Improvement Research Activity Management in Universities, by using ICT Technology

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Abstract: - Nowadays, the universities realize that research area is the most important asset for future development. In this context, the European Union and all the EU member states are committed to develop a common European Research Area. In this lecture I present an informatics system in order to improve the management of the research activity in universities. This system is based on database driven dynamic Web technologies and it provides: repository for collecting all the internal research results such as papers, books, contracts, patents, products etc. at each individual level, group level (research centers, faculties, university etc.) in order to coordinate the assessment process; research dissemination and technology transfer in order to distribute and make available its patrimony of skills and resources in an accessible form that can be exploited by interested organizations; integration between the university research systems and national or EU institutional systems, in order to simplify and to increase the research development and administration; management of all projects underway within a standard process which identifies various common operative phases, regardless of the nature of the financing body. In this way, the realized system can be integrated easily into the national/European research e-platform.

Key-Words: - Research activity management, informatics system, relational database, dynamic Web technologies.

1 Introduction
The beginning of the 21st century is marked by the passing of the informational society towards a society of knowledge, and the generation and exploitation of knowledge have become vital sources for the growth of global welfare.
At the same time, knowledge represents the central element that determines competitiveness, and consequently, the states of the world, especially the developed ones, have embarked on the systematic generation of competitiveness, developing national systems and international interactions, even more complex and varied.
Nowadays, universities hold the key for the development of an economy and of a society based on knowledge, given their dominant position in the field of research, education and innovation. Currently, European universities hire an average of 34% of the total number of researchers from Europe (Germany –26%, Spain – 55%, Greece – 70%), at this level there are being run 80% of the fundamental research at the European level. The scientific research in universities, by means of the impact on the development of the knowledge and of the human resources for a basically cognitive economy, represents one of the essential pillars of the socio-economic development. Simultaneously with the internalization of education and research, universities must cope with tougher and tougher competitions at the international level. To this competition one can add the competition with other research institutes, as well as the need to implement rapid and efficient mechanisms of technological transfer and of knowledge transfer. Consequently, universities play a major role in the international competition – important solutions are expected to be found for the surpassing of the discrepancies between the USA, Japan and Europe, be it the case of fundamental scientific research or sustainable economic development. In order to face the international competition, European universities must find solutions for the surpassing of the negative effects of the already existing discrepancies between the USA, Europe and Japan, namely: financial resources and means of financing research; human resources involved in research and the attractively of the research career; the relationship of universities with the economic environment. The role of scientific research, of results and their impact on the development of socio-economic knowledge and development for the ensuring of prestige and attractively level of universities will rise and scientific research will represent an important factor in the attraction of financial and material resources.
In this context, each research managers must to be able to monitor, to manage and to asses research activities within an university. For the improvement of the management of
university scientific research we propose the use of a centralized and automated informatics monitoring tool, based on the Web technologies. The centralization also implies the implementation of certain quality standards which will uniform the dissemination of the obtained information. The automatization implies the passing from the manual loading and synchronizing of information to the automatic management and monitoring on the basis of clear-cut quality rules. The manual monitoring of the research results, based on the collecting of more files and/or paper sheets and their counting with a view to centralization on information categories represents a difficult and slow means in a large period of time. On the other hand, this manual monitoring favors the apparition of human errors in the evaluation of every faculty member and the research entities from the university.

2 The Presentation of the system
The informatics system proposed in this paper allows the development of a centralized database, the realization of a 3 tier-type organization structure, the assurance of the maintenance of the stability and security of the system and the processing of data with a high degree of flexibility in their filtration and ordering. The informatics system is based on a relational database, developed with MySQL DBMS and PHP programming language.

2.1 Database’s development
The conceptual model of the database was elaborated on the basis of the synthetic files from the various departments, which were involved in the manual processing of the data regarding the results of the research and on the basis of the annual reports provided by faculties/departments to the top management of the university and to the institutional bodies at the national level (the Ministry of Education, Research, Youth and Sport, the Scientific Research National Council of the Higher Education). The faculties/departaments from the university were the key element in the development of the centralized informatics system, and for the design of the output there were analyzed both the annual requirements of reporting from the faculties and departments as well as the requirements imposed by top forums. After the analysis of the existing information system there were defined the data collections necessary to the informatics system, and on the basis of the rules of management of the information system there were related the data collections by means of links of the type one to many and many to many, being necessary the creation of intermediary data collections and the optimization of the database in accordance to the rules of normalization of the relational database. The application of the normalization forms led to the elimination, from the very conceptual phase of anomalies that could generate perturbations in the database during data loading or during actualization. The main requirements and information restrictions that represented the basis of the data collections establishment were thus structured:
- Personal data for the identification of persons (faculty members) within the university.
- The classification of personal data on various selection criteria: academic degree, membership in a chair or department in the university etc.
- Information included in a framework generally called CV: education, foreign languages, professional experience, professional prestige, awards, patents.
- Articles and books published: the publication year, the type of the publication (on various typologies such as ISI, indexed in database etc).
- Research contracts with multiple fields having various selection criteria: the competition period, the duration of the contract, the list of the persons that make up the contract, the financing program, the annually contracted value, currency etc.
- Products, technologies and services.
- Models, prototypes, norms, procedures, plans and methods.

In fig.1 there is illustrated the simplified conceptual scheme of the database.

![Fig. 1 – The simplified conceptual scheme of the database](image-url)
For the loading of the database the informatics system has a friendly interface, which allows the user to load after logging (fig. 2) to update and view the information in the database.

In fig. 3 there is illustrated the interface that allows the user to load in the database the information regarding the published articles.

2.2 The 3 tier type organizing structure

The files system that make up the informatics system for the monitoring of the research activity is conceived to be run in the Internet environment. The both logical and physical structure of the application as a whole is organized on a 3 tier type architecture.

If we develop the separation of presentation’s logic from the core that deals with the rules of the business type logic, we will obtain a 3 tier type architecture (fig. 4). It is worth mentioning that, between the level of presentation and the data access level there is no direct link – all the information traffic must be passed through the filter and the rules that reside in the middle level, namely the business one.

Once this architecture is introduced, one can notice the advantages brought by this system in the sense of using and sharing of the code, instead of introducing it as a duplicate, thus generating redundant. Therefore, more components from the level of presentation can use in shared system way one and the same component from the business level and all components from the business level can use the component in the shared way from the data access level, this being illustrated in fig. 5. One can notice that a component from the presentation level can access more than one component from the business level, and a component from the business level can access other components from the same level.

The major advantage to use a system based on three levels is justified by the possibility to modify the contents of any of the levels without requiring alterations in the other levels of the system. For example:

a) A migration from a DBMS to another would require not only alterations in the components found
at the level of access to data, level that uses the ADOdb class library, which is compatible with a multitude DBMSs.

b) A change in the user interface, e.g. from the desktop to the Web, would require changes only in the component at the presentation level. The advantage of classifying and using the levels of presentation and business in different languages is that they can be used by different programming teams. This means that only programmers having PHP notions can be employed for the business level and data access, and programmers who have knowledge of (X) HTML, CSS and XSL can be used for the presentation level, being more likely to find different specialists for these levels than one who knows the programming of all levels. An advantage in using XML/XSL in the presentation level is the possibility of navigating through HTML to WML or PDF or other types by simply using different XSL styles. XSL type files may be used to transform XML documents into a variety of formats, not just HTML. The developed environment is based on three-level architecture, as shown in fig. 6.

The multitude of components illustrated in fig. 6 are as follows: Component scripts, Dialog Type (Controller) scripts, Database Table (Model) classes, Generic (abstract) table class, Validation class, DML class, Screen Structure (View) scripts, XML files, XSL Style sheets, XSL Transformation process, HTML output, CSS files, AUDIT class, Workflow Engine.

2.3 Ensuring the maintenance of the system’s stability and security

Security and protection of the Web applications represent one of the most important components of integrity and continuity in good conditions of information communicated to the site’s visitors. In order to monitor the system’s stability is necessary to analyze the visitors’ accessing and traffic, which depend of the running the source code, database interrogation and network’s access levels. Fig. 7 illustrates the path between user and the Web application, that needs security.

![Fig. 7 - FRF Informational path between user the Web application needing security](image)

The fig. 7 FRF illustrates the maintenance process in terms of system security as follows:

- In terms of user, more precisely the system’s level of presentation where the user meets the visual tools needed to question the system, the focus should be on keeping track of all inputs and outputs of data from and to the user through the requirement of using the user accounts, protected with user name and password, for a operational evidence of the system;
- Over the Internet, data protection can be achieved using links employing SSL protocols (Secure Sockets Layer) or TSL (Transport Layer Security), which use encryption and ensure a secure environment for navigation type applications, e-mails, Internet fax and other transfers implying data exchange.
- Firewall type maintenance for servers, which are secure tools and used to filter data in an information network. These tools come under the form of software application or hardware unit and they can be configured as per organizational requirements;
- In terms of server’s application, which runs the source code and manages the database as archive, a page of information is generated a reply to the demand submitted by the user. The accessing and parameters listed in by users must be followed in order to determine vulnerabilities unnoticed upon the system’s creation and start-up;
- Functional and operational vulnerabilities –
functional in terms of functioning of the system as kit of applications and running of the source code and operational in terms of deliberate use of operations which are not enclosed in the range suggested by the application’s programmer.

Exposure of the system to an exponential vulnerability with the degree of risk arising from the unfolding process from the very stage of analysis continues with the functioning of main features and ends with balancing the pros and cons of argumentation of major viewpoints met in their analytical form.

2.4 Results provided by the informatics system

The information resulting from data processing has a high flexibility in filtering and ordering them. Prior organization of the database in a manner most optimal and flexible allows us to query it using complex filtering and connections. Thus, the computer system provides both reports at the level of selection type queries and complex queries with pivot rules. Reports obtained from the computer system can be accessed through a filtration system of rules, which are known to each user. Users are divided into groups, each having their own access rules. If a user requires multiple permissions, they can create a personalized schedule permit.

Types of filterable reports concern the following:

- To view the users from the system by different selection filters: person, department/faculty, degree, scientific title etc;
- To view publications from the database, namely articles published, using various selection filters: year of publication, authors, publication’s rank, Reviews/Proceedings etc. For instance, fig. 8 illustrates a Report at university level concerning the articles ranked ISI.
- To view the published books by different selection filters: publication year, authors, language, publishing house etc. Fig. 9 illustrates a Report concerning the published books by a teacher/professor from the university.

Fig. 8 – Report regarding the publications ranked ISI in 2008-2010

Fig. 9 – Report regarding the books published by an author

- To view the research contracts based on various selection filters: contract number, competition year, contracting year, completion year, contract value, list of contract members (fig. 10).

Fig. 10 – Report regarding scientific research contracts of a teacher

Similary, the informatics system provides evaluating and totalizing reports at the level of the university, the faculty, the department and the teaching staff according to a score corresponding to each scientific result stored in the database. We mention, that the score used by the IT
system is the one recommended by Romanian institutional officials at a national and university level.

3 Conclusion
The informatics system presented in this paper can provide for an university a digital repository, that collect all research outputs, and it can be named as a Current Research Information System. By using this repository the research managers can monitor, manage and assess research activities within an university. The reports provided by the informatics system support the research managers to monitor, to manage and to assess research activities within an universities. Also, the digital repository provided by the system has an important role in decision making process of the managers of the universities and it can: plan for required software development, advise on required internal targets and timescales, assess changing resource requirements and manage workflow, interpret assessment policies and ensure consistent practice, coordinate user training and response to enquiries and to help ensure external targets are met.

This informatics system can be easily implemented in any university. Moreover, by using an interface of XML files, the results of the university research can be easily exported in order to be memorized in an electronic platform at a national level that would allow both a result dissemination and a technological results transfer to the business environment.

References: