The Model of a Unified Human Resource Management Application for Tertiary Institutions on the Cloud

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Abstract: ***In Cloud Computing, users connect to the 'Cloud', appearing as a single entity as opposed to multiple servers. This work presents to tertiary institutions a model for setting up a scalable and cost effective platform for institutional human resource management on the cloud with focus on academic staff. The real-time evolutionary prototyping methodology was adopted for this model because of its continuous modification feature. This model can be deployed on any cloud computing platforms that provides platform-as-a service like Force.com. The work involves the design of a flexible database structure using ERD diagram and flow charts.***

Keywords: Cloud, Computing**,** Application

1. Introduction

Cloud Computing is a new paradigm in Information Technology (IT). There are several definitions of the Cloud, ranging from very broad as almost everything on the Internet to the very narrow only concerning Virtualization on servers only [1].

The basic idea is that anything that traditionally is possible in computing can be shifted to the cloud; Communication, scientific computing, word processing etc. In their research Vaquero and other researchers, proposed the following definition:

Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization (Vaquero et al., 2009).

In Cloud Computing clients connect to the Cloud platform. The Cloud contains all of the applications and infrastructure and appears as a single entity to the user. Cloud Computing allows more efficient use of the resources by dynamically configuring resources to cater for changes in the demand for load.

1.1 The Internet vs. the Cloud

The researcher sees the cloud as a concept that is similar to the internet in operation but not same as the internet in principle and usage. The cloud platform runs on the internet platform in that the distributed servers that host application are connected to the internet. In operation, the cloud makes use of its distributed database servers operating as a single entity [3]. Figure 1.1 shows a typical structure of a cloud computing environment

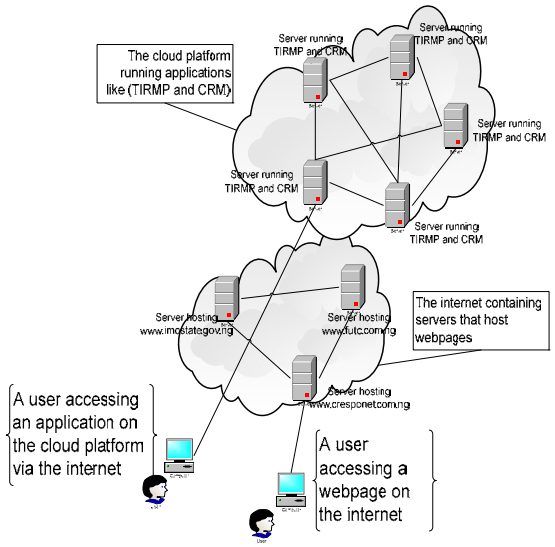

Figure 1.1: The Internet and the Cloud Platform [3]

1.2 Statement of Problem

Traditionally, Human resource management has always been carried out using hard copy documents and in recent time, software application. One of the challenges these approach has include the cost and technical skill required to manage local servers/computers running these applications, the associated cost of maintenance and security challenges associated with this methods. Another big disadvantage of using software is the need for continuous update as the size

and nature of institutions human resources keeps changing with time.

1.3 Objective of Research

Tertiary institutions need a centralized application that can aggregate all of its academic staff records together and commissions need an application that can aggregate several institutions record for managerial ease. The approach to solve this problem as presented in this paper is to leverage on an existing cloud platform to build a human resource management application.

This study intends to provide a structure that will enable an institution manage its Human resource particularly academic personnel using a cloud platform.

2. Literature Survey

A cloud is first a platform born from the internetworking concept. It provides easily usable resources to its subscribers on a pay as you use basis or on a user agreement level in a situation where organizations come together to put up the cloud platform for their joint benefit. A cloud as the name imply can span over small to large geographical areas and even the entire globe as being seen today.

2.1 Utility Computing

Utility computing is a service provisioning model in which a service provider makes computing resources and infrastructure management available to the customer as needed, and charges them for specific usage rather than a flat rate [4].

Utility Computing is a concept established by John McCarthy, who predicted already in the late 1960s that "computation may someday be organized as a public utility", such as it happened with electricity. This statement was a ground-breaking step but not further followed by that, as hardware and software capabilities could not meet this vision. As soon as the technology was not an issue anymore to fulfill the idea of providing computing resources as a service, utility computing has found its way to be realized in outsourcing providers and also cloud computing [5].

2.2 Distributed Computing

Distributed computing refers to the very idea of using distributed systems that are generally multiple computers connected to each other via computer networks to collaboratively process a common goal. Those computers communication can be homogeneous or heterogeneous, distributed globally or locally. According to the characteristics of localization or equality, distributed systems have different subsets, such as supercomputers, grids, clusters, web 2.0 and clouds [5].

2.3 Cluster Computing and supercomputers

A cluster is a type of parallel or distributed computer system, which consists of a collection of interconnected stand-alone computers working together as a single integrated computing resource [6]. Clustering these stand-alone computers together has resulted in high-performance, high-availability, and high-throughput processing on a network of computers at a much lower cost than traditional supercomputing systems, thus resulting in cluster computing being a more viable choice as a supercomputing solution [7].

Supercomputers can be easily compared to clusters, because it follows the same concept, except the fact that it is merged into one box already and is not locally interconnected with other machines [8].

2.4 Grid Computing

When defining grid computing it is necessary to differ it from clusters. While clusters are distributed locally and obliged to use the same hardware and OS, grids involve heterogeneous computers that are connected to each other and distributed globally. The OS and hardware that run on those machines can also be different from each other [7]. The computers that are interconnected over the internet can come from anywhere while there is usually no obligation to pay. For this reason already it is obvious that grids being connected are not nearly as expensive as the supercomputers that are offered from IBM and other technology companies.

The aim of Grid computing is to enable coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations [8].

2.5 Cloud Computing

Cloud Computing is a new paradigm in Information Technology (IT). The basic idea is that anything that traditionally is possible in computing can be shifted to the cloud; Communication, scientific computing, word processing etc.

2.6 Cloud Architecture

Cloud computing architecture consist of two components “**the front end**” and “**the back end**”. The front end of the cloud computing system comprises the client’s device (or it may be a computer network) and some applications are needed for accessing the cloud computing system. The back end refers to the cloud itself which may encompass various computer machines, data storage systems and servers. A group of these clouds make a whole cloud computing system. The whole system is administered via a central server that is also used for monitoring clients demand and traffic, ensuring the smooth functioning of the system. A special type of software called “middleware” is used to allow computers that are connected on the network to communicate with each other. Cloud computing systems also must have a copy of all its clients’ data to restore the service which may arise due to a device breakdown; making a copy of data is called redundancy [9].

2.7 Cloud Deployment models

Deploying cloud computing can differ depending on requirements, the following four deployment models proposed by the Dialogic Corporation have been identified, each with specific characteristics that support the needs of the services and users of the clouds in a particular ways.

These models include Private cloud, Community cloud, Public cloud, and Hybrid cloud [10].

2.7.1 Private Cloud:

The cloud infrastructure has been deployed, and is maintained and operated for a specific organization. The operation may be in-house or with a third party on the premises. The private cloud is also referred to as internal cloud or on-premise cloud, a private cloud intentionally limits access to its resources to service consumers that belong to the same organization that owns the cloud.

2.7.2 Community Cloud:

The cloud infrastructure is shared among a number of organizations with similar interests and requirements. In this case, organizations come together to setup a cloud for their common interest. Each organization has access to the platform based on their contributions to the overall setup of the cloud system. This may help limit the capital expenditure costs for its establishment as the costs are shared among the organizations.

2.7.3 Public Cloud:

The cloud infrastructure is available to the public on a commercial basis by a cloud service provider or in some cases the government. This enables a consumer to develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options. It is also known as external cloud or multi-tenant cloud, this model essentially represents a cloud environment that is openly accessible.

2.7.4 Hybrid Cloud:

The cloud infrastructure consists of a number of clouds of any type, but the clouds have the ability through their interfaces to allow data and/or applications to be moved from one cloud to another. This can be a combination of private and public clouds that support the requirement to retain some data in an organization, and also the need to offer services in the cloud.

2.8 Cloud Computing Services

Many different types of services that can be delivered in the various cloud deployment environments exist [10]. Essentially, any IT resource or function can eventually be made available as a service. Although cloud-based ecosystems allow for a wide range of service delivery models, three have become most prominent:

2.8.1 Infrastructure-as-a-Service (IaaS):

This service delivery model represents a modern form of utility computing and outsourced managed hosting. IaaS environments manage and provision fundamental computing resources (networking, storage, virtualized servers, etc.). This allows consumers to deploy and manage assets on leased or rented server instances, while the service providers own and govern the underlying infrastructure.

2.8.2 Platform-as-a-Service (PaaS):

The PaaS model refers to an environment that provisions application platform resources to enable direct deployment of application-level assets (code, data, configurations, policies, etc.). This type of service generally operates at a higher abstraction level so that users manage and control the assets they deploy into these environments. With this arrangement, service providers maintain and govern the application environments, server instances, as well as the underlying infrastructure.

2.8.3 Software-as-a-Service (SaaS):

Hosted software applications or multi-tenant application services that end-users consume directly correspond to the SaaS delivery model. Consumers typically only have control over how they use the cloud-based service, while service providers maintain and govern the software, data, and underlying infrastructure.

2.9 Benefits of Cloud Computing

Cloud computing provides a wide range of benefits which range from the reduction in the upfront capital expenditure on hardware and software development to the pay-as-you use billing system like phone bills. This enable user terminate contract at any time. Some of the possible benefits cloud computing offers it users include but not limited to the following:

2.9.1 Cost Saving:

Companies can reduce their capital expenditure and use operational expenditures for increasing their computation capabilities. This is a lower barrier to entry and also requires fewer in-house IT resources to provide system support.

2.9.2 Scalability/Flexibility:

Companies can start with a small deployment and grow to a large deployment fairly rapidly, and then scale back if necessary. Also, the flexibility of cloud computing allows companies to use extra resources at peak times, enabling them to satisfy consumers demand.

2.9.3 Reliability:

Services using multiple redundant sites can support business continuity and disaster recovery.

2.9.4 Maintenance:

Cloud service providers do the system maintenance, and access is through APIs that do not require application installations onto PCs, thus further reducing maintenance requirements.

2.9.5 Mobile Accessible:

Mobile workers have increased productivity dir to systems accessible in an infrastructure available from anywhere.

3 Previous Work

Increasingly, the information we use to manage our companies is moving to the cloud, and human resources is no exception. Here are several solutions that provide simple and affordable online employee management and tracking to save you time, money and effort.

Human Resource Information System (HRIS) is a system (typically a software or online solution) for the data entry, data tracking, and data information needs of the Human Resources, payroll, management, and accounting functions within a business [11].

Existing HRIS Paper based system Software based Human Resource Management System Drawbacks Slow and inaccurate. Extracting information from paper based system is slow and can get bulky, misplaced or even lost. Existing computer/software based HRIS is outdated and not managed properly. Data are stored but no processing done in most cases. Computerized data lost (due to lack of backup system) - producing inaccurate data to the managers. [11]

TribeHR is one of the more robust platforms of all the options, providing many HR management tools in one app. TribeHR can carry out vacation/leave tracking, employee development, employee notes and feedback, shared resources, job posting and reports [12]. Other human resource management cloud apps include BambooHR, Effortless HR, iEmployee [12].

4 Method/Approach

Resource management has become a key issue in every institution especially as expansion is inevitable. In solving the problems facing Human resource management, several interactions was made with high level officers within the higher institutions, and other staff members especially registrars or rectors, information departments, and the heads of departments and deans of studies among others. A thorough study of the existing paper system for appraisal of staff and collection of staff records was also made. An overview of available software applications and web pages being used was also perused to provide enough ground to develop a robust cloud application that will swallow all of the functions required for proper Human resource management with particular attention on academic staffs.

4.1 The Real Time Evolutionary Prototyping Design Methodology

The real time evolutionary prototyping model is a system development model proposed by the researcher for the development of cloud based applications [2]. In this model the system is tested on the fly as it is being designed. The system design process continues even after deployment or better still the design process is done on a deployed mode. Figure 3.1 shows the real time evolutionary prototyping process.

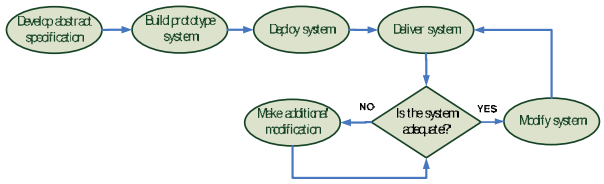

Figure 4.1: Real Time Evolutionary Prototyping Model [3]

The real time evolutionary prototyping is basically used for systems that are continuously modified even when delivered or deployed on the web. Continuous modification is a process that never stops even when the system is delivered. The process takes into consideration the fact that technology keeps changing with time, and there is a need to keep up with this changed by adopting a flexible system that can be modified continuously.

The real time evolutionary prototyping model possesses the advantages of the prototyping model with the additional advantage of online continuous modification after deployment.

4.1.1 Developing the Abstract Specification:

In developing the abstract specification, the existing system is studied and a structure is drawn for the new system. This process also involves interaction with persons the system is intended for to ensure that salient fields are captured. The entity relationship diagram (ERD) is built for the system after determining the tables and fields for the application.

4.1.2 Build the Prototype System

Here the system is built on the required platform. The ERD diagram is used to build the various application interfaces and interlinked to achieve set requirement. Security features are also configured at this stage.

4.1.3 Deploy System

The system is deployed at this stage. For systems that are deployed while in development process, this stage is superimposed on the previous stage i.e. the 'build the prototype system' stage. Ones the system is deployed, usage begins.

4.1.4 Deliver System

The system is delivered to the user and comments and inputs taken into consideration for modification.

4.1.5 Make Additional Modification

As inputs are made additional modification takes place on the system and this modification is seen by the user.

4.1.6 Modify System

If the system is adequate, the developer still has the system at his or her disposal for further modification in the future, as the need arises. This modification, range from the overall

look of the system to system capacity and addition of modules not previously taken into consideration.

4.2 UTIHRMP complete system

The unified Tertiary Institution Human Resource Management Platform (UTIHRMP) complete system is as shown in figure 4.1 below. The system consist of campus area network (CAN), connecting to the internet cloud (salesforce) via the Internet service provider (ISP).

The CAN consist of 4 basic section as illustrated in the diagram; the internal user, the access layer, the distribution layer, the core layer and the gateway. Each of these subsystems will be discussed in more detail latter on in this chapter.

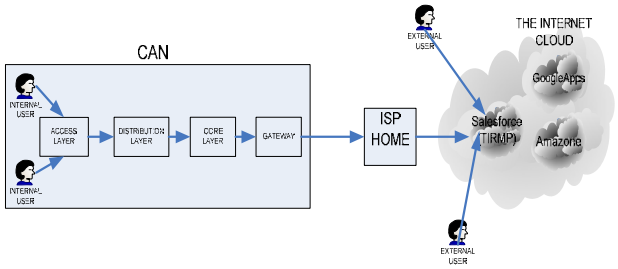

Figure 4.2: UTIHRMP complete system including CAN.

4.3 Database Implementation

The UTIHRMP database is made up of tables (objects) and fields (attributes) that represent different Figure 4.2 shows an Entity relationship Diagram (ERD) for academic staffs within an institution. This diagram can be modified at various points depending on its point of application. From the ERD eight tables can be generated to capture staff information online using forms.

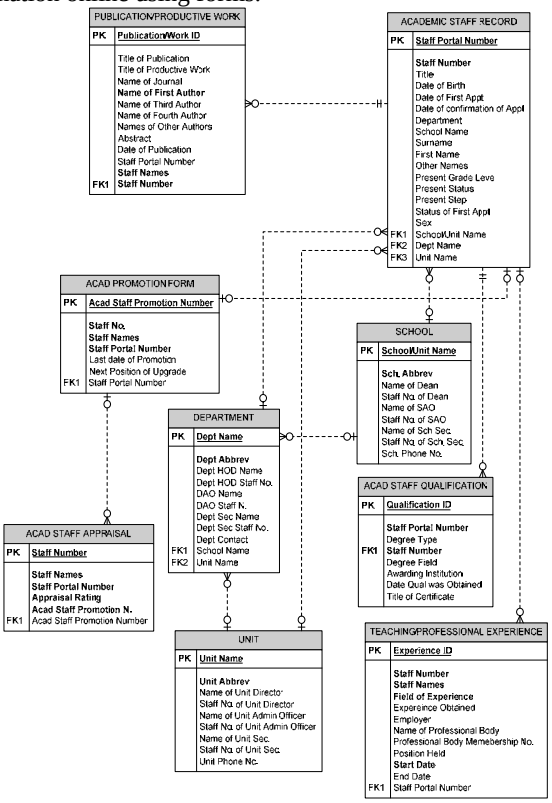

Figure 4.3: ERD diagram of Academic personnel.

4.4 Platform Development

The platform development was done using the force.com cloud computing platform. The Platform development is strictly an online developmental process. This is one of the great advantages of using cloud computing as applications are deployed as soon as they are being developed. Thus from the start of the development process testing can begin and development can be done on the fly with no restriction to location. Another great advantage provided by the platform for development it that collaboration on the design of a particular application by several users with their separate task integrated into the overall system. The development process is coordinated by the lead design administrator.

4.5 Design Flow chart

The following sections illustrate in a flow chart the activities that can be performed on personnel section of the TIRMP platform. The activities include

a. Register new user
b. User login
c. Appraisal/ promotion

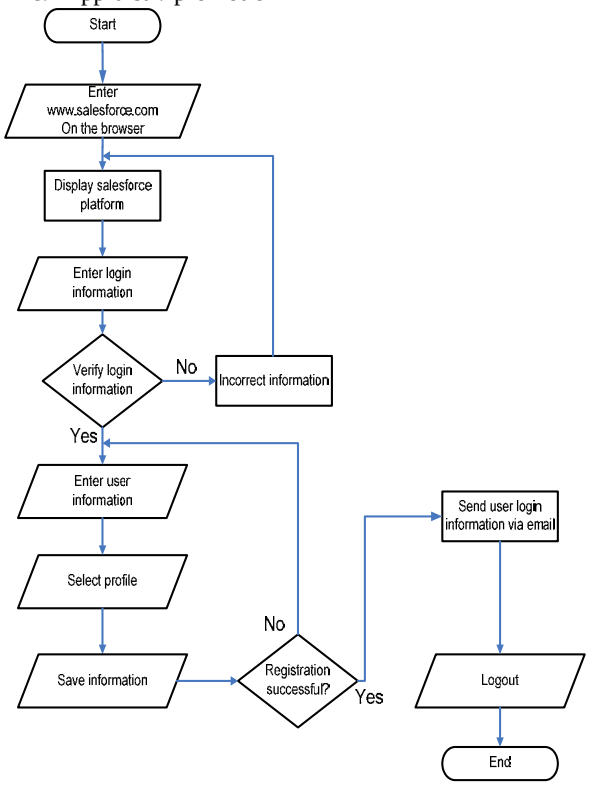

Figure 4.4: Registration Flow Chart

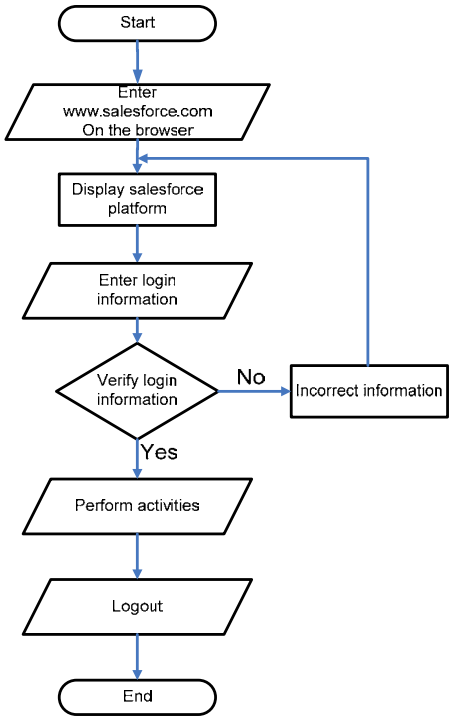

Figure 4.5: User Login Flow Chart

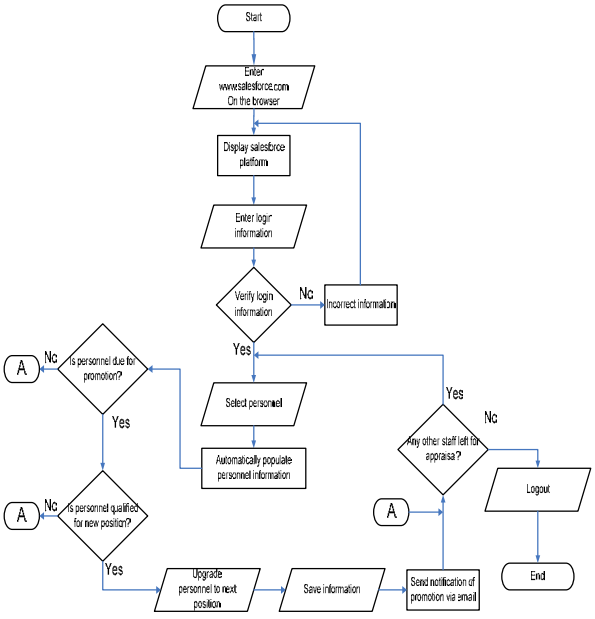

Figure 4.6: Appraisal/Upgrade form

4.6 Implementing Security and Roles

The UTIHRMP app is used by all personnel's of the institution thus the need for roles and privileges to be implemented. To assign roles and privileges on the platform, the organizational structure of the institution need to be taken into consideration. the following are some the level of access on the platform according :

Table 4.1: Table Showing the Various Profiles on the UTIHRMP

Serial Number	*Type of user*	*Officers*
1	Executive user	Executive council members and the Vice Chancellor
2	Principal users	DVC acad, DVC admin, Bursar, Registrar, Liberian,
3	Unit users	Unit heads
4	Sub unit users	Unit coordinator
5	School users	Dean
6	Departmental	HOD
7	Administrative	DAO,SAO
8	Standard users	Academic staft

5 Result and Discussion

The UTIHRMP has seven basic users as already presented in in previous sections of this work of this work. The executive user creates the principal users and the principal users particularly the registrar creates the Admin users. The admin users are responsible for creating staff users at their various levels. They are restricted to their schools, units or departments.

The platform is designed such that a staff member i.e. the standard user at the lowest level of the hierarchy can access their records on the platform but are not permitted to edit all of them at will. Some areas of the platform are however available for the staff personnel to edit like the publication and productive work session. Their submissions however on this note will have to be verified based on hard copy document submitted to their appraisal heads before these entries are authenticated.

Once a platform user is registered, his login email and password is immediately emailed to him. The user simply logs into to the platform using his email and password via the platform address.

The platform is scalable i.e. it can be expanded with increase in users and can accommodate several institutions with a common structure.

5.1 Sample Forms Generated

This section shows selected forms generated using the ERD on salesforce platform.

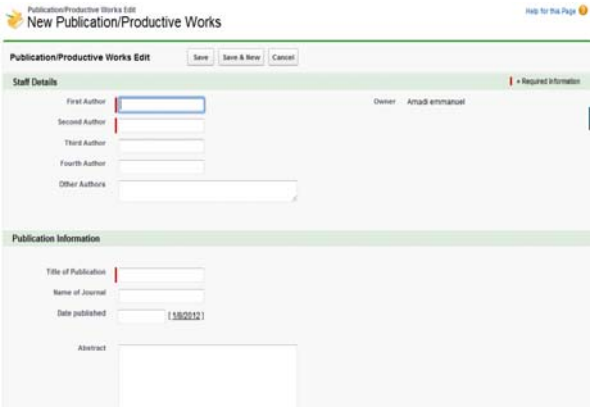

Figure 5.1: New Publication/Productive work form

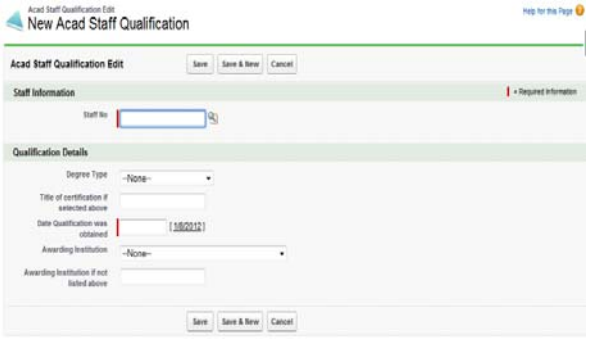

Figure 5.2: New Academic staff Qualification form

5.2 UTIHRMP Reports

This session displays some reports that are generated on the TIRMP platform using test data. On the TIRPM platform various reports of records can be generated using filters, field specification. These reports can thus be used to take decisions and also record institutional performance based on staff content. Table 5.1 shows one sample of a drill down report of Staff details

Table 5.1: Drill down Summary of Academic Staff above 40years

Title	*Surname*	*First Name*	*Acad. Staff Record: Staff Number*	*Date of Birth*
Prof	Nguzo	Chuka	SP3321	04/10/1951
Prof	Apkan	Eronini	SP7771	02/07/1961
Prof	James	Ukaga	SP8881	01/07/1959
Dr	Mary	Ekenta	SP2223	01/07/1955
Mr	Ajoku	Peter	SP2224	04/07/1957
Acad Staff Record Report				
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6 Conclusion

The UTIHRMP provides a platform on which an institution can manage its resources on a virtual environment with less physical infrastructure and scalable bandwidth utilization. The UTIHRMP focused on the **Academic Staff records** of an institution**.**

This interface can be adopted to suit any higher institution with little or no adjustments on the design interface. The Forec.com cloud computing platform was used as the cloud service provider.

This work provides a model database structure of key personnel information using ERD and how these information is keyed onto the cloud platform using tables and fields. Other relationships, roles and security features are also configured on the platform. The Personnel data structure of the Federal University of Technology, Owerri, Nigeria was deployed on the platform for the testing process

7. Future Scope

Cloud computing is a new paradigm in information technology and as such there is a need for researched to delve into this field of study to develop it further. For the development of the UTIHRMP, the following are my recommendation:

The development of cloud computing app should be done as a team as ideas sheared brings out the best from an application. This work should be expanded to include other resources within the institution

The rollup summary, security features and roles should be further modified and enhanced. In subscribing for cloud space, all the institution in a particular country can come together under a unified body and subscribe for the unlimited package as this will greatly reduce running cost. The unlimited version has no limit to number of apps or storage space.

In developing the app internet connectivity should be up and running to best performance in the development process.

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