

Design and Implementation of an Integrated Software System for Managing Research Activities in Universities

Alina Bianca Andreica, Paul Serban Agachi
Babes-Bolyai University, Cluj-Napoca, Romania
alina@staff.ubbcluj.ro , sagachi@staff.ubbcluj.ro

Abstract

The study focuses on the design and implementation of a dedicated software system for managing university research activity as a tool for quantitative research evaluation and support in designing competitive strategies in the field. We present the software system for Research Management that has been created and implemented at Babes-Bolyai University, its architecture & design principles and its significant impact in research activity management. The impact on managing research activity is important not only for the members of the academic & research staff, but especially for research management levels: chairs, institutes, departments, faculties, university

Keywords: distributed information system, research activity management, software design and implementation

1. Universities' Research Management – The Working Framework

Academic institutions face nowadays complex challenges coming from a more dynamic and globalized world, and mainly aiming at implementing strategies for increasing their competitiveness both in education and research. Universities' rankings [10] are well-known and often used, though sometimes debated, tools for comparing academic institutions achievements: scientific outputs (internationally recognized scientific papers), quality of the academic staff (relevant international prizes), quality of the students and graduates [2]

Besides strategies for improving academic programs [1], either in their classical form, or in e-learning frameworks, the development of scientific research is also extremely important. From scientific results to technological transfer and innovations for the socio-economic and industrial environment, scientific

research [2] is to be supported and developed by proficient strategies in order to become more competitive and relevant by means of the generated results. The scientific contribution of an university is the one that “makes the difference” between universities. “World Class University” [6] is a concept that defines an excellent research university and it has been recently agreed that any country should have one or several World Class Higher Education institutions as driving forces for the progress of their own society [3].

The increasing importance of research in universities comes with new challenges for universities' management [8], regarding the research activity management, which has to become more efficient and flexible. More than that, a permanent contact of the university's management to the scientific contribution of the academic staff, chairs/ departments and faculties is extremely important, since it enables to forecast appropriate strategic actions for development. A good solution for this problem is the implementation of a dedicated information / software system [7], which provides dedicated facilities for research activity management for the academic and research staff of the university, as well as for the organization's management levels.

2. Integrated Research Management System in BBU – Design Principles And Architecture

Within the above describe framework, our university's management decided to develop and implement a dedicated software system for managing Babes-Bolyai University's (BBU) research activities, by offering accessible and user-friendly means of collecting specific information, and automatically performing quantitative analyses, synthesis and evaluations based on the collected information.

The more general aim of the implementation is to ensure proficient management of the research activity within BBU by means of this dedicated software system.

The implementation of the system complied structured efficiency principles and stages [4], in order to ensure best design and impact features.

The system that was designed and implemented in this respect – **BBU Research Management System** – is accessible by means of a user-friendly web interface – the address is <http://info.ubbcluj.ro/cercetare> and provides the following facilities:

- ◇ efficient collection of the research activity for each member of the academic staff – from any Internet location, by means of a web interface and dedicated user accounts
- ◇ proficient synthesis & reporting facilities for each staff member, as well as for various management levels – chairs, institutes, departments, faculties, university – based on managers’ accounts and corresponding access facilities

The system’s user categories are:

- ◇ teaching & research staff (including PhD candidates);
- ◇ chairs / departments / institutes’ managers;
- ◇ BBU research activity managers

From a technical point of view, the system’s architecture comprises a Postgresql database accessible on a web server and dedicated php [9] interfaces (including some Java script modules) which perform the dedicated information processing. The system’s architecture is schematically described in figure 1.

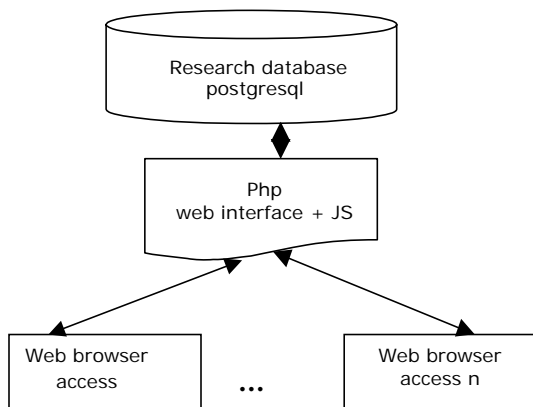


Figure 1- System architecture

The system’s facilities are consistent with *the university’s organization’s chart* since the research database is integrated into the human resources one. Therefore, management level facilities are based on managerial information collected from the organization’s chart & human resources database and

related to user account permissions (user categories & management levels), also based on the organization chart. The system’s facility levels are described in figure 2

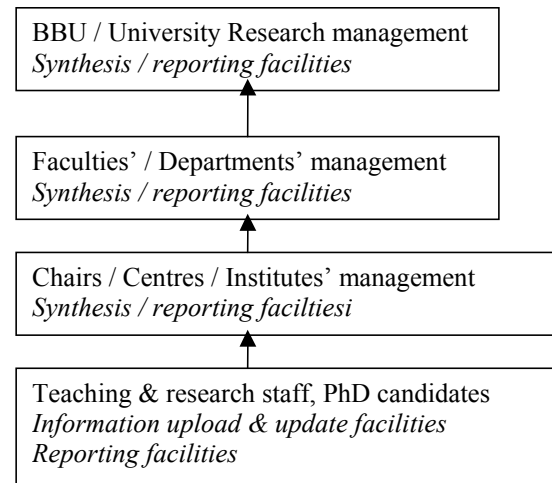


Figure 2 - System facility levels for user categories

Activities’ data structuring was performed in cooperation with BBU Research Department, according to the standards introduced by the National Council for Scientific Research in Romanian Higher Education – CNCSIS, supplemented with BBU specific criteria. We may state that this analysis stage, performed together with the Research Department, representing user specifications in the system’s implementation [5] was a laborious activity.

Currently, the implemented activity sections are:

- ◇ *Research papers* – ISI, international databases, national databases, other;
- ◇ *Books* – international publishing houses, nationally recognized publishing houses, other publishing houses;
- ◇ *Conference proceedings* – international conferences registered in international databases, other international conferences, national conferences;
- ◇ *Coordinated volumes (editors)* – international volumes, national volumes;
- ◇ *Patents & products with intellectual property rights* ;
- ◇ *Academies memberships* – international, national;
- ◇ *Prizes* – international, national;
- ◇ *Research projects* – international authorities, national authorities; declarations include topic, research domain & sub-domain, total & annual values, research team;

- ◇ *Artistic manifestations* – internationally or nationally recognized;
- ◇ *Artistic exhibitions, performances, concerts, works of art* – internationally or nationally recognized;
- ◇ *Artistic products with intellectual property rights*

In order to increase efficiency in introducing activities into the system, author list declaration pursue the following principle: activities are introduced only by the first author from the author's list, who also declares the co- authors by selecting them from the corresponding categories: teaching or research staff, PhD candidates, administrative staff. Still, duplicate activities are checked by several criteria and prevented to be uploaded twice. Similarly, for team work – such as research projects, the team coordinator declares the project. The declared activity is automatically taken into account for all the co-authors.

Activity management by the teaching / research staff is exemplified in figure 3.

Activity selection (see figure 4) may be used in order to specify reporting sections.

Reporting facilities are available both for each member of the teaching / research staff (for his / her own activity), and for all management levels: chairs, institutes, departments, faculties, university – comprising all the activities corresponding to that level and to the organization chart unit the logged on manager belongs to. In order to be largely accessible, reporting outputs are generated as rtf documents and include detailed activities and summarizing information for each (of the selected) activity categories – see figures 5, 6.

At a certain unit level, reporting facilities are available for all organization chart units that are included in the selected unit, and refer to the activity of the entire teaching / research staff belonging to that unit. For example, at “university” level, reporting facilities are available for all faculties / departments, chairs, centres, or institutes that belong to the university

The system also provides automatic facilities for exporting BBU's research activity database into the national CNCSIS (National Council for Scientific Research in Romanian Higher Education) standard, database that is annually communicated for national ranking purposes in the higher education area.

3. Directions for System Development

We are continuing the development of our Research Management System by integrating new facilities & activity types:

- ◇ improved reporting facilities with various grouping levels and reporting options are currently being developed;
- ◇ the implementation of new sections regarding scientific prestige, membership in conference boards & scientific symposium organization, etc. is on our work agenda;
- ◇ dedicated management of the scientific journal categories and publishing houses are to be developed in order to be used by the Research Department (these facilities will be available within a specific module for on-line administration of national & international accreditations for scientific journals and publishing houses)
- ◇ improving activity evaluation tools and the facilities that are dedicated to research centres are also taken into account

Regarding research topics on software design, we are in train of developing studies on comparing straightforward design to abstract design techniques in the programming technology that was applied in implementing the system

4. System Impact on Research Activity Management

The implementation of the **Integrated Software System for Managing Research Activities** has been an important step forward in managing and handling research activities in our university. Until now, at the end of each year, all academic staff, departments and faculties had to report their research activity in order to be taken into consideration and evaluated. Consequently, the scientific report of the university was issued, debated in the Senate meetings and, further on, transmitted to the National Council for Scientific Research in Romanian Higher Education (CNCSIS). Taking into account this report, the National Council for Funding Higher Education (CNFIS) allocates funds for Romanian universities based on the quality of their research activity. It is therefore understood the importance of complete and correct activity reporting. Before introducing the software application we describe in this study, the process of gathering appropriate, correct, complete information and in due time was a very tedious one and often required repeated appeals to faculties' management.

The **Integrated Software System for Managing Research Activities** was launched in November 2006, and has been used since for collecting, evaluating and reporting BBU's research activity. First full report was obtained for 2006, being synthesized in January-

February 2007. First implementation stages had an extensive operational impact on BBU's academic & research staff, since each of its ~1800 members (electronically) received a login account and password, and consequently was required to declare his / her research activity. This process was supported by dedicated trainings in each faculty / department and was complemented by a huge amount of assistance & support offered on request by e-mail from the system's support e-mail address infocercetare@staff.ubbcluj.ro, address that is managed by our IT Department; moreover, some of the received feed-backs were useful in continuous improving of the system's facilities

Though first stages of the system implementation, mainly comprising activity declaration by the academic staff were quite demanding, the significant advantages in on-line and efficient activity reporting were soon perceived by the system's users. (Previous declarations involved multiple activity reportings in different formats and were difficult to be managed in time at faculties' levels, as well as at the university's level). The advantages of the system were even more obvious and relevant when automatic synthesis started to be used at chairs, institutes, departments, faculties, university levels.

Along 2007, research activity declaration was naturally performed by means of the system, while all research management levels could evaluate the activity of their department at any time. Presently, the system has a very positive perception within BBU, based on the important advantages that it introduced in managing research activity at all levels. The system's advantages mainly refer to:

- ◇ Ensuring uniform reporting criteria;
- ◇ Minimizing delays in data gathering and the risk of missing unreported data: anyone can fill in, anytime, his/hers scientific production;
- ◇ Proficiency, accessibility and speed of activity declaration;
- ◇ Increased scale of activity declaration based on its accessibility and time flexibility characteristics;
- ◇ A rapid assessment of the research activity for any member of the academic / research staff, or university unit can be performed at any time;
- ◇ Accessibility of research activity assessment (& accuracy) for all people "in charge" – Head of the chair for chairs, Dean and Vice-Dean / Chancellor responsible with research activities at faculty levels, directors of institutes and research centres, university academic management, Rector and Vice-Rector responsible with research activities;

- ◇ on-line (real-time) reporting facilities on the updated database at all levels – academic & research staff, chairs, institutes, research centres, departments, faculties, university with a positive impact and huge benefits on the research management activity for all these levels

The system we describe supports the university's management in implementing BBU's research strategies and putting into practice certain managerial actions that are envisioned, like awarding and promoting researchers with relevant activities (for example in 2007 our university offered a prize for all members of the staff who registered internationally recognized scientific papers and books). The accessibility of various activity reports is important in collecting relevant information for designing research management strategies at department, faculty and university levels.

5. Acknowledgements

The IT team that has worked in the system's implementation and maintenance brought together: Ana-Maria Stănescu, Daniela Brăzdău, Raluca Ilban, Dumitru Petreuş, Monica Bojan, Anca Petrean (programmers and former programmers in BBU's IT Department), Daniel Stuparu (database administrator, BBU IT Department). We are in train of registering the intellectual property rights of the system for the whole implementation team

6. Conclusions and Future Work

Within the framework of increasing academic competitiveness and enhancing research management facilities, Babes-Bolyai University designed and implemented a dedicated software system for an **integrated management of research activities**. The present study focuses on the system's principles, impact and advantages.

BBU's **Integrated Research Management System** complied proficient design & implementation principles, and had a significant impact in improving research activity declaration, analysis and synthesis. Relevant management advantages of the implementation have been perceived at all levels – chairs, institutes, departments, faculties, university since, by means of its on-line synthesis availability, the system has become an important tool in assessing BBU's scientific activity.

The system we describe supports the university's management in implementing BBU's research strategies and in collecting relevant information for

designing research management strategies at department, faculty and university levels.

We may state that, in the action framework defined by the research strategy of our university, **BBU's Integrated Research Management System** has had a specific role in increasing the scientific contribution that was reported by our university.

Future work regards system development by means of new sections and facilities and, from a more specific IT point of view, we intend to compare the impact of abstract and straightforward design techniques in the technology that has been chosen for the system's implementation.

7. References

[1] P. S. Agachi, C Pop, C. Moraru, "Making Bologna Work - Europeanisation as a strategy for success with Bologna", *EUA Bologna Handbook*, C1.4-1, p.1-20, Raabe Academic Publishers, Berlin, 2006

[2] Agachi, P., Nica, P., Moraru, C., Mihaila, A., "What is new in ranking the universities in Romania. Ranking the universities from the scientific research contribution perspective", *3rd Meeting of the International Ranking*

Expert Group - Proceedings, October 28-31, 2007 Shanghai Jiao Tong University, Shanghai, China, p. 254, 2007

[3] Altbach, P., "Empires of knowledge: the challenges of World Class research universities in developing countries", *2nd International Conference on World Class Universities - Proceedings*, October 31 - November 3, 2007, Shanghai, Jiao Tong University, China, p.3, 2007

[4] Alina Andreica, "Strategies in Implementing Efficient Information Systems", *International Research on Global Affairs*, Gregory Papanikos editor, Athens Institute for Education and Research, Athens, p. 499-508, 2005

[5] Alina Andreica, IT Strategies In Increasing Business Competitiveness, *Studia Europaea*, LI, 3, p. 139-148, 2006

[6] Birnbaum, R., No World-Class University Left Behind, http://www.bc.edu/bc_org/avp/soe/cihe/newsletter/Number47/p7_Birnbaum.htm , accessed November 28, 2007

[7] Lucey, T., *Management Information Systems*, Guernsey Press, 1995

[8] Andrei Marga, *University Reform Today*, Cluj University Press, 2004.

[9] L. Welling, L Thomson, *Dezvoltarea aplicațiilor web cu PHP și mySql*, Ed. Teora, 2005

[10] Academic Ranking of World Universities - 2007 Ranking, Shanghai Jiao Tong University <http://www.arwu.org/rank/2007/ranking2007.htm> , accessed November 28, 2007

The screenshot shows a web browser window displaying the 'Managementul Cercetării UBB' website. The page features a navigation menu on the left with categories like 'Articole', 'Cărți - volume studii', 'Editare - coordonare volume', 'Traduceri', 'Brevete', 'Premii', and 'Proiecte instituționale'. The main content area is titled 'Activități' and contains a table of research activities. The table has columns for 'Tip', 'Titlu', 'Autor', 'An', 'Publicata in', and 'Actiune'. The 'Actiune' column contains links for 'Modifica', 'Sterge', and 'Detalii'.

Tip	Titlu	Autor	An	Publicata in	Actiune
articol isi	Symbolic Modelling of Database Representations	principal	2005	IEE PROCEEDINGS-COMPUTERS AND DIGITAL TECHNIQUES	Modifica Sterge Detalii
articol isi	Implementing Parameterized Type Algorithm Definitions in Mathematica	principal	2006	IEE PROCEEDINGS-COMPUTERS AND DIGITAL TECHNIQUES	Modifica Sterge Detalii
lucrare publicata in reviste indexate BDI	Evaluating ICT Implementations within the Romanian Business Environment	principal	2005	Transition Studies Review 38, Volume 11, Number 3 (ISSN:1614-4007), Springer Verlag Wien	Modifica Sterge Detalii
lucrare publicata in reviste indexate BDI	Topics Raised within the "Digital Divide, Global Development and the Information Society" Conference, http://cyber.law.harvard.edu/wsis/Andreica.html	principal	2005	Information Technologies and International Development Journal	Modifica Sterge Detalii
lucrare publicata in reviste indexate BDI	Telur 1.0 - Identification system for minerals	co-autor	1997	Studia Univ. Babeș-Bolyai, Geologia	Modifica Sterge Detalii
articol cncsis	Implementing Domains and Categories in Mathematica by Means of Parameterized Types	principal	2002	ANALELE UNIVERSITATII DE VEST TIMISOARA, SERIA MATEMATICA - INFORMATICA	Modifica Sterge Detalii
articol cncsis	Principles for Increasing Efficiency in Software Design. Case Study on Building A Decision Assistance System	principal	2006	ANNALS OF THE TIBERIU POPOVICIU SEMINAR OF FUNCTIONAL EQUATIONS, COMBINATORICS AND GRAPH THEORY	Modifica Sterge Detalii

Figure 3 - Activity management by teaching / research staff

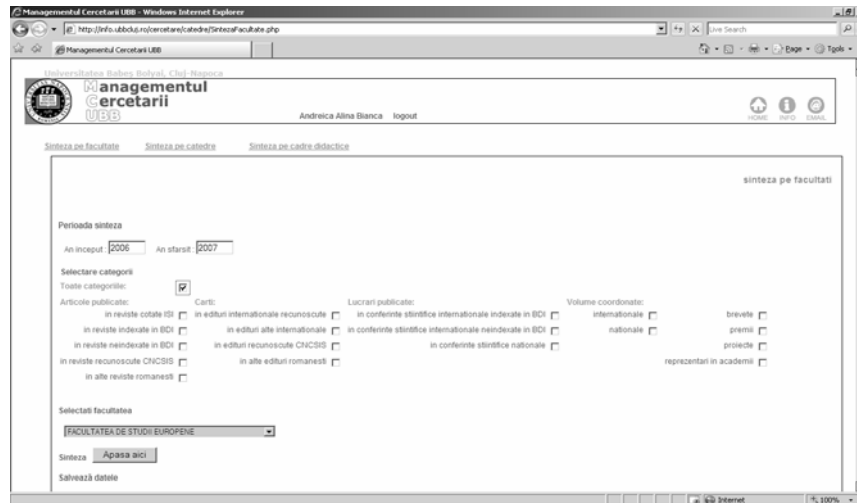


Figure 4 - Activity selection

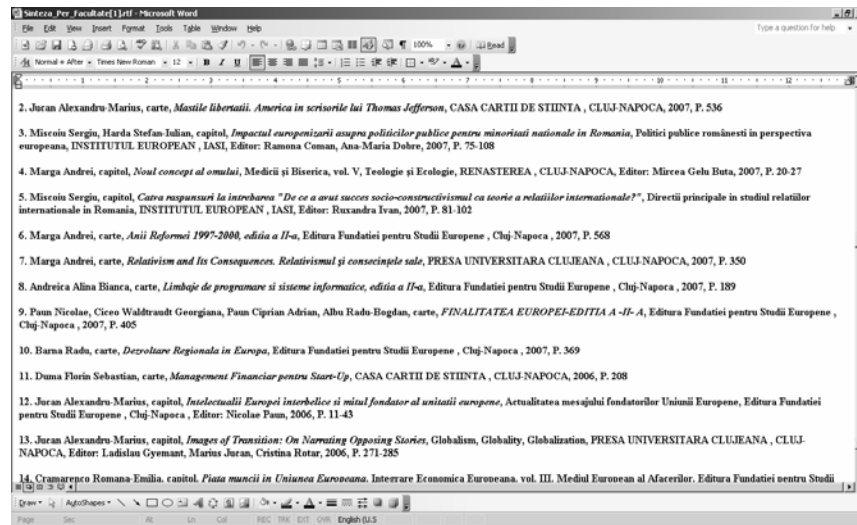


Figure 5 - Section from a detailed report at a faculty level



Figure 6 - A summarized report at a faculty level, selected from university level