Towards Designing a Model for University Environment Activities

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ABSTRACT

Automating the university activities is one of the greatest challenges most university management have been facing for the past decade as the global economy goes online. This research is aimed at designing a workable AUS model for integrating her activities using AUSFunction. An algorithm showing the steps of implementation is also presented.

Keywords – University, environment, activities, Model, Workable and Nigeria.

1. INTRODUCTION

Automating the University environment activities involves organizing all university processes in an integral computerized system for adequate management of university resources. Automating both academic and administrative activities include among others introduction of online application, course registration, fees payment, admission and result checking, intra office transactions; through the University’s e-portal with intention of making the whole processes easier, faster and fascinating to both staff and students. Study has shown that many pretty good efforts to automate university environment activities have in most cases fail to yield expected result due to incomplete automation of the university processes, most of the processes are partly manual and partly automated. For instance, in admission process, after the screening exercise, it takes quite some time for individual departments to collate their admitted students before the list is sent to ICT department for uploading.

There is an intense need for communication and co-operation between administrative staff and departments because most of the departmental resources like students’ course registration, result processing, staff and students management have to be partly managed by one or the other group (Idogho et al., 2011). This can only be achieved by integrating all university’s activities in an automated system. To achieve this, this work addresses problems which to the best of our knowledge have become central to the university system since the past decade: ‘How to automate and integrate the university activities better, as the global economy goes online’.

This study introduces a new function known as AUSFunction for resolution of issues associated with integrating the complex activities, and solve the problem incumbent in using Object Relational Database Management System (ORDBMS) to solve complex system program needs. The rest of the paper is structured thus, Section 2 Review of Related Work, Section 3.

AUS Model and Section 4 AUSFunction Algorithm.

2. REVIEW OF RELATED WORK

The Nigeria University Management System (NUMIS) was a child of collaborative development of some local Universities, Nigeria University Commission (NUC) functionaries and external consultants. (Uwadia et al., 2002, Daoleng et al., 2010). In literature, it was recorded that Initial attempts made by individual Universities to automate library activities in the mid-1970s and 1980s experienced great failure. The failure was greatly attributed to lack of technical knowhow relating to software development and maintenance of hardware, and inadequate funding (Alabi, 1987; Ife buzor, 1977). However, the TINLIB (developed by Information Management Engineering Limited) and CDS/ISIS (freely distributed by UNESCO) also did not last. (Adeyemi, 2002).

Abdulraheem and Muta, (2005) revealed that the Federal Universities’ Bursary departments were at various stages of automation. It was only the University of Nigeria Nsukka (UNN) that had completely implemented the finance modules covering final accounts and payroll, and was moving to computerize the finance records of the university’s fixed assets out of the federal Universities using the NUC-recommended computerized accounting system (CAS).
Iyabo and Adewuyi, (2012) revealed that several factors including the number of functions, size and locations of the end-user population and the number of systems to be integrated into the portal determine the size and complexity of a portal project.

Nigerian University portals are averagely designed. According to Abdulhamid and Ismaila, (2010), they fail to avail themselves the functions of a well-designed portal. Ramakrishnam et al., (2003) reported that object database system have developed along two distinct paths namely; Object Oriented Database System (OÖDS) and Object Relational Database System (ORDBS).

3. AUS MODEL

- **AUS operational structure**

![Figure 1: Modular Operational Structure](image)

University activities are set of related processes (or tasks), for instance, recruiting (engaging the service of a new person into the university system) is a university activity that involves tasks or processes such as advertising for job positions, collection/screening of applicants applications, shortlisting/interview, issuing of appointment and deployment of employee to office of primary assignment. The resource need for the activities can be people, stationaries, media (external organisations) and information access rights. The relationships connecting the activities into a process are usually timely. For example, if an applicant is communicated to come for interview, the letter conveying this message must reach the target in time to enable him/her prepare and meet up with the interview time.

- **Model And Problem Specifications**

  **Overview:**
  The goal of this research is to model university activities consisting of several related tasks.

  **Assumptions:**
  1) Each activity requires some resources to commence.
  2) An activity completes when all its sub-activities completes.
  3) Values of a given activity are discrete and number of values bounded, e.g. scores. $0 \leq s \leq 100$.
  4) Each activity considered have the following basic properties:
     a) For each activity, there is a number of resource choices (e.g. many applicants to be selected from).
     b) The activities are related to each other in some important dimensions (e.g. a student offers several courses, and a course is registered for by a number of students).
     c) Resources must be chosen for each activity.
d) The total usefulness of the university activities integration to the staff/students is a function of:
   i) The fitness of the chosen resources with respect to a specification.
   ii) The degree to which activities relationships are satisfied in holistic view.

- **Resource Constraints**
  Each resource used in a university activity often needs to satisfy some constraint. E.g. student’s admission exercise is required to start and end on a specific day. This may be adjusted due to constraints that can change management decision. It may be possible and desirable to define a function that compares resources as options for a given activity, e.g. posting of non-academic staff to various units of the university can be defined by head of unit’s choice for a staff against the others.

- **University System Organogram**

  ![University’s Structural Organogram](image)

  Figure 2 University’s Structural Organogram

- **Relationships**
  Due to the complex nature of the university activities, some resources are meant to service multiple activities, some activity must start and end before the take-off of another activity, while some must go on concurrently, e.g. admission must be completed before clearance/registration for a given set of new intakes. In this research, different types of relationships are employed for different set of activities, ranging from binary to multiple relationships. Binary relationships can be modeled using the function, \( \theta : y_2 \ast y_2 \rightarrow R^+ \), where \( y_1 \) is admission and \( y_2 \) stands for clearance/registration. Here semantics of a problem are mapped to algebraic specification.
Modelling University Activities

Let X be a universal set of a University system that it is made up of components such as campuses, faculties, departments and sections/units in which campuses are direct subset of X (University). This can be represented as:

\[ X = \{ c_1, c_2, \ldots, c_n \} \quad \ldots \quad (1) \]

Where \( c_1, c_2, \ldots, c_n \) represents campus1, campus2, ..., campusn respectively are elements of X.

The function \( g(X) \) is a set of a University system containing campuses as its elements, that is

\[ g(X) = g\{ c_1, c_2, \ldots, c_n \} \quad \ldots \quad (2) \]

campus in turn contains faculties as its subsets. Representing faculty with f,

\[ C = \{ f_1, f_2, \ldots, f_n \} \quad \ldots \quad (3) \]

and

\[ g(C) = g\{ f_1, f_2, \ldots, f_n \} \quad \ldots \quad (4) \]

On the other hand, faculty \( F \) is a super set of departments here represented as \( d_i \) where \( i \) is values 1 to n.

So set

\[ F = \{ d_1, d_2, \ldots, d_n \} \quad \ldots \quad (5) \]

And

\[ g(F) = g\{ d_1, d_2, \ldots, d_n \} \quad \ldots \quad (6) \]

\[ D = \{ u_1, u_2, \ldots, u_n \} \quad \ldots \quad (7) \]
u represents units/sections within a department which are sometimes regarded as course of study in academic departments.

The university set and its components shown in the mathematical set theory in Equation (1 to 5) are pictorially depicted in University Structural Organogram in Figure (3).

Staff and Students Echelon shows all who are involve in carrying out university activities. The echelon defines authorities and responsibilities assignment to individual group.

- **The University Activities Components:**
  1. Visual Management Information System (VMIS)
  2. Visual Finance Management System (VFMS)
  3. Visual Human Resources Management System (VHRMS)
  4. Visual Office System (VOS)
  5. Visual Student Information System (VSIS)
  6. Visual Library System (VLS)
  7. Visual Law System (VLAWS)
  8. Visual Medical System (VMS)
  9. Intra Mail and Intra Messenger (INTRAM/M)
  10. News and Events

The integration of all these activities forms an integral system of University. These set of activities (referred to as A) are modeled into AUS 3-tier structure as shown in Figure 4.

![Figure 4 AUS 3-Tier Architecture Model](image-url)

The AUS 3-tier Architectural Model consists of:
- **AUS Data Model:** Data connectivity, request validation and categorization is carried out in this model and reply returns back to user via the response line. Synchronization of data between AUS database and AUS entities (object) is done anytime there is connection between the database server and the webserver hosting the AUS applications.
• **AUS Application Model:** This model represents the activities automation solution for universities systems which consist of the user’s interface through which requests are made and responses are received. The Middle-tier communicates with both the User-tier and Data-tier to ensure that requests made by users are responded to promptly by targeted resource.

• The User-tier (AUS Application model) showing the logical /relational operations of the AUS modules (which form the set of activities that make up the whole system’s activities).

Considering A as set of university’s activities carried out in i campuses/colleges; grouped into j subsets of activities known as modules (VMIS, VFMS,VHRMS, ....,VMs), are allocated to number of users’ group according to staff/students Echelon k, where i, j and k have values 1 to m, 1 to l and 1 to s respectively.

[Figure 5: Use Case Class diagram of the AUS Operational Structure]

AUS security is modeled from the overall activities of the institution alongside with the staff/students ranking echelon and office responsibility. Since activities are assigned mainly to and not the individual, deployment of staff to an office is a function of his/her capabilities in line with his/her rank. For example, the vice chancellor cannot be appointed to a non-academic staff, no matter what; a non-medical personnel even as a professor as the director of health.

Another consideration is the external contracts/transactions with the university. For instance, there must be direct link to the banks that are doing business with it for efficient accounting, like fees payments and salary payment reconciliation.

AUS security is modeled in modular classes, in roles (grouped into users with equal access rights) and user profile for resources access permission from the three tiers, using users ID, password, role, rights and biometry depending on how critical the activity may be.
AUSFunction

This function solves the problem of access interruption at the database server breakdown by mirroring the database; it provides virtual database and connectivity for users’ data need, for continuity and synchronizes when connection is re-established. Mapping Sequential Language (MSL) (which consists of Conceptual Schema Description Language (CSDL) and Stored Schema Description Language (SSDL)) was used by AUSFunction to map the Entities and Entity associations of AUS Entity Data Model(EDM) to Relations and their relationships in the AUS Database (DB). These relations’ tuples are appended, updated and deleted by synchronizing it with stored data of entities in AUS EDM.

The function process:

Let \( R \) be set of relations in AUSDb, \( r \in R \) and \( n(R) = l \)
Let \( E \) be set of entities in AUSMDB, \( e \in E \) and \( n(E) = j \)
Let \( T \) be set of tuples in AUSMDB, \( t \in T \) and \( n(T) = k \)
Let \( A \) be set of attributes in AUSMDB, \( a \in A \) and \( n(A) = b \)
Let \( C \) be set of columns in AUSDb, \( c \in C \) and \( n(C) = c \)
Let \( PK \) = primary key and \( fk \) = foreign
Let \( Db = AUSUb \) (University database)
Let \( MDB = AUSMDB \) (University mirrored database)
Let \( P \) be set of parameters, \( p \in R \) and \( n(P) = g \)

\[
\text{AUSfunction}, f(p_i) = \{ f(p_1), f(p_2), \ldots, f(p_n) \} \ldots \ldots (8)
\]

\[
\text{for } n \text{ number of relations / entities.}
\]

\[
M_{p_i} : \ p_i(E) \leftarrow p_i(R) \ldots \ldots (9)
\]

where \( M_{p_i} \) maps all parameters of entities \( (e_j) \) to parameters of relation \( (r_k) \)

Creating, appending and updating by relating two similar items of same properties and values with their date.

\[
\text{if } f(p_i) < 0 \text{ Then } (\Rightarrow p_i(E) \leftarrow p_i(R))
\]

\[
f(p_i) = M_{p_i} : p_i(E) \leftarrow p_i(R) \ldots \ldots \ldots \ldots (10)
\]

all relations in \( R \) will be replicated and converted to entities and association of same properties in \( E \).

\[
\text{Else if } f(p_i) > 0 \text{ Then } (\Rightarrow p_i(E) \leftarrow p_i(R))
\]

\[
f(p_i) = M_{p_i} : p_i(E) \leftarrow p_i(R) \ldots \ldots \ldots \ldots (11)
\]

(all entities and Association in \( E \) will be replicated and converted to relations and relationships of the same properties in \( R \))

\[
\text{Else if } f(p_i) = 0 \text{ Then } (\Rightarrow p_i(E) = p_i(R))
\]

\[
f(p_i) = M_{p_i} : p_i(E) \xrightarrow{\text{Append, and Update}} p_i(R) \ldots \ldots \ldots \ldots (12)
\]

(Appends new records, and update existing ones from \( p_i(E) \) in \( MDB \) to \( p_i(R) \) in \( Db \))

4. CONCLUSION

AUS Model was a three tiers system architectural model that implements the AUSfuncton as a connector as well as users data provider. This model was designed to surmount the challenges of implementing complex systems with Object Relational Database Management System (ORDBMS), and meet the set objectives, which is to proffer solution to the problems of integrating University’s complex activities to achieve timely and accurate construction and sharing of information and knowledge in the Nigerian Universities.

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REFERENCES


