Higher Education ERPs: Implementation Factors and Their Interdependecies

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Abstract: - In this paper we have analyzed some critical implementation factors of an ERP project implementation in universities and their interdependencies. Taking into consideration that for industry implementations there are already many performed studies we started by considering university implementations as a particular case for the industry ones. Starting from this, we have identified and analyzed differences for the case of universities regarding communication structure, management involvement, organization, implementation team competences, legacy systems, inter-department communication, user training, suppliers/ customers' partnership, external consultants. The conclusions of this study are going to be used in developing an evaluation framework of ERP solutions for higher education management.

Key-Words: - ERP systems, critical success factors, higher education, university management

1 Introduction

The Romanian educational system is now at the point where it needs to implement a software solution to integrate and increase the efficiency of the university processes.

Identifying the most important specific aspects related to the implementation of university governance systems in Romanian, and generally speaking Eastern European, universities is the focus of our current research. Local universities have different processes from their Western counterparts and that is why implementations of solutions developed in Western countries had limited success.

At this moment, in the Romanian universities almost every faculty or department has its own software applications, developed in-house, applications that use various operation systems, tools, databases and protocols [12]. All these generate important disadvantages that put pressure on local universities to migrate toward ERP (Enterprise Resource Planning) systems [5].

The attempt of evaluating the solutions that exist on the market and identifying the best fitted for a Romanian university was hindered by the difficulty of finding a compatible evaluation framework for this type of solution. Of course, there are plenty of evaluation frameworks for industry ERP solutions, i.e. Enterprise Resource Planning (ERP) Evaluation Center [7] or studies regarding success implementation factors (e.g. [19]).

In our research we have evaluated the main studies regarding industry ERP implementations and confronted them to the realities of the Romanian universities. Our team have identified the main critical success factors and analyzed the differences, particular elements and situations for the case of universities. All there elements determine the occurrence of new aspects and approaches that often make impossible the use of the common industry methods and practices.

2 Critical success factors

The success or the failure of an implementation project depends on who and how defines it [30]. So, it is important to define the notion of success for an ERP system implementation [2]. The success of an ERP implementation project is represented by the project delivery on time and on budget [13][16], while for the organization that adopts the ERP system the success is represented by significant improvements of its business processes [8], [26]. Agarwal and Rathod have identified two perspectives on the success of an ERP implementation: an internal one, related to the duration, costs and scope of the implementation, and an external one, oriented towards increasing the client satisfaction and system quality [1].

The concept of critical success factor for an ERP system implementation is well defined in the specialty literature. Here are some of the performed studies and their main focus.

- Inter-dependencies between critical success factors [3], [11] were studied by recording the relevance of the critical success factors as defined by Somers [24] in order to establish the main causes determining the failure or the success of an implementation and the

confirmation of a direct relationship between critical success factors.

- Relevance of critical success factors reported to the success or failure of the ERP implementation projects [20], [29].
- The incidence and the impact of critical success factors during the entire implementation project from the temporal point of view. One of the most extensive reviews of critical success factors in ERP implementations is Somers paper [25]. This paper describes and ranks 22 critical success factors for ERP implementations according to the stages of implementation. The study concluded the main activities and personnel categories that have a decisive influence during the first four-five stages of the project are: the existence of a managing board formed of key-users or super-users, top management support, clearly defined objectives and user training.
- Quantification of relevance and incidence degree of critical success factors during each phase of the implementation project: initiation, adoption, adaptation, acceptance, routinization, and infusion; the conclusion was that inter-department communication and cooperation prevails as relevance degree in four of the six phases [22];
- The incidence of critical success factors in ERP system multi-site implementations [16][23], presenting a high implementation difficulty level from the perspective of: business strategy, system configuration, IT platform and execution management or the incidence of critical success factors in multi-national ERP system implementations [18], confirming the critical success factors universality. The study also approached the international software vendors' impact on multi-site ERP implementations, suggesting the positive character of their involvement, as it facilitates the establishing of precise implementation objectives, the user training and education related to the new economic processes and the forming of a competence team to ensure the project management [21].

Esteves [8] proposed a unified success factors model (Table 1). 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 procesess. The technological perspective focuses on technical aspects like hardware and software requirements for configuring an ERP system. The tactical perspective includes communication and interdepartamental cooperation. The analysis of ERP literature shows that the organisational aspects are more important than technological aspects.

ERP systems for higher education represent a special case of ERP implementation. Which are the characteristic elements that must be taken into consideration in the analysis of critical success factors in this case?

We have collected and studied the relevant papers related to the implementation of an ERP solution in universities. The research data was obtained by direct discussions with representatives of some european universities or by consulting websites of the ERP projects implemented in universities from USA, Australia and Europe

Table 1. Unified success factors model

	STRATEGIC	TACTICAL
Organizational	Sustained top management support Effective organizational change management Adequate project team composition Good project scope management Comprehensive business process reengineering Adequate project champion role Trust between partners User involvement and participation	Dedicated staff and consultants Appropiate usage of consultants Empowered steering committee Adequate training program Strong communication inwards and outwards Adequate project management Formalised project plan/schedule
Technological	Minimize customizations Adequate ERP implementation strategy Adequate ERP version	Adequate software configuration Legacy systems

(*Source*: Esteves, 2001)

In order to accurately gather data regarding the use of ERP software in higher education, we also studied the papers published by the Educause Center for Applied Research (ECAR). ECAR conducted a qualitative and quantitative survey of institutions that completed an ERP implementation since 1995. The papers examined the successful cases from small, medium, and large universities, and numerous problematic ERP implementations. Some papers have focused mainly on how to choose ERP software for higher education. But

many case studies came from American universities or Australian universities and their organizational structure and business processes are very different from our universities.

When comparing industry ERP implementations with university ERP implementations, we have identified some important differences regarding: communication structure, management involvement, organization, implementation team competences, legacy systems, inter-department communication, user training, suppliers/ customers partnership, external consultants. In the following sections, we will present here the particularities related to all these aspects.

2.1 Communication structure

Companies have usually clearly established formal communication structures. There is a small number of coherent groups, using clearly identified communication and reporting channels.

In universities, we find a large number of very different groups, having different objectives and interests, activating in different fields, so that communication is more difficult.

An important role is played by promotion of trust and mutual respect, and there are recommended informing meetings and discussions with small groups of people in order to eliminate the miscommunication or even the lack of communication. Of course, these types of communication are time consuming. In the ERP projects developed in universities, the communication can have various approaches:

- A strict control of the project information flows by the project team and top management in order to control the ERP project resistance. This approach can lead to negative consequences, like distrust and spreading of negative rumors about the project, or even fear or panic.
- A very open attitude towards communication, pleading for the ERP project through numerous committees and meetings. These lead to a general understanding of the project objectives in the entire organization and to an increase of tolerance.
- Conviction and involvement of department managers and stakeholders, so that they have the possibility to express their own vision, to agree and to sign a project support statement.
- Inclusion of members of the financial department in the project team in order to ensure their involvement and support.

A multitude of communication tools and methods must be used in a variety of ways to gain acceptance of new technologies, changed administrative practices and expanded opportunities inherent in the project. Information will be communicated among project team members and to the University in a variety of ways, primarily:

- Using the project Web site - to disseminate news and information including newsletters, articles, project documents, white papers, Q&A sheets, training information, etc;
- Creating a database to store information about problems that occurred during implementation and how they were resolved, and which can be accessed by all persons involved in the project;
- Regularly scheduling team meetings;
- Organizing meetings with small user groups for change informations;
- Sending e-mails to specific groups.

2.2 Management involvement

For a successful implementation of an ERP system in a university, the top management support is a decisive factor. In the model presented in [24], the top management support was identified as the most important critical success factor. The top management is the one that establishes the organization agenda, influenced by the strategic objectives, responsibility to the university members, political, university power relationships and also external influences.

Examples from the specialty literature demonstrated that a low initial top management support means that the ERP implementation can be considered a failure. The ERP project must be very well organized, requiring the constitution of a decision committee for strategic integration in the university. It must include members of administrative management structure and IT services structure, it must have a clear and comprehensive understanding of university strategic development plans and of its main objectives it must know very well the general integration plan.

Dual team structure is necessary, including both IT representatives and administration representatives to ensure the project acceptance, a common problem understanding and to create a maximum synergy among performed activities.

It is important to resort to external consultants for supplementary expertise in order to get recommendations, to facilitate planning and implementation, to get validations for the performed validation efforts. But the success of the implementation plan depends mostly on the support and involvement of administrative management and on the university staff effort of developing a comprehensive and complete plan. For example, in the case of a Romanian university, the management committee should include:

- Members of the executive senate board: the rector, the vice-rectors responsible for academic activity, for the administrative activity, for research activity,

for information technology, the university administrative manager;
- The managers of the Computer Science Department and of the Computer Network Department;
- The HR Department and Financial Department managers;
- The faculty deans and members of Professor's Board;
- The project manager;
- External consultants.

The main responsibilities of the executive committee are the following:
- Set vision, goals and priorities of the project;
- Assure communication support for the project throughout the University;
- Approve budgets and changes in the scope of work;
- Review progress, provide guidance and oversight;
- Resolve escalated issues in a timely manner.

A very important role in a university ERP implementation project is the "project champion". He is the person who makes the project work, he must be chosen with much responsibility and care. Project champions are managers with vision, courage and tenacity who actively and firmly promote, support and encourage the project. They must also have special human qualities, like creativity and energy and must give life to the project [17].

In a Romanian university, the project champion could be the information technology vice-rector, assisted by an external consultant for specific integration aspects. He is on a position that allows him to support the project realization on the established time and budget.

2.3 Organization (culture)

There are many differences resulting from a university organization itself compared to a company organization, differences that influence the means of ERP implementation.

For example, from the point of view of the followed strategy, in the case of companies both the general company strategy and the one related to the information system development are clearly defined. In the case of universities, with rare exceptions, there are many complex strategies, reported to many areas, but very precisely defined.

If in the case of companies the responsibilities are clearly defined and allocated, in universities there are frequent overlaps (i.e. administrative and didactic responsibilities overlaps). Because the lack of personnel or competencies, there may be un-allocated responsibilities, but generally, the responsibilities description and control are much more diffuse and vague.

Companies have established control system for activity efficiency, to help them function in a competitive environment. In the case of universities, the control systems can take various forms, often informal ones, adapted and customized according to the needs of a specific department or staff.

The work style is also different. Companies are focused on tasks and results of task performance, while universities adopt a flexible, existentialist style of work, adapted to the emerging needs and loosely coupled, with a stronger focus on individual work.

Organizational culture has a major impact over implementing an ERP system in universities. This may be explained by the crash of cultures that took place during the last 20 years. On one side, there is the belief that a university culture should rely on the ideology and the values of the private sector: "The time has come to recognize that education is a business and students are customers" [27]. On the other side, many university members plead for keeping the cultural values reflected in a work style based on independence and academic autonomy.

ERP system implementation and business process reengineering can be seen as an attempt of changing the university culture at the deepest level. An important change due to the ERP implementation is a shift of power to the middle management, who can have access to business information anytime.

A primary objective of an ERP project is to implement best practices where possible, while maintaining the accuracy of information and preserving good internal controls throughout the university. The organizational changes may include reclassifying positions, shifting work and/or positions from one department to another, retraining current staff, reassignment of duties and new expectations for existing staff positions. The organizational, policy or procedural changes must be discussed with all departments involved in the change process.

2.4 Implementation team competences

An ERP project involves many persons working in different university departments, and also external consultants. Lack of participation in the implementation process could influence the new system acceptance by the university community and may contribute to a lack of communication between management and staff perception.

An important success factor for the project is the ability of different groups of forming a unique team, where there are not "us versus them" groups (i.e. functional vs. technique group, anyone vs. contractor, etc). Technical and functional management must establish a real working partnership.

Regarding the project team, a relatively new concept is in use: competence center. It is formed of three teams:
1. Business process team – having as main tasks:
a. Change management;
b. Continuous process improvement;
c. Operational architecture;
d. Level two user support;
2. Application development and integration team– having as main tasks:
a. System architecture;
b. Custom programming;
c. Application integration;
d. Business-to-business integration;
3. Application operation team– having as main tasks:
a. Technology architecture;
b. Configuration of multiple ERP environments (production, test, etc);
c. Maintenance and upgrades.

Traditional IT functions (PC support, networking, etc) are not included among the functions of a competence center. The key users play an important role in this model, as they are the first support line for end-users. Teams must be formed considering: main functional areas (financial, HR, rectors' office, dean's office, technical), infrastructure, institution network, existing software services/applications, information security.

A Higher Education ERP project is more than an information technology project. It is a University project. For this reason it is very important the feedback and expertise of the university community to ensure that the system best meets the needs of each department and the university as a whole.

2.5. Legacy systems

A study performed on Romanian universities in 2008[12][14] revealed that almost every faculty or department had its own software application, developed in-house, applications that used various operation systems, tools, databases and protocols. These applications cannot offer an integrated view over the activities developed in a university and increase uncontrolled data redundancy. All these applications are also sources of information for the new implemented ERP, so, it becomes mandatory to create a Data Standards Committee in charge with development of rules to govern how data will be entered, the format that will be used, and who will be responsible for specific shared data items.

For adapting the Romanian universities to European standards, the decision making process must be based on quality information, fresh and accessible in real time and also on a complex analysis of this information.

Nowadays, 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 do not 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. For instance, if an ERP implementation would include the Student module, the Financial module and the Human Resources module, the ERP database should include students data (a history over 10 years of courses and students), financial data (all current records and historical data records for the last 10 years), personal data (at least 10 years of historical data for all employees and usually three years for those who left the university).

2.6. Inter-department communication

In a classic ERP project there are many parts involved: decision makers, developers, users and other persons. In the case of Romanian universities, the main involved parts are:

- University senate and rector;
- IT department manager;
- HR manager and managers of all departments implementing ERP modules;
- Dean and Professor's Board for each of the faculties.

A faulty communication between these parts is a major failure cause in implementing information systems (i.e. between IT specialists and users or IT specialists and university management) [9]. Communication is associated with other success factors like user and management involvement, project monitoring, etc.

The next figure presents a schematic representation of the main communication channels into a university. Horizontal communication appears inside each rectangle and between rectangles on the same level (informal communication between users of various modules) while vertical communication appears between levels.

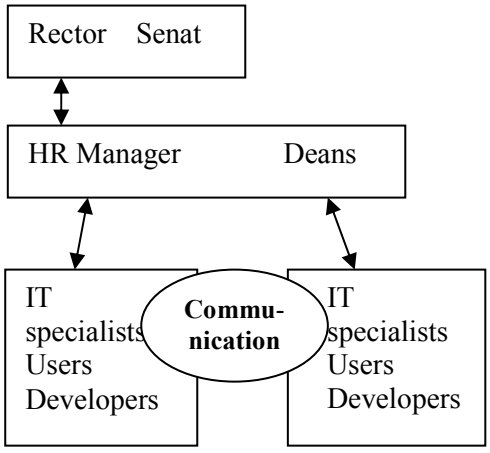

Figure 1. University communication channels

The lack of feedback in communication, an ambiguous or unsteady communication and a lack of confidence between the involved parts can lead to an increase of communication complexity. For example, there are differences between the language used by IT specialists and the one used by university management that can lead to a communication complexity increase [4].

2.7. User training

User training is an important and delicate phase in an ERP implementation. Usually, the training activity is structured by functional modules and consists of presenting all the system functionalities, with focus on those that will be used by the client. User manuals, technical and functional specifications are used.

Training activity can be organized on phases, depending on the IT knowledge and skills ant the role played of users in the university. Usually, there are two main groups of users: key users – qualified persons that should have an overall image of the entire application and main processes, and end users –users that perform specific activities, usually routine tasks from IT point of view, but possessing specific domain knowledge and understanding of business functionality of the ERP module. Beside those, a system administrator should be trained in the area of database management.

Reticence and lack of enthusiasm in using the ERP system, difficulties in changing organizational culture, are frequently involved as failure factors in ERP implementation. In order to accept an ERP system, users usually look for the satisfaction of the following aspects:

- Perceived usefulness;
- Compatibility with business processes;
- Ease of use;
- Coverage of organization functional requirements.

A complex IT acceptance model is proposed and empirically demonstrated in [28], unifying 8 pre-existing models. The eight models reviewed are the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behavior, a model combining the technology acceptance model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory.

Adapting the model to the case of ERPs, the software solution should take the steps presented in Figure 2 in order to respond to the needs and expectations of the staff using it. Surprisingly, the subjective factor, introduced here like a subjective norm (the person's perception that most people who are important to him think he should or should not perform the behavior in question [10]) play a really important role in accepting the software solution.

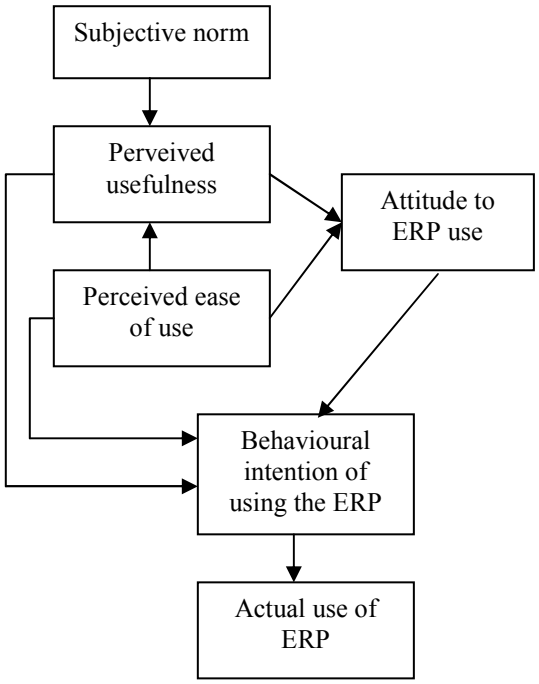

Figure 2: An ERP acceptance model

Management support for introducing IT in a university must aim at improving system acceptance at the level of every employee. Permanent technical support is recommended by training programs, 24 hours helpdesk, and encouragement of a favorable organization climate. Managers should consider the openness that young people have towards accepting new technologies and adapt their strategy to the user category.

There is also a cultural factor influencing IT adoption: in Western countries, the perceived utility is the most important acceptance factor, while in Eastern countries the ease of use is considered to be the key element.

Usually, companies have the tendency of cutting-off the budget allocated for training or the number of trained people. But, if the employees do not manage to use all the necessary ERP features because of the poor training or natural resistance to change, the software solution benefits will diminish. So, user training represents a way of protecting the high IT investment.

In the case of universities, the training process could be partially adapted in order to reduce costs. As universities usually benefit from didactic staff with high IT knowledge level, high openness to new technologies and high capacity of learning and a vast experience in teaching [6], some of them could be formed and further used as trainers. This way, a university could easier adopt an ongoing training strategy, taking into consideration some essential aspects like: university culture and internal policies, staff openness to new,

openness of university management to ensure ongoing staff training.

2.8. Suppliers/ customers partnership

Nowadays organizations have new demand, focusing on flexible and quick responses to customer needs. Emphases falls on integrating the best form of traditional management, quality and project oriented approach in order to optimize organization activity.

Customer oriented project management is a management philosophy, a set of rules to follow and a set of tools and techniques. It integrates project management and quality management with a customer-oriented structure. Quality is defined reported to the total customer satisfaction, a process that is controlled by the internal or external customers that select, plan, design and implement projects involving the project team.

Specialty literature speaks about the integration "overcoming the organizational barriers" we meet in the ERP systems, by extending its functionalities toward customers and suppliers.

This management approach that take into account customer/supplier relationship offers a flexible and receptive approach, capable of acting or reacting against all present economic forces. The emphasis is on understanding the actions directly or indirectly exerted by internal or external forces on customers, leading to improvement of quality, reduced costs for customer needs satisfaction, total customer satisfaction for best quality deliverables at the lowest price, in order to face competitors in a global economy.

In the case of universities, the main customer is represented by students that have to choose between one university and another, between one study program and another, between continuing or interrupting his studies.

The process of attracting, enrolling and keeping the students is influenced by the quality of information and services to which they have access, and the quick feedback to the requests and problems they encounter. Also, providing a quality education process implies optimal management of human resources, materials and money, the final objective remaining total customer satisfaction.

2.9. External consultants

ERP systems are open systems that can be customized to respond to all customer need. The need of implementing such a complex system, with various functions from complementary activity fields makes inevitable the use of external consultants whose experience is essential both for analysis and modeling the business processes, but also for implementation and testing phases.

There is a delicate balance between the organization tendency of reducing the use of outside consultants due to the high costs of services on one hand, and the technical, functional obstacles and lack of internal knowledge that make inevitable the use of external resources.

Choosing the best consultants, correlated with the retention and transfer of knowledge to internal staff becomes crucial to overall success of projects.

An external functional consultant has as main attributions:

- Management of tasks and support applications regarding end-users;
- Diagnosis, analysis and solving of problems arising in application;
- Writing functional specifications, preparing test data and testing;
- Training for end-users and knowledge transfer to the university;
- Interaction with other consultants to provide an overview of the ERP system functionality;
- Validation of ERP solution implementation to ensure impartiality and objectivity on the success or failure of implementation.
-

Although universities have usually restricted budgets, a quick look over the attributions ahead convinces us that external consultants cannot be replaced and play an essential role in the implementation process. Considering the particularities of the university staff we already mentioned, an advantage could be obtained by the quick and substantial transfer of knowledge from consultants to qualified university staff, creating the possibility for them to participate to the tasks of external consultants or even to take them over.

2.10. Factor interdependencies

The studied factors do not work in isolation, without one factor affecting another and vice versa. Figure 3 shows how these factors interrelate and directly or indirectly influence each other, leading to successful implementation of a Higher Education ERP project. Figure 3 focuses only on organizational perspective of Esteves model.

For a more suggestive representation of these factors relationships, we have used a Causal Loop Diagram. The arrows show how one factor affects another factor. Each arrow is labeled with a minus or plus sign. A plus sign is used to signify that a change in one factor causes the second factor to change in the same direction. The arrows come together to form loops, and each loop is labeled with an "**R"** or "**B"**. "**R"** means reinforcing (i.e., the causal relationships within the loop create exponential growth or collapse) and "**B"** means balancing (i.e., the causal influences in the loop keep things in equilibrium). For instance the loop formed between Organizational communication and University

community involvement in Figure 3 is a simple reinforcing loop (R). A proper organizational communication causes the involvement of all needed people in the implementation process and a lowering resistance to change.
Figure 3 also illustrates that organizational communication is associated with several critical success factors, such as university community involvement, change management and project management, and it has been considered as one of the most critical success factors.

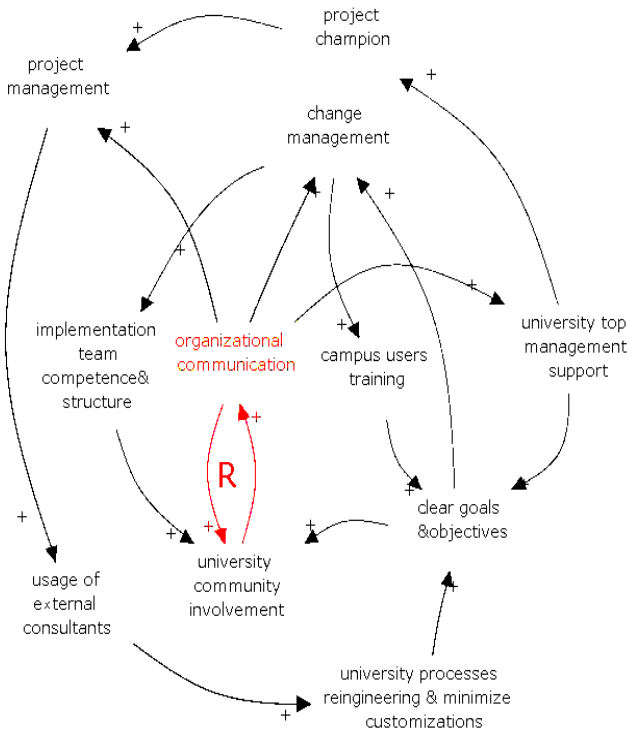

Figure 3. Inter-relationships of critical success factors in Higher Education ERP projects

Taking into consideration the analyzed aspects, we propose here some important action steps a university can make to increase the likelihood of success for an ERP system implementation (Table 3).

	ACTION STEPS
University community	University community must be well prepared for the new system transition
	A positive attitude toward the new system
	Involvement of functional areas in the implementation process. User participation is a key factor to ensure that users will further use the system.
	Training using a variety of delivery methods appropriate to university roles.
Management	Commitment of university top management A adequate executive committee
	Implementation efforts must be led by a person with strong skills and knowledge in the business processes.
	Effective change management plan
	Interdepartment cooperation and communication. Appropriate communication channels needs to be established.
	Management of expectations. Increased service for all employees should be a major priority when selecting a solution for business problems in a university environment
	Knowledge management. Appropriate documentation of every process is essential for future knowledge in an implementation project. Key technical knowledge describing the new and the old system must be kept in organization in order to make possible system maintainance and upgrade with future versions when applicable.
	Usage of consultants.
	Well- defined project scope
	Well-defined project charter (objectives, scope, project plan, risks, resource requirements, project governance)
Organization	Optimized business process reengineering Consult the people within the organization environment (staff and academics) with the best possible knowledge and experience for expertise on how the processes should be done
	Minimize customizations The University must be able to upgrade the ERP package when the vendor releases new versions.
Team	Communication and cooperation between team members and teams
	Team composition represents all functional areas
	Full-time consult support for the duration of project
	Team members assigned full-time on the project and normal job responsibilities reassigned
	Team members should have necessary skills and experience to understand the business requirements the system have to solve.

	Training in using and modifying the ERP package is also essential.
System	An adequate ERP solution. A rigorous selection process should be conducted.
	A adequate data conversion plan
	Information and access security Security needs are of high importance in an environment where everyone can access and share information using a web interface.

Table 3. Action steps for successful implementation of an ERP system in a Romanian university

3. 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 performed analysis shows that, in the case of universities, a special attention should be paid to organization and human factors, which are significantly different from companies.

A Higher Education ERP implementation will be probably the most complex technology project ever undertaken on our campus. Therefore, university executives and university community must know as much as possible about ERP systems and the ERP project.

Although it offers many advantages, an ERP system by itself does not offer a competitive advantage in a University environment. In order to obtain this, quality services for students and collaborators should be a major priority with an ERP system implemented within the university.

The results of this study is going to be used in elaboration of an evaluation framework of ERP solutions for university management that will be than applied to some market leader solutions in order to discover the best fitted one for the Romanian universities.

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