CHED Faculty Information System Utilizing Cloud Computing Infrastructure

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Abstract

Higher Education Institutions (HEIs) are required to submit documents to the Commission on Higher Education (CHED) including faculty members' data when applying for a new program offering. Based on the documents submitted, problems were encountered by CHED as some academic institutions submit documents of faculty members' who are not connected with them, or faculty members' who are connected but associated with other institutions. Proper and automated validation processes may be utilized to improve the commission's regulation procedures on validation processes of the documents.

The study proposed the CHED Faculty Information System (CHED-FIS) utilizing Cloud Computing Infrastructure. Relevant information where gathered through CHED's Memorandum Orders and by interviewing CHED personnel as the bases in developing the system. The study made use of descriptive and developmental methods of research. The software development process applied is prototyping. The study likewise utilized the Hierarchical Input Process Output (HIPO) chart to describe the various components of the system and their relationships to one another during implementation. A structured analysis technique known as data flow diagram (DFDs) was used and presents a graphical representation of data processes in the organization. The framework for the information systems architecture was structured using a 3 –Tier architectural model which consists of presentation, logic and data tier. For the evaluation of the system, five-point rating scale questionnaire was used, with CHED Central Office and CHED Regional Office personnel as respondents, to determine the system's functionality, efficiency, usability, reliability, portability and security. Descriptive statistics like frequencies and weighted means were utilized to analyze and interpret the responses. The concept of CHED-FIS is composed of a computer as a tool, cloud computing infrastructure for interactions over a network and a state-of-the-art web application. This system is capable of managing faculty and school records, handles queries and generates important reports which are specifically suited to the needs of CHED and the HEIs in the country.

Moreover, it can be accessed through capable mobile devices and desktop computers. With an evaluation rate of "Excellent" as perceived by the respondents, the system fully realized the objectives of the study and will be able to address the needed requirements for effective decision making and elucidate the problems encountered by CHED and its clientele.

Keywords: Faculty Information System; Cloud Computing Infrastructure; Commission on Higher Education; CHED Central Office; CHED Regional Office; Faculty Member; Administrative Position.

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1. Introduction

Information is one of the most important assets of an organization. Having right information is needed in the day-to-day running of activities especially in decision making. Likewise, accurate information is used by management in making policies, drawing strategies for improvement, short-term and long-term planning, analyzing and providing solutions to problems of an organization. This increasing importance of information makes Management Information System (MIS) as one of the critical organizational activities.

At present, wide implementation of computerized information systems, combined with modern methods of communications, is the recent mechanism being used by organizations to their operation. It became a requirement in the business industry as businesses strive to become more competitive, increasing their demand for operational effectiveness and efficiency. MIS is a system that stores, analyzes and processes data through a computer system which could provide the information necessary to manage an organization [20]. The information it generates are generally considered essential components of prudent and reasonable business decisions. It can provide full and flexible support for the management to enhance the quality of business processes within and between enterprises, be it in private and public organizations and the government.

Academic institutions, as high-performance organizations, are interested in having an effective, efficient and robust integrated management information system which allows for the development of the full potential of its information resources in order to achieve its goals and objectives [14]. In like manner, for development of educational institution's strategy and policy, timely and precise analysis of current business activity on all levels of the organization, are not possible without wide implementation of computerized information systems.

There are adverse findings with regards to the processes in applying for a new program offering or curriculum of Higher Education Institutions (HEIs) to the commission. These findings were observed during evaluation of the faculty members' profile particularly their current employment status and school affiliations. According to Engr. Edgar C. Cepe, the CHED-NCR IT Education Supervisor II during an interview, the HEIs submit documents of faculty members' who are not connected with them or faculty members' who are connected but associated with other institutions. Thus, the Commission on Higher Education (CHED), which is the highest governing body of higher education institutions in the Philippines, sees the need of this computerized information system as a tool to enhance the effectiveness of their operation especially in decision making. One of its mandates is to rationalize programs and institutions of higher learning and set standards, policies and guidelines for the creation of new programs [27]. Doing these tasks require CHED to have a wide array of valid information in order for them to verify and analyze the submitted documents. Without proper and effective information management could lead to more sets of unreliable information that could possibly result to poor decision making. Developing CHED's Faculty Information System in Cloud Computing Infrastructure could be of help in verifying accurately the faculty and school document to avoid such findings and in providing faster, more responsive and quality service to CHED's clientele.

1.1. Conceptual Framework

For this study, the framework for the information systems architecture was structured based on a 3 –Tier architectural model. The concept of 3-Tier architecture was originated with the idea of Rational Software. 3-Tier architecture is defined as the client server architecture that feature the user interface, data storage, data access, and functional process logic maintained and developed as independent modules. Frequently, they are also found on different platforms [19]. And for up to date Internet-enabled applications, 3-Tier architecture is most commonly used. Hence, this framework was used. Figure 1 shows the conceptual diagram of the CHED-FIS architecture.
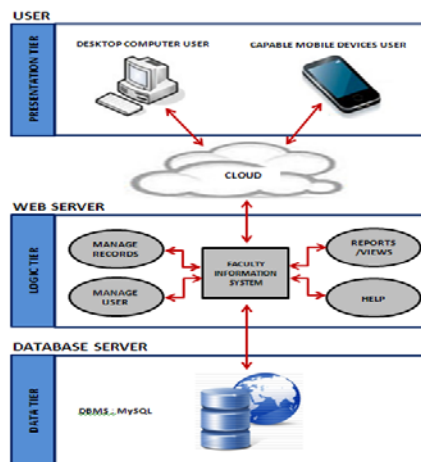

Fig. 1. CHED-FIS System Architecture

Based from figure 1, every tier is directly related to one of the three elements needed in systems architecture which is interaction, manipulation, and storage. Its three major components are the Presentation, Logic and Data tiers. Presentation tier provides for interactions between the system and its users online. Users interact with the system via compatible web-browser of access devices. A web browser is used to translate tasks and results to something the user can easily understand. The system has two access devices present on this layer, the desktop computer and capable mobile device. These devices are independent with each other; hence do not have any hard coded references to the (logic) tier. Logic tier or the application's business service layer presents the different modules required for the system to work. The CHED-FIS has four (4) modules viz. manage record, manage user, view/report and help. Manage record module is responsible in adding and updating/deleting faculty and school data. Whereas, manage user module manages user data. View/Report Module handles queries and generates important reports. Lastly, the Help module provides some pertinent information guidelines in using the system and handles user registration request. Data tier or the data service layer host the actual database storage platform which the system utilizes MySQL as the database management system. In this tier, the database is being set up, create and load the database schemas, occasionally generate reports, and regularly back up the database. It allows simultaneous access, provides security, data integrity and support applications. The system requires "cloud services" as its data repository. The services offered by these hosting sites depend on the volume (the inflow and outflow of data and information) requirement and the complexity of online transactions which the proposed system tried to consider.

1.2. Project Objectives

The study focused on the development of a faculty information system utilizing cloud computing infrastructure. This system can add, update/ delete faculty and school data, handle queries, and generate important reports to be utilized mainly by the CHEDCO (CHED, Central Office) and CHEDRO (CHED, Regional Office) personnel. Specifically, the study aims to have a system which could:

- determine whether a faculty member is holding position in numerous institutions;
- validate whether a faculty member is qualified as faculty or as an administrative officer in the applied program;
- query faculty information by school, by department, by position, by employment status, and whether active or inactive;
- display list of schools per region and list of delinquent schools;
- track user's activities; and
- improve and rationalize faculty information validation processes.

1.3. Scope and Delimitation of the Study

The study was conducted in response to the need of the commission to improve its regulation procedures on validation processes of faculty member and school documents. This section conveys the coverage and the characteristics of the system.

1.3.1 Geographical Scope

The system will be applied in all HEIs offering Information Technology Education (ITE) programs in the Philippines. Based from the data compiled by the OPPRI (Office of Policy, Planning, Research and Information) - IPD (Information and Publication Division) of CHEDCO as of February 19, 2013, there are one thousand three hundred thirty five (1,335) HEIs in the country offering said programs. These HEIs are composed of Private, State Colleges and Universities (SUCs), Local University and Colleges (LUCs), Special HEIs and other government schools.

1.3.2 User Access Level

The system is composed of four (4) modules but has limited access according to user. Record management will only be employed in CHED Regional Office (CHEDRO) personnel only. Whereas, queries and reports will employs in CHEDRO and CHED Central Office (CHEDCO) personnel level and to the system administrator. In addition, the system administrator is the only authorized to manage user data.

1.3.3 Characteristics of the System

The following are the basic characteristics of the system which conforms to the need of the user.

- A Web-based system
- Captures and store data
- Provides report in soft and hard copies
- Accessible via capable mobile devices or desktop computer
- Could be accessed via compatible web-browsers

- Validates faculty and user information
- Tracks user activities
- Handles user registration requests
- Password encryption

1.4. Importance of the Study

The study developed a web-based faculty information system which is capable of managing faculty, school, and user data, handle queries and requests for user registration and generates important reports suited to the needs of the CHEDCO and CHEDRO personnel. This system, therefore, could benefit CHED Central Office, CHED Regional Office, CHED Regional Quality Assessment Team, Higher Education Institutions, faculty members' and future researchers.

The system can handle queries concerning faculty records such the active and inactive faculty and faculty with multiple employers. In addition, school records are also provided, in terms of school information by region and delinquent schools. These valuable features are beneficial to CHEDCO in monitoring faculty member's qualification and their respective HEIs.

CHEDRO personnel such as RQAT, Technical Panel Group, Technical Committees and National Assessor are responsible for the review of required documents of HEIs in applying a new program offering to CHED. These documents are their basis of reports and recommendations for final approval. The faculty information system stores the faculty member information such as current employment status, school affiliation, work experiences and educational background among others. Likewise, it validates faculty records accordingly. Thus CHEDRO personnel can easily determine whether a faculty member is holding position in numerous institutions and whether qualified as faculty or as an administrative officer in the applied program. Indeed, this could help them to efficiently come up with precise findings and fair recommendations for the approval of the program.

The system is also beneficial to the HEIs because they would be made aware of the CHED processes and evade from any disreputable act like submitting unreliable information of a faculty member. Similarly, to faculty members, as a caution for them in accepting multiple positions or teaching loads, from numerous institutions without considering the CHED standard policies and procedures.

The system is likewise valuable to future researchers because the outcome of this study could serve as related study in the field of information technology.

2. Related Works

This section presents the literature and studies reviewed which are relevant to the present study. The first part deals with review of related literature regarding Information Systems and Cloud Computing Infrastructure, while the second part presents some related studies that have bearing on the present paper.

2.1. Related Literature

One of the key factors in creating high performance organizations is having a valid, well-organized and ready to use information. Nowadays, it is being considered as one of the most important assets of an organization. Having the right information at the right time is essential to make the right decision in attaining the objectives of the organization. That is why information should be properly managed and organized in order to maximize its value and one way of managing information is having a well-structured information system.

Information system is a set of interrelated components that collect/retrieve, process, store and distribute information to support decision-making and control in an organization. In addition to supporting decision-making and control, information systems help managers and workers to analyze problems, visualize complex subjects and create new products. It contains information about significant people, places and things within the organization or in the environment surrounding it. In order to have an information system, there had to be raw data that had to be transformed into information, which was meaningful and useful to its users [9].

Many studies have shown that proper information management contributes much to the success of an organization be it in public or private sectors. Information Management, as defined by [18], is a process of establishing the organizational principles for various data life cycles across both structured and unstructured data sources, instituting a committee to govern the principles, and setting up the processes and procedures to harness the data such that meaningful business insights are derived and delivered to the consumers at the right time in the right format.

Managing information through a system is known as Management Information System (MIS). As defined, management information system is an organized approach to the study of the information needs of an organization's management at every

level in making operational, tactical, and strategic decisions. Its objective is to design and implement procedures, processes, and routines that provide suitably detailed reports in an accurate, consistent, and timely manner. It encompasses all the systems and processes within an organization for the creation and use of corporate information according to Robertson [24]. This includes people, process, technology and content. Each of these must be addressed if information management projects are to succeed. In many cases, 'information management' has meant deploying new technology solutions, such as content or document management systems, data warehousing or portal applications.

Goldberg [20], emphasized that management information systems make it possible for organizations to get the right information to the right people at the right time by enhancing the interaction between the organization's people, the data collected in its various information technology systems, and the procedures it uses. It brings together the raw data collected by the various business areas of the organization, which, while useful for specific functions such as accounting, does not provide, by itself, information that can be used to make decisions. He added that well-constructed and well-organized MIS can provide management with the knowledge it needs to reduce operating costs and increase profits.

Effective information management however is not easy. There are many systems to integrate, a huge range of business needs to meet, and complex organizational issues to address. Likewise, numerous factors are to be considered to improve organizations effectiveness and efficiency. According to [8], this would not be realized without a framework which will guide management and system planners. The system will result into a greatest crisis, with no clear path and inflicts an unnecessary expense on the organization.

MIS involves numerous functions and one of its important functions is the monitoring system. According to Mugoya [13], monitoring is the tracking of the information to monitor progress of a particular record. The record would show various details to enable monitoring of various activities. Monitoring was the act of overseeing the progress and ensuring the right system was protected, accurate data entered, complete, verifiable and compliant with the system. At the same time, accessing data was restricted by giving privileges to the right people to access it. With the right monitoring system, MIS could provide timely, reliable and useful information to management for quick decision-making.

In the management information system, modern, computerized systems continuously gather relevant data, both from inside and outside an organization. Internet as its medium of some information systems has become pervasive and cloud computing is the newest offering as service over the ubiquitous Web according to [23].

As [4] defines it, cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams. A cloud service has three distinct characteristics that differentiate it from traditional hosting. It is sold on demand, typically by the minute or the hour; it is elastic - a user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider (the consumer needs nothing but a personal computer and Internet access) according to Rouse [25]. In a cloud computing system, there's a significant workload shift. Local computers no longer have to do all the heavy lifting when it comes to running applications. The network of computers that make up the cloud handles them instead. Hardware and software demands on the user's side decrease. Strickland [26] point out that the only thing the user's computer needs to be able to run is the cloud computing system's interface software, which can be as simple as a Web browser, and the cloud's network takes care of the rest.

Cloud Computing is particularly beneficial for small and medium businesses, where effective and affordable IT tools are critical for helping them become more productive without spending a great deal of money on in-house resources and technical equipment. Large businesses are moving to the cloud as well, for a variety of reasons, such as cost savings, remote access, ease of availability and real-time collaboration capabilities. As added by Aymerich [5], Cloud computing infrastructure allows enterprises to achieve more efficient use of their IT hardware and software investments: it increases profitability by improving resource utilization. Pooling resources into large clouds cuts costs and increases utilization by delivering resources only for as long as those resources are needed. Cloud computing infrastructure can be located in areas with lower costs of space and electricity.

Nowadays, you can access internet with a number of mediums like PC, laptops, land or cell phones, mp3 players, television sets, DVD players and so on. Cloud computing is the stream of these web technologies and how they get hooked up to the wireless world. This fact brings in some drastic changes in the industry. Long gone are the days when you have to depend on a computer to avail information data or entertainment, cloud computing technology has made life a whole lot easier for those, who know how to connect any significant piece of technology to the world of internet [21]. With a number of well-known companies jumping on board, cloud computing technology is improving day by day.

In [11] the authors stated that information resources management continues to dominate general management concerns in the public sector. The relative importance of information management (IM) is increasing at an accelerated pace. He added that the use of IT predisposes public organizations to acquire specialized skills and substantial capital investment, improve efficiency by streamlining the management of information, and share or disseminate information. As also mentioned by [8], IT may improve productivity, but such improvements occur only when IT is introduced in conjunction with certain organizational practices oriented to take advantage of new data availability.

Among the many institutions or public sectors that uses technology in its operation is the Commission on Higher Education. CHED is an arm of the government responsible for the development and efficient operation of the higher education system in the country. The delivery of higher education in the Philippines is provided by private and public higher education institutions (HEIs). Among its functions is to rationalize programs and institutions of higher learning and set standards, policies and guidelines for the creation of new ones as well as the conversion or elevation of schools to institutions of higher learning (26). The two thousand two hundred forty seven (2,247) Higher Education Institutions (HEIs) consist of total of forty one thousand nine hundred one (41,921) faculty members' in permanent and temporary status [31]. Aside from monitoring the HEIs, CHED is also responsible to keep track of the records of these faculty members' nationwide. In recognizing such function, CHED need valid, authentic and timely information for the effective and efficient implementation of its functions.

The proposed system adopted the concept of management information system in monitoring faculty information using cloud computing infrastructure. It can manage faculty, school and user data. Likewise, it can handle queries regarding faculty and school information and generate important reports.

2.2. Related Studies

In [16]; study on "Understanding and Capturing People's Privacy Policies in a People Finder Application" pointed out an application that enables cell phone and laptop users to selectively share their locations with others (e.g. friends, family, and colleagues). The objective of their work is to better understand people's attitudes and behaviors towards privacy as they interact with such application, and to explore technologies that empower users to more effectively and efficiently specify their privacy preferences (or "policies"). This is relevant to the present study as both studies are focusing on finding people through the use of electronic gadgets like cellphones and laptops. The latter however will concentrate on the faculty information rather than his geographical location.

A study on enterprise People Finder, combining evidences from web pages and corporate data was investigated by [12]. The emphases of the study were web based system which automatically identifies experts in an area, based on the documents already published on an organization's intranet or part of the corporate data. The system can be queried like a standard Web search engine, but instead of producing documents, it provides a list of experts. Each expert listing includes contact details and supporting evidence. The study revealed that use of structured corporate information improves the accuracy of finding experts. The above review is related to this paper in terms of determining a person's qualification through documents provided by the source which could easily be queried online.

Subramaniam and his colleagues [15], study was developed to improve the accuracy of valuable reports for management. The findings showed that the efficiency and accuracy at the production lines enabled a better production and utilization of the available resources. Likewise, it captured and distributed unadulterated production information at all levels along the production process without human intervention. The above-mentioned study has a relation to the present paper because both studies are trying to improve the accuracy of valuable reports for management. The present study adopts a monitoring system but will focus on the faculty and educational institutions' profiles. The aim is to provide valid and authentic data about the subjects in order for CHED to come up with the right decision.

Mugoya [13], studied the requirements of Management Information System for Uganda Prisons Department and found out that it was possible for the department to implement the system. He was able to set up a prototype which used to test the implementation of a computer-based information system that added prisoner's details stored this data and output various reports of the committed and convicted prisoners with the information system. The present study is similar to Mugoya's work as both are using a system to monitor and update their respective subject's records to effectively attain their objectives.

In [17]; the paper focused on developing a set of guidelines, which can be followed for preparing the sites for the various server and computer rooms which will be setup in tertiary institutions in Nigeria. These guidelines provide a generic framework for various aspects of Information Technology (IT) site preparation, specifically for setting up server rooms in a local area network enable environment. The authors aimed to establish a Management Information System in tertiary institutions, so that information can be extracted from the operations systems to provide a stimulus for decision-making by the management. This study is akin to the present study in a sense that it is also intended to provide ways to an education-related institution for a more reliable and timely decision-making activities.

Pougatchevet and his colleagues [14], studied on the technical aspects of the integrated management information system for

educational institutions. Authors practically implemented the e-Management Control and Evaluation System (e-MCES) in the University of Technology, Jamaica (UTech). The intention of the e-MCES is to provide a robust yet flexible online tool for the University to measure how well it is able to achieve its strategic targets, while providing a mechanism for communicating with each staff member their individual contribution to the success of the institution. The system provides an accurate diagnosis of the educational reality and an objective assessment of the impact of intervention policies to society. On the other hand, the information produced by the system may be used as social control tool to press those responsible for managing the educational system to produce necessary improvements. This study is very much related to the present study as both has the intention to improve the educational structure of a country For development of educational institution's strategy and policy, timely and precise analysis of information is essential.

Carter and his colleagues [6], in their study "The Utilization of E-government Services Citizen Trust, Innovation and Acceptance Factors", confirmed that web-based system increased the convenience and accessibility of Management Information System services and information about prisoners in order to develop prisoners details with an Integrated Management Information System. In this study, users are provided with accessible, relevant information and quality services that were more expedient than traditional manual system through integration of an automated system. This study and the present study are relative. The proposed, likewise, will emphasize on managing information through a web-based system.

3. Research Methodologies

This section presents the research method, locale of the study, respondents of the study, research instrument and technique used in the paper.

3.1. Research Method Used

The study made use of descriptive and developmental method. According to Ariola [1], descriptive method attempts to analyze, interpret, and report the present status of a subject matter. It describes and interprets what is. It is concerned with conditions of relationships that exist; practices that prevail; beliefs, processes that are going on; effects that are being felt, or trends that are developing [2]. Calderon [3] added that descriptive research reveals problems or abnormal conditions so that remedial measures may be instituted. Developmental approach on the other hand is concerned with the existing status and interrelationships of phenomena and changes that take place as a function of time. It is a creative development of a model or system (paradigm) based on a thorough determination of the present situation or system and the goals sought according to Key [22].

This study first came up with the description of the status of the evaluation of documents submitted by HEIs in applying for new program or curriculum to CHED. Second, it proved that among the submitted documents, the faculty and school data is the hardest part to evaluate. Third, it disclosed that these HEIs submit documents of faculty members' who are not connected with them, or faculty members' who are connected but associated with other institution. Finally, the study sought to develop a system that can manage faculty and school records, handles queries and generates important reports which will help CHED in evaluating the validity of the documents or information submitted to them and eventually come up with a fair decision for the approval of the applied program offerings by HEIs.

Since it involves thorough determination of the present situation or system and the goals sought, the developmental type of research is the most appropriate.

3.2. Locale of the Study

The study was conducted in the Philippines. Development of the system was conducted at Technological Institute of the Philippines, Cubao Quezon City and data gathering was conducted at CHED, Central Office, C.P. Garcia, Diliman, Quezon City.

3.3. Respondents of the Study

The respondents of this study were CHEDCO and CHEDRO personnel. They were invited for an actual presentation and demonstration of the whole system as the end user. The presentation likewise was conducted to let them evaluate the quality of the system by rating them based from the criteria reflected on the questionnaire.

3.4. Research Instrument and Technique Used

The study made use of a questionnaire in the evaluation of the whole system. The questionnaire is composed of six (6) criteria with a 5-point rating scale and its corresponding ranges and interpretation as shown in Table 1.

Table 1. 5-Point Rating Scale

Value	Mean Range	Interpretation
5	4.21 – 5.00	(E) Excellent
4	3.41 – 4.20	(VG) Very Good
3	2.61 – 3.40	(G) Good
2	1.81 – 2.60	(F) Fair
1	1.00 – 1.80	(P) Poor

The criteria used were defined in (International Organization for Standardization) ISO 9126. ISO 9126 [29] is concerned primarily with the definition of a quality model, which can be used to specify the required product quality, both for software development and software evaluation. The six criteria used in the questionnaire are systems functionality, efficiency, usability, reliability, portability and security.

The study made use of descriptive statistics in interpretation and analysis of data. These include the frequencies and weighted means. Simple frequency count was applied in tallying responses while weighted mean was utilized to determine the average response for every criterion description. Also, weighted average mean for each of the seven criteria were also computed by adding all the weighted means divided by the total number of descriptions for every criterion. Lastly, an overall weighted mean was calculated to get the overall quality characteristic of the system as perceived by the respondents.

3.4.1 Respondents

There are a total of thirty-two (32) CHEDRO and CHEDCO personnel who participated in the evaluation. This is composed of seventeen (17) CHEDCO personnel and fifteen (15) CHEDRO personnel. Respondents were able to accomplish the questionnaire based from their actual evaluation of the system. Below is the overall-tabulated rating of the respondents.

Table 2. Tabulated Rating of the Respondents – Overall

	Criteria	Weighted Mean	Qn	Ql
1	Functionality	4.39	5	E
2	Efficiency	4.29	5	E
3	Usability	4.41	5	E
4	Reliability	4.22	5	E
5	Portability	4.41	5	E
6	Security	4.35	5	E
Overall Weighted Mean		4.34	5	E

Legend:

5 – Excellent	-	(E)	4.21 – 5.00
4 – Very Good	-	(VG)	3.41 – 4.20
3 – Good	-	(G)	2.61 – 3.40
2 – Fair	-	(F)	1.81 – 2.60
1 – Poor	-	(P)	1.00 – 1.80

Qn – Quantitative Characteristics/Result

Ql – Qualitative Characteristics/Result

Table 2 shows the overall weighted mean of the criteria used in the evaluation of the systems quality. The overall weighted mean got is 4.34, which has an equivalent qualitative result as "Excellent". The result may imply that respondents find the system valuable and was able to attain its goals and objectives.

4. Design and Development of the System

4.1. System Development Process Model

The software development process used in this study is prototyping as shown in Figure 2. Using this process provides better understanding of the user's requirements and development technologies. Likewise, prototyping allow the customer to explore possibilities and investigate the feasibility of a development project. It does not necessarily model the whole system rather it means of "learning by doing".
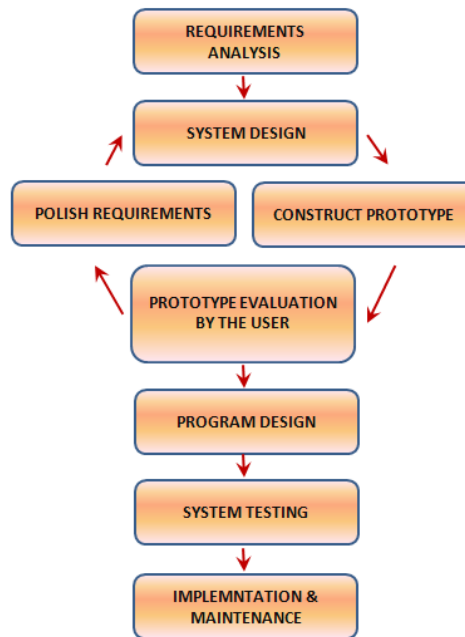

Fig. 2. Prototype Model

This study first identifies user's basic information requirements in managing faculty data, querying faculty and school information and in generation of specific reports. Secondly, the study develops an initial prototype/application model which was designed based from the user requirements. This application was used in testing the systems capabilities and features, to refine user's requirements. Lastly, revisions and enhancements of the prototype/application follow until such time the requirements were completely provided.

4.2. Design of the System/Software

The concept of the system is composed of a computer as a tool, cloud computing infrastructure to be accessed online and a state-of-the-art web application.

This system has three major components, the record management, user management and the view/report menu. In record management, it comprises adding, updating/deleting faculty and school data. In addition, validating faculty data was included to determine faculty member's records if any from numerous institutions. Similarly, in user management, it includes adding, updating/deleting user data, a menu for responding on the new user request and activity log were provided. On the other hand, view/report menu was included for query purposes and to generate important reports of faculty and school data. It can query faculty data by school, department, position and employment status. In addition, it can display lists of active and inactive faculty, including faculty with multiple employers. Schools per region and delinquent schools were also included. Reports generated can be printed.

The end users of the system are CHEDRO and CHEDO personnel, and a system administrator. Each user has a limited access level to avoid from accessing data beyond their region. CHEDRO is the only one who can access record management for they are the once in-charge in managing faculty and school records. Similarly, the system administrator has the sole access to user management for his functions rely only to manage and track user activity. Aside from CHEDRO and system administrator, the CHEDCO is given full access to view/report menu to monitor faculty and school records nationwide.

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4.2.1 HIPO Chart

The system made use of the Hierarchical Input Process Output (HIPO) chart to describe the various components of the system and their relationship to one another during implementation as shown in Figure 3. HIPO chart is one of the earliest methods devised to describe systems by their functions [28]. This tool was used to analyze the problem and visualize solution using the top down design approach.
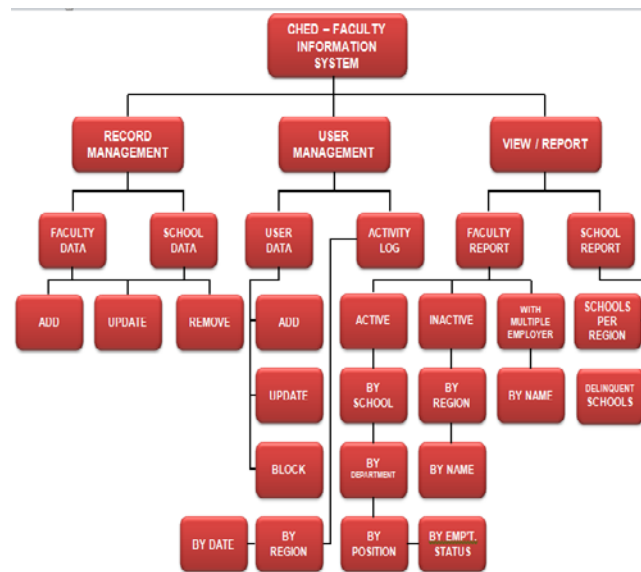

Fig. 3. HIPO Chart

Figure 3 illustrates an application of the model used by the system. The system is broken down into (3) three processes in the first level. Each process is composed of several sub-processes or functions. In records management, the faculty data and school data are required as input. The process in this level includes adding, modifying and deleting faculty, and school data. In user management, user data is required as input. Similar with records management, user management could add, modify, and delete user information. Likewise, the processes in this level include activity log, which could able to track user's activity by whom and when the system was accessed.

In report and view processes, it requires faculty data as input. The report function displays the status report of the faculty data by school, by department, by position, and employment status. Also in the same level, the schools per region and delinquent schools are also displayed. In addition, faculty data by school, by department, by position, and employment status report can be printed in this level.

4.2.2 Business Process Flow

To easily comprehend the information requirements of the users, we have to conceptualize first the behavior of data in an organization and its outputs [30]. The study utilized a structured analysis technique called data flow diagram (DFDs), and present a graphical representation of data processes in the organization. Below is the data flow diagram of the system.
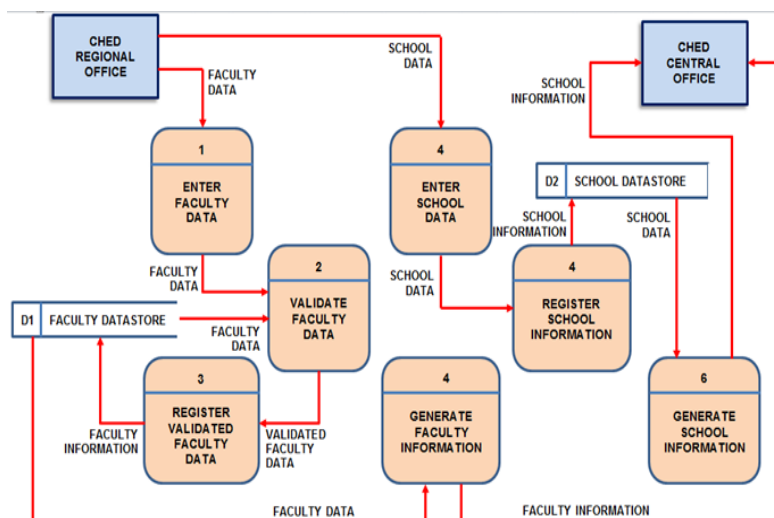
Fig. 4. Data Flow Diagram of the System

Figure 4 presents the interrelatedness of systems and subsystems. The system is composed of two external entities namely CHEDCO and the CHEDRO. Likewise, it is composed of seven (7) specific processes such as enter faculty data, enter school data, validate faculty data, register validated faculty data, register school information, generate faculty information and generate school information.

Enter faculty data is the process where the CHEDRO is entering faculty information into the system upon receipt of the faculty information from the HEIs. Upon entry, the name of the faculty will be validated and registered into the faculty data store. Validation of faculty information is the process for checking previous records of the faculty and its qualifications. Likewise, this is being done to determine whether a faculty member has a multiple position in numerous institutions. This process is the primary subject of the study. The enter school data is also a process of registering the basic information of the school. Generate faculty information and school information are the processes in which the system provides important reports of the faculty and school information.

4.3. Development of the Prototype / Software

This section discussed the system design modules in a more technical manner, that is, in terms of adata structures and representations, relationships among the functions performed and the data used.

4.3.1 Database Scheme

The study utilized a data model of the systems database including types of information to record in the database. This is composed of eight (8) associated tables such as the faculty information, educational background, activity log, region, school, user, new user request and floating faculty The Record_ID is the primary key that connects the faculty information table and the faculty educational background table. Faculty table were designed separately, because not all processes will include educational background. In addition, it will decrease the performance or speed of data during process if the educational background of the faculty will always be included in the entire faculty information queries.

Faculty information table is consists of relevant information of faculty who are qualified to handle the applied program. School table provides all necessary information about the school and its region. Faculty educational background table provides the various educational attainment of a faculty. The following degree earned in different level such as undergraduate courses, masters and doctorate degrees. Schools attended and the year graduated was included in the table to evaluate its validity in terms of course assignments. Activity log table displays certain information regarding the access security of the system. The date, time, the user, the school visited and the activity made by the user was included in the table to effectively monitor the behavior of the user. Region table stores the region code and the region name of the school. User table and new user request table, stores user information including his position and region. Finally, the floating faculty table is consists of relevant information of faculty who are no longer active in the service. The date terminated was included to monitor his length of services.

Systems primary function is to validate records as well handle queries of the faculty and school data. To have an efficient validation and queries, it utilized Multi-word MySQL Search algorithm. It is a simple alternative to using the FULLTEXT search feature of MySQL. The script automatically takes into consideration how many search words are in the search string which is submitted from the HTML search form. It then creates a MySQL query and executes it, displaying the results. You can easily edit the fields that the search script searches by changing the values in the $arrayFields array [32].

4.4 Software and Hardware Specifications

The systems were able to develop a prototype using these hardware and software requirements. Web pages were made for data entry and retrieval.

For the design and development of the prototype software, high-end computer unit was utilized. For the back-end of the prototype software, MySQL - relational database management system was used. Web pages were developed to accept formatted text. The software tools used for the Web application program are Hypertext Preprocessor (PHP), Hypertext Markup Language (HTML) and JavaScript. For the graphic and user interface design, Macromedia Dreamweaver and Adobe Photoshop were used.

For testing and implementation of the whole system, it utilized the cloud computing technology to deliver the information over the net. The CHED-FIS utilized a web service or "cloud service" which provides server space and file maintenance of the whole system. According to Olivier et. al. [7] almost every web service is already being dubbed a "cloud service," often purely for marketing reasons. On the other hand, Grossman [10] points out that cloud computing provides on-demand resources and

services over a network, usually the Internet, with the scale and reliability of a data center. The present study, utilizes the "cloud service" in a very limited manner, only to make the system accessible online.

5. Summary of Findings, Conclusions and Recommendations

This chapter presents the summary of findings, conclusion and recommendations of the study.

5.1. Summary

The study was able to develop the CHED Faculty Information System (CHED-FIS) which accepts faculty data and validates faculty information particularly position, employment status and school affiliation and determine whether the faculty is qualified as faculty member or as an administrative officer in the applied program. Other features of the system include adding, modifying and deleting faculty and school data, tracking user's activity, querying faculty and school data and generation of important reports.

Evaluation of the system was made by CHEDRO and CHEDCO personnel through questionnaire. Responses from the questionnaire revealed an overall weighted mean of 4.34 which means that the system has an excellent functionality, efficiency, usability, reliability, maintainability, portability and security. With these, it can be assessed that the system could be of big benefit to CHED and all the HEIs in the country in attaining its goals and objectives.

5.2. Conclusion

The Commission on Higher Education (CHED), which is the governing body of academic institutions in the Philippines, is mandated to rationalize programs and institutions of higher learning and set standards, policies and guidelines for the creation of new programs. By providing a central database of faculty and school records, it can aid its clientele to have the needed information in an instant and to enhance the effectiveness of their operation especially in decision making analysis and reporting. The CHED-Faculty Information System is indeed a realization of the said mandate based on the objectives set in an earlier section.

5.3 Recommendations

The CHED-FIS is a web-based system which needs to be updated, maintained and monitored by the system administrator. To be able to satisfy the importance of the system, the commission may impose a policy which will require academic institutions to update regularly their faculty and school information.

At present, the system requires a user to input his username and password to validate access level. Likewise, user information will be used in tracking activities while using the system. Additional security restrictions are recommended to effectively secure the data.

Also, to enhance the systems functionality, the commission may develop a Knowledge Management System to further improve the processes in allowing acquirement, distribution, organization, and integration of information in academic institutions.

Finally, the system could determine whether a faculty is holding position in numerous institutions. The CHEDRO and RQAT personnel therefore may be very careful in using the system to avoid misconception and false information.

To my beloved parents, siblings and most especially to my wife, who aided me in this endeavor, for her encouragement all throughout this undertaking; this project is simply impossible without them.

Above all, to the ALMIGHTY GOD for his blessings.

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Appendix A

LETTER TO RESPONDENTS

Technological Institute of the Philippines
GRADUATE SCHOOL
938 Aurora Boulevard,
Cubao, Quezon City

March 6, 2013

Dear Respondent,

The undersigned is a graduate student of the Technological Institute of the Philippines conducting a study entitled "CHED's Faculty Information System in Cloud Computing Infrastructure". The study aims to provide an information system which could help the Commission on Higher Education and Higher Education Institutions in the country easily and automatically inquire, update and generate valid and reliable information or reports needed in their respective undertakings.

In this regard, I would like to request from you to accomplish the attached questionnaire regarding the software quality of the system. Rest assured that all your responses will be held with utmost confidentiality.

Thank you very much.

Very truly yours,

(SGD)RONNIE B. SANTELICES
Researcher

NOTED:

(SGD.) DR. BARTOLOME T. TANGUILIG III
Adviser

Appendix B

SOFTWARE QUALITY EVALUATION
CHED's Faculty Information System in
Cloud Computing Infrastructure

Name (Optional): _____   Date: _____

Type of Respondent (Please encircle the number corresponding to your answer):   1. CHEDCO Personnel
                            2. CHEDRO Personnel

Direction: Please evaluate the developed system by using the given scale and placing a checkmark **(√)** under the corresponding numerical rating with respect to its sub-criteria. Each rating is quantified by the following.

5 – Excellent	2 – Fair
4 – Very Good	1 – Poor
3 - Good	

CRITERIA	RATINGS				
	5	4	3	2	1
FUNCTIONALITY					
1. The system is capable managing examination.					
2. The system can register student information.					
3. The system can validate examiners information.					
4. The system provides downloadable files.					
5. The system provides list of schools per region and list of delinquent schools.					
6. The system provides list of active and inactive faculty and faculty with multiple employers.					
7. The system accepts queries of faculty data by school and can be further specified by department, by position and by employment status.					
EFFICIENCY					
1. The system can validate data accurately.					
2. The system provides appropriate and useful data or reports.					
3. The system's pages loads quickly.					
4. The system's on page and off page links are working properly.					
5. The links to other pages within the system are helpful and appropriate.					
USABILITY					
1. The system has readable formatted text.					
2. The system provides simple and easy to follow directions.					
3. The system provides an easy navigation between pages.					
4. The system provides a user friendly interface.					
RELIABILITY					
1. The system provides accurate data on every query and validation.					
2. The system can generate reports consistently on every query					

	conducted.					
	PORTABILITY					
1.	The system can be accessed via capable mobile devices or desktop computer.					
2.	The system functions well in any browser of either capable mobile devices or desktop computer.					
	SECURITY					
1.	The system is capable of preventing unauthorized access.					
2.	The system provides a limited access level for the users.					
3.	The system provides a record of all user activities.					