DESIGN AND IMPLEMENTATION OF A COMPUTERIZED MANAGEMENT INFORMATION SYSTEM TO IMPROVE SECONDARY SCHOOL ADMINISTRATION IN CAMEROON

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Abstract - The need for Secondary School Management Information System in the context of recent developments in the digital economy is as critical as the need for education itself. Secondary Schools in Cameroon and many developing countries put in a lot of effort in managing information and giving the right output to the ever waiting public. The paper is aimed at designing and implementing a school management information system tailored to suit the needs of Cameroon's secondary educational system in order to solve the problem of data collection, processing and sharing within the educational milieu. The methodology used in the programming is MERISE Method of database design and the program achieved is named DBeztSCUL M.I.S. The program is a network-based Windows program that is both desktop and web-based. The network design is suggested to enhance the system sharing and division of labour. The result of this paper is to produce an electronic school management information system that is functional at micro and macro level.

Keywords - Management Information System, School Management Information System, Secondary Eduction, Cameroon's educational system, school administration

I.INTRODUCTION

Business administration the world over has turned a new live; matching forward at the speed of light towards the digital economy due to the numerous advantages it brings. Jones (2003) maintained that what gives the administrator the power and control to manage the resources is the availability of information. According to Ogbonnaya (1994), it is the administrative responsibility of both principals and teachers to embrace ideal administrative practices that ensures effective and efficient school records keeping in school system. Ololube (2012) maintained that rising cost of running school systems leave some schools with low quality and inadequate human and material resources. Thus, the need for alternative ways of utilizing slim resources to attain set objectives makes school record keeping imperative. Keeping records about school manpower and material resources is critical for effective school administration. The administration of schools in Cameroon though a very complex venture that goes beyond the ordinary business of profit motive cannot be left behind. There's the will to go digital like other countries have done with their educational systems. Like other developing countries, Cameroon lacks the resources necessary to digitalize education; one of which is School Management Information System.

The Cameroon Government has made significant efforts to modernise educational policies to meet the current demands of the job market. Such efforts can be evident with the creation of Higher Technical Teachers' Training Colleges (HTTTC) in the University of Bamenda, University of Buea and the most recent one in the town of Ebolowa to add to the old one in the University of Douala. This is in a bit to respond to the growing need for technology in different sectors of the economy. These efforts seem inadequate because there's more than just the need for personnel in Secondary School. Material and technological needs are critical. School Management Information System can help the trained teachers and administrators carryout their task effectively. Administrators should spend less time in providing school statistics and issuing documents; while maintaining accountability, efficiency, accuracy, dependability and security of school information and records.

II. BACKGROUND OF STUDY

The complexity of school administration the fact that the school system activities generate a wide range of records, reports, statistics and documents which have to be processed, stored and disseminated to ensure effective school administration. The ever growing population of students enrolling into secondary education in Cameroon makes the task of secondary school administration a difficult on the country. Secondary School Administrators in some parts of the country have been heavily criticised for poor performance ranging from non-accountability, mismanagement, poor statistics, non-respect of timeframes, etc. According to Akubo (2004), manual record keeping is prone to errors andmistakes especially in processing accounting data.AU-YEUNG (1995) maintained that records are those which keep track of the exchange of the goods and/or services of an organization for money.

The population of students in secondary schools is in a continuous rise in Cameroon. UNESCO (2010) reported that nearly 1.3 million total students in 2009 .This continuous increase in population outweighs the available manpower and materials for managing schools. This rising population also means rising cost

in running schools. UNESCO went further to emphasize that there existed a lot of unequal learning outcomes in Cameroon. These unequal learning outcomes also reflect the inequitablequality of learning environments in Cameroonian schools. Information and Communication Technologies consist an integral part of school environment nowadays.

School Management Information Systems (SMISs) can serve as a catalyst to secondary school administration in Cameroon. This would go a long way to demystify the complexities of school administrative systems in the country, facilitate data collection, quicken administrative decision taking, harmonize the nature of issuing documents in secondary school, ensure accountability, provide statistics for government policy and ensure effective communication within the school milieu. The development and implementation of a School Management Information System to like the one proposed in this project is therefore critical to improve the administration of secondary schools in Cameroon.

III. STATEMENT OF THE PROBLEM

A lot of issues surround the effective functioning of Secondary School Administration in Cameroon. These issues include unnecessary differentiation and discrimination amongst schools in terms of admission and promotion criteria; non-accountability, poor student and staff record keeping; undependable school; embezzlement of school funds due to lack of control techniques; slow decision taking and inadequate statistics for policy development.

Hardly can one find a secondary school in Cameroon especially public school which is not plagued by one or more of these problems. It is for anyone to just ask questions to a school principal such as: How many students were admitted this year? How many students registered? How much was collected in terms of registration fee? How many students passed the first term exam in the school? How many teachers does the school have? What can identify the students? The answers to these questions cannot be provided instantly; even if done, the reliability of such data is often found wanting due to the crude methods of collection, processing and storage of school records. It's with this backdrop that this researcher sought to embark on a project to design and implement a school management information system presumed to solve these administrative problems in Cameroon's secondary schools to a greater extent.

IV. OBJECTIVES OF THE PROJECT

This project has the followings as objectives:

- To design a School Management Information System (SMIS) tailored to suit the needs of Cameroon's educational system at secondary level to improve administrative performance.
- To implements the School Management Information System (SMIS) in schools in Cameroon in order to measure the level of improvement of school administrative work.

V. RESEARCH QUESTIONS

- How can we design a technology that can be used to resolve the problems of managing information in Cameroon's secondary school?
- At what level can technology be implemented to effectively resolve problems of information management in Cameroon's secondary school?

VI. CONCEPT OF INFORMATION SYSTEMS

Bourgeois (2014) defines information systems as "... combinations of hardware, software, and telecommunications networksthat people build and use to collect, create, and distribute useful data, typically in organizationalsettings."

Darwen (2014)sees a business information system as a group of interrelated components that wok collectively to carryout input, processing, output, storage and control actions for the purpose of forecasting, planning, control, coordination, decision making and operational activities in an organization.

Steyaert et al (1996) argued that today, information systems are assumed to be the most extensively used application of information technology in the human services. To confirm the usefulness of information, Jones (2003) maintained that what gives the administrator the power and control to manage the resources is the availability of information.Bourgeois (2014) classified Information Systems into 3 categories namely: Management Information System (MIS), Decision Support System (DSS) and Expert Support System.

Management Information System (MIS) is basically concerned with the process of collecting, processing, storing and transmitting relevant information to support business management. These systems are needed for managerial decision making, information dissemination and business result analysis. Some users of MIS include top level management, middle level management and supervisory management, auditors, the state, potential investors and creditors. They use these systems to get information such as accounting information, marketing information, stock control and personnel information.

Decision Support System (DSS) are systems specifically designed to support decision making. They are developed to analyse massive collections of data. They fall in two main types namely: model-driven decision support system and data-driven model. A decision support system can make use of data from internal and external sources.

Expert Support System (ESS) is an information system that captures and stores the knowledge of human experts and then imitates human reasoning and decision making process for those who have less expertise.

VII. ORGANISATION OF CAMEROON'S EDUCATIONAL SYSTEM AT SECONDARY LEVEL

According to LAW No 98/004 of 14th April 1998, to lay down guidelines for education in Cameroon:
The organisation and control of education at all levels shall be the bounden duty of the State.
The educational system is organized into two sub-systems: the English-speaking sub-system and the French-speaking sub-system, thereby reaffirming the bi-cultural nature of Cameroon. This law maintains that the two sub-systems shall co-exist, each preserving its specific methods of evaluation and award of certificates.
At secondary level, Cameroon's educational system for both sub-systems has:

- A first cycle of 5 (five) years having an observation sub-cycle of 2 (two) years with a common-core syllabus and an orientation sub-cycle of 3 (three) years of general or technical education;
- A second cycle of 2 (two) years of general or technical education

This organisational brings about an administrative setup in secondary education in Cameroon which can be simplified in the figure below:

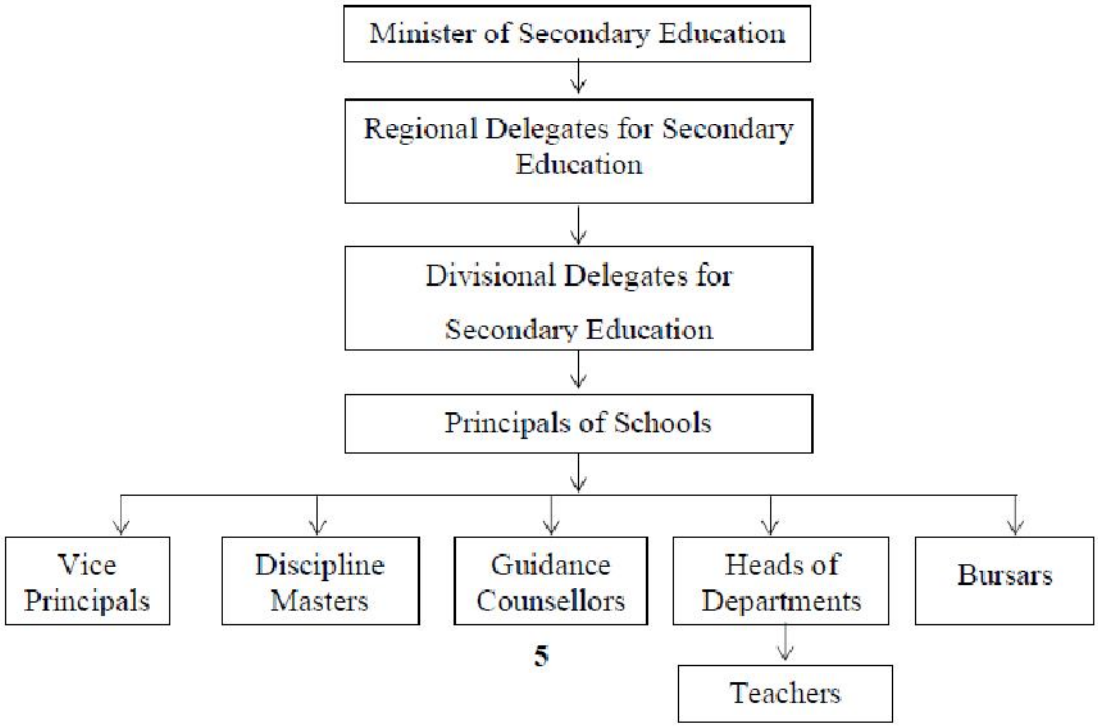


Figure 1: Administrative Structure of Cameroon's Secondary Education
Source: Author's design from field data

The School Management Information System (SMIS) envisaged in this project is based on the administrative structure above. From the structure, we developed a model which will guide us to see the necessity for a School Management Information System and can then proceed with the development of the system.

VIII. OUR MODEL FOR ELECTRONIC SCHOOL MIS

This model is based on the assumptions that:schools unlike other forms of businesses have**people**as input,**people** as processors, **people**as output and **people's actions** as feedback.Electronic Data Processing has a similar cycle to that of schools but in electronic format; it has **data**as input, **microchips**as processors;**information** as output and **user's reactions** as feedback. This unusual form of business in the midst of the digital economy today must give a valid response to the changing times by blending the cycle of schools and that of electronic data processing to come up with an **electronic school management information system**. Below is our model on which this project is based which works with the assumptions that: **people are vital machines and participatory management is desirable.**

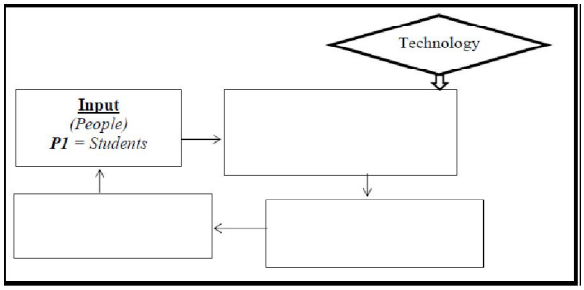


Figure 2: NSHOMSON's Model for Electronic School M.I.S

Model summary

School Administration = Process of [P1 + (P2+Technology) + P3 + P4]

The model assumes that an injection of technology at the level processing of the school input will improve administrative performance in Cameroon's secondary schools. This technology embodies a School Management Information System (SMIS) like the one under design.

Going by our model above and following the real situation of Secondary School in Cameroon, it is vital to incorporate Information and Communication Technologies at both micro and macro levels of educational administration. This has been done at minimal level but this project proposes a bigger picture for school management information system (M.I.S) in Cameroon; which is tailored for the Cameroon's secondary educational system and culture.

IX. METHODOLOGY

The methodology we will adopt is to enable the development of the application easier with less complexity. It should be achieve the goals while keeping to the standards of system development. There exist different methods of system design which but we will use one of the Object Oriented Method (OOM). The method to be used here is MERISE method. According to Quang (1991) MERISE is a method based on the Conceptual Data Model (CDM) for designing databases. In this method, all objects you have to deal in your application are Entities and are linked by Associations. Both entities and associations have attributes. Relations have cardinalities (min and max). The choice of MERISE method for this project is for its simplicity, closeness to human thinking and its compatibility with the normal System Development Life Cycle (SDLC).

X. CONCEPTUAL DATA MODEL (SYSTEM DESIGN)

The Conceptual Data Model (CDM) of the MERISE method is equal to the system design stage of the System Development Life Cycle (SDLC). This consists of setting the data dictionary, the entities, identifiers, properties, associations and occurrences.

The dictionary shows the different tables, field names, codes and data types used in the system. The data dictionary helps the developer to know the different fields which are required in the system. It gives the developer a preview of the database in which records will be stored. Some items on the data dictionary include:

NO	Table	Name	Code	Data Type
1	AdmissionReg	Admission Number	ADM_NUM	Autonumber
2	AdmissionReg	Student's Name	STU_NAME	Text
3	Registration	Class	Class	Number
4	Registration	Academic Year	Ac_Yr	Text
5	PayFees	Amount Paid-in	PayIn	Number
6	PayFees	Amount Paid-out	PayOut	Number
7	Contacts	Student's phone number	Stu_Phone	Number
8	Contact	Emergency	Emergency	Number
9	IDCARD	ID Number	ID_NUM	Number
10	IDCARD	IssueDate	Issue Date	Date/Time

Table 1: Data dictionary

The entities of this system include:

Admission, Registration, Examination, Finance, ID Cards, Staff, Messenger, About Us, Setup, Help. Each entity has an identifier. For instance, the identifier field Admission is the ADM_NUM which is unique. Attributes are the specific characteristics of each entity. Some attributes of the Admission entiti of our system include ADM_NUM, STU_NAME, SEX, DOB, POB, ADM_CLASS, ADM_Yr, etc.

An association is what defines the nature of the relationship between two or more entities. It defines which entity creates the relationship and to which entity it is directed. For instance, the relationship between Admission and Registration is created by Admission and directed to Registration signifying a one-to-many relationship since a student is admitted once but registers every year. An occurrence is the value that an attribute or property can take. For the Admission entity,ADM_NUM takes Autonumber while STU_NAME takes text.

XI. LOGICAL DATA MODEL (SYSTEM DEVELOPMENT)

The movement from Conceptual Data Model to Logical Data Model involves some rules to follow:

- Entities become Tables with rows and columns.
- Identifies become Primary Keys in those tables.
- Associations become relationships which will be One-to-Many or One-to-One.
- The associations move from primary key of one table to foreign key in another table.

The development of this system is done in two ways:

- Desktop application approach
- Web application approach

The desktop application is developed using Microsoft Access 2010+ to host the database, macros and Visual Basic for Application (VBA) to automate the graphical user interface. The choice of Microsoft Access for the desktop application is for the following reasons:

- Most schools in Cameroon use Microsoft computers

- Microsoft access is a database management system (DBMS) that is supplied by Microsoft in the Microsoft Office Suit.
- Local schools in Cameroon are used to the functioning of MS Access and can easily manage and maintain an application developed in Access.
- Maintenance of the application will be easier for the local expert team.
- The Desktop system is intended to be hosted at Micro (Schoollevel).

For the Web Application, the database is a MySQL database, the graphical user interface is automated using HTML, JavaScript and PHP. This makes the system web compatible and user friendly. The web application is desirable for the following reasons:

- It uses open source database (MySQL) and PHP
- It is very compatible with most common operating systems
- It runs on a web browser, thereby making network sharing an easy task.
- It is good for Macro (Divisional Level) implementation.
- The maintenance of the system is done only at the server.
- It is supported by most portable devices such as Smart phones and Tablets

The two versions of the system are fully developed and functional and any of them can be implemented to suit the situation of the school where it is to be used. The codes used are simple and dynamic and provide for a lot of customization within the system. The program is named DBeztSCUL MIS and is ready for testing and implementation.

XII. PRESENTATION OF REALIZED PRODUCTS OF THE PROJECT

In order to effectively provide solutions to the above mentioned problems plaguing our educational system at secondary level, this project has realized the following:

12.1. A Computerized School Management Information System

A computerized school management information system will be realized named DBeztSCUL MIS. This system is capable of the following:

- **Admission:** (Admitting students annually, getting student's admission letters, getting admission lists and admission analysis)
- **Registration:** (Registering students per year, getting class lists, get enrolment statistics and analysis)
- **Examination management:** (Entry and processing of student's Marks, Analysing the marks, producing Report cards for students, producing student's Transcripts etc.)
- **School Identity Cards:** (Applying for ID cards, Getting ID cards, getting list of issued IDs, etc.)
- **Staff Management:** (Registering staff, getting staff list, staff appointments etc.)
- **Finance Management:** (Recording fees, getting receipts, getting reports and analysis)
- **Messenger:** (Send and receive short messages from users and publish notices)
- **About Us:** Get basic information about the school, courses and specialties offered.
- **Help:** Get help on the operation of DBeztSCUL MIS
- **Setup:** For the system administrator; have control over your school system.

All of these provided to a school on a single integrated system is a breakthrough in Cameroon's educational system at secondary level.

The figures below give a foretaste of the system:

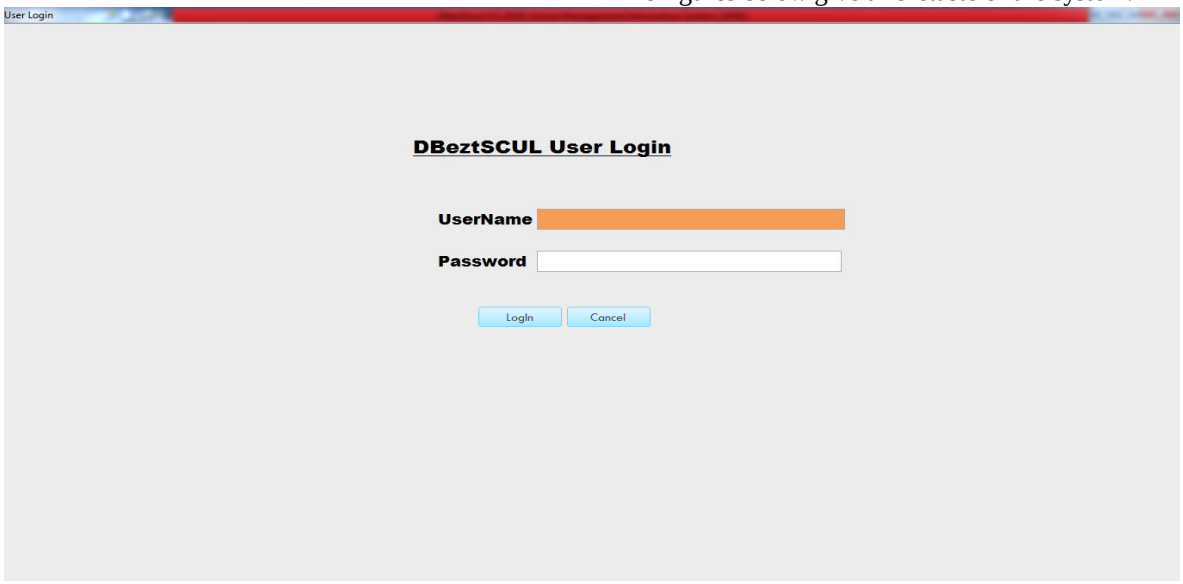


Figure 3: Authentication window of DBeztSCUL

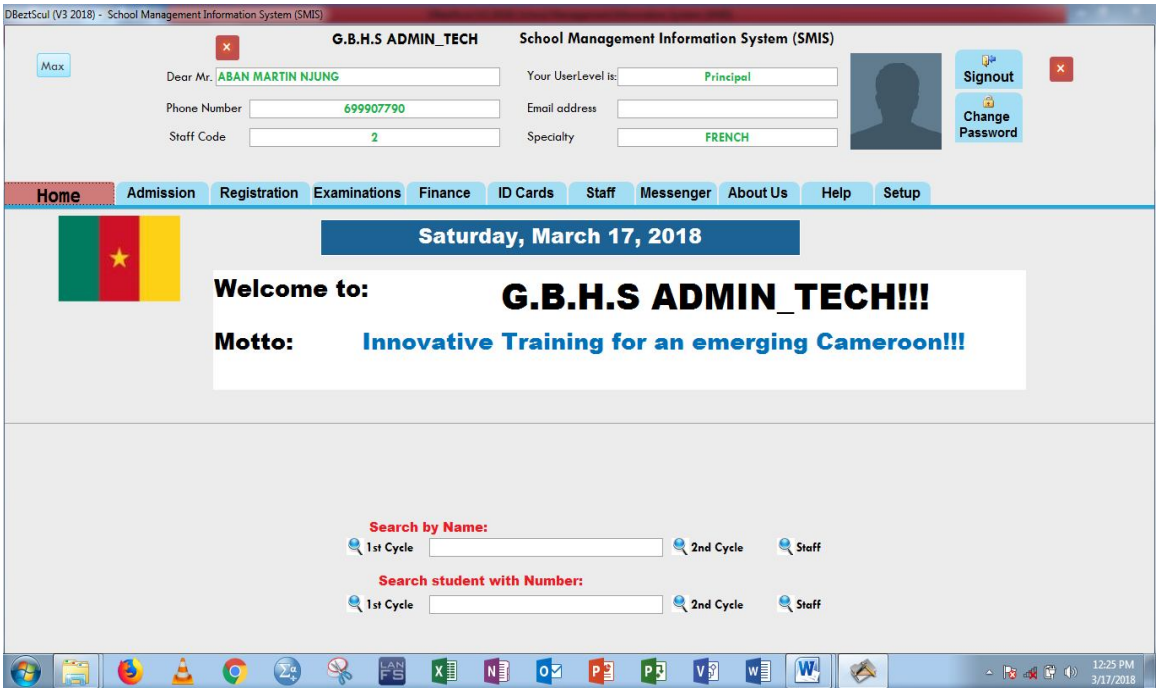


Figure 4: Home Screen of DBeztSCUL

12.2 Network plan to run and share the system

A local area network (LAN) or metropolitan area network (MAN) will be designed for the sharing of the system at all levels of implementation (micro or macro). The choice of locally designed LAN or MAN instead of a Wide Area Network (WAN) like the internet is to guarantee continues flow of the network. Internet services depend largely on the network of the Internet Service Providers which may at times fail school activities. Locally designed networks will be managed by trained experts within the institution and the network problems can easily be diagnosed and managed.

12.3 Training program for experts

Selected personnel from the schools that will adopt this system will be trained in database management, management information systems and network management to enable them serve as the local expert team for the school system. This will be achieved through:

- Organized seminars and training workshops
- Use of explicit training materials
- Elaborate system manual

XIII. EVALUATION OF THE SCHOOL MANAGEMENT INFORMATION SYSTEM (DBEZTSCUL MIS)

- The future of secondary school administration in Cameroon is hopeful with increased performance given that with a system like this one developed; if implemented school information and statistics will be available in real time to the users.
- With all schools using a standardized information system, hierarchy can ensure that long cry for equal opportunity to all in Cameroon's secondary education is achieved through setting uniform criteria for admission and promotion to the next class or level.
- The system bears a Secondary and High School Transcripts designed with similar grading techniques to those used by Bachelor-Masters-PhD (BMP) system universities in Cameroon such as the Universities of Buea, Bamenda and Dschang.
- School enrolment statistics can be obtained at real time without any further processing after the students have been registered.
- Control of school finances can be improved through the secured finance system that is up to date with other finance systems in other nations. This will ensure that accounting statements issued from school are standardized formats which can be read and understood by internal and external finance controllers.
- School Identity Cards can be issued with referential records kept in the system. In the wake of insecurity and fraud the world over, it is necessary to identify the student of every school and leave a record in school for reference purposes.
- The processing and issuing of Report Cards which contain student's progress record for the period would be done automatically by the system. The teacher's job will end at keying in marks and checking that the marks entered are correct. The report card module of the system will process the marks, rank the student and prepare report cards which require only printing and signing by the administration.

- Information about staff, staff list and appointments can be safely stored and updated with the staff module of the system. With the information about students and staff kept and updated, decision making can be accelerated.
- The messenger in the system provides a chat forum for the exchange of short messages amongst school users. This will improve communication amongst the members of the school community especially administrators.
- The printable output in this system is designed with a lot economic consideration. The output is designed with following a critical cost-benefit analysis carried out at the feasibility studies stage of this project. Following the analysis and design, it is expected that school implementing this system should be able to cut down administrative cost and benefit up to about 35.7% of cost reduction.

XIV. PROJECT IMPLEMENTATION PLAN

The project implementation will be in two (2) levels (micro and macro) depending on the choice of users.

14.1 Micro level implementation

The micro level refers to implementation at the level of the school itself. In this level, the system is hosted in a local server in school and shared through the administrative offices using a local area network. The figure below illustrates the micro level implementation.

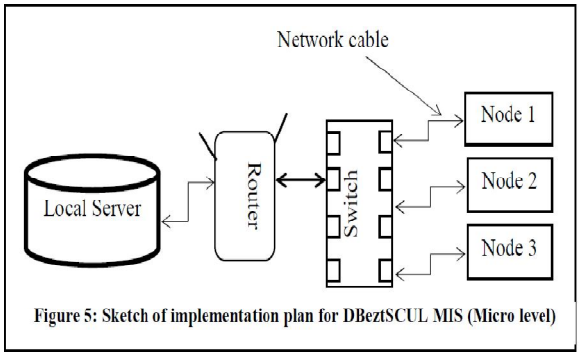


Figure 5: Sketch of implementation plan for DBeztSCUL MIS (Micro level)

14.2 Macro level implementation

The macro level refers to implementation at the level of the Divisional Delegation of Secondary Education (DDSE). At this level, the system is hosted in a large server at the DDSE and each school is given an instance of the system. The users of that school will create accounts which are affiliated to their own institution in the server.

At macro level, an extended macro can also be created where the server at the DDSE hosts all the schools but each school also hosts its own instance of the system such that if there's any breakdown at the DDSE, the schools can still function. This will entail a synchronized server interface at the level of the DDSE.

The system is then shared through a metropolitan area network (MAN) to cover the entire Division. Users from each school are registered under the school. The macro level can be illustrated by the figure below:

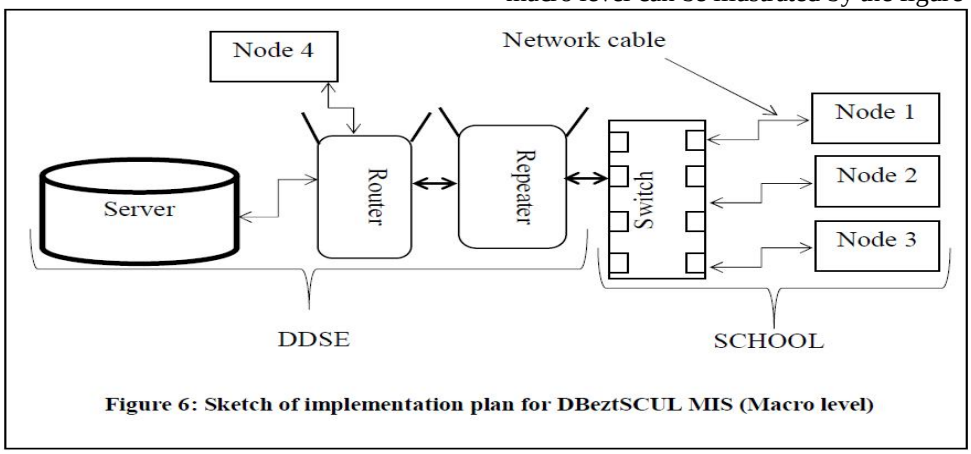


Figure 6: Sketch of implementation plan for DBeztSCUL MIS (Macro level)

14.3 Requirements for implementation

SN	Device or Software	Details	Remark
1	MS Access 2010^{+}		For desktop application
2	Web browser	Requires support for JavaScript	For Web application
3	Windows XP SP3^{+}		For desktop application
4	MS Excel		For both desktop and Web applications
5	Network operating system		For Web application
6	Local server (Software)	Requires support for PHP and MySQL	For web application
7	Server PC	Minimum 1TB HDD, 8GB RAM, Core i5 2GHz	For Micro level of implementation

8	Server	Minimum 10TB HDD, 32GB RAM, Core i8 4GHz	For Macro level of implementation or X-Macro
9	Router	(Dynamic)	As the case may be
10	Switch	Minimum 16-ports	As the case may be
11	Repeaters		As the case may be
12	CAT6 Network cable		As the case may be
14	RJ45 Connectors		As the case may be
15	PCs	With required software installed	To serve as nodes
16	Power source	Preferably independent	As the case may be
17	Voltage Regulators	Minimum 10,000 VA	
18	Surge Arrests		As the case may be
19	Electrical distributors		As the case may be
20	Electrical cables		As the case may be

Table 2: List of system requirements

XV. CHALLENGES AND MITIGATION TECHNIQUES

This School Management Information System is designed to the standard of Cameroon's educational system at secondary level. Cognizance of the fact that Cameroon is a developing country and coupled with its own peculiar challenges and the challenges of education in general, the following can be foreseen as controllable challenges for this project:

- **Need for experts at school level or level of the DDSE:**Given the low level of computer literacy hence scarcity of computer experts in developing nations, getting experts to manage a SMIS will pose a challenge. However, it's mitigated through the well planned training program for expert teams at school and DDSE levels.
- **Cost of implementation:** Secondary Schools in Cameroon both public and private barely survive with the minimal resources they can raise. Acquiring the software application and its complementary devices/software to would be a serious challenge to most schools, especially those in the rural areas. This challenge can be handled by appealing for state subsidy to the project, appealing for community support, appealing for aid from national and international non-governmental organizations (NGO) and appealing for support from Parents-Teachers Associations.
- **Electrical energy problems:** The major source of power in Cameroon is Hydro-Electricity Power produced and distributed by a para-statal. It is characterized by low voltages and frequent power cuts. This will pose a serious challenge to school intending to implement such an information system. However, this can be handled effectively by acquiring alternative independent power sources like solar energy.

CONCLUSION

It can be concluded that a School Management Information System (SMIS) branded DBeztSCUL MIS has been designed and developed; tailored to fit the needs of Cameroon's educational system at secondary level. The system has been pre-tested and it's functional. A critical analysis of the functionality of the system has been made and it's concluded that it is beneficial to schools in Cameroon. An implementation plan is drawn up and awaits adaptation and implementation by Cameroon's Secondary Education authorities. This system is therefore expected to solve a wide range of issues and be profitable to school administrators, teachers, students and the Cameroon's society in general.

RECOMMENDATIONS

With final achievement of developing a system like this, the following recommendations are made:

- Cameroon's Ministry of Secondary Education should adopt this SMIS for as the standard system for secondary schools in Cameroon.
- The Cameroon government should subsidize the project in schools willing to adopt it.
- The training offered in teacher training colleges in Cameroon should incorporate a wide range of knowledge ICT and information system to enable teachers cope with new developments in the teaching/learning field like this one.

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