

**DOCUMENT INTERCHANGE MODELING WITH THE ZACHMAN
FRAMEWORK: NIGERIA'S INSTITUTIONS IN PERSPECTIVE**

Nwankwo Wilson*, Olanrewaju B. S. and Olayinka T. C.

Department of Computer Science, Wellspring University, Benin City, Nigeria.

Article Received on 18/12/2017

Article Revised on 08/01/2018

Article Accepted on 29/01/2018

***Corresponding Author**

Nwankwo Wilson

Department of Computer
Science, Wellspring
University, Benin City,
Nigeria.

ABSTRACT

This paper is part of a study aimed at evolving a platform-independent distributed document interchange system to ease the challenges associated with the information flow cycle between Institutions of higher learning and their prospective candidates especially during verifying and validating academic documents submitted to such

Institutions by the candidates. The first part was the proposition of an interchange framework wherein the basic foundations and principles of document exchange were laid down. This study exploits the Zachman framework for Enterprise and Information Systems Architecture. The proposed model ensures that each Institution could implement its information system in such a way that it could exchange requests and verification information directly with a system owned or managed by another institution over a public network such as the Internet with little or no involvement on the part of the candidates. The model is cost-effective and sustainable in the Nigerian environment owing to its being built on existing infrastructure with ease of integration into an existing independent information system.

KEYWORDS: Document exchange, Interchange framework, Information Systems Architecture, Zachman framework.

INTRODUCTION

A document is the main information medium in corporate environments and a key aid in the integration of office functions.^[1] Document processing and transmission are vital

procedures in any administrative system, educational sector inclusive although what constitutes a document is usually a matter of specification for the requesting party or authority.^[2] Document interchange among various categories of tertiary institutions is common and also vital in all segments of the educational sector. There may be the need for a candidate enrolled in a program to seek a transfer to another Institution or admission to different institution for higher degree or study. In such cases, the candidate in question may be required to transmit his personal and academic documents to the proposed institution for evaluation and subsequent processing.

Exchanging information with another party especially in paper-based format is susceptible to errors, easy distortion, loss in transit, time-consuming and economically expensive owing to the deterioration of public postal services and the high-handedness of private courier services. This could mean substantial losses to the business of the affected party, and where such information is so sensitive and highly confidential; it may pose serious security risks when it gets into the hands of the wrong person. In order to boost efficiency and simplify the workflow in educational administration, electronic data exchange with secured layers of securities has shown enormous potentials in the last decade.^[2] For instance, the document interchange between open systems has been standardized by office document architecture (ODA) and office document interchange format (ODIF).^[3] Exchange of structured document among Nigeria's tertiary institutions as examined by^[2] is described as follows

“It may be safely submitted that exchange of vital information across tertiary institutions in Nigeria is next to zero as there is no formally established information sharing framework that interfaces or controls information exchange among tertiary institutions especially as it affects structured documents. E-mail appears to be the commonly used electronic medium of exchange. However, electronic mail is bedevilled with such issues as security, content, and incoherent structure. As a result, information to be passed through e-mail is not usually considered safe and secure. The odd practice still remains that a student who seeks admission in one tertiary institution would be required to initiate a process to have his previous academic profile or transcript processed by his former institution and forwarded usually by post to the new institution to which he/she seeks admission. For instance, a graduate of University of Lagos who wishes to undertake a post-graduate study at the Federal University of Technology Owerri will be required to initiate a process to have his transcript processed and sent by University of Lagos. This often creates bottlenecks as well

as confidentiality issues. Since the student must pay for the transcript, and in some cases must ensure that the said transcript or document gets to its destination within the stipulated time, there is the existence of “man in the middle” which usually subjects the entire process of document exchange to manipulation. To this end the very purpose of verification may be defeated”.

Considering the perspective of^{f2]} document exchange in Nigerian tertiary institutions as presented above, it is evident that developing a simplified and well-explained uniform electronic document exchange system for use by Nigeria’s tertiary institutions is justified.

II. Statement of the Problem

Several problems have been identified in the information flow as it affects the traditional transmission and processing of documents following the demand for such documents by Institutions of higher learning in respect of candidates seeking to be enrolled in such Institutions. These problems include delays in sending the documents by the certifying Institutions, high cost of verification, student’s unlimited involvement in the process, etc. To reduce these problems, a uniform document interchange system which could be adopted by the appropriate regulatory authorities (Federal Ministry of Education, National Universities Commission, National Board for Technical Education, and National Council for Colleges of Education) is important.

III. OBJECTIVES OF THE STUDY

This paper is aimed at presenting a model for a document interchange system using Zachman framework. The specific objectives are:

- a. To demystify the complexities of adopting the document interchange system.
- b. To avoid any unforeseen administrative issues that could count against the success of the model.
- c. To solve general management problems which could arise during the deployment of the document interchange system.

IV. The Zachman Enterprise Framework

Enterprise architecture may be described as a container for all representations used by an organization to reflect explicitly the enterprise operations and resources.

To ensure a complete understanding of the architecture of the document interchange model,

it is necessary to develop the model in a way to present the objects and aspects that constitute the framework unambiguously. We achieved this by employing the Zachman Framework schema. The Zachman enterprise framework was invented by John Zachman in 1980 while working with International Business Machines (IBM).

The framework provides a way of viewing an enterprise and its information systems from different perspectives, and showing how the components of the enterprise are related^[4] In modern business environments, many large organisations experience difficulty while dealing with change. This difficulty is often connected with lack of explicit understanding of the complexities associated with the internal structure and components in different areas of the organisation. The Zachman framework is a theoretical foundation that expressly defines the existence of a structured set of essential components of an object for which explicit expression is necessary for designing, operating and changing the object which may be an enterprise, a department, a project, a building, or whatever.^[5] The Zachman framework for enterprise architecture is a 6x6 classification schema, where the six rows represent different perspectives of the enterprise and the six columns illustrate different aspects.^[6] It is a logical structure for classifying and organizing the descriptive representations of an enterprise, in different dimensions, and each dimension can be perceived in different perspectives. The columns represent various aspects of the enterprise that can be described or modeled; and the rows represent various viewpoints from which the aspects can be described. Each cell formed by the intersection of a row and a column represents an aspect of the enterprise modeled from a particular viewpoint. The architect selects and models the cells that are appropriate to the immediate purpose, with the ultimate objective of modeling all the cells.^[7]

The six viewpoints are:

- a. The Scope (Contextual) viewpoint - aimed at the planner
- b. The Business Model (Conceptual) viewpoint - aimed at the owner
- c. The System (Logical) viewpoint - aimed at the designer
- d. The Technology (Physical) viewpoint - aimed at the builder
- e. The Detailed Representations (Out-of-Context) viewpoint - aimed at the subcontractor
- f. The Functioning Enterprise viewpoint

The six aspects - and the interrogatives to which they correspond - are:

- a. The Data aspect - What?

- b. The Function aspect - How?
- c. The Network aspect - Where?
- d. The People aspect - Who?
- e. The Time aspect - When?
- f. The Motivation aspect - Why?

Although the Zachman Framework applies to enterprises, the Framework itself is generic.^[7] It is a comprehensive, logical structure for the descriptive representations (i.e., models or design artefacts) of any complex object, and it does not prescribe or describe any particular method, representation technique, or automated tool.^[8]

According to^[7,8] the Zachman Framework is a predefined model in Enterprise Architecture and the framework interface diagram shown in Figure 1 below serves as a template for the development of an enterprise Architecture based on the Zachman classification framework.

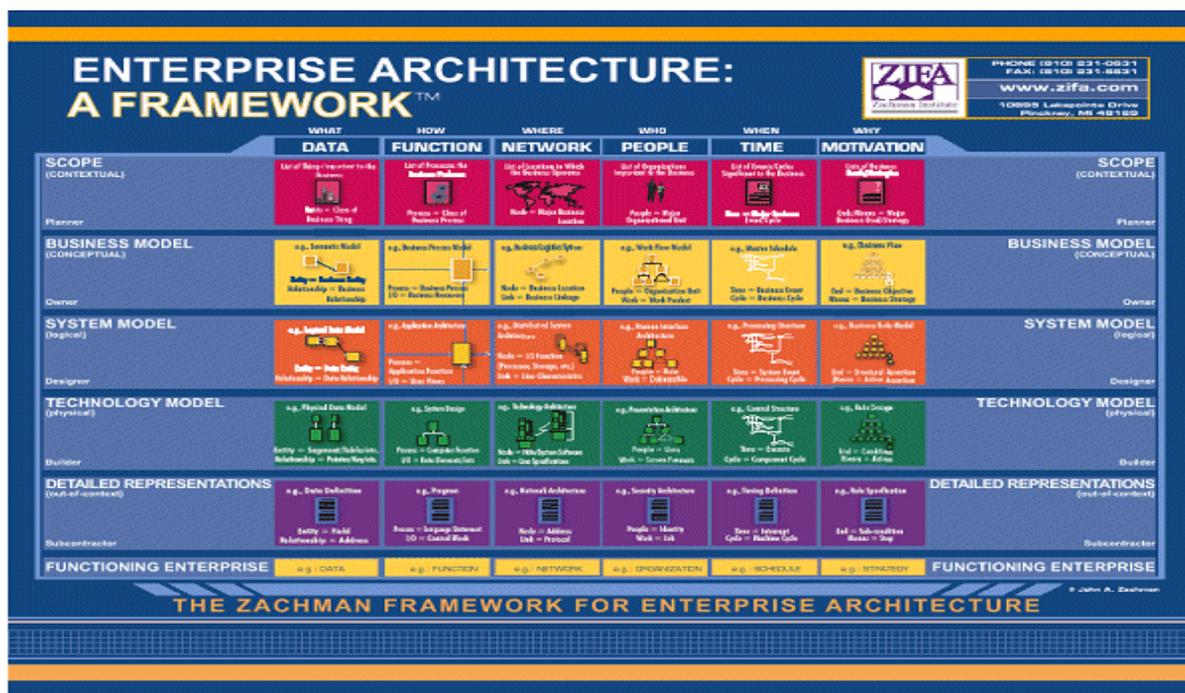


Figure 1: The Zachman Framework Interface Diagram [Source: Nithiya Ugavina, 2008].

V. METHODOLOGY

The document interchange model herein proposed is based on existing infrastructures in Nigeria and subject to the assumptions laid down below. The study employs a qualitative

approach involving human psychological and sociological concepts in the design of the model. The model is a four-layered structure as shown in the Figure 2 below. The first layer reflects the access point where bio-data and other necessary documents are acquired. The second layer is the document processing layer that caters for proper document structuring and representation for the purpose of document exchange in conformity to the established document structure. The third layer represents the network facilities such as computers, switches, routers, etc. for acquiring student's data from the relevant departments and sources in the Institution. The fourth layer also known as layer 4 represents a secured link/connection over a public network such as the Internet, to each of the affiliated Institutions through the coordinating and regulatory authority. It should be noted that layer 2 interacts with layer 3 in a coordinated and controlled manner to exchange information and to authenticate every connection to it.

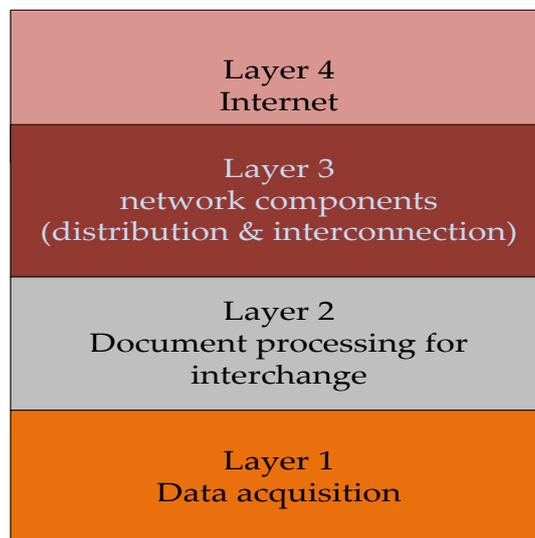


Figure 2: Layered structure of the Architecture.

Assumptions

The following assumptions were made in this study

- All affiliated tertiary institutions are interested in having a uniform document interchange system with a central coordinating authority.
- Communication systems to be used for data transfer, access and authorization are available in each of the institution.
- Data acquisition can be carried out by using a variety of information technologies including biometric devices.
- There is a data verification mechanism available in each of the institution.

The network architecture proposed for the document interchange model is shown in Figure 3 below. The diagram shows a hypothetical student that seeks admission into an Institution by way of making application to the said institution. The Institution (herein called the requesting institution), unlike in the traditional system, would initiate a request for the student's transcript where necessary. The said request is made to another Institution (herein called the servicing institution) listed by the student in his/her application document. The servicing institution (SVI) processes the request, prepares the transcript and other documents and then sends same over a secured internet connection to the requesting institution (RQI).

To discuss this concept further, we consider a hypothetical prospective student(S) and two hypothetical tertiary institutions (RQI and SVI). S is seeking admission into a RQI and would need verifying documents from SVI. Prior to admission advertorial, the admission office in RQI would specify the required qualifications needed for admission into the enlisted programmes. Note that some of the qualifications may include documents that should necessarily emanate from SVI. SVI represents the Institution from where S had his/her previous studies. S provides her bio-data as part of the admission application process to RQI. In this model, the distributed messaging platform provides a messaging structure which would permit RQI to bypass S in initiating a request to the SVI. The SVI through a certifying officer initiates a service response request which includes a message that contains the requested information in an established structured specification unlike that seen in e-mail and conventional structure-less documents, over a secured internet connection to the RQI. If the said application for admission by S is successful, S's data may also be taken at the department and faculty/college at SVI and matched against the pending service request. It is assumed that different units at the SVI are connected through a Local Area Network (LAN) or Campus Area Network (CAN) for the purpose of managing academic information. The Federal Ministry of Education (FME) is given control over a central information centre to which all affiliated institutions are connected. Hence each connected institution can freely exchange such structured data as it deems fit as well as initiate verification processes.

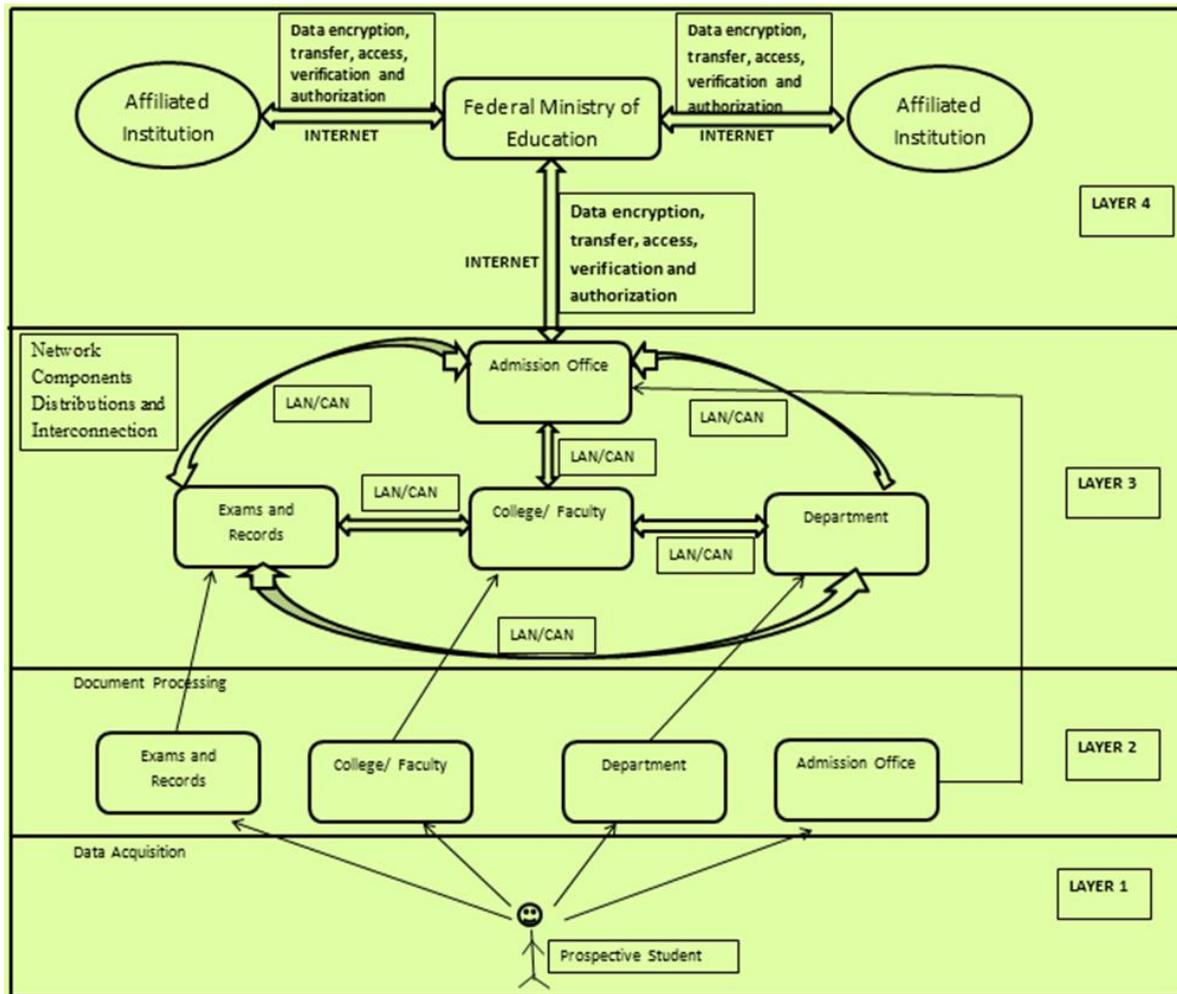


Figure 3: Network architecture of the document Interchange model.

VI. RESULT AND DISCUSSION

Figure 4 shows the proposed model expressed in terms of the Zachman framework shown in Figure 1 above. The Zachman enterprise framework is used to describe the scope, operations, architecture, technology and function of the model. The model and its information processing components are viewed from different perspectives that reflect how the components of the model are related.

The cycle starts when a prospective student makes an application to a RQI which in turn requests for the student's transcripts from a SVI. The SVI in turn sends the requested transcripts to the RQI. The RQI and SVI on their part rely on the relevant offices such as academic department, college, admission office, and exams and records office for the preliminary processing of such data. Also that verification of documents through requests to a SVI is not only restricted to students seeking admission to academic programmes elsewhere but may also be extended to any occasion where verification is

required perhaps for employment and certification purposes. However, our model presently revolves around transactions involving students and their present and future undertakings requiring verification across similar institutions which should have a seamless platform for information exchange. Here, the entire process is regulated by the FME through a document-based database that synchronizes with those of the various institutions under its control as shown in figure 5. Service requests may involve more than two institutions for a given transaction at a time but is often two, the requesting institution and the servicing institution.

	What	How	Where	Who	When	Why
Scope	Transcripts	Transcripts Processing	Institutions	Actors	Initialization/Completion of Process	Secured Transmission of Transcripts
Operational Model	Requesting/Service Institution College/Faculty Admission Office Exams and Records Department Student	Student Application to Requesting Institution Requesting Institution Requests for Transcripts Servicing Institution Sends Transcripts	Requesting Institution: Name/ID Code/Address Servicing Institution: Name/ID Code/Address	Academic Officer in the Requesting/Service Institution Certifying Officer in the Requesting/Service Institution Student's Name/Application Number/Dept. in the Requesting Institution Student's Name/Registration Number/Dept. in the Servicing Institution	Application Date by Student Date for Request of Transcripts by Requesting Institution Date of Reply of Transcripts by Servicing Institution	Secured transmission E.g. Passwords, Encryption
System model (Architecture)	Student Make Formal Application Requesting Institution Specifies and Requests documents to be provided from the Servicing Institution Servicing Institution Confirm students' certificates Federal Ministry of Education Controls the Processes	SVI Get students' records from Department Collate results Prepare transcripts Send documents to requesting institution	Get secured Internet connection to receiving institutions	Name of students Academic Officer of RQI Certifying Officer of SVI	Students' bring request Start of processing End of processing	Requesting Institution Encrypted Message → Servicing Institution Encrypted Message → Requesting Institution
Technology Model	Database Server Personal Computer Printer Scanner Internet with Network security	Student' PC → RQI Database → SVI Database → RQI Database	RQI Admission Office → SVI Exams and Records Office → SVI Student's Department → SVI Exams and Records Office → RQI Admission Office	Student → RQI Academic Officer → SVI Certifying Officer → RQI Academic Officer	RQI Academic Officer Sends Request SVI Certifying Officer Processes Request RQI Academic Officer Posts Reply	Encryption and Decryption Keys Generation
Function	Data	Process	Network	Organisation	Schedule	Strategy

Figure 4: The Zachman Model of Document Interchange System.

The details of each request are as stated in Table I. in each request, the three parties i.e. student, RQI, and SVI are identified by the fields: RFI.PRG.NUM, RFI.SVI.COD, and RFI.RQI.COD respectively.

The principal actors in the model are the students, the academic officer (from RQI) and the

certifying officer (from the SVI). On receipt of the request for information (RFI) message by the SVI, it initiates a feedback message acknowledging such a receipt. Table II is a specification of the feedback response message. In this way control is maintained in the messaging cycle in a connected mode. The model also provides a secured information exchange between two parties in such a way that it is difficult for a third party to intercept any message in transition.

Table I: Request for information (RFI) message.

Component Message	XML field	Description	Mandatory	Field specifications
RFI	RFI.PRG.NUM	Registration number of student	Yes	Maximum length of 12 characters
RFI	RFI.DAT	Request date	Yes	Date as dd-MM-yyyy
RFI	RFI.SVI.COD	SVI identification code	Yes	Maximum length of 3
RFI	RFI.SVI.NAM	SVI name	Yes	Maximum length of 30
RFI	RFI.PRG.NAM	Student's programme name	Yes	Maximum length of 4 digits
RFI	RFI.PRG.QUA	Student's programme qualification	Yes	Maximum length of 4 digits
RFI	RFI.PRG.CER	Certificate number of student's qualification	No	Maximum length of 15 characters
RFI	RFI.RQI.COD	RQI identification code	Yes	Maximum length of 3
RFI	RFI.SER	Request identification OR Serial number	Yes	Maximum length of 10

Table II: Feedback on Request for Information.

Component Message	Field name	Description	Mandatory	Field specifications
FRI	RFI.PRG.NUM	Registration number of student	Yes	Maximum length of 12 characters
FRI	RFI.DAT	Request date	Yes	Date as dd-MM-yyyy
FRI	RFI.SVI.COD	SVI identification code	Yes	Maximum length of 3
FRI	FRI.DAT	Feedback date	Yes	Date as dd-MM-yyyy
FRI	RFI.STA	Request status	Yes	Maximum length of 3
FRI	RFI.SER	Request identification OR Serial number	Yes	Maximum length of 10
FRI	RFI.PRG.CER	Certificate number of student's qualification (where student registration number does/does not exist)	No	Maximum length of 15 characters
FRI	FRI.SER	Feedback message serial number	Yes	Maximum length of 10

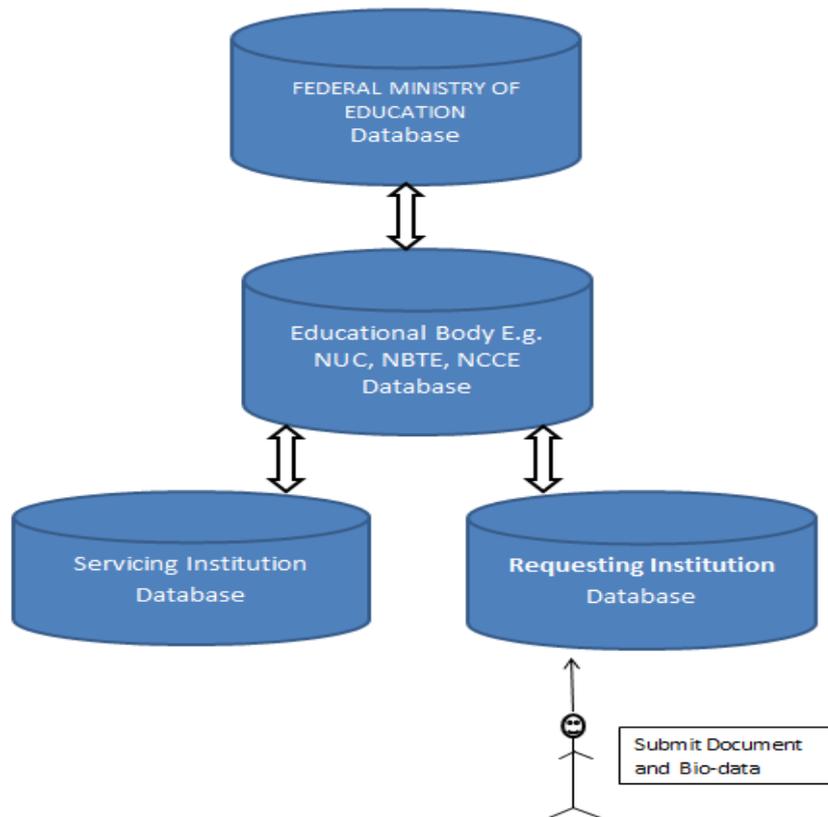


Figure 5: Hierarchical structure of Databases of participating institutions.

VII. CONCLUSION

The document interchange model for educational and allied institutions in Nigeria is a leap towards redefining and restructuring the traditional way vital data are exchanged between academic institutions especially as it relates verification of students' historical records and qualifications. The proposed model employs the Zachman enterprise architecture in order to define the various enterprise levels that should be considered for a structured information processing system. The model takes care of data acquisition, processing, transfer, authentication, authorisation and verification of students' academic documents. The network architecture is the basic infrastructure needed for the success of the document interchange model. By employing the descriptive specification provided by the Zachman framework, the seeming complexities of a structured document exchange system is easily eliminated. The Zachman framework also provided a clear definition of roles of objects involved in the system thus avoiding any administrative lapses and thereby enhancing the efficiency and effectiveness in the management requests and responses.

REFERENCES

1. A. L. Ananda, "Document formatting for interchange between word processors", Department of Information Systems and Computer Science, National University of Singapore, Kent Ridge, Singapore, 1988; 11(6).
2. W. Nwankwo, B.S. Olanrewaju, and T.C. Olayinka. "A Document Interchange Framework for Tertiary Institutions", World Journal of Engineering Research and Technology (WJERT), 2017; 3(5): 144-162.
3. Gunther Krönert, "Importance of the ISO standard 8613 for document interchange Basic standard, functional standards, initial experience, benefits", Computer Physics Communications Elsevier Science Publishers, 1990; 61(1): 209—218, 209.
4. Stan Loche, *The Zachman Enterprise Architecture*, Metadata Systems Software Inc., 2003.
5. J.A. Zachman, "The Zachman Framework: Solving General Management Problems", Enterprise Architecture. Zachman International, 2011.
6. Terry Bahill, Rick Botta, and Jesse Daniels, "The Zachman Framework Populated with Baseball Models", Journal of Enterprise Architecture, November 2006.
7. Nithiya Ugavina, *MDG Technology for Zachman Framework: User Guide*. Sparx Systems Pty Ltd, 2008.
8. Andreica Alina, Josef Küng, Gabriela Șerban Czibulla, and Christian Sacarea, "Designing A General Architecture for Data Interchange", International Conference on Web Information Systems and Technologies (WEBIST), 2014
9. Tao Li and Wei Mao, "Intelligent Document Technology in University Educational Administration Management System" in Proceedings of IEEE International Symposium on IT in Medicine and Education, 2008.