

Key Success Factors Analysis in the Context of Enterprise Resourcesplanning Systems Projects Implementation

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Abstract

The authors of the paper have systematized key factors, which influence ERP projects implementation success at the different stages of its life cycle. The authors develop the dynamic model of stage-by-stage diagnostic readiness assessment of company potential regarding ERP project. Fours authors' hypotheses were suggested and tested in the context of the offered model. The paper identifies and systematizes key factors influencing the success of Enterprise Resources Planning System project implementation (ERP systems). The paper reveals stage-by-stage diagnostic potential assessment of a company regarding project implementation, which can be used by company heads, practical persons and scholars for the purpose of the identification of soft critical factors of ERP projects success, wrong treatment of which can lead to their transformation into risk factors, which endanger project successful completion.

Keywords: integrated information systems, key factors, projects, human resource management, implementation stages

1. Introduction

Information society establishing in developed countries – is a global process that accompanies the modern development of world economic and financial system. The formation of information society in our country is an essential condition for our country's integration into international business environment. Whereas the development of information society is impossible without appropriate information and communication infrastructure formation, the most important part of which is integrated information systems.

The appearance of ERP systems is considered most significant event in the area of corporate information technology in the period of 1990s (Davenport, 1998). Today ERP systems have become extremely important components of modern business processes. The causes for companies' active switch to ERP systems use are various technical, financial, operational, and strategic advantages promised by the ERP systems providers. According to Olson (Olson, 2004), ERP systems' expected advantages were, name a few, data collection speed-up, increased in-house cross functional interaction, enhanced orders management system, financial and operational expenditure reduction, improved interaction with clients and suppliers, delivery accuracy increase and efficient treasury management, etc. As a rule, ERP system implementation is a long term and costly process that requires involvement of extensive resources, including people. Moreover, within the framework of the ERP projects it is necessary to integrate various concerned groups, perform works under the conditions of tight schedule and face other obstacles on the path to implementation. It is not surprising that failure rate of ERP systems implementation is high. A good deal of research papers were concerned with the study of factors influencing implementation process. The goal of such researches was identification of critical factors at the heart of ERP systems implementation success. As a rule, these factors include support on the part of top management,

effective leaders of project teams, relations with software suppliers, user training, use of consultants' services, in-house interaction and communication, etc. Herewith many researches place human factor into the lists of critical success factors they formulated and agreed that correct management of human resources is a key to successful completion of ERP systems implementation. ERP system implementation project also unavoidably starts the process of changes, that is attributable to behaviour and management tasks emerging, such as user opposition, manager opposition, lack of staff motivation, rapid turnover in staff, lack of expert knowledge, lack of human resources and provided training, etc. Similar tasks related to human factor are more difficult to solve than technical challenges. In support of this view, many scientists suggest that failure of a considerable number of ERP systems implementation projects is caused by inadequate managerial attention to human factor. In other words, to achieve success in ERP systems implementation project it is necessary to take active measures regarding needs and causes of staff concern. Currently human resource management HCM has become one of the fundamental functions of project management. HCM progressed from non-active, focused on the solution of arising problems to strategic one, oriented to retention and development of the best staff members (Clemmons & Simon, 2001). Traditionally HCM practice consisted of such activities as salary payment, staff recruitment, personnel records keeping, accounting etc. In the modern world, HCM plays a greater part providing staff complex support. Since the appearance of ERP systems, the function of human resource management effected complete integration with the operational part of business. Nonetheless, the theme of HCM research in the context of ERP is relatively new, and not many learned works are concerned with it that presents a problem for companies, which plan carrying out or are in the process of carrying out ERP systems implementation project and extensively search theoretical and practical guidelines for corresponding operations. The above determines the relevance of carried out research theme.

1.2 Literature Review

Aladwani, A. M., Jewels, T., Kettelhut, M. C., Lario, F., Marjanovic, O., Milford, M., Mital, A., May, D., Nelson, K. G., Olson, D. L., Ortiz, A., Ros, L., Sutcliffe, N., Somers, T. M., Stewart, G., Wateridge, J., Hawa, M., Hunter, T., Hunter, B., Zucchi, F., Edwards, J. S., Evans, R., and others studied human aspects effect on ERP projects results. Akkermans, H., Helden, van K., Nelson, K. G., Gibson, Kim, Y. G., Light, Nelson, K.G., Sumner, M., Somers, T. M., Umble, E. J., Haft, R. R., Hong, K. K., and Holland made a considerable contribution to the studies of critical success factor of ERP projects.

It shall be noted that ERP systems implementation projects are complicated in terms of realization, require extensive resources, and take 1-5 years. Moreover, before reaping benefits from ERP system, as a rule, a company experiences decline in performance and operation productivity. Olson (Olson, 2004) generalizes the results of two studies concerned with motivation research at the bottom of ERP system implementation in American and Swedish companies. Both studies revealed that existing systems replacement and processes standardization were the main causes for business switch to ERP systems.

Academic literature offers a number of implementation models developed by researchers and empirics. The analysis of these models made it possible to conclude that a model offered by Ross (Ross, 1999) is most detailed and more focused on the reflection of long-term strategic nature of ERP projects than other models. In addition to critical success factors, project perception by various concerned groups involved in ERP project, such as executives, users, system suppliers, and consultants, is also shall be considered as a key factor that influences project result. The cause is different concerned groups may have different idea of project success. Skok and Legge (Skok & Legge, 2002) conducted the research of key interested individuals and revealed four main concerned parties involved in ERP system implementation project: executives, users, developers, and consultants. Human activities system diagram was used to illustrate correlations between various concerned parties, zones of possible conflicts were defined as possible sources of failure. Likewise, the research of Akkermans and Helden (Akkermans & Helden, 2002) also indicates that presence and actions of key interested parties, such as top managers, project team, project team leader, and software suppliers have great impact on the project success. In particular, Akkermans and Helden consider executives, developers and consultants concerned parties of paramount importance. Moreover, the authors suggest there is a possibility to rescue ERP project on the verge of failure by means of introduction of changes in presence and behaviour of these concerned parties. Hawa (Hawa et al, 2002) states that large reengineering projects require coordination of multidisciplinary teams consisting of executives, technicians, end-users, consultants, systems suppliers and other concerned parties. Wateridge (Wateridge, 1997) also adds that project managers shall have necessary skills to manage mutual relations with a great number of parties interested in the project. The best part of academic literature defends a point of view according to which success cannot be achieved without qualified and motivated personnel. In his research Hawa (Hawa et al, 2002) examines the competences of personnel necessary for project and concludes that two different

types of competence is important regarding the project – engineering and operational ones. Herewith, it is not enough to have employees who have such competences, these employees shall work closely with each other. The ideal case is when an employee has two types of competence in such a way he would be able easily switch between different areas. Welti (Welti, 1999) distinguished availability, expert evaluation, structure of project team and trust as important requirements for HCM regarding project successful execution. Wateridge (Wateridge, 1997) carried out the research of the importance of skills, which project managers shall have to manage IT projects successfully. The key important skills were leader skills, administrative skills (such as planning and control), interpersonal, and communication skills.

2. Materials and Methods

Currently concerning project management, the personnel management trend dominates. The majority of researches agree that people are most valuable company assets, and cause of the majority of projects failure is inadequate attention of management to human factor. Correspondingly, many scientists placed HCM aspects into the lists of critical success factors of ERP projects they made. May and Kettelhut (May & Kettelhut, 1996) analysed presence and impact of human factor on reengineering projects and indicated high price, which companies, paying inadequate attention to human factor, pay. The authors also represented recommendation for human factor management in order to increase probability of reengineering projects successful execution. As opposed to common opinion, Belout and Gauvraeu (Belout & Gauvraeu, 2004) indicate that although there is a distinct interrelation between human factor and project success, human factor does not exercise significant influence upon project results. This research conducted the retesting of hypotheses previously considered by other scientists in the context of other study. However, both researches arrived at the same conclusion regarding the issue. Academics also mentioned the majority of projects models success is based on academic literature, rather than empirical studies. In this regard, it is necessary to conduct additional studies to detect, analyse and systematize key factors influencing project realization at different stages of its life cycle; prove its division into hard and soft factors, and develop methodology of diagnostics of company staff readiness to cross-functional ERP projects introduction.

3. Results

3.1 Key Factors That Have Impact on ERP Systems Implementation Project Success Were Identified and Systematized, Structural Functional Model of Identified Factors' Influence at the Different Stages of Projects Life Cycle was Developed

Company operating results improvement depends on the success of integration projects and business process reengineering projects it implemented. Certainly, ERP systems implementation projects belong to complex cross-functional integrated projects that exercise direct influence upon company operating results improvement, and factors fundamental for such success require in-depth analysis. In the course of thesis study crucial variables of successful execution of ERP systems offered in academic literature were studied and clarified, their functionality was analysed (Table 1).

Table 1. Critical factors for ERP systems successful completion

No	Factor	Functionality
1	Project mission	Initial clearness of purposes and general suggestions concerning project strategic goals. Software choice is agreed with company strategy.
2	Project diagram	Availability of detailed specification providing single steps necessary for project execution and their terms.
3	Communications and interaction between project participants	Availability of effective practices of information sharing and interaction between ERP key participants.
4	Expertise and resource availability	Availability of necessary technologies and expert evaluation to execute project technical stages
5	Client's concernment – client's consent	“Sale” of project to end users. Includes staff expectation management.
6	Problem identification	Ability to deal with unforeseeable crisis and deviation from a plan regarding terms or budget.

		The factor is based on project management efficiency, program manager competence and project management committee.
7	Management support of the company chief executives	Top management adherence to project execution goals, participation in project trends formation, readiness to allocate resources and authority necessary for project execution.
8	User training	Organization and carrying out user training to work with new system and operations under the conditions of changed business processes.
9	Project team competence	The company own staff having necessary skills, knowledge and experience regarding implementation project. Availability and competence of project team external participants - implementation consultants, developers, software suppliers' representatives.
10	Business process reengineering	Company's business processes reorganization in order to achieve their conformity with standard functionality of ERP system under implementation. Includes change management.

Project managers play a key role when realizing enterprise system projects execution. The list of key skills they shall have for cross-functional projects' successful realization was systematized. The key distinguished factors are leader skills, administrative skills (such as planning and control), interpersonal, and communication skills. The authors identified 22 critical factors fundamental for successful implementation of the project on ERP system implementation, grouped by key players and kinds of activity.

We have found that majority of factors are relevant for any IT-project, while some are of particular interest for ERP projects.

These factors analysis allowed identifying hard (H) and soft (S) factors (Table 2) and their correlating to main aspects of human resource management (Table 3) and proving a great impact of soft factors on ERP system realization success.

Table 2. Soft (S) and hard (H) factors of project management

Key project participants	Key business activity
Top management (H)	User training (S)
Project leader (H)	Expectations management (S)
Start-up committee (H)	Careful selection of proper package (services, systems, modules, etc.) (H)
Implementation consultants (H)	Project management (H)
Project team (S)	Customization (H)
Partnership between provider and client (H)	Data analysis and conversion (H)
Provider's tools (H)	Business process reengineering (H)
Provider support (H)	Architecture definition (H)
	Resource allocation (H)
	Change management (S)
	Sound goals and objectives definition (H)
	New business processes training (S)
	In-house communications (S)
	In-house interaction (S)

Table 3. Ratio of soft factors of systems successful implementation and the aspects of human resource management

HCM aspects	Soft factors
Project team competence	Expectations, needs, and skills management
User training	Education, trainings and development
New business processes training	
Change management	Job cuts, change in job duties (struggle against staff opposition to changes)
In-house communications	Communications
In-house interaction	
Expectations management	Rewarding mechanism (acknowledgment, compensation, advantages)

3.2 The Analysis of Critical Soft Factors Impact on ERP Project Outcome with Different Significance of Above-Noted Factors in Case of Successful and Unsuccessful Projects, and at the Different Stages of ERP Project, Dynamic Model of Stage-By-Stage Diagnostic Readiness Assessment of Company Potential Regarding The Implementation of ERP Project

For the purposes of the research structural functional model of ERP project implementation was used, which includes 6 independent variables representing soft critical success factors, one dependent variable (project outcome) and one determining variable – ERP project life cycle's stage. The models offered by Ross (Ross, 1999) were used, who had identified five significant stages in the process of ERP system implementation: design, implementation, stabilization, continual enhancement, and transformation.

The subject of research is studying of argumentativeness regarding factors influencing ERP systems projects success, which are provided in literature on ERP and project management by the example of the largest Russian enterprises, which have already implemented ERP systems projects. Data for the research were collected by means of on-line inquiry. The proposal of polling was sent to 375 companies. The key focus group of the research is HCM managers, Chief Information Officers (CIO) and other key persons in company's top management. The testing of hypotheses was carried out using questionnaire developed by the author and consisting of 21 questions: 11 questions are free response questions, 20 questions are questions with several answers to choose from them. The questions cover such themes as determination of ERP systems projects' implementation success criteria, the importance of identifying critical success factors, human resource management in the context of ERP projects and identifying risk factors arising at the different stages of ERP projects, etc.

First 10 questions (q1-q10) are related to expenditure incurred, project term and realization of required system functionality / performance, i.e. project's success factors we chosen. 11th question (q11) identified the importance of each critical factor of ERP system project success using Likert scale. The list of factors includes 4 hard and 8 soft factors. 12th question (q12) identified at what stages of ERP project's life cycle each soft factor is most significant. In the questionnaire section dealing with skills (q13-q15), respondents are asked to indicate the degree of significance of each HCM requirements for ERP system project implementation. The following sections of the questionnaire identify the importance of training regarding ERP projects (q16), respondents are asked to assess each practice of change management (q17), communications and interaction (q18) to execute ERP project. The next section of the questionnaire (q19) is concerned with identification and assessment of risk factors significance. Respondents are asked to enumerate risk factors arising at the different stages of ERP project and evaluate their level of significance using Likert five-grade scale. The last question of the questionnaire (q21) asks respondents to indicate their company's field of concern.

The key features of projects executed in respondents' companies are shown in Table 4.

Table 4. Respondents' companies implemented ERP projects features

ERP systems in current use (n=16)	Respondents, %	Q-ty of companies
SAP	37.5	6
Own system	6.25	1
Inreo Dealflow	6.25	1
MFG/Pro	6.25	1

Oracle Financials	6.25	1	
PRMS	6.25	1	
Sentera Enterprise	6.25	1	
Solagem enterprise	6.25	1	
TietoEnator Efekto	6.25	1	
Name is unknown	6.25	1	
Wintime Economa	6.25	1	
Industrial sector (n=15)	%	Q-ty	of companies
Energetics	19	3	
Oil and gas	19	3	
Food industry	13	2	
Construction	13	2	
Machine manufacturing	6	1	
Paper industry	6	1	
Retailing	6	1	
Media	6	1	
Metallurgy	6	1	
Transport logistics	6	1	
Operation time (n=15)	%	Q-ty	of companies
Last year	7	1	
From 1 to 3 years ago	26	4	
From 3 to 5 years ago	27	4	
From 5 to 7 years ago	20	3	
More than 7 years ago	20	3	
ERP system input results measure (n=16)	%	Q-ty	of companies
ERP project was completed as scheduled	50	8	
ERP project was completed within budget	53..3	9	
Currently ERP project is in operation	93..8	15	
Required system functionality was achieved	75	12	
Planned business scenario was implemented in full	73..3	11	

Based on the given assessment one may draw conclusion that majority of ERP systems implementation projects was successful. In this particular case, the success was measured with financial terms and was considered from the viewpoint of executives. The paper proves that commonly used criteria for project results estimation are project completion in time, within or under budget, and also system key functionality realization, i.e. implementation project success depends on both implementation speed, material profits for business and short pay-off period, and many other factors. Critical success factors studying will help top managers to exercise effective management and, in such a way, increase probability of their project successful realization. In the course of the analysis of respondents' answers the importance of key success factors of ERP system implementation was ranked (4 hard (H) and 8 soft factors (S)) on the scale from extremely low to extremely high importance (1-5 scores) (Table 5)

Table 5. ERP systems implementation critical success factors significance rating

Critical success factors (n=16)	Scale
Top management support (H)	4.25
User involvement (S)	4.25
Effective project management (H)	4.19
In-house interaction (S)	4.19
Project team competence (S)	4.13

User training (S)	4.06
In-house communications (S)	4.06
Business process reengineering (H)	3.96
Change management (S)	3.50
New business process training (S)	3.44
Expectation management (S)	3.38
Software and physical compatibility (H)	3.19

(H) hard factors, (S) soft factors.

The authors studied the structures of projects teams for ERP system implementation, the evaluation of project participants importance was elaborated, and the analysis of skills employees shall have to take part in ERP projects was carried out (Table 6-7).

Table 6. Key participants in the structure of implementation project (respondents' percentage)

Key persons	%
Executives	66.7
IT staff	55.6
Top management	44.4
Consultants	44.4
ERP systems suppliers	27.8
IT consultants	11.1
Others	11.1

Table 7. Key skills ERP system project's key participants shall have (respondents' percentage)

Top management	%	Executives	%
Leader qualities	55.6	Communication skills	77.8
Communication skills	44.4	Control skills	55.6
Control skills	27.8	Leader qualities	50.0
Interpersonal skills	16.7	Planning skills	50.0
IT projects management skills	11.1	Interpersonal skills	50.0
Planning skills	5.6	IT projects management skills	27.8
ERP systems implementation experience	5.6	ERP systems implementation experience	22.2
Technical skills	0.0	Technical skills	0.0
End users	%	Consultants	%
Communication skills	61.1	ERP systems implementation experience	44.4
Interpersonal skills	55.6	Planning skills	38.9
Planning skills	33.3	Communication skills	38.9
Technical skills	27.8	Technical skills	33.3
ERP systems implementation experience	27.8	Interpersonal skills	27.8
Control skills	16.7	IT projects management skills	22.2
Interpersonal skills	0.0	Leader skills	11.1
IT projects management skills	0.0	Control skills	11.1
IT consultants	%	ERP systems suppliers	%
IT projects management skills	22.2	Technical skills	33.3
Technical skills	16.7	ERP systems implementation experience	27.8
Communication skills	11.1	Communication skills	22.2
Planning skills	5.6	Technical skills	22.2
Interpersonal skills	5.6	Interpersonal skills	16.7
ERP systems implementation experience	5.6	Control skills	11.1
Leader qualities	0.0	Interpersonal skills	5.6
Control skills	0.0	Leader qualities	0.0
IT staff	%		
Communication skills	72.2		
IT projects management skills	72.2		

Planning skills	61.1
Technical skills	61.1
ERP systems implementation experience	50.0
Control skills	38.9
Interpersonal skills	38.9
Leader qualities	27.8

We chose project execution in time, within budget, system reaching planned functionality/performance indicators as success criteria for ERP system project.

Consequently, we use three sub-measurement scales instead of unified scale for project success measurement: term (“in time/ “time-lagged”), expenditure (“within budget”/ “budget excess”), system functionality/performance (“implemented”/ “not implemented”).

The following soft factors were tested by three sub-measurement scales by the chosen parameters (term, expenditure and system functionality/performance) using statistic method T-test: project team competence, training, change management, communications, expectation management.

The results of estimation of all soft factors for projects classified by implementation term, implementation expenditure and system functionality/performance are shown in Table 8.

Thus, the use of descriptive statistics allowed identifying difference in “soft” factors between the groups: “in time” versus “behind time”, “within budget” versus “budget deficit”, “performance is effected” versus “performance is not effected”.

Table 8. Total block of obtained estimations by all factors.

Rating from 1 (extremely low importance) to 5 (extremely high importance)

Soft factors	In time	Behind time	Within budget	Budget deficit	Performance is effected	Performance is not effected
1) Project team competence	3.39	2.88	3.19	3.15	3.83	3.83
2) Training	3.78	4.56	3.83	3.73	3.75	3.93
3) Change management	3.93	3.75	3.98	2.9	3.7	2.75
4) Communications	4.12	3.92	3.98	3.83	3.81	4.11
5) Expectation management	3.52	3.5	3.49	3.13	3.24	3.70

The work proves demonstratively the importance of various critical success factors difference depending on one or another stage of the project’s life cycle. Table 9 presents data regarding each soft factor importance at each stage of the project’s life cycle.

Table 9. Soft factors importance at the different stages of the project’s life cycle (n=16)

Design	%	Implementation	%
Project team competence	55.6	Project team competence	66.7
In-house communications	50.0	Change management	55.6
New business process training	33.3	User training	38.9
Change management	11.1	In-house communications	38.9
User training	5.6	New business process training	22.2
Stabilization	%	Continual enhancement	%
Project team competence	66.7	In-house communications	55.6
User training	66.7	New business process training	50.0

Change management	61.1	User training	38.9
In-house communications	44.4	Change management	33.3
New business process training	38.9	Project team competence	27.8
Transformation	%		
Change management	38.9		
New business process training	33.3		
Project team competence	33.3		
User training	27.8		
In-house communications	27.8		

The level of significance of 5 chosen key soft factors (project team competence, training, in-house communications, new business processes training, change management, user training) is directly attributed to ERP project success and the importance of each soft factor differs at the different stages of ERP project's life cycle.

Diagnostic models obtained in the course of work can be used by top managers and project leaders to assess company potential by their readiness to successful ERP project implementation or certain stage of the project's life cycle.

4. Discussion and Conclusion

1. Authors' hypotheses are stated:

Hypothesis 1: Soft factors exercise significant influence on project success.

Hypothesis 2: Successful and unsuccessful ERP systems implementation project are characterized by differences in the approach to human resource management.

Hypothesis 3: Soft factors importance changes depending on one or another stage of the project's life cycle.

Hypothesis 4: Various concerned parties such as managers, developers, consultants and users influence interrelation between soft factors and project outcome.

2. The tools set for ERP projects soft critical success factors identification to transformation into risk factors was developed, and also identification of ERP projects life cycle's stages, where the transformation of each of soft critical success factors into risk factors is most probable, was carried out.

The approach the authors offered is based on the assessment of conformity between risk factors revealed in the result of ERP projects' participants polling and ERP projects' soft critical success factors. Total estimated significance of risk factors associated with soft critical success factors in the context of ERP projects and each its stage is used to identify the potential of ERP projects' soft critical success factors to transformation into ERP projects' risk factors. Also, it is used to identify the ERP project' life cycle stages where the transformation of each of soft critical success factors into risk factors is most probable.

According to the offered methodology, the research was divided into 5 stages.

At the first stage, the polling of respondents – ERP projects participants – is carried out. Herewith, respondents are asked to indicate risk factors, which they consider significant at each stage of project and also rank the importance of these factors using 5-score Likert scale (from 1=extremely low importance to 5= extremely high significance).

At the second stage, the answers are analysed in order to unite similar answers of different respondents in the framework of our expressions. The average value of significance is calculated for each of obtained risk factors. Herewith, significance estimation of factor respondents did not mention is taken as nil.

At the third stage, the correlation between risk factors and soft critical success factors is carried out, the list of which is formed based on the academic literature analysis.

At the fourth stage within the framework of thesis study in accordance with methodology the authors offered the table of calculation is compiled (Table 12), wherein risk factors are classified by stages of their originating in the context of ERP project's life cycle. Additionally, digital value is assigned to each of risk factors, which corresponds to the respondents' estimation of this risk factor significance. Subsequently, obtained values are used to calculate the total significance of risk factors corresponding to each critical success factors at each of project stages and during the whole project. It is assumed that calculated total values are being suitable for the measurement of soft key success factors potential to transformation into risk factors.

At the fifth stage, the research findings are finalized. At this point for the purpose of increase in readers' perception effectiveness, the author recommends using graphical presentation methods.

The developed methodology of stage-by-stage diagnostic readiness assessment of company potential regarding ERP project execution can be used by enterprises heads, empirics and scholars for the purpose of ERP projects' soft critical success factors identification, wrong treatment of which can lead to their transformation into risk factors, which endanger project successful completion.

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