning [7, 8], COTS selection and evaluation approaches [2-5, 9-19, 21, 22], and software process improvement [20].

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4 Vice Chancellor of El-Nileen University in Khartoum and Senior Consultant at the NIC. This meeting was held on August 8th, 2010 which reviewed an approved the case study recommendations.

Management aspects:
The model consists of seven phases and each phase is composed of a number of steps. It encloses the five phases of the IEEE 1062 which includes planning, contracting, implementation, acceptance and follow on activities and recommended for acquiring tailored and off-the-shelf software products. These phases are preceded by an acquisition project initiation phase and followed by a set of steps that facilitate the start of a new project to improve the organisation's acquisition process. Some phases have a longer duration or involve more activities than others. The phases are broadly defined by a set of milestones that establish the beginning and end of each phase. They represent the software acquisition life-cycle – considered as the period of time that begins with an idea (identified need) for a software system and ends when the software is in use by the acquirer's organisation and the lessons learnt from the acquisition project are identified. Based on learnt lessons, the final phase in the model involves a decision process that may lead to the initiation of an improvement programme to the organisation's acquisition practices. Additional guidelines on performing the steps within the phases, as well as methods, tools and templates that can be used to produce the specified outputs (work products) are included in the model description.

The rationale for including an initiation phase is two fold. First, to support the organisation in developing the project idea into a defined proposal that has scope, objectives, overall strategy and team. Secondly, to accommodate government financial and project approval procedures. In the context of government procurement, an important element is the tender process that is facilitated through requests for proposals (RFP) which entails the separation of requirements definition and products evaluation. The final phase in the model (process improvement) is included to stress the importance of continuous feedback to the process model after implementation – seen as mandatory in the context of newly established processes.

Technical aspects:
Technical activities elaborated on COTS and MOTS acquisition. This is achieved by adjusting the steps in the IEEE standard that deal with defining requirements and evaluating proposals from potential suppliers to incorporate best practices on COTS-based system development. The two processes are seen as necessarily intertwined in COTS-Based system development where a number of approaches have been proposed e.g. Off-The Shelf Option [10], Comparative Evaluation Process [3], COTS-based Requirements Engineering [2], COTS Acquisition Process [16], Socio-Technical Approach to COTS Evaluation STACE [11], PECA [5], COTS-based Integrated System Development (CISD) method [21], PORE [15] and CARE [4], where they combine the processes of COTS matching and evaluation. The latter three approaches specifically address the processes of requirements gathering and specification using a goal-oriented requirement engineering approach (high-level specification of requirements). This involved incorporating two iterative processes in the model – the first is similar to the CISD method and deals with establishing software requirements in a way that considers the need to negotiate requirements (to ensure matching) and to define requirements (to enable tendering); and the second iterative process is based on the SEI's PECA process and deals with RFP and product evaluation.

Implementation and tailoring of the software acquisition process model (see Annex A for graphical representation of process model) to suit the acquisition project or the acquiring organisation require organisations (1) to establish their own acquisition process and strategy based on the recommended practice and (2) to select appropriate approaches/tools from the toolboxes and templates that accompanied the model. The acquisition process will specify the set of activities and work products while the strategy identifies the capabilities and responsibilities of supplier/acquirer as quality characteristics that in turn will establish the acquisition approach, operational practices and contractual terms.

4. Challenges in COTS-Based System Development

An important aspect of shifting from the build philosophy, where by an organisation is developing a custom system, to the buy mentality, where by the problem shifts to one of identifying, buying and then integrating implementations that are built by others, is the loss of control over the product implementation and the adoption of standard interfaces based on COTS market. This shift requires organizations to have an understanding of the capabilities and limitations of products and standards in their domain, conduct market research and product evaluation to select products, and involve different kinds of expertise such as business analysts and legal consultants in the acquisition process. A simultaneous exploration of the system context, potential architectures and designs, and available products in the marketplace, and negotiation of the organisation's requirements with available functionality; replace traditional requirements specification where the requirements' engineer must accept product limitations (and excesses) and that there are requirements that cannot be met by any available products.

Even though there is great anticipation from using commercial software (wherever possible) because of the gains that can bring in terms of functionality and/or cost, it is still important to make a carefully reasoned decision based on what is available and the immediate and long term needs of the particular project. The changes that come with buying software stem from the shift to the consumer model that may alter organisational processes or require new acquisition strategies and capacities; as well as necessitates a thorough approach to market research and policy development/implementation. This is due to a number of reasons:

- **The need to negotiate requirements and products' functionality** – this is one of the biggest challenges in using commercial products of realising that they are created on the basis of the developer's assumptions about the environment in which they will be deployed. Among those are assumptions about architectures and requirements, especially built-in notions of what processes the user will use and how the user will use the product to support those processes. This is why a rigid top-down approach to requirements may make it impossible to find a product that can fulfil the need. It is therefore important to understand the relative importance of the various requirements (sorting and ranking essential and desirable features of required system); that the capabilities of available products may influence the final set of requirements; and that there are some essential requirements that simply cannot be obtained be satisfied by any product. A careful approach necessitates generating (at the beginning) a general tentative specification that determines the kinds of products to look at, and involving stakeholders in the requirements negotiation to turn the notional requirements into a set of requirements that can be fulfilled by the marketplace.
- **The approach to testing and evaluation** – this involves determining whether and how well the implementations and the overall system serve their purpose and satisfy requirements. These implementations being based on standards will make it easy to test them individually (usually confined to black-box testing), however integration testing becomes more complex which entails creating and maintaining an ongoing test capability, being aware of test certifications, and giving special consideration for factors such as interoperability, portability and scalability. In addition, final acceptance a product is associated with the level and cost of customisation required. This entails defining a strategy and developing skills on analysis of risks of the various kinds of customisations, and acceptable integration techniques (e.g. filters, wrapping).
- **The change in system support and maintenance** – maintenance planning and support may change due to the fact that the implementation of a product is controlled by the vendor. The vendor can modify the product without notice, a standard may change, or

support may be discontinued for old versions of products. Planning for system evolution will involve selecting new products or upgrades to existing products instead of developing new implementations. On the other hand, the marketplace will force some component changes that may be unnecessary and as the system becomes dependent on vendor extensions, moving to another product may be very difficult. Routine market assessment to keep abreast of upgrade opportunities is useful to manage the turnover in the marketplace.

- **Commercial software products implement particular technologies** – doing market research, which is the first kind of evaluation that is conducted to determine suitable products in the marketplace, must examine competing technologies before competing products. A technology, such as distributed object technology, may have more that one approach (e.g. DCOM or CORBA), each of these are implemented by a number of products from various vendors. This has implications on current and future e-government projects and requires planning for multiple generations of hardware and software to keep them synchronised with each other and across government offices.
- **The level of flexibility in contracting** – The variation in approaches to develop a contract when acquiring a system is about spreading the risks and responsibilities among those involved in the acquisition process. Five contracting strategies are discussed in [13] that vary in the level of responsibility placed on contractor and acquirer. For example, strategy 1 gives the acquirer full control over requirements specification and product selection, and therefore places a heavy burden with respect to risk and responsibility and strategies 4 and 5 shift a large share of that burden to the contractor and encourage the use of integrated project teams. The choice of strategy influences how the request for proposals are written because it determines the contractors responsibilities and risks in the project. Other common risks such as continuity of vendor/product and third-party contractor that are of particular relevance in the local context must be addressed in contractual terms (e.g. using escrow accounts).

5. Concluding Remarks

This recommended practice can be applied to software that runs on any computer system regardless of the size, complexity, or criticality of the software. However, acquirers will need to identify the classes of software to which the recommended practice applies and the specific quality characteristics and activities that need to be included in the acquisition process. Generally, success in acquiring high quality products and services from software suppliers can be achieved by doing the following things [6]:

1. Identifying quality characteristics necessary to achieve the acquirer's objectives.
2. Including quality considerations in the planning, evaluation, and acceptance activities.
3. Developing an organisational strategy for acquiring software.
4. Establishing a software acquisition process using the recommended practice as a starting point.
5. Putting the defined process into practice.
6. Conducting process reviews and improvements.

Even though these six points can achieve best practice they assume transparency and a developed culture of information that imply the need for fundamental changes in the way we do things. More specifically, there are number of salient issues in government practice that need to be addressed to enable implementation of the process model that include:

1. The derived process model assumes an intertwined technical and financial evaluation process during the first three phases. This is different from existing government practice that uses separate teams to perform the technical and financial analyses.
2. Follow-on procedures are not enabled in government practice. This information can only

be obtained at service level. Without enacting the role of IT management Units in Ministries and creating mechanisms to accumulate acquisition projects experience, information gathering activities during the final two phases of the model cannot be realised.

3. The decisions on which strategies will be used in government acquisition, which practices are possible and those that are not, affect planning, selection of products and services, and the nature of control and influence in the acquisition of systems.
4. Assigning a process supervisory role within the NIC (or any other implementing agency) is useful to ensure that the process is followed; that the work products meet the defined standards; and that lessons learnt are analysed and incorporated for future acquisition projects.
5. Equipping acquisition team with necessary skills to carry out management activities such as project planning and technical activities such as product testing in addition to involving external expertise in business and legal aspects of acquisition.

There are a number of imposed constraints on the selection of software products by political sanctions that limit availability or increase acquisition costs and by the fact that most government IT projects are sponsored by donor grants which sometimes involve restrictions on selection of suppliers to those suggested by the donor. Other constraints will stem from choices that are made by the government on overall acquisition strategies that include:

- Choosing between a closed or open path to develop and maintain system determines whether product choices will be based on the standards they implement. This decision has implications for how much emphasis is put on changes introduced by marketplace and influences system development and evolution.
- Choosing an open source route mandated strategy for governments in some developed and developing countries (e.g. EU, Peru, Malaysia, South Africa). The elements of an OSS strategy may include the decision factors suggested by the OSS Advisory Committee that include the readiness of the OSS, the commitment to open standards, and consideration of hidden costs of OSS (e.g. using third-party support and maintenance).
- Choosing between sub-system integration approaches which determines whether integration will take place at the level of implementations (point-to-point) or standards or architectures; where architectural integration gives the most leverage to system integration and evolution while point-to-point can handle special requirements but can become uncontrolled.

These choices require establishing long term and broad IT strategies with implications on the ongoing e-government project. At the time of conducting this case study, high-income ministries such as Energy are more independent in their decisions on software purchases than others who are not income generating ministries such as Health. Also, there is wide gap within the set of organisations that are targeted with the recommended practice, in levels of readiness and commitment to adoption of standards and software-based systems and experience of IT personnel for different reasons related to how ~~"im~~portant" they are. For example, the Aviation Authority are fluent in implementation of standards and keen on staff training, while the Ministry of Urban Planning is devoid of any specialised software as a GIS and the National Archives still uses a manual cataloguing system.

The recommended practices that came out of this case study have been approved and disseminated by the NIC and are now under consideration by the National Standards and Measurements committee to be followed by translation into Arabic language and training of a core set (trainers-of-trainers) from NIC personnel on the guideline and associated tools and techniques. This is expected to be followed by putting the guideline into practice using one of the established and joint software project need by NIC such as an ERP system. Nevertheless,

without addressing the challenges and areas of concern discussed to enable and plan for change across the spectrum of stakeholders, these kinds of initiatives by the NIC (a regulatory body) to develop standards have less room to succeed and flourish into an IT renaissance.

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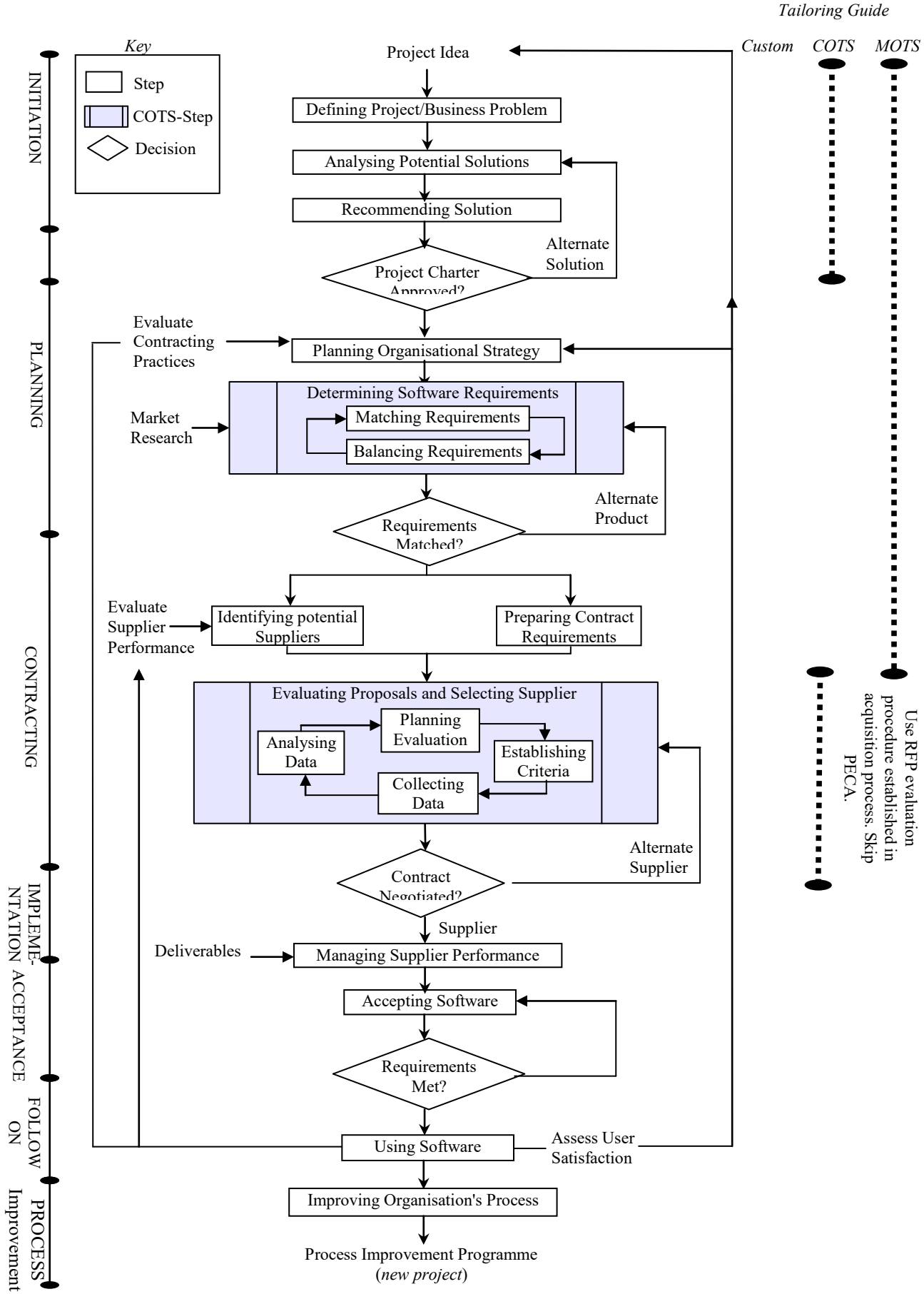
Annex A: Graphical Representation of Process Model (adapted from IEEE 1062, SEI PECA)



Partnering Universities and Communities in ICTs for community development: Case of Masendu Community, BulilimaMangwe District, Zimbabwe

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Key words: Community development, ICT, Rural development, Digital divide, Knowledge management

Abstract
In this paper we summarize our experiences in working on a rural ICT initiative with the Masendu Rural Community in Bulilima-Mangwe District, Matebeleland South Zimbabwe. The objective is to demonstrate the impact of incorporating ICT centers as sub projects in rural development programs. The project also intended to enhance access to developmental information in Bulilima Mangwe District through the provision of relevant knowledge management skills. The center is solar powered and the Internet connection was via a radio link between Masendu Primary School and the National University of Science and Technology. The project was developed based on available technologies and cost consideration. Activities for the project helped us realize that with careful planning, such a project is economically feasible & self-sustaining. Results from the project indicate that it is possible to incorporate information and communication technology (ICT) centers as part and parcel of rural development projects.

1. INTRODUCTION

Community Development is concerned with building the capacity of people to define and address their problems and visions within the context of their own culture. Good community development is action that helps people to recognize and develop their ability and potential and organize themselves to respond to problems and needs which they share. It supports the establishment of strong communities that control and use assets to promote social justice and help improve the quality of community life. It also enables community and public agencies to work together to improve the quality of government. [3]

Experiences around the world show that, if used for the right purposes, ICT can play a key role in national development strategies. Countries have pursued diverse strategies: some have focused on developing ICT to boost exports, or to build domestic capacity, or other countries are pursuing strategies which seek to use ICT as an enabler of a wider socio-economic development process. [Aloyce R. Kaliba, 2003]

The unique characteristics of ICTs are derived from the fact that ICTs are crosscutting. Encouraging information sharing among people fosters community empowerment and participation. Communities can share and exchange information on mutual interest, strengthen their collective power, and shape their own development solutions. [13]

Knowledge management has become central to the achievement of developmental aspirations of various communities worldwide. Generally, access to information and the means to communicate play a strategic role in attaining food security, resource mobilization, job creation and rural development. The need to empower people in Bulilima-Mangwe through the provision of information can be seen as in line with Article 19 of the Universal

Declaration of Human Rights which has a provision of access to information and communication services to all without discrimination.

Part of ICTs‟ potential is to transform the landscape of social and economic development in poor communities. In recognition of that potential, attention has been focused on how to eliminate the “digital divide” – the gap between the levels of hardware and software resources that are available to poor communities and to more affluent sectors of society. Far less concern has been devoted to two equally important questions: How well are low income communities able to take advantage of ICTs once they have them? And what difficulties and opportunities face these communities when they try to make innovative use of ICTs? [6]

Many policy questions center on two points: access to data transit portals and computer access for the poor. Unfortunately, the dialogue does not go very far beyond these two points. Concentration on these two issues, while important, directs attention away from potentially creative uses of information technology to help revitalize communities. There have been infrastructure assessment studies of what it would take for poor communities to access the "information super highway". What is lacking is an assessment of the challenges, opportunities and best practices using technology to accomplish community revitalization. [3]

We believe that by examining areas of community capacity to undertake development and use of the Internet to foster economic development, we can more effectively judge the impact of IT on community change.
- In determining the activities for this project we considered the following important points:
- Building human capacity of individuals through knowledge creation and acquisition is an influential factor in sustainable development that should not be overlooked;
- The low penetration of ICT is related to poor infrastructure and/or the cost of services;
- Knowledge resides in each community. It can be created, shared and utilized in each community.
- Sustainable ICT projects should be locally owned and accompanied by human capacity development.
- Capacity in effectively using ICTs for development is often the main constraint, not equipment.
- For ICTs to have a positive development impact, the various social groups must have equal access to them, particularly disadvantaged groups such as the poor, children and indigenous people.

The paper is organized as follows. The following section presents a brief about Bulilima-Mangwe district; the section that follows will present an overview of the ICT situation in Zimbabwe. The objective of this section is to give the highlights of what is happening in terms of infrastructure development, capacity building and policy changes. In the subsequent sections we then present the project methodology and challenges before presenting the results, lessons learnt and conclusions in the last sections.

1.1 Bulilima-Mangwe District

The population of Bulilima-Mangwe is estimated to be approximately 225 900. The population in the district is extremely youthful, with some 51% under 15 years of age and 43% within the economically active category. Only 6% are beyond the age of 65%. There is also a predominance of females over males especially the young adults age groups, mainly due to the high rate of out-migration to South Africa and Botswana by the young adults males. The percentage of women in the district is estimated to be at 53%.

The district is made up of 35 wards of which 29 are within communal and Resettlement Areas. The whole district is under the jurisdiction of Bulilima-Mangwe Rural District Council. In the communal and Resettlement Areas of the district, committees are responsible for the management of natural resources in their areas.

Major economic activities in the district consist of agriculture, wildlife utilization, commerce, social services, light industries, public services and informal sector. Irrigation schemes in the district are inadequate due to shortage of dams. There are only two schemes in the District and these are Moza (55 hectares for 149 plot holders) and Ingwizi (45 hectares for 100 plot-holders). Cattle rearing appear to be the main agricultural activity in the District although there is a critical shortage of grazing land. Unemployment and underemployment are major problems. The unemployment are much higher due to an increase in school-leavers, which was not complimented by an equal number of employment opportunities.

Activities for this project were conducted in the Masendu ward. The project centre was located at Masendu primary school. Some activities of the project were also carried out at the National University of Science & Technology (NUST) in Bulawayo.

2. ICTs in Zimbabwe

The role of ICTs in development has been recognized by the Zimbabwean government through such landmark measures as the e-Readiness Survey (2004), and the National ICT Policy Framework (2007) that recommended the institution of a National Information and Communication Technology Authority and a Converged Regulator. This has led to the draft ICT Bill which sets out the key legislation and regulation framework regarding the access and use of ICTs in Zimbabwe. The Ministry of ICT was set up to oversee all ICT issues in Zimbabwe. The Ministry has already drafted its Strategic Plan in which it spells out some of the critical issues (short and long term) that need to be addressed in the area of ICT in Zimbabwe. This visionary Strategic Plan of the Ministry of ICT guides and consolidates the priorities to transform Zimbabwe into a knowledge society, and pulls the entire nation around a single game plan for execution. [9]

The synopsis of the ICT indicators for teledensity, mobile access, internet access and number of PCs per 100 people for the SADC region shows that the environment is challenged, where the average teledensity and average mobile access levels of SADC region is half of the Africa average. The Government of Zimbabwe is geared to rectify this developmental anomaly through the implementation of the National ICT Policy Framework and the Strategic Plan spearheaded by the Ministry of ICTs. Tremendous opportunities abound in Zimbabwe in ICTs for development with respect to the following areas which at best can be addressed through collaboration, consultation and smart PPPs: Infrastructural facilities for connectivity and equitable access; A common electronic–business framework; Information and content development and sharing platforms;e-Government platform that serves Government and citizens; A conducive enabling political, legal and technical environment; ICTs industry and support services and; human resource development. [12]

One of the major functions of the Ministry of ICT is to develop supportive and enabling infrastructure to ensure equitable access to ICTs by all citizens including disadvantaged groups and rural communities. The Ministry of ICT in its Strategic Plan 2010-2014 identifies the issue of Communications Infrastructure as one of the projects that can be implemented in a short space of time subject to availability of resources (Quick wins).

Communications Infrastructure *– There is need to develop a communications master plan to ensure reliable and efficient communication and applications development in Zimbabwe. The project covers the entire country and will be executed in phases. Access to the Internet backbone through the current gateway has serious capacity challenges and therefore development of an optic fibre link between Harare and Mutare is important in view of connecting to the undersea cables (EASSy and SEACOM) in the Indian Ocean through Beira. An alternative route is to lay an optic fibre cable from Harare to Beitbridge for the same purpose and to facilitate fast and reliable communication between our country and South Africa. The optic fibre is a cost effective solution compared to the costly VSAT communication link.* [12]

Work on the proposed project to connect to the undersea cable (EASSy and SEACOM) in the Indian Ocean through Beira, Mozambique has already been started. This has also been complemented by similar projects inside Zimbabwe being done by Network Operators, ECONET and Tel-One. ECONET embarked on a project where they laying fibre cables linking major cities (Harare-Gweru-Bulawayo-Plumtree) within Zimbabwe.[8] These measures provide for an enabling ICT environment for business, public administration and services delivery, education, and communications.

2.1 Internet Access:

In Zimbabwe just like most African countries most people who access the internet do so via Cyber cafes, colleges, varsities, work place an some at home. The limiting factors are basically cost and unavailability. Most urban dwellers either can‟t afford it or the ISPs serving them are out of capacity

Internet Usage Statistics in Zimbabwe

1,481,000 Internet users as of December 2009 13.0% of the population, according to ITU.

YEAR	Users	Population	% Pen.	Usage Source
2000	50,000	14,712,000	0.3 %	ITU
2002	500,000	13,874,610	3.6 %	ITU
2005	820,000	12,247,589	6.7 %	ITU
2008	1,351,000	12,382,920	10.9 %	ITU
2009	1,481,000	11,392,629	13.0 %	ITU

Table 1: Zim. Internet Usage and Population Growth.

Source: *Zimbabwe Internet Market and Telecommunications Report, Internet World Stats: Usage and Population Statistics. [11]*

Zimbawe just like most African countries basically faces a number of hurdles in order to roll out effective computing technologies to the general population. Rollout issues and challenges do include but not limited to: cost of computers and equipment, inadequate access technologies (data & voice), inadequate electricity, poor national & international bandwidth, Regulation and licensing, Censorship and control, brain drain & lack skilled manpower & I.T. certifications, egov [12]

2.2 Similar Initiatives promoting ICT usage in schools

In Zimbabwe there are some similar projects that have been initiated in schools to allow school pupils access to computers. These initiatives have however been based more in urban areas where electricity readily available. The programs include

- The WorldLinks program mainly focused on schools (both primary and secondary) – mainly located in urban areas and at growth points (district centers) - Sponsored by the World Bank.

- SEITT (Science Education In-service Teacher Training) program mainly targeted training science teachers on the use of computers and internet for research purposes.
- President‟s office initiative. During the period 2003-2008 President R.G Mugabe was donating 10 computers per school (Official figures as to how many schools benefited, not available).

3. Project Methodology

Many ICT for development projects fail because they are technology-led rather than development-led or people-centred. To be successful and sustainable, projects must be tailored to a community's needs and ways of working. Development agencies should be analysing, and mapping, social network structures. This would help them understand communities' socio-cultural contexts and provide a guide for introducing ICTs in a sensitive way. [1]

We started by conducting a baseline study to identify developmental issues in the Masendu community, the challenges faced and possible ways of intervention. The baseline study helped us to establish that there was limited access to information essential for development due to the absence of local radio (ZBC) and television signals (ZTV) resulting in the local community not benefiting from developmental programs broadcast and telecast by the national broadcaster. We also found out that the local community was experiencing problems in sharing developmental news from their own area with other communities in Zimbabwe. In baseline study, we engaged communities in interactive group and individual discussions which saw the communities cataloguing their general problems and developmental needs. Indications were that there is generally an information blackout in the district with villagers being the worst affected. Villagers have problems accessing various newspapers. The community was also experiencing problems of communication, for example with other communities in Zimbabwe and the outside world in terms of mobile and fixed lines. The community had access to the Botswana‟s Orange Cellphone Network service which was expensive and unreliable. They had no access to local mobile networks.

It was against this background that we saw this project as a potent instrument in empowering the Masendu community in accessing vital information for their developmental needs as development is enhanced if communities are able to share developmental news. When used effectively, information and communication technologies can have a positive impact on development. [5]

The baseline study was then followed by a needs assessment study which helped us focus on ways of intervention through a series of activities.

3.1 Project activities

The activities of this project involved mainly setting up the tele-center and skills training for the youths, the community and teachers at the school. Initially we intended to source funding for 15 computers to start with but we were lucky to get a donation of 25 Computers. With funding sourced from Integrated Rural Development Program (IRDP) and National University of Science and Technology (NUST) we managed to purchase 2 printers, 2 scanners a photocopier, a fax machine and networking equipment. We also used the same funding for the purchase and installation of a solar system to power the computers and all other equipment. NUST also made available their internet link. So a radio link was setup between Masendu primary school and NUST to allow access to the Internet via NUST network infrastructure.

Masendu ward consists of 6 villages. We started by training 3 teachers from Masendu primary school and 6 youths per village. The youths and the teachers would in turn help us train the school kids and the community. Skills included basic computer operation, word processing, spreadsheet, database management, internet usage and basic computer maintenance. The youths also received basic news gathering and newsletter editing training. These youths were then given a special name in the community, Knowledge Workers. These Knowledge Workers would gather developmental data, eg records of livestock per household, number of people per household, dipping schedules etc in their respective areas and maintain a database of that data. The 6 youths per village were then responsible for maintaining and updating their village‟s database. They would also gather community news, eg cattle sales, cultural events, health news etc, and other general interest news and publish this in the Masendu community newsletter.

3.2 Centre management

The center is managed by a team of 9 people that comprises of 2 teachers, 6 village youths (one per village) and one community leader.

3.3 Services offered at the center

Computer Applications Training, Secretarial/Typing and printing services, IT Consultancy, Internet and Emails, Photocopying, Scanning, CD Burning, Video hire/shooting/show (seeking video cameras, etc.), Fax and Telephone and Access to village data

4. Challenges

The sustainability of the project (during the start) was very difficult due to a number of factors that included poor telecom infrastructure (Telephone connection), availability of power, language barriers, few computers while we have a large population to serve and operating space (small and crowded room)

5. Results

We managed to establish an ICT telecenter with 25 networked computers is now operational at Masendu primary school. Regardless of our poor computers at the center, we managed to train a total of 120 youngsters, 3 Teachers, 89 women and 58 men. Many NGO personnel, working in the area, use the telecenter as a reliable source of village data; they also use it for printing and typing their works and for communication. The center has attracted great attention from the community and all are asking to train their kids and family members. We have received numerous requests from different parts of the district requesting us to establish similar projects. 29 youngsters out of the 120 trained have secured places for studies in institutions of higher learning (11 in universities, 7 in Polytechnic Colleges, 6 in Teacher training colleges and 5 are doing nurses training) while 23 have secured employment elsewhere. 21 women out of 89 trained have secured employment at the District center and elsewhere. A village bulletin Masendu community Newsletter, *Masendu Bhalule-Ngina KaMasendu* was launched. The school teachers and the community youths we trained, are providing training to the local people in other villages.

Government departments, the rural district council, Ministries and community development organizations/agencies like ADRA, CRS, CARE, and World Vision that work in the area are finding the data maintained to be very useful for their planning and for implementing their own programs.

5.1 Users of the center by age group

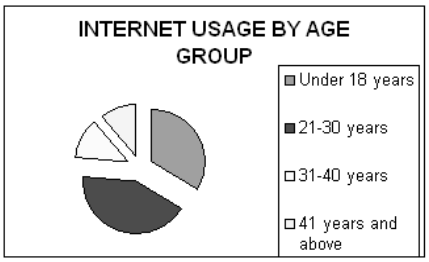

Fig.1 shows that there are more users in the age groups below 30 years of age. This is the more active part of the rural population that includes youngsters that are still in primary and secondary school and those that have just finished their secondary school education and are still looking for something to do.

Fig.1: Internet Usage by age group

5.2 Centre Usage by Gender

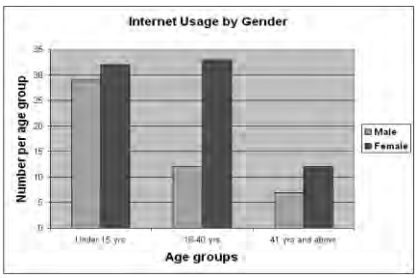

Fig.2 shows that to a large extent there are more females who use the center. This possibly is due to the fact that most of the male in the age groups 15 – 40 have left the area to look for employment elsewhere in South Africa and nearby Botswana, mainly because of the economic problems prevailing in the country during the period covered by the project.

Fig 2: Internet Usage by Gender

5.3 Factors that contributed to the success

Accountability/Good Management Team, Community Participation, Good policies, Services that address community needs, Use of volunteers from local community mainly the youth, Good Customer Care, are the main factors that contributed positively to the successful implementation and completion of the project. Obviously we cannot forget the unwavering support we got from community leadership, the National University of Science and Technology, IRDP and the Bulilima-Mangwe Rural District Council (RDC).

6. Lessons learnt

We observed that the factors that mainly affect the uptake of ICTs in rural communities center around issues of social behavior, infrastructure, inadequate skills and lack of awareness. Partnerships between community groups and institutions of higher education appear to be a promising way to foster IT innovation. But in general community groups, which have many competing claims on their budgets, and lack of adequate skill, find it challenging to take the step of adopting new technologies because skills shortage and high costs – both the direct costs of purchasing applications and the indirect costs of securing the technical assistance to support their use. Funders, institutions of higher learning and intermediaries can play important roles in helping community groups meet these challenges. Through the project implementation we noted that governments can use ICTs to balance sustainable economic growth with social empowerment.

8. Conclusions

In our view this project is a success story and we would therefore want to see it continue to grow. Now that the construction of Masendu Cultural Centre has been completed, there may be need to move the telecentre from the school to the cultural centre. Our main goal was to bring ICTs as an enabler of Community development closer to hands of people (especially rural areas and marginalized groups) and let them exercise and use it. The main factors limiting the innovative uses of ICT in community development is lack of awareness, knowledge management skills and lack of access to training. Institutions of higher learning can make positive contributions by way of developing customized training programs and technology models that suit the conditions and the people in rural communities.

From our experience working on this project we noted that ICTs have yet to transform the field of rural community development in Zimbabwe. We noted during the project that the people in the area have embraced the idea of community-based tourism, and we think this can actually become a pump-primer for introducing the telecentres into rural communities. Telecentres that target income-generating opportunities from the onset are more likely to survive after the initial start-up funding dries up. Above all there is need to incorporate information and community centers as part and parcel of rural development projects.

Output indicators such as the number of subscribers are easy to measure but do not report on what the technology is being used for, who is using it or how it is helping to improve livelihoods. More complex analysis is needed that considers impact on money, skills, motivation, confidence, trust and existing knowledge. We feel that a lack of action, risks increasing the digital divide and losing out on sustainable development opportunities offered by ICTs.

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Using Business Rules Standards to Advance E-Governance

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Key words: e-governance, e-government, business rule standards. Knowledge management

Abstract

The business community has played a leading role in establishing standards for sharing knowledge across computing platforms. Developments in e-commerce have led to developments in e-governance and e-government. One of the latest efforts to standardize electronic communication in the business community is the development of international business rule management standards. This study focuses on an examination of one of the most popular business rules standard – Semantics of Business Vocabulary and Business Rules (SBVR). Standards in the e-governance arena will not only facilitate the expansion of e-governance within nations, but also greatly facilitate e-governance in the international arena. Standards across national boundaries are of particular importance to Africa as the African Union (AU) seeks to implement continental unity. E-governance is viewed as a particularly effective approach to using information and communication technology (ICT) to empower the general citizenry. This makes the expansion of e-governance a key concern of appropriate computing. This effort concludes with suggestions for further research efforts in standardizing and advancing the utilization of e-governance across national boundaries.

INTRODUCTION

"In poll after poll, citizens want their governments not only to fix economic problems, but also to be active in almost every domain". A 2008 survey involving 50,000 people across 60% of the world indicated that over 87% of people want governments to provide food to the hungry, health care and public education to all citizens [1]. As populations become more literate, countries become more economically and industrially developed and communication technology advances the expectations of government increase. The ability for governments to use technology to both assist its citizens and involve its citizens has greatly increased for both developed and developing countries. This sets the stage for advances in e-government and e-governance.

Advances in the ICT sector in Africa have set the climate for the private sector, civil society and government sector to improve service delivery. "Africa"s telecoms sector is the most rapidly growing of any in the world. With many markets globally at saturation point, the opportunities for expansion in the continent are plentiful. But only those investors who understand the complex dynamics of Africa and the unique challenges it throws up will succeed in realizing the immense potential. With three submarine cables now installed, the availability of cheaper broadband connections and the Internet could transform communications in Africa. Mobile banking is already doing so in the financial sphere" [2]. With the connection of submarine cables to fiber cables across Africa, broadband speed has greatly increased while reducing in cost significantly. Fiber is replacing the slower and more costly satellite connections. The global reach and financial potential of telecom advances in Africa is apparent in the following report: "Safaricom, in Kenya, has a service called M-Pesa that lets the cell work as an ATM; … Cellphone minutes are traded by phone as a cash substitute. Credit card payments are mad by cellphone. Remittances from relatives overseas come by cellphone. (Amounting to about $350 billion a year these days, remittances are expected to reach $1 trillion soon; in some developing

countries, the remittance total is already higher than foreign aid and foreign investment combined.)" [3]

African e-government

African countries have embraced the utilization of information and communication technologies to reduce disparities among its citizens. Some such as Rwanda [4] have been very aggressive in planning and implementing ICT based projects. Earlier initiatives dated back to 2000 initiated government backed national internet access projects, Government website, computerization of ministries, a national GIS applications project, as well as a effort to establish a comprehensive computer-based information system to deliver government services. In 2005, Rwanda extended on these efforts with twenty new initiatives outlined in Table 1 below.

Project	Purpose
Document Tracking & Workflow Management	To provide a system that can be used in any Ministry, agency, or large organization to track the progress of documents through their life cycles.
The Citizen"s Guide to Governmental Procedures	To define and document all procedures that the citizen or the private sector needs to interact with the public sector.
Rwanda National Portal	To develop an official Rwandan gateway to all governmental and non-governmental information and procedures.
Budget Management System	To allow preparation of detailed Government budget lines and to manage budget execution.
Tax Management System	To provide a tax management system integrated with other public accounting applications.
External Finance Inflow Management System	Management of development projects, integrated definition of public projects and development budget, and financial execution of projects as development budget execution.
Public Accounting	To establish a Public Accounting Planned Action that collects financial data from revenue collection, budget execution and central bank data, and presents them in accounting terminology, running various financial reports on the State finances.
Border Control and Visas	To support the Immigration and Emigration Departments.
National ID and Smartcard System	To provide every citizen with a Smartcard based on a national ID. It will include additional information that is useful to various entities such as health, traffic, etc.
Automation of Postal Services	To modernize the Post Office in order to provide a more efficient service to the people of Rwanda. This is to be achieved through a widespread automation of the postal services.
Information Decision Support Center (IDSC)	To provide valid and robust information for use in decision-making by key central authorities.
Ministry and Agency ICT	To develop strategic plans for ICT in each Ministry and Agency.
Donor Coordination Network	To provide information for planning, monitoring and evaluation of donor projects across Rwanda.
The Citizen"s Guide to Parliamentary Operations	To introduce the citizen to the ways in which their representatives work in Parliament.
Parliament Management Automation	To assist the management of Parliament in all administrative procedures as well as to provide other services such as web casting of sessions and scheduling of meetings.
Transport Management Information System	To automate all procedures and systems related to transportation and which are currently under the Ministry of Infrastructure.
The National Computer Center (NCC)	To establish a National Computer Center that has the responsibility of providing technical support to all Ministries and public institutions.
Establish the National Information Center (NIC)	The unit that processes national data. It will be in the responsible position of collecting national data, analyzing it and disseminating it.
MIS in RITA	Introduce a Management Information System in RITA.
Automate Street Names	This project assigns clear, usable street names in all towns and cities in Rwanda.

Table 1: Rwanda's NICI 2010 E-Government Projects (source [4])

These projects illustrate the potential of e-government. They range from projects focused on enhancing the information technology capacity of individual agencies (MIS in RITA) to those that will impact the country"s whole population (National ID and Smartcard system). The broad coverage of these projects can serve as a model for other countries as well as a starting point for an Africa-wide initiative.

E-government as Appropriate Technology

The core concept of appropriate technology is „technology to empower people" [5]. Electronic governance and electronic government can be designed to empower people by structuring greater involvement in the governing process. E-government enables users to take advantage of automated government administration processes accessible on-line. E-government involves government to citizen, government to government, and government to business interactions. All three types of interaction can empower the individuals involved. Government to business interaction enables greater business productivity, contributing to the country"s economic productivity. Government to government interaction should result in greater governmental efficiency, consistency and transparency. It is the 3rd type of interaction – government to citizen – that most empowers the individual. It reaches out to the total citizenship of a country. This e-government effort is most pervasive when it maximizes the number of citizens involved and addresses the populations most in need of assistance.

[6] points out that "The public awareness, in general, of the potentials of the advances in ICT has led to increased expectations of government efficiency and access. This will serve to increase pressure on policy makers to make e-governance more people-centered." With that in mind [6] recommends a framework that emphasizes decision support processes involving knowledge development and sharing from the highest leadership to the common citizen. These decision support processes must build on the knowledge repositories from the local to global levels.

Knowledge management and Decision support

Electronic government projects build on existing information systems and government communication processes. Knowledge management is a valuable concern of government. The identification of „best practices" across different government agencies is a starting point. The capture of these „best practices" in a knowledge representation standard and placement in a knowledge management system widely assessable is the next step. The potential users of this knowledge management system must be properly educated on usage of the system, particularly accessing knowledge relevant to their responsibilities and needs. The knowledge management system should be complemented with decision support tools that allow for effective manipulation and alteration of the stored knowledge artifacts as well as information stored by the government. This decision support tool set should consist of standard popular software (with a focus on open source software) as well as customized software developed to address particular needs of the particular communities and circumstances. These computer-based tools must be well integrated with a broader set of decision support techniques that are people-centered.

Need for multi-national approach to e-government

Globalization has created a reality where citizens and businesses have a need to conduct varied and regular interactions across national boundaries. Governments can facilitate these interactions by extending e-government operations beyond their national borders. This can best be achieved by multi-government web-based efforts. Multi-national e-government broadens the opportunities of citizens and businesses. This larger e-government effort requires standards that address the decision processes and knowledge representation that is critical.

Semantic web and Pan-European e-government

The European Union recognized the need for a multinational approach to e-government and launched a program to deliver pan-European e-Government services in 2005. This five-year program was to deliver services to public administrations, businesses and citizens. "Overall the evaluation (after 5 years) concludes that the programme is in line with the e-Government Policy priorities of the European Commission, plays a unique role within the European instruments to foster the integration of Europe through interoperable public administrations and is on track in the implementation of actions [7].

"When moving the focus from national to Pan-European e-Government Services (PEGS), additional challenges appear mainly due to the existing inconsistencies amongst the administrative systems. Apart from problems of multilingualism, the clients have to overcome a series of difficulties such as different names for the same services provided by different administrative levels, and providers; different titles, names of documents and their structure; extensive use of different administrative and legal terms; different communication patterns must be followed when interacting with different PAs". To solve this a conceptual model is developed that depicts infrastructure levels such as service requestors, front-office applications, application layer and service providers where the underlying transport network is facilitated by the Trans-European Services for Telematics between Administrations network [8]. This addresses some of the ontology needs of e-government system standardization. However, addressing the decision process standardization requires rule standardization. Production Rule standardization is particularly important. Production rules allow the representation of a wide variety of decision processes that reflect the following structure: (conditions + constraints imply actions).

Business Modeling Knowledge standards

In most cases the business sector is more advanced than the government and civil society sector in developing international standards. This naturally follows since the internationalization of commerce has been a driving economic force for centuries. Political or governmental cooperation has largely served to facilitate economic forces. In recent years e-commerce has played an important role in this global economic drive. This is the situation with regards to establishing standards for knowledge representation and decision-making. Rule based systems have flourished for years and the business community has dominating in their utilization. Three of the most prominent business modeling knowledge representation standards are analyzed and compared [9].

Howard University (HU) researchers devoted significant effort to survey three major business knowledge representation standards, SWRL (Semantic Web Rule Language), SBVR (Semantics of Business Vocabulary and Business Rules), and XBRL (eXtensive Business Reporting Language). "These are standards and mechanisms used by industry organizations, such as

Object Management Group (OMG), World Wide Web Consortium (W3C), as well as various business rule management system (BRMS) vendors. Semantic Web Rule Language, or SWRL, was developed by the W3C to be the rules language for the semantic web. It is essentially a combination of OWL and RuleML and thus supports both a sophisticated ontology and a strong system of rules. Semantics of Business Vocabulary and Business Rules, or SBVR, is a standards product of the OMG. The standards group started work on SBVR in 2005 and the first public release was Version 1.0 in January 2008. The eXtensible Business Reporting Language, or XBRL, is an open standard approved by XBRL International that is now widely adopted by over 400 organizations in 11 global jurisdictions, including 19 stock exchanges and 10 country-wide taxing authorities." [9]

The table below Table 2 compares the strengths and weaknesses of the three standards. This is based on a study done to determine which standard is most appropriate for a particular business environment. However the results are very helpful in establishing suitability in the e-government setting.

STANDARDS	SWRL	SBVR	XBRL
Advantages	--It is very expressive, essentially being able to express all of first order logic. --It has facilities to allow easy calling of external programs (e.g. querying databases). --It has extensive academic interest and there are a number of open source rule engines.	Flexibility of expressing rules in: -Natural language (such as English, German, Dutch) -Specialized terminology (such as that used by lawyers or engineers) -Constructed language (such as the UML)	--SEC approved and recommended --Addresses financial knowledge representations
Disadvantages	--The standard is so expressive and powerful, that only a subset can be used. Otherwise inference will be undecidable. --Does not natively support natural language statements.	--Does not directly address linking to other knowledge sources such as Oracle or SQL databases. --The absence of a traditional object-attribute representation can be a shortcoming.	--Lack of a flexible, comprehensive rule representation --Limited ontological knowledge representation capabilities --No consideration by industry leading vendors

Table 2: Comparing SWRL, SBVR and XBRL (source [9])

SBVR

"SBVR is appropriate to be used by business experts, since it allows the representation of business vocabulary and rules using controlled natural language" [10]. SBVR may prove the best standard to pursue in a broader e-government effort. SBVR presents the strongest case of knowledge representation flexibility. Users do not have to be skilled programmer analysts to express their domain knowledge. This opens the development process to a wider community. This is important with e-government and e-governance. The potential pace for development and the involvement of stakeholders, decision-makers and citizens is important.

The basic components of SBVR constructs are the Noun and Verb concepts. They are used to construct simple as well as complex facts. Noun and verb concepts are used to build the fact knowledge base for the domain, instead of less readable object-attribute constructs. There are

two types of rules in SBVR: structured rules and operative rules. Structured rules are logic rules that are unbreakable. They are used to present complex relationships in the domain that help define both static and dynamic structural realities in the domain. Operational rules are action-oriented and are breakable (i.e. they need to be enforced) [11].

Pan-African e-government

The African Union has established processes that are designed to lead to the full integration of African states politically and economically. A continental electronic governance system would both facilitate the integration of government processes across borders. It would allow for greater shared administrative resources. This is particularly important given the limited expertise in information and communication technologies. The best practices of the stronger and more developed states in Africa such as South Africa and Egypt can be used to accelerate development in smaller less developed states. The potentials for citizen users are even greater. Best governmental practices will be made available to citizens in their local communities at a much quick pace given the standardization facilitated by user-friendly international standards such as SBVR. Citizens will have much better access to opportunities on a continental scale through a well-planned Pan-African e-government structure. This ranges from improved access to visas and travel opportunities to access to jobs across Africa.

Conclusion and future research

This initial study concludes that a nexus of conditions exist for the advancement of a Pan-African e-government and e-governance initiative. This effort can link not only the 53 independent African countries but also the various African communities in the Diaspora. Technology advances in telecommunications and computing have set the stage for a wide range of advances in global connectivity for business and government. Initially information and communication technology was strictly the domain of the most developed countries. Technology transfer to the developing countries has accelerated in recent years. The projected impact on Africa will lead to advances in commerce as well as democratization. The business community is taking the lead in developing standards for knowledge representation and the exchange of knowledge artifacts. These are international standards that can apply not only to the business communities but are well suited for government efforts. SBVR has emerged as a leading candidate in the standards development efforts. The strength of SBVR is its flexibility for expressing rules, particularly its use of natural language constructs. This can open doors to rapid development of internet-based knowledge management decision support systems across national boundaries. The authors plan to extend this research in two directions: 1) expand the examination of rules standards and rule development tools; and 2) engage researchers from different countries in this effort.

1) Identify best projects for empowering people. These should be projects that have the broadest impact on the most disadvantaged communities and effect the largest populations.
2) Identify cross-national linkages. These may be sister agencies in difference countries such as: social security agency or motor vehicle authority.
3) Replicate projects across national boundaries. This may be as simple as utilizing the same website templates or may involve complex linkage of knowledge structures across national boundaries
4) Further investigation of SBVR as a standard for e-government efforts. Several issues

must be addressed including the role of UML models and how will Production Rule Representation (PRR) and Rule Interchange Format (RIF) be used in development efforts
5) Planning for the human resources needed to implement a comprehensive Pan-African e-government effort in terms of immediate needs and long term development.
6) Address the required network infrastructure development needed. This must particularly address end delivery points such as: mobile, portable PC-based, telecenters (public, private, and PPP), home based access
7) Address connecting Pan-African e-government to Asia, Europe and the Americas.
8) Develop a process of continuous assessment. Measuring effectiveness across boundaries and over time and making the necessary adjustment is key.

Table 3: Starting points for comprehensive plan of action

Initial multi-national efforts at e-government have been initiated by the European Union. They focus on using Semantic Web Service (SWS) specifications [8]. This study finds SBVR to be a more expressive and powerful candidate for extensive e-government development. The application of this e-government development process across Africa can have an even greater human impact because it addressed the most disadvantaged populations and the structurally weaker government. This can be a truly effective approach to reducing the „digital divide". One key to implementing these ideas is how completely the African Union and its member states embrace this effort. A comprehensive plan of action is needed. Table 3 above outlines points that should be addressed in such a comprehensive plan. This will be the starting point of our continued research effort.

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