Information and Knowledge Organization-The Case of the TEI of Athens

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Abstract: *The new operating model of a University must be reflected in an appropriate organizational structure including all the relevant roles and responsibilities of the administration hierarchy. It should be enforced by the creation and operation of an integrated Information System, and the continuous development of a system for managing the generated knowledge in all the related levels.*

Keywords: *Higher Education Institution; Quality management; Management information system; Knowledge management.*

I. INTRODUCTION

Knowledge Management (KM) in Higher Education Institutes (HEI) can be perceived as the possibility offered to decision makers and administrators to improve the services, to organize the internal knowledge in order to support the mission of the institute, to control the outcome services and to design the outcome knowledge due to the needs of the society.

HEI administrators are in charge of academic accreditation and assessment in higher education. For the evaluation of Institutes, schools and departments are used well established criteria that International/National quality assurance agencies have set. The aim of the academic evaluation is to extract and publish information related to the examined academic sector(s), to conclude if the schools and the departments of an Institute follow recognized quality criteria and also to monitor specific indicators useful at the administrative level and observe/control the measurement and evaluation of the criteria-indicators that are associated with the management of the institute [0]. Those indicators are called Key Performance Indicators (KPI) [0].

In European countries the evaluation processes are being conducted by the European Association for Quality Assurance in Higher Education [0], and at each one of the European countries, the corresponding agencies adopt/specify indicators, etc. In Greece, the Hellenic Quality Assurance Agency [0] is responsible for the accreditation and evaluation of the Greek HEI.

Academic Evaluation is a difficult and complex task because different people and academic units should gather and handle the data. As a consequence, there is often a lack of standardization of the different forms-ways of collecting educational data (e.g. electronic forms, .xls files). Eventually, there is a difficulty of integrating various data from different "local" systems in a centralized system, in the level of the campus. Unfortunately, "local" systems, operating in the academic units' level, are not usually designed to provide and exchange data between the units and the centralized system. In Greece, all these difficulties that HEI administrators face, are combined with the obligation of all the departments of the Institutes to yearly produce an internal evaluation report of the academic activities. It means a great demand in personnel, time and money. In this direction, in Technological Educational Institute of Athens, the described Quality Assurance Information System is developed to gather data from different resources (e.g. external databases or staff's reports) of the Institute. The aim is to provide the possibility to external web services to have access to our database, to create pre-forms of the evaluation reports, to provide the possibility to specific key users and decision makers to set and use strategic management methodologies e.g. Balanced scorecard [0], to set and monitor the Key Performance Indicators and finally to provide techniques and tools of data mining and decision support.

The paper is organized as follows. Section 2 gives a brief analysis of the proposed information system. Section 3 describes the System Development & Functionalities. The paper ends with a conclusion summing up.

II. SYSTEM ANALYSES

The initial phase of the system analysis is to identify the requirements and the criteria that the quality assurance unit of the institute should satisfy [0].

Various criteria are proposed by the Hellenic Quality Assurance Agency and are organized in the following directions:

- Educational Program
- Learning
- Research
- Relationships with Social and Cultural events, with industry and Production
- Academic development strategy
- Administrative services and infrastructures (administrative services, student concern, transparency in the management of economic resources, etc.)

Each one of these criteria should be calculated by taking into consideration the infrastructures, the students, the curricula, etc. Data that we have to store and handle are heterogeneous and are also subject of daily changes. Each department has to store and handle details of: students, teachers, specific courses, and marks/grades. Another important aspect is the outcomes of the system, the information that the administrators should get/extract

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from the stored data and also the connectivity and intercommunication with other systems.

In order to satisfy the user requirements and improve the effectiveness of the system we propose a hierarchical structure of the Quality Assurance Information System (QAIS), where there are different layers of controlling the information. Fig 1 illustrates a framework for accurate views, and decisions' support offered to the administrators. To provide such a framework we identify the following roles [0].

System administrators, that perform system maintenance and management

The staff of the Quality Assurance Unit (QAU)

The members of the staff that are responsible for producing the internal evaluation report (MIE)

The educational staff (ES)

Students

The managers of the administration services (AS).

The following units are considered: Directorate of Administrative Affairs, Directorate of Finance, Directorate of Studies Coordination & Student Welfare, Director of Computing & Technical Assistance Services, Department of President, "Vice-Presidents & Secretary General" Secretarial Support, Administration Structure, Faculty Secretarial Support Office, Faculty Department Secretarial Support Office, Department of Research & Development Project, Department of Public & International Relations and Legal Assistance Service, Independent Department of Emergency Administration & Policy Planning

The Quality Assurance Information System (figure 2) could be based on the combination of information technology, quality criteria in HEI, and people's role and activities in order to support operations and management.

The basic layers of the Quality Assurance Information System (QAIS) are the following [0].

- Data Base System (DBS)
- Data mining
- Decision support system
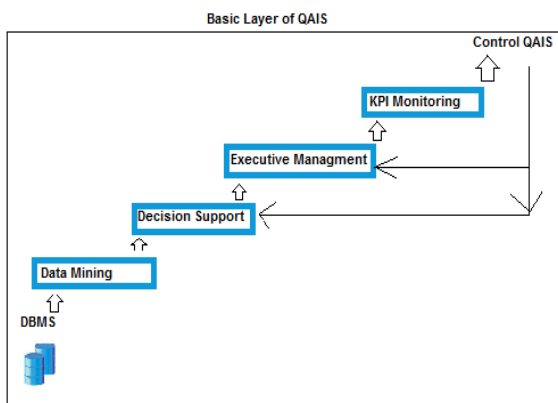- Executive Information System (EIS)
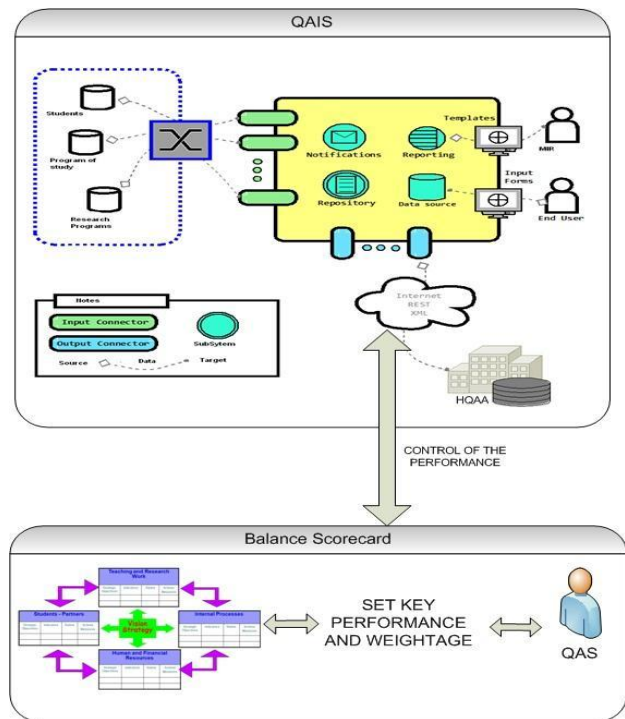- KPI Monitoring

Figure 1 Layers of QAIS.

Figure 2 System Architecture

A. Data Base System

In the proposed architecture the Database System (DBS) is used for data storage and retrieval, and information management in the HEI. The DBS accepts and serves requests for data from the Information System (IS). Queries and responses are submitted and received according to the JDBC driver that is used in order to establish the connection between the database and the IS. The DBMS, in the kernel of the DBS, provides the mechanism for controlling data access, data integrity, back up of data files, and recovery.

The DBS consists of three subsystems:

1. The first Subsystem is used for retrieving data for the academic evaluation processes. This subsystem collects all necessary data for the internal evaluation reports e.g. educational activities, research activities, learning process and its goals, the relationships of the academic community with Social/Cultural/Production events.

2. The second Subsystem is used for retrieving data for the evaluation of the administrative services.

3. The Database subsystem is the repository for the evaluation reports and provides the ability to monitor and exchange all the data and the indicators that are useful for the self-evaluation reports. The database also facilitates the interaction with other systems.

B. Data mining

The database of our system includes data, indicators, and rates about the infrastructures, the education staff, the administrative staff and the services. Data mining can be used for discovering/extracting hidden

knowledge in the database. Common data mining techniques [0] that we plan to incorporate into the system are the following:

- Association rule learning – Searches for relationships between variables.
- Clustering – the task of discovering groups and subsets in the data that share similar characteristics. Cluster analysis in educational data [0,0] can be used for data exploration, cluster confirmation, and hypothesis testing.
- Classification – the task of generalizing known structure to apply to new data.
- Summarization - providing a general view of the data set, including visualization and report generation.

A free available framework in order to implement data mining algorithms is the weka tool [0]. The SPSS statistical application will be used for predictive analyses [0].

C. Decision Support System

A Decision Support System (DSS) in Higher Education can serve the decisions within the institute, the changes in the curricula and the management of administrative activities. In a HEI the DSS should also have the responsibility to gather row data, documents, and executive knowledge and combine all of them in order to structure information, identify and solve problems and make decisions.

Three fundamental components of the DSS architecture [0] are:

1. The database or data warehouse which is used for reporting and analyzing.
2. The model, where we set the criteria, statistical processes and data mining tools (i.e. the decision context and user criteria),
3. The user interface for monitoring the results.

D. Executive Management & Key Performance Indicators (KPI) Monitoring

The Executive Information System (EIS) is a Management Information System which is developed in order to support the information and decision-making needs of senior executives (President, Vice-President and the managers/directors of the administrative services) by providing access to key performance indicators and the external information according to the strategic goals of the organization.

The management of the Quality Assurance Unit of the institute can monitor all performance indicators in order to support the administration of the institute in taking decision for the improvement of the quality of the educational and operational processes and in setting its strategic objectives. The indicators are influenced by the data, which have been collected from the QAIS. Thus, the directors of the departments have the ability to monitor/view the performance of the criteria and enable feedback, in order to improve specific indicators.

III. SYSTEM AND FUNCTIONALITIES

The Information System is developed using open source tools as J2EE, MySQL as the database management system (DBMS), services oriented applications (SOA) and weka for data mining. We also use OCR applications, in order to process the evaluation forms, in combination with the SPSS statistical framework in order to apply data mining techniques. Finally we use the Adonis Business Process Management tool [0] to help the administrators to set key performance indicators for specific criteria. The administrators have also the possibility to monitor these KPI and suggest possible solutions and make the appropriate changes in order to improve the services.

The functionalities that our application will provide are:

- KPI Monitoring
- Dynamic definition of the KPI
- The experts have the possibility to specify the data that they are interesting for and make them available to other systems (as the system of the Hellenic Quality Assurance Agency). These data are exported in xml format
- The students have the possibility to access and fill evaluation forms using their pc, laptops or mobile phones.
- The education staff has the possibility to apply forms with the appropriate data that the experts have set.
- The evaluation report will have some optional fields filed automatically with the necessary data. Also the MIE could have the ability to use data mining techniques in order to get more accurate results for specific sectors.
- QAIS provides graphical representations and monitoring to help managers to analyze and compare, to monitor performance indicators and identify opportunities and problems.

In our prototype system we attempt to use cloud computing techniques. We suppose that the data that we deal are very interesting and moreover the area of HEI management seems to have a lot of fields which should be discovered in more depth. So the technique of cloud computing will offer the possibility to experts from different places, institutes and countries to interact each other in order to offer interesting tools.

IV. CONCLUSIONS

Knowledge Management in Higher Education Institutions is a very serious task because it is closely related to the services offered to the students, the research community, and society. Data stored in the institutes are huge, complex, and heterogeneous. So it is difficult to manage all the incoming information in order to provide the best outcomes. Our aim is to achieve the best handling and usage of the incoming information in order to get the best results. Due to this attempt we consider that data mining techniques,

knowledge management methodologies and cloud computing applications are the appropriate mechanism in order to provide data, information, and knowledge, and support decisions.

Regarding the strategic management of the institute we decide to use a data modeling tool which provides the ability to set KPI and monitor their performance. Also we support the creation of the of the final MIE reports offering preliminary evaluation reports. These preliminary reports include a great number of fields automatically filled or data automatically retrieved from other systems e.g. the repository of the students.

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