

The Analysis of CSFs in stages of ERP Implementation – Case Study in small and medium – sized (SME) companies in Croatia

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Abstract - This paper elaborates the stages of ERP implementation in terms of critical success factors in small and medium-sized enterprises in Croatia. These stages and their associated success factors were evaluated by company executives, implementation managers and advanced users. The implementation is an extremely critical process especially in small companies which have limited resources, particularly human resources, where some people often have to perform more than one business function. The paper shows that the number of critical success factors of implementation significantly differs in six examined stages and the quantity of critical factors in the stage with the highest number of them is 100% higher than in the stage with the lowest number of them. If we sum up the factors obtained through the stages and compare the result to the global list of critical success factors of implementation – the results differ to a considerable extent.

I. INTRODUCTION

After years of procurement, implementation and application of solutions based on ERP philosophy, these became prevalent solutions for monitoring the business functions of companies. Given the problems which accompany the totality of the implementation process of such solutions, the authors divide the totality of the implementation process differently. Thus, [1] some divide them into five stages (Define, Design, Build, Transition and Go Live & Support), this paper [2] suggests seven steps (Strategic Plan, Readiness Assessment, Prepare for Vendor Selection, Vendor Selection, Post Implementation Assessment, Implement the ERP Solution and the Plan Implementation), Adam et al. [3] only the solution selection process is divided into 4 stages (Intelligence, Design, Choice and Review), Bajwa et al. [4] divide this process into 5 stages (Awareness, Selection, Preparation, Implementation and Operation). In his dissertation, Otieno cites the importance of each stage of implementation, and divides them into 5 stages (Project Preparation, Business Blueprint, Realisation, Final preparation and Go Live & Support) [5]. On the other hand, Yingjie provides a somewhat different approach [6], which basically divides the implementation process into four basic stages, the Chartering phase (Preparation, Analysis, Design), the Project phase and the Shakedown phase (which basically constitute

Implementation) and Phase Onward & Upward (which is essentially Maintenance) [6]. Peslak and others [7] have presented the implementation of SAP in two divisions of a manufacturing company. In their study the implementation was divided into four phases Preparation & Training, Transition, Performance & Usefulness and Maintenance. They came to the conclusion that there are two key phases which most directly affect the success of the implementation - the first and the third phase (Preparation & Training and Performance & Usefulness). Accordingly, a strong focus on these phases is recommended. Kronbichler et al. [8] have divided the totality of the implementation process into three phases (Planning-Preimplementation, Implementation and Stabilisation / Improvement and Post-Implementation). In the aforementioned paper there is a review of literature in which the critical success factors of implementation are linked to each of these phases. Hustad and Bechina [9] have made a comparison of the critical success factors of implementation in 4 companies, based on the previous research of the same methodology through the three phases of implementation (Pre-implementation, Implementation and Post-implementation). Bhatti divided the research on the critical success factors of implementation in 53 Australian companies into 4 stages of implementation (Implementation Planning, Installation, Final Preparation and Go Live) [10].

There are many articles describing the particular stages of implementation in terms of importance, i.e. which factors within them are especially critical. In one of them Hustad and Olsen [11] examine the ERP Pre-Implementation Process in a Small and Medium-sized Enterprise (SME), and identify critical issues in this process. The ERP Pre-implementation phase consists of selecting ERP software, vendors and consultants. Ara and Al-Mudimigh [12] present a review of the impact of project management in ERP project life cycle by studying various project management methodologies. Nicolau and Bhattacharya [13] empirically examine the extent to which discrete changes to ERP systems over a post-implementation time-frame affect the company's ability to deliver long-term organizational performance. Chen and Tsai [14] present a very interesting approach; they investigated organizational readiness through the three variables of

implementation (ERP adoption, process adoption and organizational resistance). In his research, Hedman [15] attempts to reduce the critical factors of success to organizational, project and technical factors, while at the same time, he tries to classify them according to six stages of the implementation (Initiation, Adoption, Adaptation, Acceptance, Routinization and Infusion). A different approach has been taken in the work of Ahmad and others [16]. They tried to correlate the 4 stages of implementation (Project Initiation, Project Preparation, Realization, Operation and Maintenance) and their associated activities with those responsible for their realization. Olson and Zhao [17] investigated the positions of those in companies responsible for IT through 4 phases of implementation (Assessment phase, Planning phase, Implementation phase and Renewal phase). Tsai and others [18] examined the relationship between the critical success factors of implementation and the success of the ERP system of implementation through 4 phases of implementation (charter phase, project phase, shakedown phase and upward phase). Hasibuan and Dantes [19] have established priority CSFs in the ERP implementation phase by using weighting factors. The success of implementation is measured by five indicators: system quality, information quality, service quality, tactical impact and strategic impact.

From the abovementioned papers, as well as many others, it is evident that the implementation process generates certain critical factors of success. It is especially important to identify which CSFs are crucial in particular phases of the implementation in terms of targeted management of implementation, i.e. paying particular attention to the key factors of success. Some studies suggest that in 2015 the value of the Croatian ERP solutions market should reach \$ 59,000,000 [20], wherein the significance of the implementation process is undisputed.

The paper is divided into four chapters. In the introduction there is a partial literary overview of CSFs according to various phases of implementation, and a glance at some of them, in relation to their corresponding phases. The second chapter presents a methodology of implementation with an emphasis on the key research question. The third chapter presents the results related to the "ranking" of CSFs related to the 6 stages of implementation and the comparison of sum values of CSFs with research in which the same CSFs were treated in total at the level of implementation as a whole [21]. The fourth chapter is the conclusion.

II. RESEARCH METHODOLOGY

A questionnaire with 32 proposed critical success factors of ERP implementation as a whole, in alphabetical order was sent to 120 companies. These factors had to be ranked according to degree of importance ranging from critical (1) very high (2), high (3), weak (4) and low (5). The questionnaire was addressed to three parties within each of the companies: the company executives, project managers and advanced users. Replies were received

from 60 company executives, 80 project managers and 72 advanced users. Therefore, we can claim that 212 individuals [21] have responded. Of these people, 35 of them were selected and were sent the same questionnaire but related to the next phase of ERP implementation:

- Selection of ERP solution (Phase 1),
- Project preparation (Phase 2),
- Analysis of the compliance of the organization's business functions with the options of ERP solutions (Phase 3),
- Physical realization of the compliance analysis of business functions in the organization and ERP solution options (Phase 4),
- Transition to the new solution (Phase 5) and
- Everyday operations running on ERP solutions with the implementers' support (Phase 6).

Distribution these 32 critical success factors of implementation had to be ranked according to above mentioned phases of implementation. Critical success factors of ERP implementation were listed in alphabetical order:

1. Analysis and motivation regarding the necessity for ERP,
2. BPR & minimum customization,
3. Business culture,
4. Change management,
5. Clear goals and objectives,
6. Complex architecture and high number of implementation modules,
7. Data conversion,
8. Data management,
9. ERP treated as a program not a project,
10. ERP software package selection,
11. ERP system quality,
12. Implementation approach methodology,
13. Interdepartmental cooperation,
14. Management expectations,
15. Monitoring and evaluation of performance,
16. Organizational fit,
17. Organizational communication,
18. Partnership with vendor,
19. Performance evaluation and management,
20. Project management,
21. Relationship of business and IT strategy,
22. Software development, testing and troubleshooting,
23. Steering committee of project ERP implementation,
24. Team competence composition,
25. Top management support,
26. Understanding key problems of ERP implementation,
27. Use of external consultant,
28. Use of vendor's tools,
29. User acceptance,
30. User involvement & participation & competence,
31. User training and education (timely defined) and
32. Vendor support.

The questionnaires were sent by e-mail and post to 35 companies which earlier provided replies in this research. This time separate responses from company executives, project managers and more advanced users were not required, and the emphasis was on those that were considered “the best”, which implies a high level of awareness of the totality of the implementation of ERP solutions. These questionnaires were sent out in mid-April 2012. A time frame of one month was set within which the responses were expected. The basic intention of the “in-depth analysis” was to answer the following research question:

- To what extent do the critical success factors of ERP implementation deviate when they are summed up through phases of ERP implementation compared to the same factors when responding to the global questionnaire related to the totality of ERP implementation, with the same suggested CSFs?

III. RESULTS

Replies were received from 20 respondents, a little over 57%. These responses were collected within more than two months and more than 80% responded after several requests, or after paying an actual visit to the persons in question. After processing received responses, the reviews of the implementation phases are as follows. Factors which received more than 12 votes have been particularly stressed.

A. Selection of ERP solution

At this stage the basic framework should be set which will allow the selection of the appropriate ERP solution. This phase presumes a consensus on the need for a new solution, if there was a previous one, or the awareness that without ERP solutions market competition is not possible. One of the strongest insights of the authors, based on a large number of completed implementations, is that at some point of discontent the company demonstratively decides on the transition to a new solution. Therefore, the decision cannot be a momentary whim of anger or ignorance. This phase consists of the first 7 critical factors (Table 1):

- Analysis and motivation regarding the necessity of ERP,
- Clear vision and business objectives,
- ERP software package selection,
- Management expectations,
- Organizational fit and
- Relationship of business and IT strategies.

These first seven critical success factors of ERP implementation are undoubtedly logical choices, considering the suggested CSFs.

B. Project preparation

Project preparation should focus on all activities related to the adequate assembly of a project team as well as the project preparation phases with related activities and with

an emphasis on resources. Table 1 shows the first 7 critical factors:

- Clear goals and objectives,
- Team competence composition,
- Top management support,
- Thorough understanding of the key problems of ERP implementation,
- BPR & minimum customization,
- ERP system quality and
- Analysis and motivation regarding the necessity of ERP.

C. Analysis of the compliance of the organization's business functions with the options of ERP solutions

This is a very important phase of the whole of the implementation process. The specificity of this phase is reflected in the potential need for overhauling business processes or customizing solutions according to methods of executing processes within particular business functions. Table I states separately all critical success factors of implementation, related to this stage:

- Clear vision and business objectives,
- Top management support and
- Thorough understanding of the key issues related to ERP implementation.

D. Physical realization of the compliance analysis of business functions in the organizations and ERP solution options

This is “hard work” with users in the actual business environment or, as it is often referred to in practice, implementation “in the strict sense”. After this phase, both external and internal implementation teams and employees should be able to know how the business processes will be running when the implementation is completed, i.e. in real life. Table 1 shows the most critical success factors of ERP implementation which are related to the fourth stage:

- User Involvement and participation,
- Interdepartmental cooperation and
- Team competence composition.

E. Transition to the new solution

This period includes the first few weeks of the operation, during which the thinking process is still adapted to the previous solution (and the habits associated with it), in case of replacing one solution with the other. Depending on the amount of work that has been invested in the previous phases, in terms of training, at this stage there is a degree of disorientation, fear and rejection, which is only natural. Based on this phase the most important critical success factors are:

- Data conversion,
- User involvement and participation and
- User training and education (timely defined).

It should be noted that when it comes to the degree of criticality, the votes in the questionnaire were the least critical.

F. Everyday operations running on ERP solutions with the implementers' support

This phase implies that the users have generally accepted the new solution and have become almost addicted to it. What is particular about this phase is that the users, apart from focusing on their immediate area of operations, are beginning to realize the overall context of the solution, all the activities that precede their activities as well as those which depend on their own correct performance. Based on this phase - Everyday operations running on ERP solutions with the implementers' support - provided the least number of outstanding critical factors:

- User acceptance and
- User involvement and participation.

G. The comparison of critical success factors according to the phases of ERP implementation

Based on degree of importance (critical-1) of all six implementation phases their total value can be summed up.

TABLE I: SUMMARIZING SIX PHASES ERP IMPLEMENTATION (P1-PHASE 1, P2-PHASE 2, P3-PHASE3, P4-PHASE4, P5-PHASE5) FOR DEGREE OF IMPORTANCE CRITICAL-1

Critical Success factors of ERP Implementation	P1	P2	P3	P4	P5	P6	Total
Top management support	9	15	14	12	8	5	63
User involvement and participation	4	8	4	16	13	15	61
Clear goals and objectives	18	18	18	2		2	58
Thorough understanding of the key issues related to ERP implementation	10	13	14	9			46
Relationship of business and IT strategy	14	10	10	6		4	44
Analysis and motivation regarding the necessity of ERP	18	15	4	4	2	2	45
BPR & minimum customization	7	13	12	6		4	42
User acceptance	2		5	6	8	16	37
ERP system quality	14	13	5	4			36
Steering committee for project ERP implementation	3	12	13	4	4		36
Team competence composition	2	17		14	2		35
ERP treated as program rather than project		10	11	10			31
Interdepartmental cooperation		4		14	4	9	31
Management expectations	16	4	4	3	2		29
Organizational fit	16	4	5	2			27
Monitoring and		2	6	6	6	5	25

evaluation of performance							
Project management		4	5	12	4		25
Organizational communication	3	6	2	7	4	2	24
Change management		4	6	4	3	6	23
User training and education (timely defined)				12	9	2	23
Partnership with vendor	4		6	4	5	2	21
Data management			2	6	9	4	21
Implementation approach and methodology	8	2	6	4			20
Data conversion			2	4	13		19
ERP software package selection	18						18
Performance evaluation and management			2	5	8	2	17
Software development, testing and troubleshooting	1	2		3	8	2	16
Complex architecture and high number of implementation modules		2	2	2	4	3	13
Business culture		2	2		2	4	10
Vendor support			3	4			7
Use of vendor's tools				2			2
Use of external consultant							0

Based on the Table I it could be concluded:

- The three most CSFs in terms of importance (critical-1) are: Top management support, User involvement and participation and Clear goals and objectives,
- CSFs which are rated degree of importance in all phases of the life cycle ERP implementation are: Top management support, User involvement and participation, Analysis and motivation regarding the necessity of ERP and Organizational communication,
- CSF Clear goals and objectives is given 18 votes in first three phases of the life cycle ERP implementation,
- Most votes, from the point of importance (critical-1) are given: Clear goals and objectives, in first three phases and in phase 1 Analysis and motivation regarding the necessity of ERP and ERP software package selection and
- Interesting is the perception of respondents towards suppliers and consultants. Vendor support is given only 7 votes in 3th and 4th phases of the life cycle and Use of vendor's tools only 2 votes in 4th phases of the life cycle ERP implementation. Use of external consultant did not get any vote.

Of all the implementation phases the ‘most dangerous’ for the respondents was the actual physical realization of the implementation, i.e. practical adaptation to business operations through ERP solution. The project preparation stage and the selection of the appropriate ERP solutions are almost as important to them. It should be noted that the last two phases are not so criticality.

In this way, defined critical success factors of ERP implementation are somewhat different (Table II) from the ranking of critical success factors of implementation in the paper of Nikitović and Strahonja [21]. In that paper the same questionnaire for three categories of respondents, company executives, project managers (or IT managers) and advanced users, was offered for the totality of the implementation process.

TABLE II: COMPARISON OF RANKING SUMMARY ACCORDING TO IMPLEMENTATION PHASES WITH GLOBAL RANKING

Critical success factors of implementation	According to implementation phases (total)	According to global evaluation of the average grade
Top management support	1	2
User involvement, participation and competence	2	5
Clear goals and business objectives	3	4
Understanding the key problems of ERP implementation	4	10
Relationship of business and IT strategy	5	19
Analysis and motivation regarding the necessity of ERP	6	1
BPR & minimum customization	7	21
ERP system quality	8	11
Steering committee for project ERP implementation	9	28
User acceptance	10	7
Team competence composition	11	27
ERP treated as a program not a project	12	6
Management expectations	13	18
Interdepartmental cooperation	14	23
Organizational fit	15	12
Project management	16	9
Organizational communication	17	25
Change management	18	8
Monitoring and evaluation of performance	19	20
User training and education (timely organized)	20	15
Partnership with vendor	21	17
Implementation	22	13

approach methodology		
Data management	23	14
ERP software package selection	24	3
Software development, testing and troubleshooting	25	22
Data conversion	26	30
Performance evaluation and management	27	24
Complex architecture and high number of implementation modules	28	31
Business culture	29	29
Vendor support	30	16
Use of vendor’s tools	31	26
Use of external consultant	32	32

IV. CONCLUSION

The implementation process of such an expensive and long-term solution must be carefully planned. In this paper the authors tried to compare the global approach to implementation with the implementation in phases, from the standpoint of critical success factors of implementation. Given that the study involved three groups of respondents, company executives, project managers and advanced users of the implemented solutions, the obtained responses gain significant importance. The research issue of this study, when it comes to responses, indicates that it is much better to conduct the implementation in ERP implementation phases, in terms of criticality, than when it is done at the level of global responses to the totality of the implementation. That way, each success factor associated with implementation can be examined more accurately. Undoubtedly, such a method of implementation is more expensive, but in the end can lead to the more successful completion. According to the paper [21], the attitudes of groups of participants in the implementation process are clearly different. Therefore, external participants in the implementation process (vendors, consultants, implementers) should receive special training for each of these groups, and within each phase of the implementation process, no matter how many there are.

The difference which can be seen in Table II, in terms of the importance of critical factors for the totality of the implementation process in relation to its phases, has two potential causes. The first was the decision to reduce the number of respondents from 212 which completed the global questionnaire to 35 carefully selected respondents (with more experience and knowledge). The second is related to the possibility to define more accurately the importance of each phase in relation to the totality of the implementation process.

Table I in our opinion deserves special attention. It shows the totality of the critical success factors of implementing ERP. According to this table, users found that the physical realization of the analysis of the compliance of the organization’s business functions with the options of ERP solutions was a 100% more “dangerous” phase (188 critical success factors) than the one with the least of

them – the phase Everyday operations running on ERP solutions with the implementers’ support (90 critical success factors). It should be noted that just the aforementioned phase “everyday operations” is a challenge for many researchers.

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