

An Evaluation Framework for Higher Education ERP Systems

GHEORGHE SABAU, MIHAELA MUNTEN, ANA-RAMONA BOLOGA, RAZVAN BOLOGA,
TRAIAN SURCEL

Department of Informatics in Economy
Faculty of Economic Cybernetics, Statistics and Informatics, Academy of Economic Studies
Bucharest, P-ta. Romana 6
ROMANIA

sabau@ase.ro, mun61mih@yahoo.co.uk, ramona.bologa@ie.ase.ro, razvanbologa@ase.ro,
tsurcel@yahoo.com
<http://www.ase.ro>

Abstract: - A Higher Education ERP system can be used as a solution to integrate and increase the efficiency of the Romanian university processes. This paper examines the application of ERP software in Romanian Universities. We made an SWOT analysis for implementing an ERP system in Romanian Universities. Also, we proposed a comparison framework of ERP solutions for higher education management using as starting point the requirements of a Romanian University. The framework was applied to four of the top Higher Education management solutions. The process of evaluating an ERP system for use in higher education requires that a university compare the existing ERP software available to their current processes and see which ERP solution will best fit the existing procedures.

Key-Words: - Higher Education, University Management, ERP Systems, Integration, Quality Services, Evaluation Framework

1 Introduction

In order to deal with the wide range of challenges introduced by the Bologna Process, Romanian universities will have to equip themselves with integrated information systems strongly oriented towards governance of the processes, and yet be flexible in regard to configuration of the same processes.

A university integrated information system must provide:

- **Integration.** Integration is a necessary condition for the creation of quality services, quality services measured in terms of ease of access, complete coverage of all needs and availability of information. The integration will not be limited to the inner applications of the university, but will be extended to the national and international processes typical of the university domain.
- **Flexibility.** The context in which the universities are operating nowadays is complex and subject to change. It is therefore fundamental that the university information systems able to match the continuous evolutions of their organization.
- **Support in decision making.** A university integrated information system must provide the instruments to support the governance

processes, showing the data and analysis necessary for strategic planning and control.

- **Service evolution.** A strong development area for universities is represented by the delivery of services for students, teachers and researchers. These services should be a major priority with a university integrated information system implemented within the university. These services should also be accessed by different devices.

Up until today Romanian universities have been choosing information systems based on the need to satisfy different requests in a short time. Our universities have been forced to use in house developed information systems or to buy software solutions from small vendors having no experience in the field because of budget restrictions. These information systems have a low integration level and they are not based on homogeneous framework standards. They increase the proliferation of heterogeneous systems, complicating the integration among the various applications. Each application has its data and functions separated from the other applications already existing in the organization. These applications don't provide an integrated view of all activities in a university [2].

There is also a need for stronger performance metrics and indicators to support strategic decision

making. Current information systems have not been developed for strategic analysis and don't store historical data about students, courses and personnel. It is therefore impossible to develop a complex analysis that provides real time reports and useful indicators to the university management.

Our universities may choose the following methods of integration:

- in-house development of IT integration plan, and primary use of in-house resources;
- development of an ERP solution;
- adoption of a service-oriented architecture (SOA).

Each of these has numerous project phases with different levels of complexity and cost. Many factors can influence each approach and each phase of the planning, design and implementation processes.

Taking into consideration that most Romanian universities are public universities, a possible solution would be to develop a custom (in-house) integration plan. This solution has as its primary benefits: the lower initial costs, greater use of existing resources, and typically lower consultant fees. However, as the university grows, the cost of maintenance and future software changes will always remain high, due to the custom programming and integration work that must be done for each redesign.

The combination of in-house solutions (typically used in the didactic and in the research area) and ERP (often adopted for Accounting and Human Resources) solutions is another solution for Romanian universities. This combination often leads to an integration problem of the information systems in the university with an increase cost of management.

The paper presents the results of the second phase of the national research project "Integrated Information Solutions for Competitive Management in Romanian Universities".

2 Problem Formulation

Development and Deployment of an Enterprise Resource Planning Initiative is a challenge for Romanian universities. An ERP system can be used as a solution to integrate and increase the efficiency of the university processes. Such a system provides many benefits for our universities:

Business benefits:

- campus wide integration on a common system;

- improve internal communications;
- reduce or eliminate manual processes;
- enhance strategic decision making and planning capabilities;
- establish a self-service environment for employees;
- improve self-service environment for students and faculty;
- enable higher availability of administrative systems;
- support sophisticated data analyses for use in decision-making;
- integrated workflow, industry best practices, and reduced dependence on paper;

Technology benefits:

- reduce or eliminate the need for backup or shadow systems;
- platform for re-engineering business practices and continued process improvements;
- develop and maintain consistent data definitions;
- provide accessible, user-friendly administrative and student support services;
- increase data integrity, validity and reliability;
- assure system wide security and protection of confidential information;
- create a more seamless integration between technology and education delivery by providing a single platform based on new technologies;
- access to data in real time.

Such a system should also provide complete management of the main functional areas of the university:

- Planning and controlling (planning and budgeting, research analytics, academic analytics, student analytics, accounting analytics, HR analytics, HR forecast);
- Accounting (payments, incomes, fixed assets, general ledger, etc);
- Research (project management, research assets management);
- Student and learning (course planning, student services, resources management, community, e-learning);
- Human Resources (organization management, career, skills management, training, payroll);

- a portal.

We made an SWOT analysis for implementing an ERP system in Romanian universities (table 1).

Table 1. SWOT analysis

| S (STRENGTHS) | W (WEAKNESSES) |
|--|--|
| - campus wide integration on a common system; - improve self-service environment for students and employees; - business best practices; - enhance strategic decision making and planning capabilities; - support sophisticated data analyses for use in decision-making; - improve internal communications; - reduce or eliminate manual processes; - increase data integrity, validity and reliability; etc | - lack of Romanian language support; - very expensive; - proprietary framework/ lack of open source; |
| O (OPPORTUNITIES) | T (THREATS) |
| - platform for continued process improvements; - complex knowledge base; | - reducing the managing autonomy of the system from the university side; - issues of integration with the existing applications; - academic culture; |

Many factors can also influence the success or failure of any ERP implementation. The first research task of the second phase of our project was to identify the critical success factors for ERP implementation in a university [3] [21].

Over the past few years, a considerable amount of research has been conducted in critical success factors (CSF) for implementing ERP systems in companies ([6], [24], [26]). Esteves [6] proposed a unified success factors model. This model divided the critical factors in four perspectives: strategic, tactic, organisational and technological. The organizational perspective focuses on organizational structure and culture and business processes. The technological perspective focuses on technical aspects like hardware and software requirements for configuring an ERP system. The tactical perspective includes communication and interdepartmental cooperation. The analysis of ERP literature shows that the organisational aspects are more important

than technological aspects. For instance, Gargeya [8] identified that organizational culture and project management as the most important factors contributing to success of ERP implementation in companies.

One of the most extensive reviews of critical success factors in ERP implementations is Somers paper [26]. This paper describes and ranks 22 critical success factors for ERP implementations according to the stages of implementation. Somers identified that top management support, change management, project champion role and usage of external consultants as the important critical factors.

We have highlighted the specific aspects of Romanian universities to be considered in the analysis of these factors. We have identified some important differences regarding: organizational culture, top management support, team composition, inter-department communication, user training and external consultants [21].

The table 2 presents only the particularities related to: top management support, organizational communication, competences of the teams involved in the ERP project and organizational culture.

Table 2. The specific aspects of Romanian universities

| Critical factors | Specific aspects |
|------------------------------|---|
| Top management support | complex structure of executive committee |
| Organizational culture | organizational structure is complex and dual (exist in parallel, an administrative hierarchy and an academic hierarchy) |
| | a high resistance to process re-engineering |
| | complex strategic plans, concerning multiple aspects, but not very precisely defined |
| | responsibilities overlapping, gaps |
| | description of responsibilities is more vague than in the companies |
| | diverse, often informal control systems |
| Organizational communication | flexible work style, with greater emphasis on individual work |
| | large number of diverse groups, difficult communication |

| | |
|-----------------------|---|
| Team composition | no enough experience to develop integrated information systems |
| | no clear transfer knowledge from consultants |
| Adequate ERP Solution | there are not solutions that can specifically fulfil all the needs of a Romanian university in the areas of Student and Research management |
| | no support for Romanian language |

In the case of universities, a special attention should be paid to organizational communication and human factors, which are significantly different from companies. Organizational communication is associated with several critical success factors, such as university community involvement, change management and project management, and it has been considered one of the most critical success factors.

The adoption and implementation of an ERP involves high risks, mainly because of the huge initial investment, the frequent over budget cases (90%), the low success rate (30%), the missing of the initially proposed ROI (65-90% of the cases), partially achievement of the initially planned implementation, etc. Also, integration costs are traditionally much higher than a customized integration plan for the software, hardware, and consulting components through the implementation phase, but maintenance and modification costs post-implementation are lower.

The purpose of evaluating ERP solutions is to improve their selection, development, implementation and usage. The attempt of evaluating the solutions that exist on the market and identifying the best fitted for a Romanian University was hindered by the impossibility of finding a compatible evaluation framework for this type of solution. Of course, there are some evaluation frameworks for industry ERP solutions, although this was a neglected research area. Here are some examples:

- [27] proposes an evaluation framework of the key issues involved in the selection process of ERP software and the associated costs and benefits. The study underlines the need of a qualitative and quantitative evaluation of ERP systems, taking into consideration its strategic impact on the competitive position of an organization.

- A Web based DSS to assist organizations to evaluate the success of their ERP implementation and measure the benefits obtained is proposed in [29]. The study proposes a measurement of the ERP benefits and a list of productivity indicators.
- [23] examine an attempt of incorporating intangibles into traditional cost-benefit analysis in an ERP project.
- Hedman [11] proposes a practical approach of using narratives as a means of improving ERP systems as a complement to traditional valuation methods starting from three assumptions: evaluations should make the bases for action, narratives can make evaluation more relevant, and evaluations should be made with the purpose of improving selection, implementation and use of the system;
- Software solutions to assist the selection process, ([7], [30]), that gather primary data to measure ERP software solutions against unique client business and technical needs.

After a first task, when we identified and analyzed the critical success factors in implementing such an integrated solution in universities [3], we stepped on analyzing some really successful solutions on the international market of higher education management solutions. In the next section, we will define an evaluation framework. The framework was applied to four of the top Higher Education management solutions.

3 Evaluation Framework

The preparation for the evaluation framework development consisted of:

- Analysis of the Higher Education ERP solution market;
- Identification of the main Higher Education ERP vendors. For this purpose we used information offered by Gartner Industry Research [10];
- Direct contacting of some of the vendors. For this purpose our team sent them some Requests for Quotation, and got some answers for the specified functional requirements;
- Definition of the evaluation framework;
- Evaluation of some ERP solutions using the elaborated framework.

The information technology consulting group, Gartner, periodically reviews the state of ERP vendors in higher education. According to Gartner

Industry Research [10], the most important vendors of ERP solutions for universities are: Banner, Jenzabar, Oracle, Datatel, SAP and CINECA.

Datatel, Oracle and Banner continue to be places in the Leaders quadrant. Their suites represent approximately two-thirds of the institutions running an integrated administrative suite (HR, Finance and Student Information System).

Jenzabar (with two solutions, CX and EX) has one of the largest customer bases in the higher education market.

The European market of ERP solutions for universities has been reduced: Oficina de Cooperacion Universitaria solution and Cineca solution. Spain's Oficina de Cooperacion Universitaria has experienced continued growth in Spain and Latin America. The solution adopted by Italian universities Cineca appeared in Gartner analysis as a result of a large number of implementations, 96 universities in 83 countries.

Current research shows that the vendor is not the primary measure of success. The best measure of success is implementing with little or no modification to the ERP system.

The solutions chosen for analysis are the following:

1. SAP for Higher Education and Research;
2. Jenzabar Total Campus Management;
3. Banner-Sungard Higher Education;
4. Oracle PeopleSoft Enterprise Campus Solutions.

In order to analyze the features of each of those solutions, we used various methods for information gathering:

- Getting information directly from vendors, by meeting their sales representatives;
- Gathering online information from vendor sites;
- Gathering and analysis of some valuable observations made by universities that implemented those software solutions.

Our analysis adopted a functional perspective, taking into consideration the main features offered by each solution as this aspect is very important for Romanian universities at this moment.

3.1. Analysis categories

In preparing the Request for Proposal we used as a starting point requirements specific to our university, resulted from performing a minimal business analysis of the existing business processes.

The functional requirements were grouped into several categories:

- Student system (students self-service, faculty self-service, document imaging,

communication and correspondence, transcripts and transfer credit, faculty management, define academic programs, maintain catalog and schedule of classes, student academic management, continuing education/distance learning, integration with other software components, etc);

- Financial Management (general accounting, budget development and management, projects and research grant accounting, etc);
- Human Resources (HR self-service, payroll, etc);
- Reporting (operational and ad hoc reporting, analytic and strategic reporting)
- Technical requirements

The paper presents only the following aspects:

Semester scheduling, course management, facility utilization:

- course scheduling is manually made and there are often problems regarding activity overlaps for a professor;
- there are often changes in the initial scheduling after the semester beginning;
- classrooms and laboratories allocation is also manually made and there are often overlaps of activities in the same room or the rooms are allocated based on preferences, not on real needs (number of students, room facilities corresponding to course requirements etc).

Semester scheduling is an iterative process, involving both human and material resources. There are a number of compulsory classes for each year a study and a number of optional and facultative classes for each year of study.

Course selection is made by manually, by completing some forms and then centralizing them.

The new system should:

- create a central campus calendar to manage and monitor activities;
- enable users to view the usage of a building and room calendar activities;
- provide the ability to view all the activities in which a person is involved;
- search for buildings and rooms, which are available for a requested time;
- modify the calendar when facilities, buildings, and rooms are booked for activities or events;
- list faculty office hours, and/or a faculty-teaching schedule,
- provide the ability to create course catalogs;

- provide the ability to display course offerings, including meeting dates and times and location via the Web;
- provide real-time scheduling and modification with immediate update, etc.

Facility utilization refers to university facility management: classrooms, labs and equipment used for didactic activities according to the semester schedule.

The new system should:

- enable the institution to perform a wide variety of queries on facilities data to assess and analyze the effectiveness of space utilization;
- provide the ability to assign equipment to specific facilities/rooms;
- provide the ability to describe every aspect of the infrastructure of the campus, including buildings, rooms, equipment within rooms, and other facilities, etc.

Student admitting and registering

There are two distinct information systems that are not communicating with each other:

- an information system for the management of undergraduate students;
- an information system for the management of Ph.D. Students.

There is no information system for managing Master's degree students or the graduating students. Student admitting and registering should be integrated in the new system.

This integrated system should:

- allow online student registering, reducing the dependency on the secretary staff implied by traditional registering;
- offer concrete and complete information about students, starting with their admitting, registering and continuing post-graduation (entire student education life-cycle: license degree, Master's degree, Ph.D. Degree and post doctoral studies).

Student grades

The new system should simplify the capture of grades, improve delivery of grade information and tracking of grade appeals, assuring data integrity and compliance with university graduation policy.

Transcript evaluation and graduation

There is no centralized information system that keeps all data related to each student matriculation. This information is mostly recorded on paper or in

separate files by the secretaries. Diplomas are manually filled in a special department.

The new system should provide a secure and instantly accessible repository for documents which authorized staff can access from anywhere on campus.

Fee payments, payment processing, and repayment of exceeding payments

At this moment, scholarship and grant management is hindered by the lack of real time integration between student management information system and financial activity management information system.

The staff responsible with scholarship management is overwhelmed by the work overhead at the beginning of each semester or at payment deadlines because of the lack of automate processing of payments.

Payment processing

The integrated system should provide accurate real time information to support billing and payment processing.

Payments for tuition

There is an information system managing all the pay office payments, but it doesn't reflect the bank payments, and are not automatically associated with the student record. All payments data processing and integration are made by IT department.

Reporting, analysis, modeling

For adapting the Romanian universities to European standards, it is necessary that decisions must be determined by quality information, fresh and accessible in real time and also on a complex analysis of this information.

Today there is a need for stronger performance metrics and indicators to support strategic decision making.

Current information systems have not been developed for strategic analysis and don't store historical data about students, courses and staff. It is therefore impossible to develop a complex analysis that provides real time reports and useful indicators to the university management.

This integrated system should:

- permit saving ad hoc query as a permanent report; i.e., adding it to the list of reports;
- provide a powerful querying tool with drill down capabilities to provide different levels of information;

- support flexible report development based on the following report types: standardized, cross-tab, dashboard;
- provide forecasting capabilities;
- support the capability to provide management-level information to feed the planning process throughout the institution in all areas: what-if scenarios, statistics, and trend analyses, etc.

The analytics should be easy to use for end-users. The results of queries should be generated in user-defined formats, such as charts, graphs, or tables.

Users should quickly/easily develop comparative reports by selecting data from a current year or other period and from a past year or other period.

Ad hoc reporting capabilities should be accessed via the web.

Technical requirements

These requirements are related to security and administration: encryption techniques, user rights and authentication, system scalability, response time, e-mail protocols, technical architecture, operation system, minimum hardware and software requirements, etc.

This integrated system should provide:

- integrated security throughout the product suite;
- administrative tools to monitor unauthorized access;
- login statistics, i.e. last login date/time, source IP;
- the ability to restrict access by job function;
- the ability to restrict access by group, etc;

Control should be centralized for all aspects of security for the operating system, the database management system, and the application software.

System data should be protected by appropriate security measures, which prohibit access by anyone to data unless they have specific permission to access it, including reporting access.

3.2. Evaluation Framework

When asking for information about ERP systems, we used a RFP model, with a table form in order to facilitate the filling in and to increase legibility. As the questions contained by this RFP were often very detailed, we eventually developed a summarized framework containing the most important aspects analyzed during our research.

We studied some of the similar frameworks used for comparing industry ERP solutions. The following table summarizes the result of applying

the elaborated framework for the comparison of the four chosen solutions.

Table 3. Comparison of ERP solutions for universities

| | Functionality o-online/ n-offline | 1 | | 2 | | 3 | | 4 | |
|----------------------------|---|---|---|---|---|---|---|---|---|
| | | o | n | o | n | o | n | o | n |
| Admission | Student enrolment monitoring and management | x | | x | | x | | x | |
| | Student enrolment document management | | x | x | | x | | | x |
| | Admission fee collecting and monitoring | x | | x | | x | | x | |
| | Admission exam management | x | | x | | x | | x | |
| Semester Scheduling | Automatic generation of student groups | x | | x | | x | | x | |
| | Automatic generation of registers based on some selection criteria | x | | x | | x | | x | |
| | Semester scheduling auto generation | x | | x | | x | | x | |
| | Academic events management | | x | | x | | x | | x |
| | Curricula management | | x | | x | | x | | x |
| | Student grades introduction and management | x | | x | | x | | x | |
| | Student academic performance tracking. Student record | x | | x | | x | | x | |
| | Student tuition and other fee payments. Student record | x | | x | | | | x | |
| | Student and staff notification of alerts by various communication methods | x | | x | | x | | x | |
| | Calendar automatic generation | x | | x | | | | x | x |

| | | | | | | | | | |
|------------------------|--|---|---|---|---|---|---|---|---|
| | Multiple calendars: Academic calendar, Grant/Project calendar, Fiscal (State) calendar | x | | x | | x | | x | |
| Graduation | Management of all documents required for graduation | x | | x | | x | | | x |
| | Graduation exam management | x | | x | | | x | | x |
| | Graduation diploma fee management | x | | x | | | x | x | |
| Human Resources | Payroll management | x | | | x | | x | | x |
| | Staff recruiting monitoring | | x | | x | | x | | x |
| | Employee and payroll management | | x | x | | | x | | x |
| | Payment processing | x | | x | | x | | x | |
| | Tax and fee reporting | x | | x | | x | | x | |
| Financial | Financial accounting management | x | | x | | | x | x | |
| | Budgeting management | x | | x | | | x | x | |
| | Compliance with national and international standards in the field | x | | x | | | x | x | |
| | Fixed assets and inventory objects management | x | | x | | | x | | x |
| | Purchasing and accounts payable | x | | | x | x | | | x |
| | | | | | | | | | |
| Reporting | Predefined reports | x | | x | | x | | x | |
| | Predefined alerts | x | | x | | x | | x | |
| | Multidimensional analysis tools. Data marts | x | | x | | | x | x | |
| | Advanced reporting tools | | x | | x | x | | | x |
| | Dashboard and scorecard implementation | | x | | x | | x | | x |
| | Tools for statistic analysis and surveys | | x | | x | | x | | x |

| | | | | | | | | | |
|------------------------|--|---|---|---|---|---|---|---|---|
| | Support for definition save and reuse of personalized queries | x | | x | | x | | x | |
| General Aspects | Automatic generation of Ids for students or academic staff | x | | x | | x | | x | |
| | Multilingual support | | x | | x | | x | | x |
| | Component for managing communication with students, staff and graduates, integrated with all system modules component for managing documents at university level, including options for scanning, localization, identification, archiving, attaching to database records | x | | x | | x | | x | |
| | Component for content management | x | | x | | x | | x | |
| | Support for accreditation at department and university | x | | x | | x | | x | |
| | Component for internal auditing of the entire academic and nonacademic activity | | x | | x | x | | | x |
| | Component for project planning and management, regardless of their nature: administrative, research, etc, integrated with all the system modules | x | | x | | x | | x | |
| | | | | | | | | | |

4 Conclusion

ERP solutions are very complex software packages. To improve the chance of success, they must be

carefully evaluated and selected, needing a proper evaluation and analysis framework.

The comparison of the four solutions revealed that all are complex solutions, offering approximately similar features. Significant differences can result from price conditions and specific requirements and expectations of each institution's top management. Taking a deeper look at the functionality provided by the four solutions and at the detailed answers contained into the Request for Proposal document, becomes obvious that, neither of them fits the present needs of Romanian universities.

The analyzed solutions are aligned to international standards, so that implementing one of them would somehow force and accelerate the alignment to international standards and the re-engineering of the business processes

After selecting the most appropriate solution, the adaptation and customization effort would be significant. Taking into consideration that most Romanian universities are public universities, the financial effort of such an initiative would be very high for any of them. A possible solution, adopted in other European countries, would be the setting up of a university consortium to support, promote and manage the entire process of buying, localizing and implementing the solution into the interested universities.

An ERP implementation will probably be the most complex technology project ever undertaken on campus. Therefore, executives at university and university community must know as much about ERP systems and the ERP project as practical.

However, an ERP system in itself does not offer competitive advantage in a University environment. Service for students should be a major priority with an ERP system implemented within the university.

In the coming years the biggest challenge of our universities will be the attempt to manage the complexity in one systematic vision through an information system that can be shaped and up-to-date with the evolution of technology.

References:

[1] N. Agarwal, U. Rathod, Defining success for software projects: an exploratory revelation, *International Journal of Project Management*, Vol. 24, 2006, pp. 358-370.
[2] A. R. Bologa, R. Bologa, Gh. Sabau, M. Muntean, Management Information Systems in Romanian Universities, *Proceedings of the International Conference on e-Business (ICE-B 2008)*, 2008, pp. 425-428.

[3] A. Bologa, M. Muntean, Gh. Sabau, I. Scorta, Higher Education ERPs: Implementation Factors and Their Interdependencies, *WSEAS TRANSACTIONS on COMPUTERS*, Issue 4, Vol. 8, 2009, pp 651-660.
[4] S. Campanella, G. Dimauro, A. Ferrante, E-learning platforms in the Italian Universities: the technological solutions at the University of Bari, *WSEAS Transactions on Advances in Engineering Education*, issue 1, Vol. 5, 2008, pp 12-19.
[5] G. Dimauro, D. Impedovo, R. Modugno, A LMS to Support e-Learning Activities in the University Environment, *WSEAS Transactions on Advances in Engineering Education*, Issue 5, Vol. 3, 2006, pp. 367-374.
[6] J. Esteves, J. Pastor, Towards the unification of critical success factors for ERP implementations, *10th Annual BIT conference*, 2001, pp 1-9.
[7] Enterprise Resource Planning (ERP) Evaluation Center, <http://erp.technologyevaluation.com>.
[8] V. B. Gargeya, C. Brady, Success and failure factors of adopting SAP in ERP System implementation, *Business Process Management Journal*, Vol. 11(5), 2005, pp. 501-516.
[9] P. Goldstein, R. Katz, *Academic Analytics: The uses of Management Information in Higher Education*, Research Study from Educause Center for Applied Research, Vol. 8, 2005.
[10] M. Harris, J.M. Lowendahl, M. Zastrocky, Magic Quadrant for Higher Education Administrative Suites, *Gartner Industry Research* note G00161549, 2008.
[11] J. Hedman, A. Borell, Narratives in ERP Systems Evaluation, *Journal of Enterprise Information Management*, Vol. 17(3), 2004, pp 20-32.
[12] J. Hedman, A. Borell, The impact of Enterprise Resource Planning Systems on organizational effectiveness: An artifact evaluation. *Enterprise Resource Planning: Global opportunities & challenges* Hershey, PA: Idea Group Publishing, 2002, pp. 78-96.
[13] S. Impedovo, Information Communication Technologies: in Support of Knowledge-Based Society Development. Some Experiences at the University of Bari (Italy), *WSEAS Transactions on Advances in Engineering Education*, Issue 2, Vol. 3, 2006, pp. 69-74.
[14] D. Impedovo, M.G. Lucchese, R. Modugno, Dedicated e-Learning Infrastructure in a Metropolitan Academic Network, *WSEAS Transactions. on Advances in Engineering Education*, Issue 2, Vol. 3, 2006, pp.80-85.

- [15] P. King, R.B. Kvavik, J. Voloudakis., *Research Bulletin: Enterprise Resource Planning Systems in Higher Education*, Vol. 2002, issue 22, Educause Center for Applied Research, 2002.
- [16] T. Klobucar, iCamp Space - an environment for self-directed learning, collaboration and social networking, *WSEAS Transactions on Information Science & Applications*, issue 10, Vol. 5, 2008, pp 1480-1489.
- [17] R. Kvavik, K.Beecher, *Research Bulletin: The promise and performance of Enterprise Systems for Higher Education*, Vol. 4, Educause Center for Applied Research, 2002.
- [18] H. Lin, A framework to evaluate n-tier architecture ERP Systems, *Electronic commerce Studies*, Vol. 3, no.1, 2005, pp 79-96
- [19] A. R. Lupu, R. Bologa, Gh. Sabau, M. Muntean, "The Romanian Universities in the Process of Data and Information System Integration", *Proceedings of the 7th WSEAS International Conference on Artificial Intelligence, Knowledge Engineering And Databases (AIKED '08)*, Cambridge, 2008, pp. 527-532.
- [20] A. Lupu, R. Bologa, Gh. Sabău, M. Muntean, Integrated Information Systems in Higher Education, *WSEAS TRANSACTIONS on COMPUTERS*, Issue 5, Vol. 7, 2008, pp 473-48.
- [21] A.R. Lupu, I. Scorta, Gh. Sabau, M. Muntean, Critical Implementation Factors in Higher Education ERPs, *Proceedings of the 8th WSEAS International Conference on Artificial Intelligence, Knowledge Engineering and Databases (AIKED '09)*, Cambridge, 2009, pp 441-446.
- [22] M. Al-Mashari, M. Zairi, K. Okazawa, Enterprise resource planning (ERP) implementation: a useful road map, *International Journal of Management and Enterprise Development*, 3(1/2), 2006, pp. 169-180.
- [23] K.E. Murphy, S.J. Simon, Intangible benefits valuation in ERP projects, *Information Systems Journal*, Vol. 12 No.4, 2002, pp. 301-320.
- [24] R. Plant, L. Willcocks, Critical success factors in international ERP implementations: a case research approach, *The Journal of Computer Information Systems*, Vol. 47, Issue 3, 2007, pp. 60-71.
- [25] Dov Te'eni, *Socio-technical Aspects of ERP Implementation: The Central Role of Communication*, Idea Group, 2005.
- [26] T. Somers, K. Nelson, Taxonomy of players and activities across the ERP project life cycle. *Information & Management*, Vol. 41, 2004, pp. 257-278.
- [27] C.J Stefanou, A framework for the ex-ante evaluation of ERP software, *European Journal of Information Systems*, Vol. 10, No.4, 2001, pp. 204-215.
- [28] Z. Zhang, M. Lee, P. Huang, L. Zhang, X. Huang, A framework of ERP systems implementation success in China: An empirical study, *International Journal of Production Economics*, Vol. 98, Issue 1, 2005, pp 56-80.
- [29] A.B. Zaitun, Z. Zainol, A Web Based DSS for the Evaluation of an ERP System, *iiWAS 2008 workshops: ERPAS: Data mining and agents for applications*, 2008, pp 698-701.
- [30] <http://www.panorama-consulting.com/erpsoftwareselection.html>.