A MEDICAL INTELLIGENT SYSTEM: THE CASE OF PANZI HOSPITAL

A Thesis

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Master of Science in Information Systems

By:

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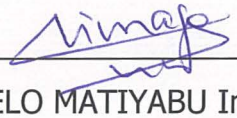
DECLARATION A

This thesis is my original work and has not been presented for a degree or any other academic award in any University or institution of learning.



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DECLARATION B

I confirm that the work reported in this thesis was carried out by the Candidate under my Supervision and it is ready for submission at the College of Higher Degrees and Reseacrh at Kampala Internation University

Dr. Conrad M. ....

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12/12/13

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APPROVAL SHEET

This thesis entitled "Development of a Medical Intelligent System for Panzi Hospital", prepared and submitted by **ITULELO MATIYABU Imaja** in partial fulfillment of the requirements for the degree of a Master of Science in Information system; has been examined and approved by the panel on oral examination with a grade of

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Grade: _____

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DEDICATION

This thesis is dedicated to my family who has been the cause of my encouragement. They have given me advices and motivation for achieving this project.

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LIST OF ACRONYMS

AI	:	Artificial Intelligence
BI	:	Business Intelligence
CIF	:	Corporate Information Factory
CMCS	:	Computer-Mediated Communication Systems
CRM	:	Customer Relation Management
CSCW	:	Computer Supported Cooperative Work
CSF	:	Critical Success Factors
CVI	:	Content Validity Index
DRC	:	Democratic Republic of Congo
DSS	:	Decision Support System
DW	:	Data Warehouse System
EIS	:	Executive Information System
EMS	:	Electronic Meeting System
ER	:	Entities-Relationship
ETL	:	Extraction Transportation and Loading
FBI	:	Federal Bureau of Investigation
GDS	:	Group Decision System
GSS	:	Group Support System
ICT	:	Information Communication Technology
IS	:	Information System
IT	:	Information Technology
J2EE	:	Java 2 Platform Enterprise Edition
JAD	:	Joint Application development
KDD	:	Knowledge Discovery in Database
MIS	:	Management Information System
NSS	:	Negotiation Support System
OLAP	:	Online Application Processing
OLTP	:	Online Transaction Processing
PDSS	:	Personal Decision Support System
RAD	:	Rapid Application Development

SDLC	:	System Development Life Cycle
SPSS	:	Statistical Package for Social Sciences
SQL	:	Structured Query Language
US	:	United States
VB	:	Visual Basic
VCF	:	Virtual Case File
XML	:	Extensible Markups Language

ABSTRACT

This study has been conducted at Panzi Hospital in Democratic Republic of Congo, it is an academic research. Development of a Medical Intelligent System is the title of this academic research. The purpose of this study was to development an intelligent system for supporting the decision makers at Panzi Hospital.

For achieving this purpose, the specific objectives defined; to investigate the level of performance of the existing Medical System, to develop a medical intelligent system and to develop guidelines for design of medical information system. The researcher used the design science research as research approach.

The population of the study was 40 and the sample size was been calculated using the Slovenes' formula. The researcher used the Design Science Research and interview as a research tool for collecting data among 36 managers and operators of Panzi hospital. SPSS was used for analyzing and interpreting the data.

The System was designed using Microsoft Visual Studio 2008 (VB. Net ASP.net) and SQL server 2008 as the database management system. The researcher recommended Panzi Hospital to implement it for their benefits. The parallel system was recommended for conversion. The research recommended practically, Panzi Hospital, the guideline to apply for the use and management of their information system.

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CHAPTER ONE
THE PROBLEM AND ITS SCOPE

Background of the study

In modern businesses, increasing standards, automation, and technologies have led to vast amounts of data becoming available. Data warehouse technologies have set up repositories to store this data. Improved Extract, transform, load (ETL) and even recently Enterprise Application Integration tools have increased the speedy collecting of data. Online Application Processing (OLAP) reporting technologies have allowed faster generation of new reports which analyze the data. Business intelligence has now become the art of sifting through large amounts of data, extracting pertinent information, and turning that information into knowledge upon which actions can be taken. Stackowiak et al. (2007) define Business intelligence as the process of taking large amounts of data, analyzing that data, and presenting a high-level set of reports that condense the essence of that data into the basis of business actions, enabling management to make fundamental daily business decisions. (Cui et al, 2007) view Business Intelligence as way and method of improving business performance by providing powerful assists for executive decision maker to enable them to have actionable information at hand. Business Intelligence tools are seen as technology that enables the efficiency of business operation by providing an increased value to the enterprise information and hence the way this information is utilized.

The Hospitals in Democratic Republic of Congo are still using the manual tools for managing their data which make the decision makers in confusion when taking actions, while, intelligence system is efficient for assisting managers to achieve their duties. The role of information in decision making cannot be overemphasized. Effective decision making demands accurate, timely and relevant information. According

to Berson (2002), information resource is one of the major issues and indices of Congolese planning. Where the relevant information required for planning are not available at the appropriate time, there is bound to be poor planning, inappropriate decision making, poor priority of needs, defective programming or scheduling of activities. Hence, the Hospital system will not be efficient and effective in its operation. Poor management information system has been identified as a bottleneck in the successful management of Hospital in the Democratic Republic of Congo (Ayittey G.B.N, 1998).

Panzi Hospital is a private hospital in Democratic Republic of Congo, DRC, where different services are handled medically, without support of a specific information system. For the Medical services, there is external services, where patient are treated and released without being admitted, internal medicine, surgery and orthopedic, cardiology and dermatology, pediatric and neonatology, anesthesia and reanimation, gynecology and obstetrics and emergency services; for the techniques and paramedical services we have laboratory, pharmacy, radiography and mammography, endoscopy, electrocardiogram, ophthalmology, dentistry, ichnography and dialyze peritoneal; and other services, these include nutrition, undesirable pregnancy, caring women and girls, rapped women, etc. The administrative services are support services for managing this Hospital. This includes the Human Resource management, finance, etc.

Problem statement

In a Health organization where information cannot be stored or retrieved as at when needed, it becomes difficult or impossible to take accurate and timely decisions on long and short term planning such as, expenditure estimates, revenue estimate, cost of each program of the Hospital and the like. Ineffective use of information system in decision making by Panzi Hospital usually result in failure of health programs, ineffective budgeting, wastage of resources, inaccurate projection of patients' enrolment, poor motivation of staff, poor resource allocation among others. It also appears that there is undue concentration on low data processing application particularly in the accounting area. This seems to slow activities and make decision outcome longer than necessary. The problem is that, Panzi Hospital's operations are constantly affected by manual procedures hence need for a computerized system.

Purpose of the study

The purpose of this study was to develop an intelligent system for supporting the decision makers at Panzi Hospital.

Specific Objectives

i. To investigate the level of performance of the existing Medical System
ii. To design and develop a medical intelligent system
iii. To develop guidelines for design of medical information system

Research Questions

i. What is the performance of the existing Medical system?
ii. What are tools and method for designing and developing a Medical Intelligent System?
iii. What are guidelines to develop medical information system?

Scope

Geographical Scope

The study was conducted at Panzi Hospital located at Bukavu, south kivu province, in Democratic Republic of Congo.

Content scope

This study intended to develop a medical intelligent system for supporting decision makers at Panzi hospital. However, for getting all the effective information, we have to meet from one service to another.

Theoretical Scope

The theoretical scope for the study was the Inmon model (Inmon, 2005); it consists of all databases and information systems in Panzi Hospital. The Corporate Information Factory (CIF) defines overall database environment as operational, atomic data warehouse, departmental and individual; the data warehouse is part of the bigger whole corporate information factory. There is only one big data warehouse for the entire Panzi Hospital and a star schema for each department.

Significance of the Study

For Panzi Hospital, the application of decision making supported by intelligent systems is most efficient and effective. The data warehouse as the basis information storage; stores the integrated data from all the departments within the hospital, and make it available for all the decision makers. These data are easily accessed and manipulated and useful for all the levels of managers. The beneficiaries of this study are the Managers of different departments at Panzi hospital and all the stakeholders in the management of this hospital.

For the researcher, the use and application of programming skills in designing this system, when compared to what learned in class and what is done in the Panzi Hospital gave a lot of ideas and realities for developing the most important systems. The application of programming tools like Microsoft Visual studio 2008 (VB. NET 2008, ASP.NET) and Sql server 2008 were applied during the development of this system.

Operational Definitions of Key Terms

Development is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements

Intelligent system is a technology that provides significant business value by improving the effectiveness of managerial decision-making.

Business Intelligence is a process for extracting, transforming, managing and analyzing large data by making a mathematical model to gain information and knowledge to help make decisions in the complex.

CHAPTER TWO
REVIEW OF RELATED LITERATURE

Introduction

In this chapter, the researcher presented the ideas, concepts and opinions from other authors and experts who have conducted the research related to this study depending on the specific objectives. The researcher presented the components of Business Intelligence. The Theoretical perspectives have been presented to prove the theory which was used. The Related studies were presented in order to see those who support and those who disagree about this research and find the gaps which were not covered with other researchers.

Definition of key terms

Business Intelligence

Today, in the rapidly changing environment, need to correct and just-in-time information is not only necessary for success but also is required for remaining in competition.

Business intelligence (BI) has two basic different meanings related to the use of the term intelligence. The primary, less frequently, is the human intelligence capacity applied in business affairs/activities. Intelligence of Business is a new field of the investigation of the application of human cognitive faculties and artificial intelligence technologies to the management and decision support in different business problems (Malhotra, 2000). The second relates to the intelligence as information valued for its currency and relevance. It is expert information, knowledge and technologies efficient in the management of organizational and individual business. Therefore, in this sense, business intelligence is a broad category of applications and technologies for gathering, providing access to, and analyzing data for the purpose of helping enterprise users make better business decisions

(Gangadharan and Swamy, 2004). The term implies having a comprehensive knowledge of all of the factors that affect the business. It is imperative that firms have an in depth knowledge about factors such as the customers, competitors, business partners, economic environment, and internal operations to make effective and good quality business decisions. Business intelligence enables firms to make these kinds of decisions.

Data warehouse

The existing system of Panzi Hospital is done manually. The information is stored on papers, which is so hard for decision makers to find the information for decision making.

According to Inmon (2005), data warehouse is a subject-oriented, integrated, non-volatile, time-variant collection of data in support of management's decision making process. The concept of integrated data for management support is not a new one. Management information systems and executive information systems have been around since the early 1970's (Gilad et al., 2002). However, the operational IT environment in most large companies is very heterogeneous as a result of decades of changing technologies (Ghoshal et al. 1986). Data resides in legacy systems in various technologies and environments, ranging from PCs to mainframes (Curt et al., 1999). As a result they are incapable of supporting management decision processes due to a lack of data integration. Data warehouses offer data integration solutions and improved access to timely, accurate and consistent data (Alexander H. et al., 1998; Curt et al., 1999). A data warehouse equips its users with effective decision support tools by integrating corporate wide data into a single repository from which users can run reports and perform ad hoc data analysis (Golfarelli M. et al., 2004).

level. CRM involves capturing customer data, consolidating, integrating, analyzing data and using the results to respond to the current and potential needs of the customer (William N. et al., 2003).

Decision Support - The strength of the data warehouse is its organization and delivery of data in support of management's decision making process (Adelman et al., 2002). Traditional databases are incapable of handling the demands for increasing online information retrieval, access, update and maintenance. These limitations affect the managements' efficiency and ability to make reliable decisions in a timely manner (Kuppusamy M. et al., 2005). A data warehouse is an effective way to provide business decision support data by integrating information and making it available for querying and analysis (OECD, 2009).

Data Mining

Data mining is the task of discovering interesting patterns from large amounts of data where the data can be stored in databases, data warehouses, or other information repositories. It is also popularly referred to as knowledge discovery in databases (KDD). Data mining involves an integration of techniques from multiple disciplines such as database technology, statistics, machine learning, high-performance computing, pattern recognition, neural networks, data visualization, information retrieval, etc. (Alexander et al, 1998)

The architecture of a typical data mining system may have the following major components: database, data warehouse, or other information repository; their server which is responsible for fetching the relevant data based on the user's data mining request; knowledge base which is used to guide the search, or evaluate the interestingness of resulting patterns; data mining engine which consists of a set of functional modules for tasks; pattern evaluation module which interacts with the data mining modules so as to focus the search towards

interesting patterns; and graphical user interface which communicates between users and the data mining system, allowing the user interaction with system. (Herrero et al, 2001)

Decision support systems

Decision support system (DSS) is the area of the information systems (IS) discipline that is focused on supporting and improving managerial decision-making. In terms of contemporary professional practice, DSS includes personal decision support systems, group support systems, executive information systems, online analytical processing (OLAP) systems, data warehousing, and business intelligence. Over the three decades of its history, DSS has moved from a radical movement that changed the way information systems were perceived in business, to a mainstream commercial IT movement that all organizations engage (IRC, 2009).

The goal of the first management information systems (MIS) was to make information in transaction processing systems available to management for decision-making purposes. Unfortunately, few MIS were successful (Torero M. et al, 2006; ITU, 2007). Perhaps the major factor in their failure was that the IT professionals of the time misunderstood the nature of managerial work. The systems they developed tended to be large and inflexible and while the reports generated from managers' MIS were typically several dozen pages thick, unfortunately, they held little useful management information (Torero M. et al, 2006; ITU, 2007).

Intelligent Decision Support Systems

Artificial intelligence (AI) techniques have been applied to decision support and these systems are normally called intelligent DSS or IDSS (Lönnqvist et al., 2006) although the term knowledge-based DSS has also been used (Thomsen E., 2002). Intelligent DSS can be

classed into two generations: the first involves the use of rule-based expert systems and the second generation uses neural networks, genetic algorithms and fuzzy logic (Thomsen E., 1999). A fundamental tension exists between the aims of Artificial Intelligence and DSS. Artificial Intelligence has long had the objective of replacing human decision makers in important decisions, whereas DSS has the aim of supporting rather than replacing humans in the decision task. As a result the greatest impact of Artificial Intelligence techniques in DSS has been embedded in the PDSS, GSS or EIS, and largely unknown to managerial users. This is particularly the case in data mining and customer relationship management.

Hospital Information System

A Hospital Information System (HIS) is an information system applied to the health sector, particularly health facilities. According to the Ministerial Circular No. 275 dated 6 January 1989 from the French Ministry of Health, the information system of a health care can be defined as the set of information, their traffic rules and treatment necessary for its daily operation, modes of assessment and management as well as its strategic decision-making (Heeks, R., Mundy, D., Salazar, A., 1999). This regulatory definition is, however, more restrictive definitions of reference information systems, because it implicitly excludes organizations and implemented process. Hospital Information system is a component of the Information System of Health. The hospital information system is inserted into the organization of the hospital constantly changing and is able, according to predefined rules and procedures, to acquire data, evaluate, process by software tools or organizational, distribute information with a high added value to all internal and external partners of the institution, working in a common task oriented to a specific purpose, namely the management of a patient and his recovery (Heeks, R., Mundy, D.,

Salazar, A. 1999). Hospital information systems today represent a condition for the modernization of the hospital management, improving the management of patients and coordination of health professionals within the institution but also to the outside.

Factors Dependent on Hospital Information System

The Hospital Information System covers all of the information used in a health facility. The performance of an information system depends on many factors. One of these is the human factor. It will receive more or less the challenges of sharing information to a common goal: an appropriate response to the demand for secure care population in an economic context now turned towards efficiency. Collection of medical information through the services will be one of the determining factors (Walker, J. M., E. J. Bieber, et al., Eds., 2005). The Hospital information system can combine several functions necessary for managing schedules, managing payroll, invoicing, budget tracking, the statement of medical, communication (Internet, intranet, protocols, messaging, forums, order, etc.). The current trend turns toward the outside of the hospital: the development of networks of health, health record, telemedicine and why not a surgical robot remote control. The objective of SIH is to follow the deployment or the status of policy and assess its relevance. Production dashboard allows you to group and summarize the indicators presented so exploitable by management and facilitate decision making (Friedman, C.P. & Wyatt. J.C.,1996). The establishment of an efficient of a hospital information policy by the information system; it must be long-term scalable and realistic because computer transfer is permanent, it must be reconciled opportunism and long-term vision. Technical solutions are one thing but the most important is to establish a real management (Friedman, C.P. & Wyatt. J.C., 1996).

Medical Information System Development Process

Health care information systems that are successfully developed and implemented can improve health care efficiency and effectiveness (NCVHS 2001; WHO 2002). However, their implementation is frequently resisted and results in failures (Anderson 1997; Kaplan 1997). The complexity and unpredictability of implementation efforts creates difficulties for organizations that attempt to implement technology based change (Goldstein 1994). Often a discrepancy occurs between the planning of implementation and how it actually takes place in practice (Barley 1986; Sofaer 1999). The challenge of identifying techniques to ease the incorporation of information technology into health care organizations remains an important one (Sittig 1994; Aarts and Peel 1999).

Process of developing medical information systems is deemed to be one of the most critical objectives for professionals in this domain. It is known that any information systems are in need for development and processing in all contingent work problems. Design of this software allows easy and fast reach to information and hence fast execution of orders and easy recall for patients' information. One of the core objectives is to support receptionists, doctors, nursing, laboratory and radiology staffs in Panzi hospital to exchange data and information is deemed to be one of the most important objectives and priorities. This is due to importance of time that helps decision makers implement necessary and most appropriate procedure for patient, especially if provided by internet. As a fundamental tool to analyze the data gathered by Hospital Information Systems (HIS) and obtain models and patterns which can improve patient assistance and a better use of resources and pharmaceutical expense (Riano *et al.*, 2000).

From a managerial perspective, understanding the hospitals cost structure and their inefficiency in utilizing resources are crucial for

making health care policies and budgeting decisions. The cost of medical services in hospitals is likely control by higher operational efficiency and to provide more affordable care and improved access to the public (Hollingsworth, 1999). Thus, the success of e-health depends critically on the collection, analysis and seamless exchange of clinical and medical information or knowledge within and across the above organizational boundaries (Bose, 2003). Developing programming and information systems are considered the most important goals sought by everyone. Most information systems are modified and developed in order to keep up with work needs and meet the needs of all people (Hassan, 2010).

Structuring potential medical information systems, gave due concern to satisfaction of all prerequisites of respective people and departments of medical professions. This included receptionists, file registrations, doctors' data, deciding times for inspection, supporting nurses to register their primary notes concerning patients, before referring them to concerned physicians; registering all medical analyses of the laboratory, in information systems, printing results, delivering them to patient, or keeping them in files, registering data about radiology needed for a certain patient, as requested by attendant physician in addition to various and diverse processes managed by such systems inside hospitals or medical entities concerned with using such systems. This is guaranteed through the big amount of reports structured and added to medical information systems after being duly tested and commissioned in several hospitals and medical organizations. On the ground, however, HIS and especially hospital information systems development in developing countries has proven difficult due to organizational complexity (Littlejohns *et al.*, 2003). Now there are HIS, Radiology Information System (RIS), Laboratory Information System (LIS) and Picture Archiving and Communication System (PACS) in many bigger hospitals, each system runs

independently in most hospitals. With the development of health researches and health standardization, this problem can be solved (Chang *et al.*, 2003) in the future, for the sake of medical information sharing, teleconsulation, hospital efficiency enhancement, medical service extension, optimizing the working procedure (Haux, 2006).

In order to successfully exploit the social and economic benefits that are emerging as a result of E-healthcare, it is important to fully understand the developments in technology, social considerations, government fiscal policy and business objectives (Bali, 2000). E-Healthcare is fast becoming an important issue, as managers are under increasing pressure to provide cost-effective healthcare. Workflows and associated internet technologies are being seen as an invaluable means to cut administrative expenses. One way to provide cost-effective healthcare, without compromising on quality, is to use IT implementations such as workflow tools which are designed specifically to automate the electronic paper flow in a managed care operation-thereby cutting administrative expenses (Latamore, 1999). These systems include electronic health records, medical knowledge bases, prescription ordering and clinical decision support systems. The availability of theses ehealth applications has introduced an opportunity for systems designers to develop integrated Knowledge Management System that can support the full spectrum of knowledge needs in nursing process. In fact, the use of knowledge-based IT to facilitate the practice of health care promises to substantially improve health care quality (Jadad *et al.*, 2000).

Kleinau E. F. (1995) stated that the design and implementation of a health information system should be driven not only by the perceived need for routine information, but also by available resources. A health information system succeeds or fails due to resource constraints at both the primary care level (the most important point of data collection in most countries) and the immediate support level (the

district).these resource scenarios determine the design and implementation of the various components of the information-generating process, such as data collection, data processing, and information feedback. Components can be scaled according to the resources or need not be fully implemented.

Facilities and offices at all support levels require staff that are responsible for health information system-related activities, but whether these activities are performed by the care providers themselves or by full-time dedicated staff depends upon the budget scenario and service characteristics (Kleinau et al., 1995). Primary care providers generally do not need dedicated staff, with the exception of large facilities.

Medical Information System Implementation

The implementation of new information systems is a significant investment for organizations. Since information systems are sociotechnical systems, development involves the joint design of activity systems and ICT systems (Davies, 2009). It is important to define the key stages of the information system implementation process. Consequently, Davies (2009) presented information system implementation stages which are concerned with a number of key activities in the process. In addition, this information system implementation process concept is similar to O'Brien (2004) who explained a five-step process called the information systems development cycle which includes the steps of: (1) investigation; (2) analysis; (3) design; (4) implementation; and (5) maintenance. The first phase of information system development process is *systems investigation* or system conception which is aimed to determine how, based on informatics planning and management, to develop a project management plan and obtain management approval. *Systems analysis* is focused on identifying the information needs and developing the

functional requirements of a system. Systems design is the process of planning a technical artifact and developing specifications for hardware, software, data, people, and network. In addition, this phase involves building the information system to its specifications. System implementation involves delivery of systems, testing the system, training people to use the system, and converting to the new business system. Finally, *system maintenance* is the process of making necessary changes to the functionality of an information system (O'Brien, 2004; Davies, 2009).

Nontehless, Zmud and Cox (1979) defined, traditionally, the MIS implementation stage which invloves different related activities including: initiation, strategic design, technical design, development, conversion, and evaluation. Each implementation stage can be described as follows: initiation includes project definition and justification; strategic design refers to establishing the scope and requirement of a project (i.e. design attribute visible to the users); technical design involves translating the strategic design into hardware, software, and process specifications (i.e. design attributes not visible to the users); development concerns the acquisition of hardware, the acquisition and construction of software, and the testing of both hardware and software; conversion relates to the insertion of the new information system into the organization; finally, evaluation assesses the effectiveness and efficiency of the MIS.

One of the most important processes of IT implementation is the initial part of the project or strategic planning of IT. Nowadays, many companies focus on their strategic planning with aims to develop long-term plans, change their organization, and improve their competitiveness (Gunasekaran & Ngai, 2004). Planning is a major issue for the IT implementation process, and IT planning can be defined as "organizational activities directed toward (1) recognizing organizational opportunities for using information technology; (2) determining the

resource requirements to exploit these opportunities; and (3) developing strategies and action plans for realizing these opportunities and meeting the resource needs" (Boynton & Zmud, 1987).

However, before implementation, it is important to view the business model, and then identify suitable IT systems requirements (Gunasekaran & Ngai, 2004). In order to increase the effective IT planning process, therefore, Boynton and Zmud (1987) suggested nine planning agenda. This IT planning agenda points out various issues that managers or organizations require giving attention to, including: (1) intra-organizational political analysis; (2) intra-organizational market analysis; (3) business strategy analysis; (4) business market analysis; (5) technology analysis; (6) organizational learning analysis; (7) organizational culture; (8) IT infrastructure analysis; and (9) IT risk-taking analysis. In IT projects management, IT planning is a significant process and Bailey (1998) also mentioned three approaches for planning in project management which are: linear planning, exploratory planning, and personal planning. Furthermore, implementation of IT systems requires a project management approach administrated by the right team for the planning and implementation of the IT project. This process should be supported by top management in order to achieve the successful IT project (Gunasekaran & Ngai, 2004).

On the IT procurement process, Beaumaster (2002) claimed that IT procurement involves all aspects of IT acquisition not only the software and hardware, but also various services, support personnel, intellectual properties, and items related to information technologies. Furthermore, Beaumaster (2002) provided the nesessary functions in this process including: investment analysis, risk assessment analysis, life cycle planning, and systems acquisition. Various factors required, according to Beaumaster (2002) regarding IT implementation, concern putting the system into practice, managing change, developing skills,

training and evaluation. In order to achieve implementation goals and objectives, Gunasekaran and Ngai (2004) claimed that successful implementation of IT needs a strong project team which can include key and IT knowledge managers from all functional areas. Moreover, they suggested that education and training are the most important factors of any change process in an organization and the users need to be motivated to work in a transparent and open communication environment. One of the important factors in IT implementation is that top management support and is involved in order to successfully implement the IT solution (Gunasekaran & Ngai, 2004).

According to O'Brien (2004), the information systems implementation activities involve hardware and software acquisition, software development, testing of programs and procedures, development of documentation, and a variety of conversation alternatives. Also, education and training of end-users and specialists who will operate a new information system are involved. The first step, acquisition of hardware, software, and services, concerns how the organizations evaluate and select the hardware, software, and IT services; thus all hardware and software requirements are set up. Most large organizations both in private and public sectors formalize these requirements by listing them in a document called an RFP (request for proposal) or RFQ (request for quotation). Then these requirement documents are sent to the suitable vendors and the agreement is signed. The next step is concerned with development or modification of software application in order to meet the organization's requirements. The third stage is a vital implementation activity which involves the education of and training of the IS personnel such as end-users and user consultants. They have to learn how the new technology impacts the organization's business processes and management. The fourth step concerns developing documentation for the system's users. Finally, the last step is the conversion process

which concerns changing the approaches from the old systems to new systems. Conversions can be achieved on a parallel basis, phases basis, pilot conversion, and plunging in to a new system (O'Brien, 2004).

Another perspective of implementation process was stated by Kuruppuarachchi, Mandal and Smoth (2002), who presented the phases and main functions of IT projects that, are similar as the literature mentioned previously. These phases consist of project initiation, requirement definition, acquisition/development, implementation, and termination. In addition, they claimed that every IT project should carry out quality control, risk management, and change management over the entire life cycle of the project. In order to achieve IT project implementation, Kuruppuarachchi et al. (2002) also explained that the manager should meet these three basic requirements that include: (1) a clear business objective; (2) understand the nature of the change; and (3) understanding the project risk, in order to achieve IT project implementation. This section has presented various views and perspectives of MIS implementation or IS development and deployment processes which provide general knowledge in order to perceive this study. In the following section, MIS implementation challenges are described.

MIS Implementation Challenges

From previous research, Beaumaster (1999) identified and categorized problematic issues regarding the IT implementation. These issues create or worsen the implementation. The more specific categorizations of the issues can be viewed as: management process issues, organizational environment issues, leadership issues, technical systems issues, and personnel issues.

the following: lack of management in the design phase of the MIS, inappropriate emphasis of the computer system, undue focus on low-level data processing applications particularly in the accounting area, lack of management knowledge of computers, poor appreciation by information specialists of management's true information requirements and of organizational problems, and lack of top management support.

Key Issues for MIS Implementation Success

There are many investigations of IT project implementation success factors. One study from Slevin and Pinto (1986) presented a list of success factors which are the same as the Project Management Institute's *Project Management Handbook* (Pinto, 1998). Also, Tan (1996) presented a set of success factors including technical characteristics, user involvement, communications, management support, project team characteristics, difference between technology provider and receiver, incentives, infrastructure support and obstacles, to identify their effects on external technology transfer project. Moreover, a list of success factors are also drawn up by Milis and Mercken (2002), who found a large number of possible success factors and also provided an overview of the possible success factors regarding IT project implementation. However, in conclusion, they can group the success factors into four categories as follows. The first category integrates factors which influence goal congruency. The second category contains the components that relate to project team in order to improve the motivation and cooperation of the team. The third category concentrates on the acceptance of the project and the result. Finally, the fourth category is concerned with the implementation process which deals with implementation politics and planning.

Theoretical Perspectives

Bill Inmon's approach (top-down) for data warehouse design is an enterprise level, not an approach for departments which have different sets of requirements without considering imposition of standards and integration. He identified need to integrate data from various systems to a centralized repository where the data could be used for strategic decision making.

According to Inmon, data should be systemized as subject-oriented, integrated, time-variant and non-volatile structures. The data should be attainable at grain level by drilling down or at summarized level by rolling up. (Inmon, 2005) The Inmon data warehouse design pattern is dependent on third normalization form, which can afford opportunity for the granularity of data that provides maximum flexibility to the enterprise. This can prove significantly helpful when organization perspective change for the data to be warehoused. Relationally designed data warehouse can be used to support diverse structure of data OLTP Databases, Exploration Warehouses and Data Mining Warehouses. Design in the top-down approach begins with the consideration of data extraction from the operational data sources. The data is then feed in to the staging area and cleansing is performed. Data is then transformed, integrated and consolidated and then transferred to operational data store (ODS). This data is then loaded into the data marts, which becomes available to end users. (Ponniah et al., 2001).

Ralph Kimball's approach (Bottom-Up); Kimball introduced the concept of dimensional modeling, which bridges the gap between relational database and multi dimensional databases. (Kimball et al., 2002) He designed the data warehouse in the bottom up fashion by connecting the data marts with a bus structure. The data marts are in conformance of bus structure in respect of dimension, domain and measure. Data marts are the dimensional model of departmental data

which can be viewed as data warehouse (union of data marts) for enterprise level. This arrangement of data marts makes the data warehouse as virtual reality. Therefore, this structure provides the flexibility to place data marts on different servers across the enterprise while data warehouse existence can be considered as virtual (i.e. nothing but sum of all these data marts). Conformed dimension is the backbone of these data marts as these can be assessed more quickly and can share dimensional tables. This approach (bottom-up) is contrary to the top-down approach. In the bottom up approach, data is extracted from the existing legacy systems and then consolidated and verified in staging area. The data is feed in to data store and then more data is added or updated. (Sen et al., 2005) As the data store contains the fresh copy of data it is integrated and transformed to the data mart structure. The data is than aggregated, summarized and available for end user for analysis and strategic decision making.

Key Differences in approach

Kimball approach does not indicate the existence of a physically implemented data warehouse. His data warehouse is the union of data marts that are conformed to dimensions. Kimball Bus architecture expresses that he does not recognize a need for a central data warehouse repository. Kimball approach manifests that raw data can be transformed into purposeful information in staging area. (Breslin, 2007) Inmon approach is certainly a top-down approach, he consider the dimensional modeling for the design of data marts only and not for the entire data warehouse. Inmon considered the bottom-up approach as brittle, as this design focuses on the end-user requirements therefore it cannot reproduce the data in the form which can be prove more purposeful enterprise wise. His approach uses the dependent data mart as the source for star schema usage, solves the problem of enterprise-wide access to the same data, which can change over time.

Inmon emphasized to integrate data from various systems to a centralized repository, his design is at the enterprise level. (Sen et al., 2005)

Key Similarities/ Agreements in approach

Both Inmon and Kimball agree that the successful performance or achievement of the data warehouse or data marts depends on effective collection of the business needs. These business needs plays the major role in designing of the data mart which eventually drives the data needed in the data warehouse. They also agree that end-user validation of data mart is significant in order to meet their expectations. Both approaches have the concept of staging, Kimball calls it backroom and Inmon calls it the warehouse. Both Kimball and Inmon approaches recommends extraction of data from a single source. They also share the view that independent data marts or data warehouses cannot fulfill the needs of end users on enterprise level for precise, timed and relevant data. (inmon, 2005)

Opinion

The researcher believes Inmon model is better approach to produce an effective design. It is much easier to implement, as we have to deal with big modules to begin with. Also Inmon approach provides more balance in terms of centralized and localized flexibility, as data warehouse is the collection of data marts which can be in one server across the enterprise.

Inmon approach is a quicker and simpler way to create a data warehouse for organization, requires only star structure to fulfill their analysis needs, as in this approach there is need of designing a data warehouse and then going for a star schema modeling.

Related studies

Ravi S. et al. (2011) conducted a research in Design for a Patient-Centric Medical Information System Using XML Web Services; this work proposed a design for a system to facilitate effective management of personal health information that is distributed over disparate healthcare providers' information systems. The system is intended for use by patients to more efficiently manage their own health information. A motivating factor to develop such a system is the results of studies that indicate a correlation between efficient management of personal health information and improved health of the patients involved. The proposed design was successfully implemented as a proof of concept prototype and testing of the system indicates that the design meets the desired functional requirements, among which the most significant is allowing patients a single point of access to their personal health information from disparate healthcare providers.

In addition, the proposed design meets the system requirements of being scalable, extensible, secure and interoperable with disparate healthcare providers' information systems.

Similarly, the authors of Medical Information systems: the Digital Hospital, contend that retrieving patient medical information is still a difficult task, especially in the cardiology domain. The goal of the work in Digital Hospital is to automate the process of gathering a patient's information without the constraints of semantic or location diversity and to accurately display it to the physician and propose using web services for this task. (Mrissa et al, 2004)

It is inherent to state that decision making is an integral part of any business. This is because a majority of operations in an organization revolve around decisions made by the management and other key stakeholders in the organization. And in order for decision to

be made adequately, it is vital for there to be a good information system since decisions are based on information available.

In relations to this, Jahangir (2005) states that based on the significant role that information plays in choice of decision to be made, organizations must ensure that they have a good management information system. As a notable general observation, a good MIS ensures good decision making just in the same way bad MIS propel the making of bad decisions.

UStudy, (2010) supports the above observation by saying that the quality of managerial decision-making depends directly on the quality of available information and the managers should therefore cultivate an environment that encourages the growth and viable sprouting of quality information.

Essentially, before deciding on which MIS strategy to use, it is vital to ensure that the choice made is fully compatible with your current system. This will not only help in avoiding erratic choices but it will also save you the time and money that would have been otherwise wasted by that person (Rhodes, 2010; Jahangir, 2005). In addition to that, it is noteworthy for the MIS strategy or tool used to be in line with the decisions that are to be made. In other words, there should be a connecting point between the decision to be made and the MIS to be used by individual or corporate business owners (Al-zhrani S., 2010).

As a key consideration, Management Information Systems is a highly complex and delicate arena that calls for a lot of caution to be taken by its managers. It is for this reason that it is recommendable for organizations to ensure that they carefully select the individuals who are placed to control the systems. The more cautious and professional a person is, the better the person gets an assurance of positive prospects of in MIS with regards to decision making and other related areas of business (Lingham, 2006).

Having clearly delineated that, what then are some of the scholarly arguments, facts, opinions and observations made by various macroeconomists with regards to the roles of Management Information System in the application of decision making?

To begin with, MIS provides a fitting platform for good decision making (Kumar, 2006).

Essentially, without the established systems of getting information in MIS, it would be extremely difficult for organizations to make their decisions. This is because they would be forced to making baseless information due to the lack of confirmed information. Moreover, MIS normally lays a firm foundation for the establishment of concrete decisions through its systematic tools, timely information and adequate managerial policies and regulations. Furthermore, Management information Systems' statutes regarding businesses act as guidelines to business owners when making critical decisions about their businesses. As a result, managers and key decision makers are bridled from overstepping their boundaries or exceeding their business mandate. This is very crucial as it helps in keeping businesses checked and balanced thus ensuring that only proven decisions are considered while the untried ones are thwarted. More importantly, the capacity to guide decision-making facilitates progress and improvement of the operations in a company (Lingham, 2006; Chambers, 1964).

In addition, most MIS programs are endowed with the capacity to give real-time updates of the occurrences in company or system. By real-time, scholars simply refer to immediate updates of occurrences in a system. These immediate updates help mangers to take necessary actions as soon as is deemed appropriate especially during the discovery and management of crises. This augments progress and improvement in company operations through timely decision making.

This is important for companies in the modern-day generation where any slight lapse in decision making can lead to very huge losses (Jun T., 2005).

Still, Management information systems are very elemental improving company securities (Jun T., 2005). For example, in many instances, most management information systems can be easily programmed by the owner to conduct certain actions at certain times. In effect, managers can program the system to perform certain routine checks which can help in improving efficiency of a company through easy discovery of bugs or problems. Furthermore, the programmability of most MIS saves a lot of priceless time and resources for owners. In other words, through programmability, business managers can program the systems to automatically discover certain deficiencies and even solve them.

Consequently, the manager or system operator can use the time and resources he/she would have used in monitoring or fixing problems for other key uses. By routinely programming a Management Information System, the business is bound to make positive progress since time and resources can be easily channeled into rightful business paths (Jun T., 2005).

As a fundamental point, a good number of MIS used today can perform multiple tasks all at the same time. This potential to multitask increases efficiency in a company since several business operations can be conducted simultaneously. With special regards to decision making, the capacity to multitask ensures that decisions are made speedily when compared to those systems which can only handle one task at a time.

Closely related to the above point, Jahangir (2005) says that some MIS allow multiple users to access the same content all at the same time without any discrepancies. This potentiality boosts accountability from the business operators since multiple people can

access a particular content and verify whether they are consistent or whether they are not. As a matter of fact, most organizations tend to suffer due to poor accountability from those charged with the mandate to manage certain details. This safeguard action of some MIS is what macroeconomists refer to as the "gate-keeping" role of MIS in decision making and overall well-being of the organization.

On another level, a good number of MIS play the role of record keeping or institutionalization of data bases that can easily keep confidential or invaluable information. In essence, decision making often calls for the reading of certain past work (Jahangir, 2005). This is where record-keeping comes in handy. On the flipside, databases normally function towards providing future places of information retrieval. Principally, the record keeping and data-basing tool of MIS definitely ensures that decisions are made viably while businesses run smoothly.

In contributing to the arguments regarding role of MIS in application of decision making, Rhodes (2010) also adds that: Management information systems give managers quick access to information. This can include interaction with other decision support systems, information inquiries, cross referencing of external information and potential data mining techniques. These systems can also compare strategic goals with practical decisions, giving managers a sense of how their decisions fit organizational strategy.

In summary, Rhodes simply believes that management information systems are a huge contributing factor in the getting of viable information from organizations. Sadly, very few organizations have been able to ardently take up on this role and even lead other organization in the society in doing the same. It is for this reason that there has been a limited improvement in decision making based on the tailoring of viable information.

Over the recent years, there has also been an increased usage of automated Management Information Systems. To a large extent, these automated systems have hugely revolutionized the decision-making process in a positive way (UStudy, 2010). For instance, by using automated MIS, companies no longer have to rely on 24-hour services from workers. Instead, the machines are able to be programmed to do things on our behalf (Al-zhrani S., 2010). Of course this offers a huge plus in decision-making since managers are relieved of making some decisions-especially the technical ones which can be best interpreted and solved by the automated system.

As a cautionary point, organizations should not entirely rely on automated systems especially when the decisions to be made have adverse implications to the organization. This is based on the alleged observation that auto systems may sometimes be faulty and thus require frequent periodic monitoring (Demetrius, 1996). So in order not to fall a victim of over-relying on automated systems, Jahangir (2005) advices managers and company owners to ensure that they find a balance in utilizing the human element in operating while assigning some duties to the automate system.

By blending the duties of these two extremes, Jahangir states that, this will ensure that both ends of the organization continue to actualize together while maximizing the potential for each side through check and balances of operations done by the management.

Again, MIS is renowned for vesting its operations on systematic methods of operations. Crucially, this ensures that decisions made in a business are orderly and well-planned which, in effect, encourages objectivity during decision making. As a result, businesses and the decision making process are improved through its systematic and orderly formula of operating (Jawadekar, 2006).

Jahangir (2005) adds that the principles, strategies and modes of operation in MIS can be intellectually used by macroeconomists to

sieve between good and bad decisions. Once the sieving is done, good decisions are encouraged while the bad ones are sidelined and greatly discouraged. Effectually, this ensures positivity in terms of decisions made by organizations which, essentially, links up directly to improving the decision making process.

A good number of scholars amass that MIS tends to be a more practical business tool with testable methods of operations. Its proposition and argumentations, therefore, provide tangible information that can be used to make substantiated decisions (Jawadekar, 2006). This is in great contrast with a majority of business tools, existing today, which are mostly hypothetical. In effect, decisions founded on MIS tend to be accurate and viable when compared to its counterpart which, in turn, encourages improvement of business decisions.

Finally, Management Information systems play the crucial role of providing a wide range of streamlined options from which decision-makers are able to make their preferred choices (The Maniac C., n.d.). Vitally, this ensures that whatever choices are made by decision makers, the outcome, more often than not, becomes positive. This, as a matter of fact, is the reason why many decision makers tend to prefer using MIS tools when making tough business choices. And as renowned concept, having good decision choices guarantees viable decisions in our businesses (The Maniac C., n. d.; Jawadekar, 2006).

Summary of Literature

Business Intelligence has two basic meanings related to the way the term intelligence is used; the first one is human intelligence capacity applies in business activities; this involves the Artificial intelligence technologies. The second relates to the intelligence as information valued for its currency and relevance. It is expert information, knowledge and technologies efficient in the management of

organizational and individual business (Malhotra, 2000). In this study, the researcher based on supporting the decision makers rather than replacing them. This means that retrieving the patient medical Information is still difficult because some information cannot be retrieved automatically using this system especially in the cardiology domain. Also, in this study, the group meeting is still difficult especially for the Medical workers they cannot discuss online about a specific subject using the actual system.

Jahangir (2005) states that a good MIS ensures good decision making just in the same way bad MIS propel the making of bad decisions. UStudy, (2010) supports the above observation by saying that the quality of managerial decision-making depends directly on the quality of available information.

CHAPTER THREE
METHODOLOGY

Research Design

This study was conducted through Design Science Research. The researcher focused on the development and performance of the product. The purposive sampling technique was adopted for selecting the sample.

Design Science Research Process

Information System is not the only field where design is relevant. For over 40 years the field of design research has been investigating how design is done and how design and research can be combined. Design science research involves the design of novel or innovative artifacts and the analysis of the use and/or performance of such artifacts to improve and understand the behavior of aspects of Information Systems.

Problem identification

In the first phase of the research process, a problem is identified. It has to be ensured that the problem has practical relevance or might be of relevance once solved. Criteria for problem relevance are reviewed. The research question may arise from a current business problem or opportunities offered by new technology. A desire to increase business process efficiency may also act as a trigger for new approaches and research areas (Hevner et al., 2004). The equivalent phase in the generic design process model is analysis.

The phase is divided into the following steps: identify problem, literature research, expert interviews and pre-evaluate relevance. It specifies a research question and verifies its practical relevance. As a result of this phase, an IS research question is defined. Its relevance is

validated by experts. The state of the art in research in the observed area is analyzed. Thus, this phase offers a solid and important foundation for the further research process (Hevner et al., 2004).

Solution design

In the second phase, the solution is designed. It is divided into the steps: artifact design and supporting literature research. After identifying a problem and pre-evaluating its relevance, a solution has to be developed in the form of an artifact. Within this phase, research rigor has to be ensured by using all related work available (Hevner et al., 2004).

Evaluation

Once the solution reaches a sufficient state, its evaluation can be started. It is possible to iterate back to design artifact or even identify problem if necessary. Evaluation is to be achieved by the means of a case study or action research (shows applicability in practice), by arranging a broad expert survey (shows general interest) and by laboratory experiments or simulations (used to compare different approaches) (Hevner et al., 2004).

Application of Design Science Research

Problem Identification and Motivation

The researcher defined the specific research problems, and then he did the semi-structured interview to the respondents which are the decision makers and workers of Panzi Hospital. The researcher analyzed the actual system of Panzi Hospital, which was done manually. The research identified the requirements to consider for developing an effective artifactual solution. The value of the solution was justified to motivate the researcher and the audience of the research to pursue the solution and to accept the results and to

understand the reasoning associated with the researcher's understanding of the problem.

Objectives of a solution

The objectives of a solution from the problem definition were inferred. The objectives were quantitative because the Design Artifact would be better than current ones, the objectives was inferred rationally from the problem specification.

Design and Development

The Artifact's functionality was determined and the artifact was created. The artifact was designed and developed using Microsoft visual studio 2008 (VB.net Asp.net) and sql server 2008. The top down approach was considered.

Evolutionary prototyping was used for requirements gathering, analysis, design and testing of prototype. The researcher analyzed each iteration and created the next level of the requirements and defined the next iteration up to the end of the product.

Demonstration

The efficacy of the artifact to solve the problem was demonstrated. The design artifact was presented and demonstrated to the workers of Panzi Hospital, and they proved that it is efficient.

Evaluation

The design artifact was observed and measured in order to know how well the artifact supports a solution to the problem. The comparison between the objectives of a solution to actual observed results from use of the artifact in the demonstration was used. Semi-structured interview was done to evaluate the artifact.

Research Population

A population is a set of persons or objects that posses at least one common characteristic. In this study, the managers and operators of Panzi hospital were involved, whereby all the managers and operators were concerned in our research. In this study, our target population was composed of 40 Managers and operators of Panzi hospital. They were interviewed to provide their opinions and ideas as the population of the study.

Sample Size and Sampling Procedure

Sample Size

The sample covered Panzi Hospital's managers and operators. The managers concerned are those in charge of administration, in charge of different clinic departments, in charge of Laboratory and pharmacy. The operators concerned were those in charge of patient data reading and recording, and in charge of computerized billing. The study area was the entire Panzi Hospital.

Our sample size was selected from the target population of the study which was all the managers and operators of our Panzi Hospital. The Slovenes' formula was useful for selecting the sample size.

$$n = \frac{N}{1+N(e^2)}$$

Using this formula, our sample size was 36 managers and operators of Panzi Hospital.

The table below determines and demonstrates the sample size distribution.

Table 1: Sample sizes distribution

s/No	Department	Estimated Total	Sample size
1	Administration	8	7
2	Clinical Departments	20	19
3	Laboratory	7	6
4	Pharmacy	5	4
	Total	**40**	**36**

Sampling Procedure

In order to determine the sample, a purposive sampling technique was employed to select the respondents from different categories of managers and operators of Panzi Hospital. The advantage of this sampling technique is that the researcher could select the respondents according to their characteristics of interest and use his research skills and prior knowledge to choose respondents and analyze their responses.

Research Instruments

The interview was used in collecting data from users, managers and operators. The data to collect were the primary data and the requirements for development of a medical intelligent system.

Validity and Reliability of Instrument

Validity refers to the extent to which a given instrument can accurately measure what it is used to measure. Reliability refers to the extent to which an instrument is consistent in measuring what it is used to measure. For measuring the validity, expert judgment was used as a primary method to measure the content validity of our instruments.

For measuring the reliability, Retest Method was used, in which the same instrument was given to the same people after a period of time.

The reliability of the instrument was estimated by examining the consistency of the responses between the two tests.

Data Gathering Procedures

Interview was used for data collection while the main theme of this instrument was centered on the development of medical intelligent system for Panzi hospital. Interview was conducted in a systematic manner. The process went through a number of interrelated steps. The most commonly steps were; Preparation; thought of various items to be covered in the interview, arranged the items to one another. Revisions; after receiving suggestions, some items were eliminated, some changed and some new added. Revision for the second time; the minor and major changes was made on the basis of experience gained in pre-testing. Preparing final draft; after editing, checking spelling, space for response, pre-coding, and final draft was prepared. This was interviewed then to the managers and operators of Panzi Hospital. The data gathered was collected, encoded and treated using SPSS.

Data Analysis

Data analysis is the process of looking at and summarizing data with the intent to extract useful information and develop conclusions. This was done soon after data gathering. Data analysis is closely related to data mining, but data mining trends to focus on larger data sets, with less emphasis on making inference, and often uses data that was originally collected for a different purpose. Data analysis assumes different aspects, and possibly different names, in different fields.

Ethical Considerations

The major ethical problem in this study was the privacy and confidentiality of the respondents. The respondents were asked to give freely their answers and drop question that violated their privacy and

confidentiality. Therefore respondents had the freedom to ignore items that they did not wish to respond to. In addition they are not obliged to identify themselves. Getting omitted information because of the privacy and confidentiality of the respondent, valid information was achieved through accessing Hospital reports.

Limitations

The limitation of this study was due to the extraneous variables; the persons on which our study was oriented are having enough skills in medicine and nursing; this has affected our study because they could not be able to provide a lot of requirements for the system being studied. They don't understand very well the use of information systems. Our study has been also limited due to the use of interview, the instrument we used, which has an unknown degree of errors and has not an established level of validity and reliability; there is not confidence of the findings and we may not compare them to findings in other comparable populations.

CHAPTER FOUR
SYSTEM ANALYSIS AND DESIGN

To investigate the Performance of the Existing Medical System

For determining this objective of our research, we have to consider the opinions from interview of all the respondents.

Table 2: The Performance of the Existing Medical System of Panzi Hospital

n=36

LEVEL OF PERFORMANCE OF THE EXISTING SYSTEM	Mean	Interpretation	Rank
It is ease for the hospital to store and retrieve data	**1.83**	Very low	1
The present system record data effectively	**1.86**	Very low	2
With the existing system, the patients get their information easily	**1.89**	Very low	3
The existing system produces the reports efficiently	**1.89**	Very low	4
The patient's information is delivered in good way and on time	**1.89**	Very low	5
The existing system requires less man power	**1.92**	Very low	6
The existing system is flexible	**2.11**	Low	7
The existing system is well protected	**2.31**	Low	8
The data warehouse serves us appropriately	**3.17**	High	9
TOTAL	**2.09**	Low	

The respondents affirmed the data are stored and retrieved at a very lower level (mean=1.83). They stated that the existing system of Panzi Hospital is recorded data at a very lower level (mean=1.86); and

patients get their information at very lower level also (mean=1.89). The existing system produces the reports efficiently (mean=1.89), the respondents confirmed that the existing system of Panzi Hospital is not producing the good reports, they are done manually. The patient's information is delivered in good way and on time (mean=1.89), the respondents affirmed that the information about the patients is not delivered in on time and the way they are using is not so useful for patients. The existing system requires less man power (mean=1.92) they said that actual existing system of Panzi Hospital is manual so it needs a big number of people. The existing system is flexible (mean=2.11), the respondents accepted the flexibility of the existing system was at low level. They also said that the protection of the existing system was at low level (mean=2.31), thus the existing system was not protected. The respondent approved that the data warehouse will serve them appropriately (mean=3.17). Thus, the performance and efficiency of the existing system is at low level (mean=2.09), so there is need of a Medical Intelligent System at Panzi Hospital.

System Description

The system analysis has been done through the collection of information from the respondents of our study. We have done the analysis for the whole existing system of Panzi Hospital from the direction to the lower level. We have gone through different departments of this hospital and gather the requirements for designing the proposed Medical Intelligent System.

Panzi Hospital has many departments which are handling their work differently but still there is a communication between these departments however, it is done manually. We have analyzed the existing system in all the departments of this hospital. In the department of Administration, there is Medical Director, the

Administrator and the Finance; for the Medical Director to get information to the Administrator he used to leave his office and go to the Administrator's office for asking what he wants. For the Administrator to get the information in the finance he had to leave his office also, the same to the finance, so the system was very manually, unsecured and inefficient. It is also tiresome for this department to share their information with other departments; because they use to go service by service; if they need the information from pharmacy, they have to go to the pharmacy, if they want some information from the laboratory; they have to go to the laboratory, etc. This made them suffering a lot and sometimes they lost their information especially when it is raining because in Bukavu it is raining almost every day.

The management of the patient was also so hard at this hospital, when a patient came he used to be received at the reception, who will direct him to the doctor whom he is supposed to meet; then, the doctor could decide if the patient has to be admitted or nor; if so, the nurses were suffering a lot because they couldn't know where is an empty bed or ward, they used to go ward by ward to see where the empty bed is, sometimes the patient could be admitted in the ward where he was not supposed to be admitted. If he was not supposed to be admitted, they will send him to the cashier to pay the bill then come to the pharmacy for getting the medicine; from the Doctor's room to the cashier's room it is a bit far and from the cashier's room to the pharmacy it is also a distance but the patient used to go there with the form from every service, from the doctor, he brought a form which prove that he has seen the doctor, then from finance, the same to prove to the pharmacy that he has paid.

In the finance, they were using a database developed in Microsoft Access 2003 for managing their data, but this one was not useful because it was not working online, it was just a database for recording and storing information about the payment of the patients. It

was difficult to retrieve information about a specific patient using this database, because it doesn't support some features.

When the Doctor needs some exams from the laboratory or the radiology, the patient used to go with the entire test request from the doctor in his hands, sometimes losing them.

In the pharmacy, for getting the list of the medicine used daily was very difficult, also for them to make an order, they used to ask for the storekeeper to make sure if what they are requesting is in the stock; it could take them time to make an order.

For looking the information about a patient, they were asking the patient their number, if you forget the number, they look it depending on the name, when in Democratic Republic of Congo some names are similar, and this was causing many problems.

In all the departments of Panzi Hospital, the records were kept on papers there was not any records which was kept using a certain device, they were all kept manually on piece of paper, expect in finance where they were using the database system. This was problems because the hospital is big they receive many patient per day, so for looking a certain information about the patient was so tiresome, they used to look for it in different folders and sometimes not get it. Due to the above gaps in the existing system of Panzi Hospital, there is need of Developing a Medical Intelligent System in this Hospital.

System Design and Development

Data Modeling

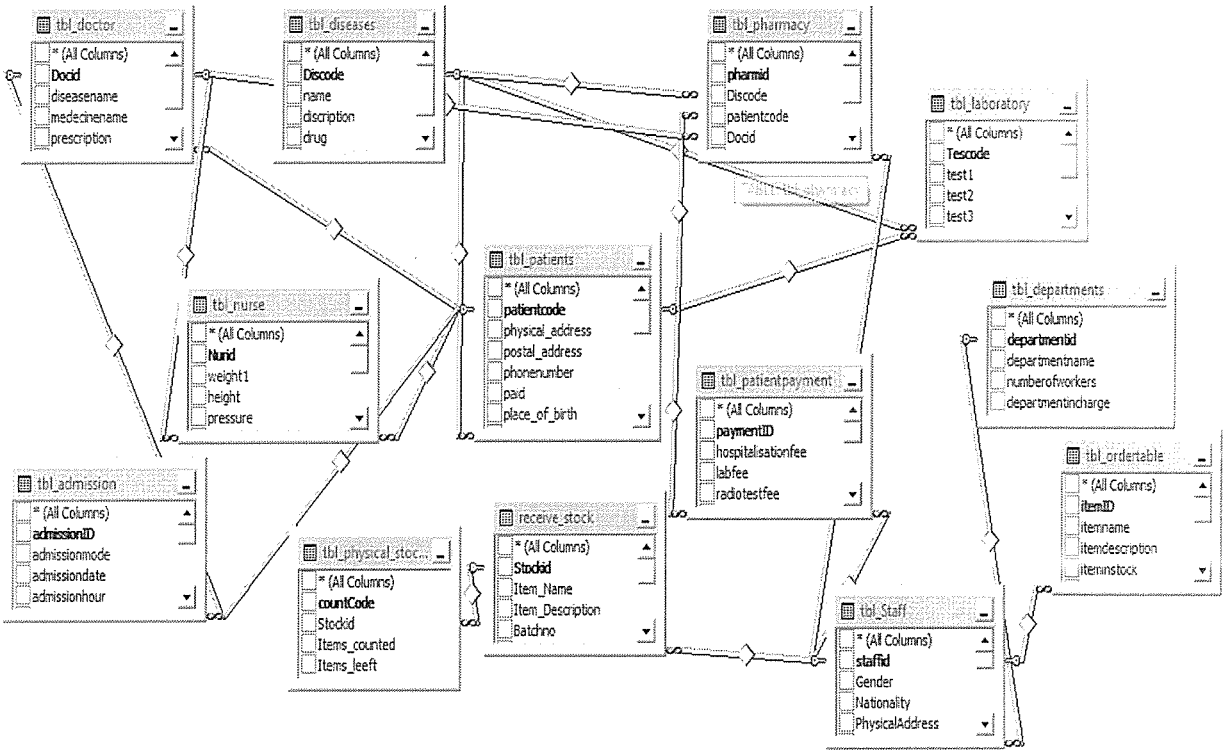

Figure 1: Data Modeling Source: own drawing

The Data Modeling above represents the conceptual design and the ER-Diagram of the Medical Intelligent System. It has the entities and the relation between them.

Logical Design

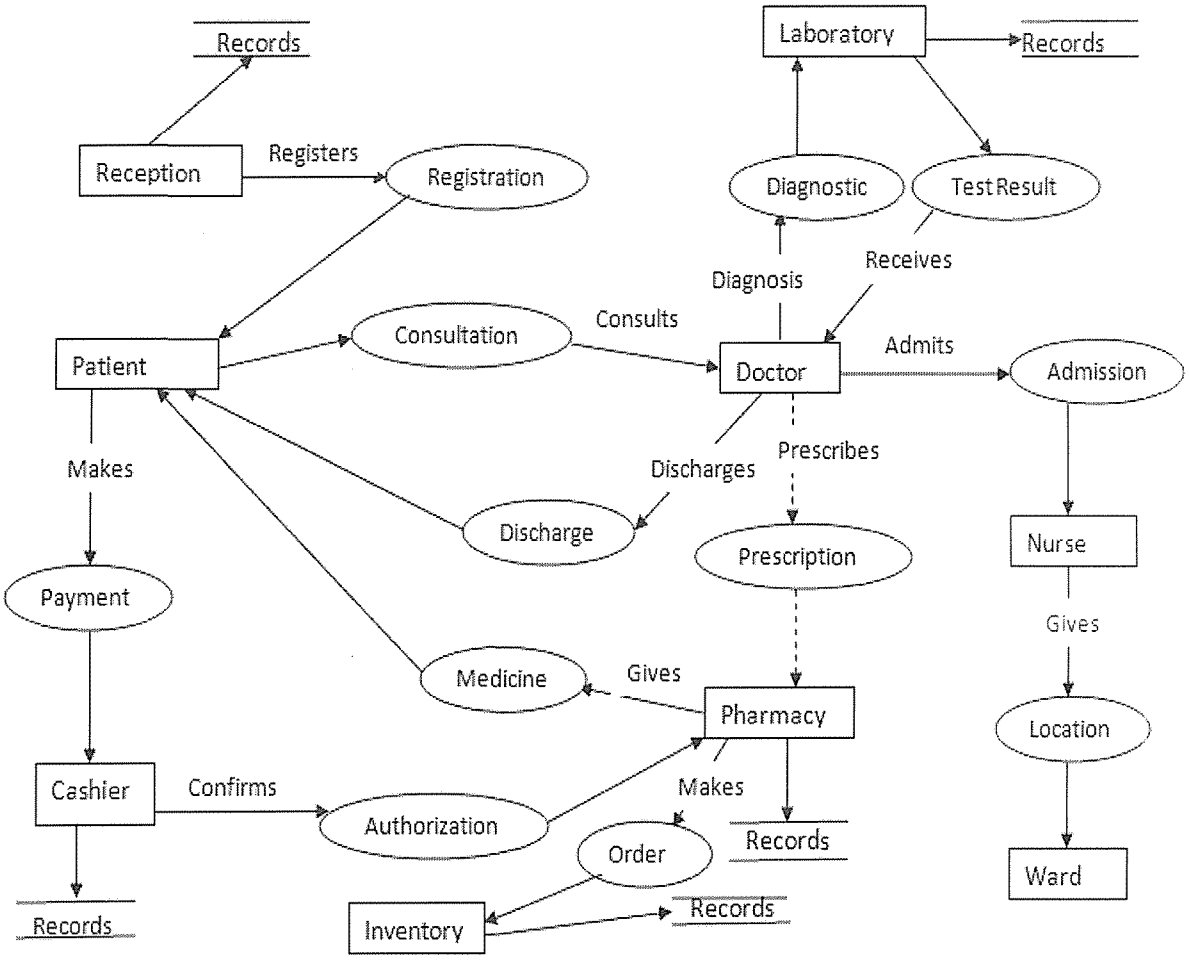

Figure 2: Data Flow Diagram Source: own drawing

The Data Flow Diagram above represents the logical flow of data through different processes. When the patient comes to the Hospital he is received at the reception, he is registered from there then sent to the doctor who will treat the patient. The Doctor will consult him and decide if the patient will be admitted or not. During the Diagnosis, the Doctor needs the test from the Laboratory and/or the radiology. If the patient has to be admitted, the Doctor will send him to the Nurse room, from there he will directed to a Ward and admit him on a specific bed. During the discharge of a patient, the Doctor will prescribe the medicine for using at home; after that, the patient has to go to the cashier to pay his bill, then to the pharmacy for receiving the medicine. The pharmacy makes the order for

medicine or other items from the Inventory for serving the Hospital. This represents the Logical Design of the Medical Intelligent System of Panzi Hospital.

Physical Design

Table 3: Patient

Column Name	Data Type	Occurrence
Patientcode	Tinyint	unique
Patientname	varchar(40)	Multiple values
physicaladdress	nvarchar(30)	Multiple values
Postaladdress	nvarchar(30)	Multiple values
Phonenumber	nvarchar(20)	Multiple values
Place_of_birth	Datetime	Multiple values
Date_of_birth	Datetime	Multiple values
Nationality	Char(20)	Multiple values
Gender	Char(10)	Multiple values
Marital_status	Char(10)	Multiple values
Discode	Tinyint	unique
Visitdate	Datetime	Multiple values

Table 4: Doctor_incharge

Column Name	Data Type	Occurrence
DoctorId	Tinyint	unique
Doctorname	varchar(30)	Multiple values
Patientcode	Tinyint	unique
Discoed	Tinyint	unique
Prescription	nvarchar(50)	Multiple values

Table 5: Disease

Column Name	Data Type	Occurrence
Discoed	Tinyint	unique
Disname	varchar(20)	Multiple values
Description	nvarchar(100)	Multiple values
Prescription	nvarchar(22)	Multiple values
categoryId	Tinyint	unique

Table 6: Laboratory

Column Name	Data Type	Occurrence
Testresultid	Tinyint	unique
testresultdescription	varchar(25)	Multiple values
Testid	Tinyint	unique
Patientcode	Tinyint	unique

Table 7:Nurse_incharge

Column Name	Data Type	Occurrence
Nurid	Tinyint	unique
Patientweight	Nvarchar(10)	Multiple values
Patientheight	Nvarchar(10)	Multiple values
Pressureunits	Nvarchar(10)	Multiple values
Pressuretype	Varchar(10)	Multiple values
Generalappearences	Varchar(20)	Multiple values
Patientcode	tinyint	unique
Docid	Tinyint	unique
Staffid	Tinyint	unique

Table 8: Pharmacy

Column Name	Data Type	Occurrence
Pharmid	Tinyint	unique
Discode	Tinyint	unique
Patientcode	Tinyint	unique
Docid	Tinyint	unique
Givenmedicine	nvarchar(30)	Multiple values
Staffed	Tinyint	unique

Table 9: Admission

Column Name	Data Type	Occurrence
Admissionid	Tinyint	unique
Admissiondate	Datetime	Multiple values
Admissionhour	Datetime	Multiple values
reasonforadmission	nvarchar(50)	Multiple values
problemdescription	nvarchar(50)	Multiple values
Nextofkinname	Varchar(25)	Multiple values
Nextofkincontact	nvarchar(30)	Multiple values
Nextofkinrelationship	nvarchar(30)	Multiple values
Patientcode	Tinyint	unique
Docid	Tinyint	unique
Wardid	Tinyint	unique
Bedid	Tinyint	unique

Table 10:Employee_Record

Column Name	Data Type	Occurrence
Staffed	Tinyint	unique
Staffname	Varchar(50)	Multiple values
Gender	Varchar(10)	Multiple values
Nationality	Varchar(20)	Multiple values
Physicaladdress	nvarchar(25)	Multiple values
Postaladdress	nvarchar(25)	Multiple values
Maritalstatus	Varchar(25)	Multiple values
Phonenumber	nvarchar(30)	Multiple values
Emailaddress	nvarchar(25)	Multiple values
Qualification	Varchar(15)	Multiple values
Hiredate	Datetime	Multiple values
Jobid	Tinyint	unique
Departmentid	Tinyint	unique

Table 11: Department

Column Name	Data Type	Occurrence
Departmentid	Tinyint	unique
departmentname	Varchar(15)	Multiple values
numberofworkers	Varchar(15)	Multiple values
Staffed	Tinyint	unique

Table 12: Job

Column Name	Data Type	Occurrence
Jobid	Tinyint	unique
Jobname	Varchar(20)	Multiple values
Jobdescription	Varchar(30)	Multiple values
Salaryscale	Varchar(15)	Multiple values
Departmentid	Tinyint	unique

Table 13: Patient_payment

Column Name	Data Type	Occurrence
Paymentid	Tinyint	unique
Hospitalisationfee	Decimal(18,0)	Multiple values
Labfee	Decimal(18,0)	Multiple values
Radiotestfee	Decimal(18,0)	Multiple values
Consultationfee	Decimal(18,0)	Multiple values
Medicinefee	Decimal(18,0)	Multiple values
Ambulancefee	Decimal(18,0)	Multiple values
Otherfee	Decimal(18,0)	Multiple values
Patientcategory	varchar(15)	Multiple values
Paidby	Varchar(25)	Multiple values
Dateofpayment	Datetime	Multiple values
Patientcode	Tinyint	unique
Staffed	Tinyint	unique

Table 14: Item_Order

Column Name	Data Type	Occurrence
Itemid	Tinyint	unique
Itemame	Nvarchar(25)	Multiple values
Itemdescription	nvarchar(30)	Multiple values
Iteminstock	Tinyint	Multiple values
Itemprice	Decimal(18,0)	Multiple values
Categories	nvarchar(25)	Multiple values
Orderdate	Datetime	Multiple values
Supplier_name	Varchar(25)	Multiple values
quantityordered	Tinyint	Multiple values
Staffed	Tinyint	unique

Table 15: Received_Item

Column Name	Data Type	Occurrence
stockid	Tinyint	unique
Item_name	varchar(20)	Multiple values
Item_description	nvarchar(30)	Multiple values
Batchno	Varchar(10)	Multiple values
Date_aquired	Datetime	Multiple values
Expiry_date	Datetime	Multiple values
Suppliername	Varchar(20)	Multiple values
Category	Nvarchar(25)	Multiple values
Quantityreceived	Tinyint	Multiple values
Itemunit	Nvarchar(15)	Multiple values
Staffed	Tinyint	unique

The physical design above represents the tables used for design the Medical Intelligent System. There are a number of many tables but only the main tables have been presented.

System Requirements

The system requirements for the Medical Intelligent System are as followed:

Internet requirements: The Medical Intelligent System is a web based system; it needs internet connection in order to work as required and meet the Hospital needs.

Hardware requirements: below is a list of the hardware requirements for the Medical Intelligent system:

- CPU(Central Processing Unit): x86 architecture or higher
- RAM (1 GB or higher is recommended)
- Secondary Storage: 120 GB or higher is recommended for the Medical Intelligent System

- Display adapter: Screen display set at a minimum of 800*600 resolution

Software requirements deal with defining software resource requirements and prerequisites that need to be installed on a computer to provide optimal functioning of an application. These requirements or prerequisites are generally not included in the software installation package and need to be installed separately before the software is installed.

- Platform: Windows Operating System(windows XP, Windows Vista, Windows 7, windows 8 or higher) and Macintosh Operating System (Mac OS–X Tiger, Leopard and Snow Leopard) and Linux
- Web browser: Internet Explorer 8 and higher, Firefox 3.0 and higher, Chrome 12 and higher and Safari 5.0 and higher, etc.

System Demonstration

The screenshot represents the login of the system, when the user enters his Level, ID and password, he will directly access the modules concerning him. Not all users will access all the modules of the system, that why when they login, they will just access the concerning modules. The access to the modules depends on the Level, the Doctor will access the modules for Doctors, the Laboratory technicians will access the modules concerning them, the same to Pharmacy technicians and others.

Figure 3: Login source: own drawing

The form below represents the patient registration form, at the reception, all the basic information about the patient will be registered.

This information will be accessed with the doctor directly. Some information are loaded automatically, like the patient numberband the visit date, the user doesn't need to enter them, they just come automatically.

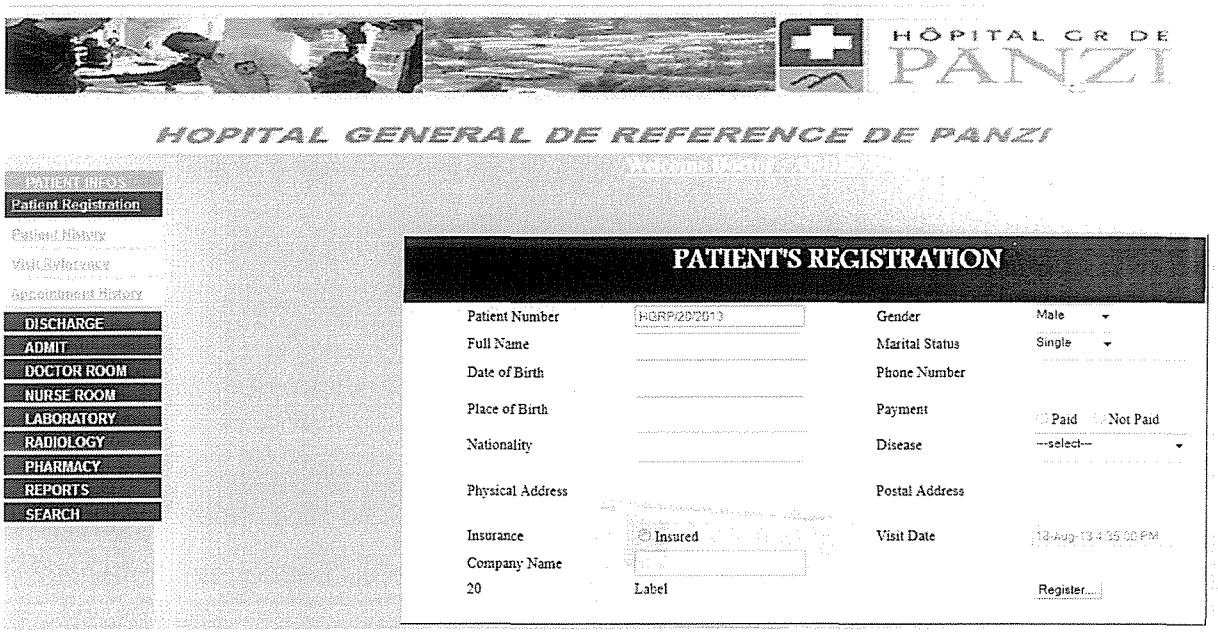

Figure 4: patient registration form Source: own drawing

After the registration of the patient, the nurse or the doctor can do the Diagnosis; this is done using the form below

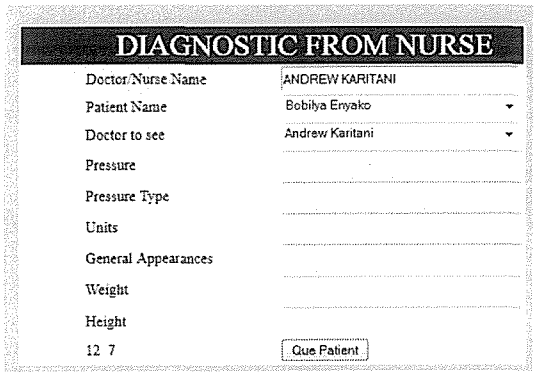

Figure 5: Diagnosis Form Source: own drawing

When the diagnosis is done and after the consultation of the Doctor; he can decide if there is need of Laboratory exams of not; or if there is need of Radiology exams. The forms below represent test request form:

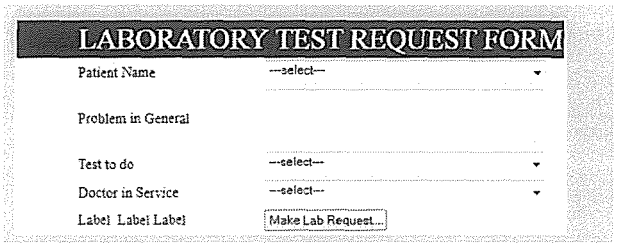

Figure 6: Test request form Source: own drawing

The doctor will also pick the result form the Laboratory or the radiology using the form below:

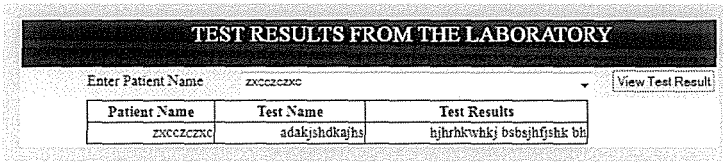

Figure 7: Test results from the Lab Source: own drawing

Then, the doctor will decides if there is need of admitting the patient or not. If the patient has to be admitted, he will be directed to the nurse who will admit him/her in a room and give a bed. The admission is done using the form below:

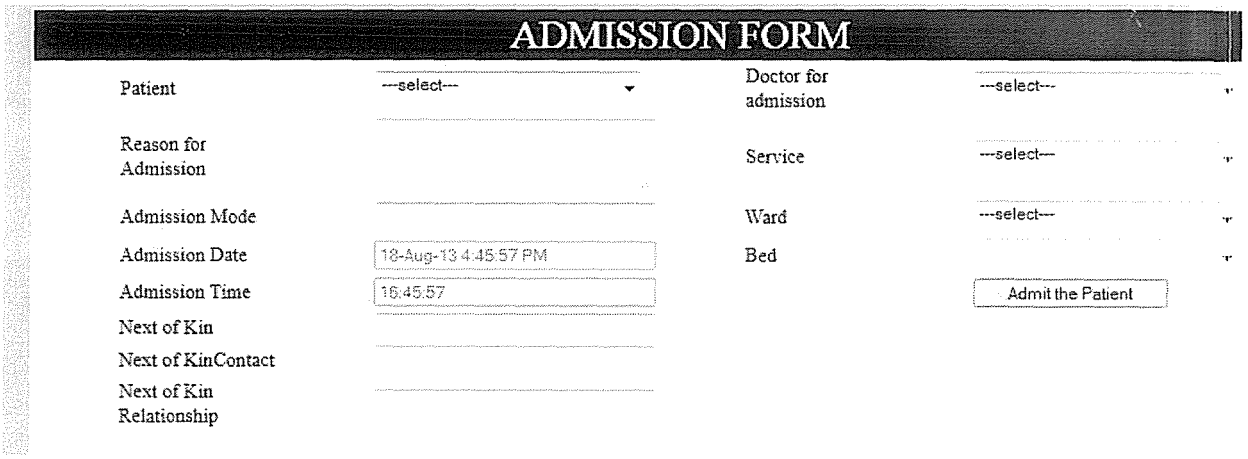

Figure 8: Admission form Source: own drawing

If the patient will not be admitted, the will make a prescription of the medicine he is supposed to take and send it to the pharmacy. At the pahrmacy, the Pharmacy manager will just select the name of Patient depending on the list from the Doctor's room. The form below represents the prescription from the doctor:

Figure 9: Prescription from Doctor Source: own drawing

The pharmacy manager will give medicine and register them on the daily usage form which is represented below:

Figure 10: Pharmacy daily usage form Source: own drawing

The department in charge of the store makes also the order for providing the hospital with the required items. The make the order about the medical and unmedical items. The form below is used for making the order:

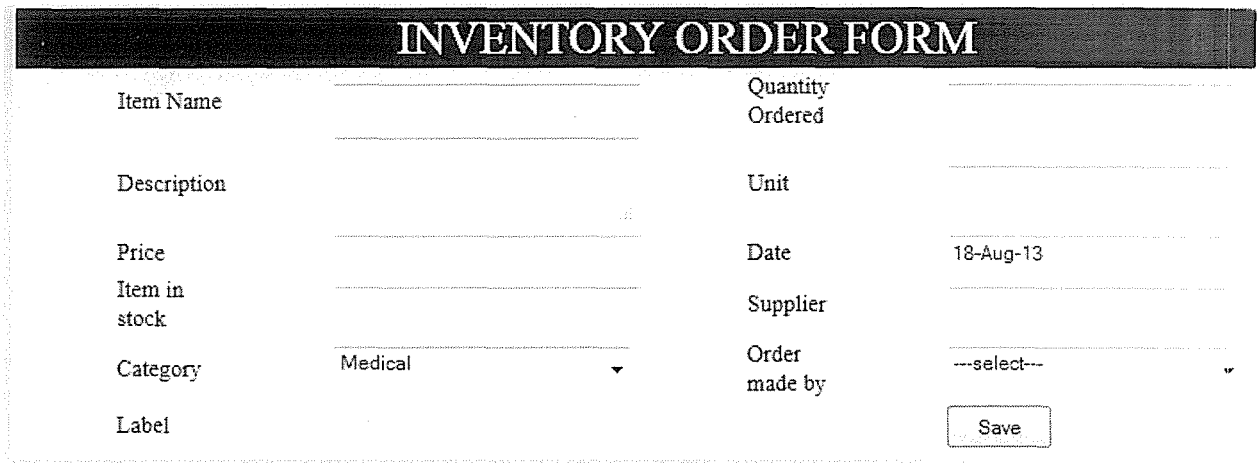

Figure 11: Inventory order form Source: own drawing

When they receive the items ordered, they use the form below:

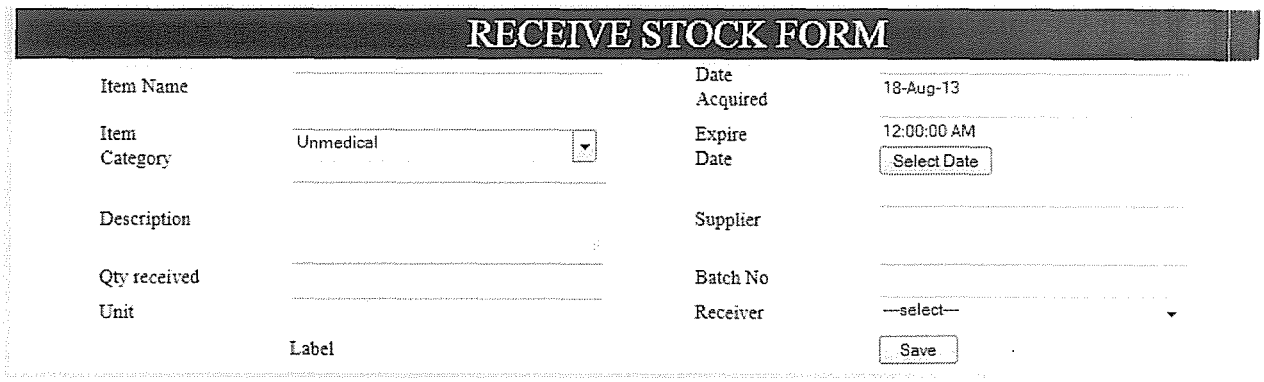

Figure 12: Received stock form Source: own drawing

Patients pays differents fees depending on the service he ha received. There is consultation fee, hospitaliation fee, laboratory fee, medicine fee, radiology fee, and other fee. The form below is used for patient payment and the receipt is printed and given to the patient when the service is done.

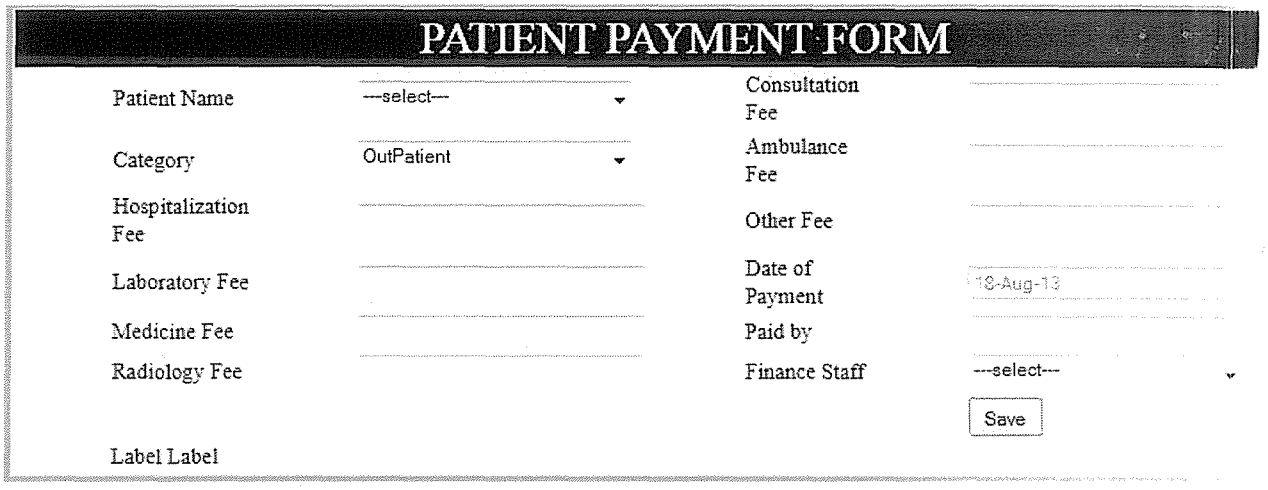

Figure 13: Patient payment form Source: own drawing

The information about the staff is recorded and stored using the form below:

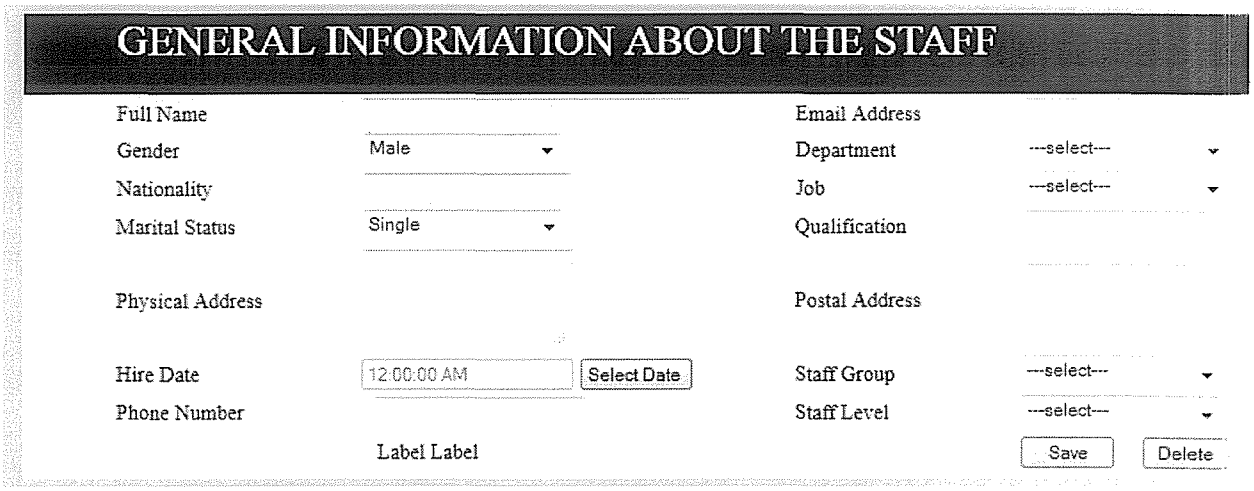

Figure 14: Staff Information form Source: own drawing

The search is done depending on the criteria and the report is printed.

The form below is used for searching:

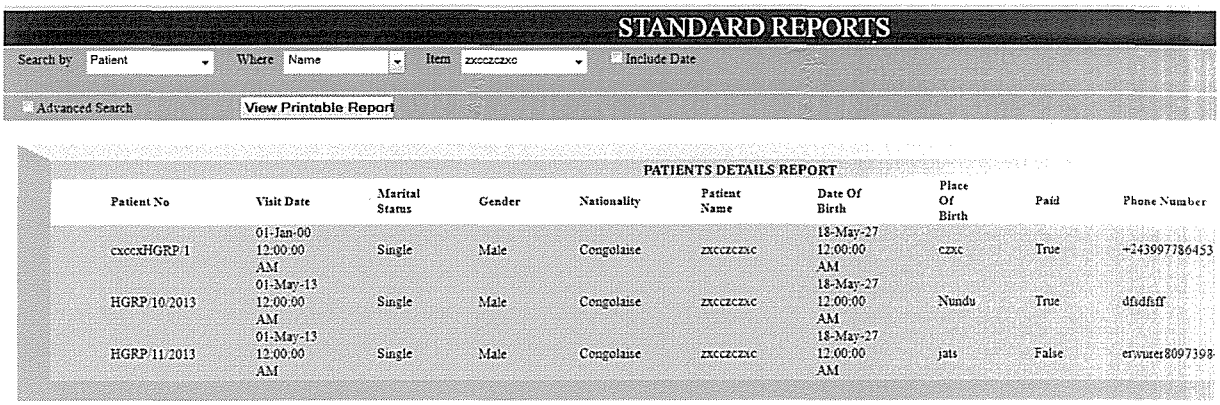

Figure 15: Search form Source: own drawing

CHAPTER FIVE
SYSTEM EVALUATION

The Level of Performance and Efficiency of the Medical intelligent System

Table: the Level of Performance and Efficiency of the Medical intelligent System of Panzi Hospital

Performance and Efficiency Of the Medical Intelligent System	Mean	Interpretation	Rank
It is ease for the hospital to store and retrieve data	3.33	High	1
The Medical Intelligent system records data effectively	3.33	High	2
With the Medical Intelligent system, the patients get their information easily	3.36	High	3
The Medical Intelligent system produces the reports efficiently	3.42	High	4
The patient's information is delivered in good way and on time	3.42	High	5
The Medical Intelligent system requires less man power	3.44	High	6
The Medical Intelligent system is flexible	3.47	High	7
The Medical Intelligent system is well protected	3.50	Very high	8
The Medical Intelligent system serves us appropriately	3.50	Very high	9
TOTAL	**3.44**	High	

The table above presents the result of the performance and efficiency of the Medical Intelligent System. They stated that the performance and efficiency of the Medical Intelligent System is High (mean=3.44). They confirmed that it is ease for the hospital to store and retrieve data (mean=3.33); the Medical Intelligent System records data effectively (mean=3.33), they also said that with the Medical Intelligent System the patients get their information easily (mean=3.36) and it produces the reports efficiently (mean=3.42). They also said that the patient's information is delivered in good way and on time (mean=3.42) and it requires less man power (mean=3.44). The respondents proved that the Medical Intelligent System is flexible (mean=3.47). They also started that the Medical Intelligent is well protected (mean=3.50). They affirmed that the Medical Intelligent system serves us appropriately (mean=3.50). Therefore, the Medical Intelligent System is useful for the decision makers of Panzi Hospital.

System Description

The Medical Intelligent system was designed for working in Panzi Hospital. Every worker of Panzi has its own login for accessing the system. When the system starts, the login page appears for asking to enter the level, user ID and the password for accessing the system. The level of the workers is for allowing the users to access the modules which are concerning him without accessing other's modules. The user ID and the password are for allowing the system users to access the system.

There are many levels of users:

- Receptionist,
- Doctor,
- Nurse,
- Laboratory technician,

- Radiologist,
- Pharmacist,
- Finance officer,
- Hospital Administrator,
- Hospital Director,
- Stock keeper and
- System Administrator

Every level has its own modules to access, but the system administrator can access all the modules in the system, that means he can work in every department.

Receptionist

When the user accesses the system as Receptionist, he is able to register the Patient, view the patient history by knowing how many times does the patient be admitted or visited the hospital and view the appointment history of the patient.

When the patient has visited the hospital for the first time, he is received at the reception where he is registered and oriented to a specific Doctor for his treatment. After saving the information about that Patient the Doctor receives it directly without coming to the receptionist office. If the patient come to the hospital and he has been admitted to the hospital sometime back, the system gets his information automatically without looking in different folders in the office; the patient is required to give his number and/or his name and all the information needed for the patient will be accessed. For viewing the appointment date about the patient, you are required to enter the name of that patient and get the information about his appointment and the doctor to meet.

Doctor

When the user accesses the system as Doctor, he gets access to the following modules: patient information, admission, discharge, doctor room, nurse room and reports. In the patient information, there is patient registration, patient history, visit reference and appointment history. It doesn't mean that the Doctor can register the patient but this is done in case of emergency. The Doctor has to get the historical information about the patient that why he is accessing the patient history and visit reference. The doctor is also accessing the appointment history for knowing the patients who are supposed to meet him.

The Doctor can admit and discharge the patient that why he has access to the admission and discharge module. When the doctor admits the patient, he gives the ward and the bed automatically by looking for the empty bed in the system. When the patient is admitted to a certain bed, it is automatically busy in the system until the patient is discharged. The doctor makes the diagnosis and registers them using the system. If there is need of making the lab requests, the doctor does it automatically and the laboratory technician is informed that there is need of testing that patient. The laboratory technician also does the test and submits the result which is accessed with the doctor for prescribing the medicine to the patient; the doctor makes the laboratory request and receives the result in his office. The doctor is also able to register the new born and the death if the nurse is not nurse is not present. The doctor can also make the reports like the admission form, discharge form, etc.

When the user accesses the system as Nurse, he is able to access the patient module and the nurse module; he can register the diagnosis, register the new born and the death. He has access to the patient history, visit reference and appointment history.

Nurse

The Nurse makes the diagnosis, when he saves it, the doctor accesses it directly. There is no need of the nurse to go to doctor's room for giving the diagnosis about a patient. He also registers the new born and the death.

Laboratory Technician

When the user accesses the system as Laboratory technician, he access the test request from the doctor, works on it and gives the result without waiting for the doctor or the nurse to send the patient with form for knowing the problem. The doctor also receives the result online and makes the prescription.

Radiologist

In the radiology module, the user gets the test request from the doctor, after working on the test, he sends the result online then the doctor makes the prescription.

Pharmacist

In the pharmacy module, the user gets the prescription from the doctor, and gives medicine to the patient; then register the medicine used daily for making the report. The pharmacist makes the medicine to the store from the system, when he enters the order, the stock keeper will access it and decide on which medicine to send to the pharmacy. After receiving the medicine from the store, the pharmacist registers them for knowing the evolution of his stock. The pharmacist registers the medicine used daily and makes the report.

Finance officer

In the finance department, the system manages the payment of patient. When the patient makes the payment required, the system registers it and produces the report on it. When there is payment to be made with the hospital, those payments are registered using this

system. The system produces the report for the finance department, it gives the invoices, view the debts, the amount received and the amount used.

Administrator of the Hospital

The administrator registers the information about the staff and gives the user ID and password to every staff who is supposed to use the system. He registers also the allowance and gives allowances to staff members. He also adds the new job, the new department, new group of workers and new level of workers. He gets access to the reports from the finance department and the stock keeper. The administrator also searches for information from the entire hospital using the search engine in this system.

Stock keeper

The stock keeper makes order from different suppliers; when he make it, it is registered in the order form; then when the product requested comes, it is registered in the receive item form where the pharmacist and other services can access that new product and makes the request on it. When there is a request, the system detects it and the user respond to it. This is saved for the report. The system produces also the report for the stock, it views items by category, by name, ordered, received and distributed items.

Hospital Director and System Administrator

The Director and the system administrator are accessing all the modules of the system because they have to be informed in what is running in every department; and also, they have how the system is working for avoiding the inconveniency. The system administrator has to work hard for the improvement of the system and make sure that every service is adapted to the system. The Director has to be updated also on what is happening in every service.

CHAPTER SIX
DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Discussion

The aim of this study is to design a medical intelligent system for supporting the decision makers of Panzi Hospital. The specific objectives were considered for achieving the purpose of this study.

The first objective was to investigate the level of performance of the existing medical system; the respondents confirmed that the data are recorded, stored and retrieved at a very lower level. They stated that the existing system of Panzi Hospital is not producing good reports because they are not getting the required information on time and it is done manually. The respondents also affirmed that the information about the patients is not delivered on time and they are suffering for delivering it because it is stored on papers. Also, the existing system requires big number of workers because it is done manually and people are supposed to gather information service by service for making the decisions. They also affirmed that the existing system of Panzi Hospital is not flexible. As the system is done manually, it is a bit difficult for the decision makers of Panzi Hospital to protect their information, sometimes the papers can be destroyed and lose everything which was there, thus the existing system of Panzi Hospital was not protected. All the department of Panzi Hospital were not connected, for a department to get information from another department, they used to go there and leave the office for accessing another one; for the reception to pass the patient to the nurse or the doctor, he used to register the patient on a form and submit that form manually to the nurse or the doctor. For the doctor to request the laboratory test for a patient, he used to register that patient and test to do and submit manually, by sending another person to the laboratory and waiting for

the test result. The laboratory was also sending another person to submit the test result to the doctor for prescription. The doctor used to prescribe by form and send the patient with that form to the pharmacy, sometimes the patients the form can be destroyed or damaged as he carried when he is feeling bad. It was also worse for admitting the patient, because the nurse used to go ward by ward for knowing the bed which is empty for admitting the patient. When it is time for releasing the patient, the doctor gives the authorization and the prescription for releasing the patient; the patient goes to the finance with that form for paying the fees and the finance gives the patient the confirmation form for proving that he has paid the fees so that he may receive the medicine. All this was so tiresome for the patient because he used to go service by service. The respondents agreed that the data warehouse can serve them appropriately; this was supported with studies such as Jahangir (2005); Ustudy, (2010); Jarboe, (2005); Rhodes, (2010) to the effect that the use of Management Information System in Decision making allows multiple users to access the same content all at the same time without any discrepancies. This potentiality boosts accountability from the business operators since multiple people can access a particular content and verify whether they are consistent or whether they are not. Also the quality of managerial decision-making depends directly on the quality of available information and the managers should therefore cultivate an environment that encourages the growth and viable sprouting of quality information.

The second objective was to develop a medical intelligent system, the system was designed; the respondents affirmed that it is easy for the hospital to record, store and retrieve data. They also stated that, with the medical intelligent system, the patients get their information easily and at time and the reports are produced efficiently. They also confirmed that the patient information is delivered in a good

way and on time and it requires less man power. The respondents also approved that the medical intelligent system is well protected and it serves appropriately. When the patient comes to the hospital for the first he has to be registered to the receptionist who directs him where to get the service. When the patient has been served at Panzi Hospital long time ego, the receptionist gets his historical data in the system and knows where to direct him. At the registration, the receptionist has to know which patient has to be treated with which doctor in service; then when saving the information about the patient, the nurse accesses it directly and makes the diagnosis. After the diagnosis, the doctor in service gets all the information and makes prescription for the patient. If the patient has to be admitted, the doctor selects the bed among the empty beds without going to the ward, the system recognizes all the empty beds; the nurse takes the patient to the ward where the patient has been given the bed for admission. If there is need of laboratory exams or radiology exams, the doctor is not supposed to send the patient to the laboratory with a form, the laboratory technician accesses all the current test requests and works on them. The result has to be sent automatically and the doctor gets them for the prescription. When prescribing the medicine to the patient, after saving, the pharmacist accesses it. The patient, then, goes to the finance department for payment, and the pharmacist access the information about the payment and gives the medicine to the patient being released. If the pharmacist wants to request the medicine to the stock, he makes the request and the stock keeper accesses it and responds to it without going there with the request form on a piece of paper. The Director of the Hospital can make the reports anytime anywhere because the system is accessed online.

The findings were contrary to studies such as Mrissa et al, (2004), who contend that retrieving patient medical information was still a difficult task even with computerized systems, especially in the

cardiology domain. To automate the process of gathering a patient's information without the constraints of semantic or location diversity and to accurately display it to the physician and propose using web services for this task is still a big task in the area of decision making in the hospital.

All these could not be for great meaning if they shouldn't consider the guideline for the information system, that why the researcher recommended the guideline for the use and management of the information system for PAnzi Hospital.

Conclusion

To develop a Medical intelligent system for supporting the decision makers at Panzi Hospital was the purpose of this study. For this to happen, the specific objectives of this study were to investigate the level of performance of the existing medical intelligent system and to develop a medical intelligent system. The design science research methodology was used as a research methodology approach. The system investigation was done using the problem identification. Structured interview was done to the workers of Panzi Hospital; they proved that there is poor recording, storing and retrieving data; the reports are done manually and the information is not gotten when needed. Also, as the information is stored on piece of paper, there is a big percentage of losing it; the existing system required big number of people because it is done manually. It was also difficult to share the information and it was tiresome for the patient to get the service required.

The solution was to develop a Medical Intelligent system for Panzi Hospital, which was the second objective of this study; the conceptual design, the logical design and the physical design were done; the evolutionary prototyping was used as the system development approach for being close to the Panzi Hospital workers

during the development of the system. Sql server 2008 was used as the database management system and Microsoft Visual studio 2008, using ASP.net, was used for developing the Medical Intelligent System. The Medical Intelligent System was developed and it has to be accessed online. The system demonstration was done to the management of Panzi Hospital; they affirmed that it ease for the hospital to record, store and retrieve data, the information about the patient is accessed easily and at time and the reports are produced efficiently and the information is delivered on time and it requires less man power and serves appropriately and well protected. The achievement of this study was the development of the Medical Intelligent System. This system can work with any hospital depending on how it is adapted. The research recommended the guideline for the well use of the information system for Panzi Hospital.

Study Contributions

The intelligent agents embedded in the hospital management information system have encouraged community members to come for medical services and camps which was never the case before; thus controlling rampancy of the epidemics and increased awareness of the mitigation measures among community members.

To come up with such intelligent systems design science research alone may not sufficiently address the problem, unless coupled with aspects such as decomposition as illustrated in Inmon and Ralph Kimball's approaches.

RECOMMENDATIONS

For designing an intelligent system there is the use and integration of new skills and knowledge for designing systems. Thus, it is better to consider the users and owners requirements during system analysis for making the system user friendly. The users have to be

involved in all the process of system design for avoiding their conflict with the system being implemented. Users have to be involved during system implementation, testing and evaluation and consider their suggestions for the improvement of the system. They have to be involved in all the process of system development.

When using the system, it is better to consider the modules which you are supposed to access for security purposes; users have to maintain their username and password for accessing the system and consider the security measures and policies. Also, the Hospital has to make sure that all the workers are trained in using the Medical Intelligent System as it is a tool for their management. They have to implement a security policy for maintaining this system.

The system has to be upgraded by adding other modules and making it usable as the technology is improving every day. We also request Panzi Hospital to make in use this system and consider for their management.

For the conversion of this system, it is better to use the Parallel Systems; it is a safest conversion method because it ensures that in case of any problems in using the new system, the organization can still fall back to the old system without loss of time and money.

These users have to be trained so that they may use the system efficiently.

Future works

For those who intend to make research in Design and Evaluation of Business Intelligent system, it is better to consider the tools for design and evaluation of Business intelligent systems, to have the knowledge about data warehousing and also to consider the use of the Decision Support System; this need to get enough skills in system analysis and System design. You have to make sure that you have some knowledge for the database management system like Sql server,

Oracle, and other programming languages like Microsoft studio 2008, 2010, Java, etc.; this will help you to know what you are doing and how to go on with.

As the development process requires enough skills, you have to read a lot and get trained about the tools you want to use for developing the system. It is also better to consider the use of statistical tools for interpreting data

Also, when you are gathering the requirements and you discovered that your respondents don't know or they don't have an idea about what you are requesting, it better to use the discovery prototyping to give them an idea about the system is supposed to work. The use of the research tools will also help you in gathering the information.

The involvement of users to the development of the system is so helpful because it will make them to be used to it and avoid many problems during implementation and testing.

Practical Recommendations

Panzi Hospital should have a written information security policy document approved by management and communicated to all relevant personnel; Hospital management should manage the security of information assets used in the handling of patient related data and information; a secure physical environment should be provided for computer equipment; Hospital management should screen personnel to ensure security.

Computers should be located in a physically secured environment (building, floor, or room) with access restricted to authorized personnel only in order to prevent unauthorized usage and to a list of authorized personnel should be documented and reviewed at a minimum annually to ensure that access is still appropriate. Unauthorized personnel (e.g. visitors, maintenance support personnel)

should be escorted. Detailed tracking records or logs should be kept of all persons entering a secured environment.

Panzi Hospital should maintain an inventory of information assets to be in a position to report on what information assets they hold, and to manage their security appropriately. Assets may include IT hardware, software, data, system documentation, and storage media. The inventory record should include an identified owner who is accountable for the asset and the location of the assets.

Removable and external electronic storage media (e.g. diskettes, CD ROMS, DVD, external hard drives, etc.) should be clearly labeled and secured in a locked desk or filing cabinet at the end of the workday and when not in use in accordance with the guidelines. When disposing of any information classified as confidential the media should be either reformatted or physically destroyed to ensure it is unrecoverable. Computers used for handling and storing health information should be dedicated to that function and not used for other purposes such as personal document processing, audio and video file downloads, Internet browsing, or other unrelated functions .

A documented backup plan must exist which defines the backup routines. A backup plan aims at ensuring that information in backups is complete and sufficiently current. A locally stored backup log should be maintained.

All computer systems must have virus detection software installed and updated regularly; Antivirus software should be configured to scan all removable media when inserted into the system for viruses.

There should be a manual data capture and recording system to allow for continued operation during downtimes. Facilities using a Medical Information System should have a ready manual or paper-based backup system for use during system downtimes.

There should be a defined process for managing requests for changes and implementation of those changes to the system. This process should be controlled by the Hospital management or a group to which the responsibility has been designated. Major changes to system should be accepted by all stakeholders.

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APPENDIX I

TRANSMITTAL LETTER

KAMPALA
INTERNATIONAL
UNIVERSITY

Ggaba Road, Kansanga
P.O. BOX 20000 * Kampala, Uganda
Mobile: +256782823482
E-mail: mpheliux@gmail.com

COLLEGE OF HIGHER DEGREES AND RESEARCH (CHDR)
OFFICE OF THE HEAD OF DEPARTMENT, APPLIED SCIENCE AND TECHNOLOGY

Date: 4th December 2012

Dear Sir/Madam,

RE: REQUEST FOR ITULELO MATIYABU IMAJA MIS/13540/113/DF TO CONDUCT RESEARCH IN YOUR INSTITUTION

The above mentioned is a bonafide student of Kampala International University pursuing **Masters of Science in Information Systems**.

He is currently conducting a research entitled **"Design and Evaluation of Medical Intelligent system for Panzi Hospital"**

Your Institution has been identified as a valuable source of information pertaining to his research project. The purpose of this letter is to request you to avail him with the pertinent information he may need.

Any information shared with him from your Institution shall be treated with utmost confidentiality.

Any assistance rendered to him will be highly appreciated.

Yours truly,

Businge Phelix Mbabazi
Head of Department, Applied Science and Technology

NOTED BY:
Dr. Sofia Sol T. Gaite
Principal-CHDR

APPENDIX II

CLEARANCE FROM ETHICS COMMITTEE

Date_____

Candidate's Data

Name_____

Reg. _____

Course _____

Title of Study _____

_____

Ethical Review Checklist

The study reviewed considered the following:

___ Physical Safety of Human Subjects

___ Psychological Safety

___ Emotional Security

___ Privacy

___ Written Request for Author of Standardized Instrument

___ Coding of Questionnaires/Anonymity/Confidentiality

___ Permission to Conduct the Study

___ Informed Consent

___ Citations/Authors Recognized

Results of Ethical Review

___ Approved

___ Conditional (to provide the Ethics Committee with corrections)

___ Disapproved/ Resubmit Proposal

Ethics Committee (Name and Signature)

Chairperson _____

Members' _____

APPENDIX III

INTERVIEW GUIDE

TO INVESTIGATE THE PERFORMANCE AND EFFIENCY OF THE EXISTING MEDICAL SYSTEM

1. How do you store and retrieve data?
2. How do you record data using this system? Is it effective?
3. With the existing system, how do patients get their information?
4. How does the existing system make the reports?
5. How do you deliver the information to patients?
6. How the existing system requires manpower?
7. How flexible is the existing system?
8. How protected is the existing system?
9. Are you with me that the Data warehouse can serve you appropriately?

TO EVALUATE THE PERFORMANCE AND EFFIENCY OF THE MEDICAL INTELLIGENT SYSTEM

It is ease for the hospital to store and retrieve data

The Medical Intelligent system records data effectively

With the Medical Intelligent system, the patients get their information easily

The Medical Intelligent system produces the reports efficiently

The patient's information is delivered in good way and on time

The Medical Intelligent system requires less man power

The Medical Intelligent system is flexible

The Medical Intelligent system is well protected

The Medical Intelligent system serves us appropriately

APPENDIX IV

PROPOSED BUDGET

Particular	Quantity	Amount
Stationary		250$
Up keep		700$
Transport costs		500$
Internet surfing		200$
Communication		200$
Miscellaneous		300$
Total		**2150$**

APPENDIX V

TIME FRAME

ACTIVITIES	March 2013	April 2013	May 2013	June 2013	July 2013	August 2013
Proposal writing	x					
Pretesting research Instrumental	x	X				
Data Collection			X			
Data Analysis				x		
Compilation of findings					x	
Presentation of thesis report						x

RESEARCHER'S CURRICULUM VITAE

ITULELO MATIYABU IMAJA

Email: Imajaitulelo1@yahoo.fr

Tel: +256754660611

RSONAL	**Name:** ITULELO MATIYABU Imaja **Gender**: Male **Marital Status**: Single **Date of Birth**: September 29 , 1983 **Place of Birth**: Nundu, Sud Kivu, DR Congo **Citizenship**: Congolese **Visa Status**: Student Pass
JECTIVE	To become Information system Manager by providing managerial skills for the organizations
PLOYMENT	**First Company, Medecins Sans Frontieres** Match 15, 2003 – October 15, 2005 **Security Guardian** Maintains physical strength vis a vis any attempted theft ensures the safety of the MSF and work at night keeps the property in the ability to enforce safety rules and the ability to maintain attention and vigilance on the MSF Ensure the safety of goods and people Communicate via HF and VHF **Second Corporation, Kamati La Maji Safi, asbl** October 1, 2010 - Present **Finance Administration Officer**

Develop, analyze and manage the operational budget for the program;

Manage budgets for different projects according to the standards of each donor

Monitor budget of each project and report on the progress of projects coordinator

Participates in budget development project proposals

Analyze and submit for approval of the Coordinator, the budgets of the various field activities

Supervise daily accounting operations and ensure that records of transactions are in accordance with the accounting of the KMS and the codification of the project budget.

Control and monitor the inflows and outflows of funds from bank accounts or boxes including payment of accounts and invoices and maintains relationships with suppliers to accounting and tax administration.

Ensure that documentation of all transactions and financial records or to accounting are classified and properly archived

Respond to internal and external audits of projects

Ensure the implementation of administrative, accounting and financial as well as their regular update

Responsible for managing staff and participates in staff recruitment and development contracts and job descriptions in cooperation with the coordinator.

Ensures that the organization is in compliance with labor laws in force in the DRC and that employment contracts meet the standards required.

Develop staff payroll and ensure compliance with the tax

measures in force

Ensure the updating and dissemination of rules

UCATION

Kampala International University

Master of Science in Information System

August 2011 - present

Focus on Design and Evaluation of Medical Intelligent System of Panzi Hospital

Hope Africa University, Bujumbura Burundi

Computer Science

December, 2010

Thesis: Design and Implementation of a Computerized System for Admission office at Centre Hospitalo-Universitaire de Kamenge

Institut de la Fraternite

National certificate, July, 2002

ILLS

Language Skills - Fluent in French, Fluent in English and Swahili

Computer Skills - Microsoft Office , VB 6.0, ASP.NET, HTML and Java script, Macro Media (Dream weaver, Flash, and Fire works), Windows 98, 2000, XP, vista &7, LAN, Other Packages.

Personal Interests – Data Processing and Data Communication (Networking)

Publications – Implementation of a computerized system at CHUK/Burndi, Patient Manager V 1.0, for patient manager;

Implementation of a Web site for Kamati La Maji Safi, asbl, www.kms-asbl.org , Implementation of a Local Area Network for Vice president in Burundi