

Open Standard Data Exchange Model for Higher Education Institutions in Oman

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Abstract— We are living in a digital age, where people, applications, and devices are communicating electronically, where every organization intend to improve their processes for better efficiency and reduction in costs. Academic institutions are no exception and uses Information systems extensively for managing stakeholder's information.

In Sultanate of Oman, almost all higher education institutions are using information systems to manage their routine processes and decision making. The primarily use of information systems for every organization is to manage and process their data locally and efficiently. Due to various academic reasons, this data need to be shared with other institutions. Although, the information at Higher Education institutions is available in digital format and shareable, but due to data format heterogeneity, it is not understandable to the system operating at other institutions. Data can be exported as such, but need human intervention for understanding and processing manually once received at the other end. The main reason for this is because of the fact that various institutions use their own custom made applications and databases for information handling. Some data can be shared, but still this shared information may not be in a machine readable format for the other institution, where applications can interact independently. If this academic data can be made standardized and shareable, it will be beneficial in various ways, which are discussed in this paper along with a proposed model.

This research is proposing an open standard data exchange model using XML for higher education institutions and regulatory authorities, to extend the use of digitized communication, for being better players in digital economy with utmost utilization of cost effective technologies. This proposed model will provide facilities to unified nature of data where data analysis can be done on larger scale to overcome information gaps with improved data quality.

Index Terms—Open Standard, Data Standard, XML, Data Exchange, Data Exchange Model, Higher Education Information Standardization, Electronic Data Standard.

I. INTRODUCTION

Higher education institutions and government bodies in various countries are already using XML for data

exchange to some extent [5, 6, 7, 8] based on their needs. In Sultanate of Oman, Higher education students are migrating from Institute to another, and such transfers especially with incomplete programs, brings lot of background work to be done manually by the receiving institutions. These transfers lead to delay in analysis of marks, grades, Cumulative GPA and registration process. To avoid the said delays and improve the professional quality of the system, we are proposing an open standard model that can standardize the data exchange, electronically in the true sense.

XML is the proposed standard which stands for Extensible Markup Language. It is designed to store and transport data in both human and machine readable format. A model which is a platform to provide functionalities that will lead to solutions for a domain area, encompasses software models, which stands for a programming abstraction.[10] Here the main aim will be to provide a set of code common in nature and will provide some kind of generic functionalities for the users. These functions can further be fine-tuned, hidden or overridden by adding or changing the codes and design which will give more specific functionalities. An open model does the functionalities using an open standard software architecture that can be debugged or changed by users openly, with certain limitations. Also the main advantage will be that this model can be used by any organizations or higher education establishments as our study infers to, and do not require individual colleges to go for proprietary based software APIs. Another advantage will be that the student or course related data can be easily migrated to any organization that the student wants to do her higher studies in.

This paper aims to propose an open source model which can be used for higher education institutions like universities/colleges and also by regulatory authorities like Oman Academic Accreditation Authority (OAAA) with the objective of digitalizing formal communication of documents needed by the respective organizations. Here the proposal is to use open source mechanisms like XML, which will be a database storing and retrieving standard using open source architecture model.[10] This will enable all the above organizations to reach a common platform for sharing student/academic related details for each other's benefit. Also by using these standards which are easily accessible, and can be coded using open source APIs, data programming will become easy and updated. Further this model will facilitate seamless information-exchange like course description, course equivalencies, transcripts and also student data sheets.

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II. PROBLEM STATEMENT

The current scenario for all educational institutions in Oman is that all of them are following different meta-data and models along with the diversified handling programs for data collection. Data processing after academic inputs using data collection interfaces, GPA/CGPA calculation, data-objects, database models, sharing and decision making are all different with respect to the type of software used by the respective organizations. This is creating a lot of inconveniences to the higher education institutions in situations where the students apply for transfer in the same level-course or try to join another institute for higher studies. Problems are further aggravated when the student need course equivalencies in another college, where the QA manual and bylaws in colleges/universities state that courses need to be matched and equivalencies-weightages need to be ascertained before granting admission to students.[9] There are no digital standardized systems available for this as of now. Course descriptions and outcomes are also not digitalized to be shared using open architectures, because of which equivalencies are to be made manually.

Further, accreditation agencies like OAAA who benchmarks the education systems and institutions in Oman [1] also face similar digital dilemmas. They will need to access the above said academic records also in a standard digital format as all institutions follow their own database setups and standards. Also if they want to check for changes or patterns in the recommendations or commendations in the next verification session, all the changes has to be plotted manually for them to arrive at the correct interpretation. This is because of the fact that all colleges and universities in this part of the work collects and store academic data in a way to make their own individual data standards[9] and not following an open standard data architecture for sharing and involvement for other academic institutions too. This will definitely hamper the function of the accreditation agencies in many ways as they have to do all their works in a manual way.

III. DATA EXCHANGE MODEL

To resolve the handling of heterogeneous data exchange between academic institutions we have proposed a model as shown below in Figure 1. The model will provide a mechanism using open source standard. Thus, the sharing of data in a form of native XML document will be understandable among all the participants no matter they are on different environments and technologies. The only requisite thing is to introduce an electronic XML based data standard from regulatory authority for academic institutions like OAAA. That data standard will contain the minimal required information it contains from each subject e.g. student, course etc., represented by relations in database.

The participants can generate the data whenever whatever is required in that described format. To generate the data in required format it is not needed to make any alterations in existing database or application. Instead of changing physical or logical model the required data can be logically generated in such form e.g. alias by using data queries, which is a programming construct representing an alternative or more significant name for a defined data object [11].

Defined data object can be called by the defined aliases (can be more than one) which also refers the data object. Data can be exchanged in various ways.

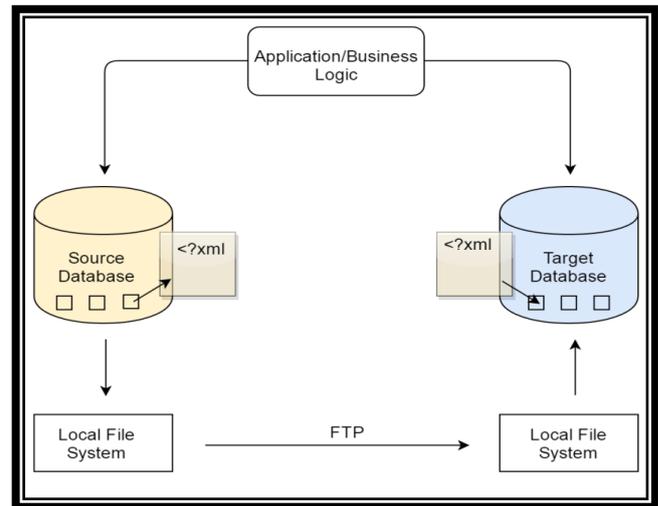


Fig. 1 : Open Standard Data Exchange Model

Our model illustrates two basic possibilities. Firstly, it can be exported as individual file in xml format that can be transported using file system and can be populated in target database. Secondly, to make this process more stable and dynamic we can use a web interface or business logic which can be in the form of java servlet or web class for secure exchange of data among participants. This is a valid example when one student is moving from one institution to another. His personal and academic details need to be received at a place where he is going to join. Manually carrying these documents and manual processing by analyzing courses related information is time taking. Although the data is coming from digitized system it needs human evaluation. Instead our model is introducing an approach which is machine readable and this process can be streamlined in pure virtual form without human intervention.

Once data is received in XML file at destination the file can be imported in database to its corresponding fields and data will become reusable at destination. A sample of student basic information is given in figure 2 in XML structure.

The xml file shown in figure 2 contains two types of information. It has the student data in xml file structure along with its associated description and rules defined in DTD (Document Type Declaration) part. The XML document type declaration contains or points to markup declarations that provide a grammar for a class of documents. This grammar is known as a document type definition, or DTD. The document type declaration can point to an external subset (a special kind of external entity) containing markup declarations, or can contain the markup declarations directly in an internal subset, or can do both. The DTD for a document consists of both subsets taken together. [3]. It is useful for applications accessing and reading xml document automatically. Also independent groups of people can agree on a standard DTD for interchanging data [4].

```

<?xml version = "1.0" ?>
<!DOCTYPE student [
<!ELEMENT student (name, address)>
<!ELEMENT name (firstname,
lastname)>
<!ELEMENT firstname (#PCDATA)>
<!ELEMENT lastname (#PCDATA)>
<!ELEMENT address (street, city,
email, phone)>
<!ELEMENT street (#PCDATA)>
<!ELEMENT city (#PCDATA)>
<!ELEMENT email (#PCDATA)>
<!ELEMENT phone (#PCDATA)>
]>
<student>
<name>
<firstname>Text</firstname>
<lastname>Text</lastname>
</name>
<address>
<street>Sample Street</street>
<city>Sample City</city>
<email>sample@email.com</email>
<phone>9393939</phone>
</address>
</student>

```

Fig 2: Sample student data in XML structure (student.xml)

The xml document given in figure 2 is a text document and is based on open standard specified by W3C (World Wide Web Consortium) [2] and doesn't require a software to be a bridge between source and target databases. All modern databases are having built-in functionality to work with XML. If a source user is having an accessibility of target database via web based interface or middle ware, the data can be populated in allocated objects of target database effortlessly.

IV. DISCUSSION

The proposed open standard data exchange model will be useful in various ways. At first this effort will bring all institutions on one page and is commonly known data standard. The information in that standard format can be easily generated by any institution instantly. Government bodies can collect and use the data centrally without compromising quality and processing overhead without delays. Data collection, processing, sharing, and decision making will become easy and up to date. Generally, when a student is joining second institution, his past institutional records are not in order, to be fully utilized digitally for historical data analysis. Our model helps to keep all past data intact due to its uniformity in structure and can be used for historical analysis by government agencies and institutions.

There are many aspects of information exchange that can be included and facilitated through proposed model. Few major areas are sharing of course outlines, course descriptions, student transcripts, course equivalencies, degree audits, and personal information. Also, once higher education

institutions start to adopt the standard data model, it will have broad applications for historical data analysis to analyze the trends and apply data warehousing and data mining.

V. CONCLUSION

The implementation of the above proposed model at a national level will bring dramatic changes in decision making without demanding any infrastructural changes and additional cost. The fulfillment of the proposed model is the need of today because of the difficulties in exporting digitized data in the correct format for the needed institutions. It will revamp the traditional communication and information exchange structure between all higher educational institutions and accreditation agencies, with the capabilities of automated machine reading and processing, which will aid in better and efficient information exchange. Security in academic records that will be exported across the institutions seamlessly, will need to be handled which the scope for another research in this field.

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