Critical Success Factors in ERP Systems Implementation:  
the case of medium and small sized Enterprises

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Enterprise Resource Planning (ERP) systems cover today a wide area of IT applications aimed at optimizing resources within an Organisation. In deciding whether to use an ERP and then the appropriate type of ERP system and software for a specific Organisation, a number of parameters and critical success factors have to be taken into account.

The research work reported in this paper focuses on the issue of defining critical success factors – CSFs, for the implementation of ERP systems in Small and Medium sized Enterprises (SMEs) in the service sector and light manufacturing.

The research being reported in this paper, used a “hybrid” methodology approach which consisted of both a quantitative and a qualitative data analysis. In more detail, it consisted of a literature review and a consequent questionnaire survey among a number of Organisations in several countries. Furthermore the survey results were applied in a case study for an SME Organisation in Greece involved in research production (Research Center).

The conclusions of the study show that top management support, end user involvement in the implementation process, and proper training of the end users are the three most important critical success factors in the case of an SME Organisation. In addition, the need to provide a credible business plan and future vision for the Organisation’s performance with the ERP system in place is a major condition for success as it provides the necessary guiding framework for the whole implementation.

The work can be utilized by SME Organisations who are planning to purchase and implement ERP systems as well as by ERP consultants giving them valuable insights about the factors that are critical for the successful implementation of an ERP investment.

Keywords: ERP, implementation of ERP, SMEs, critical success factors, CSF, data management systems.

Introduction

Enterprise Resource Planning (ERP) systems cover today a wide area of IT applications aimed at optimizing resources within an Organisation. As Thomas H. Davenport (Davenport, 1998) observed, one of the main problems that ERP systems were designed to solve is the problem of fragmented information. Organisations produce a great amount of information and data in their daily transactions and this information and data need to be properly collected, processed and stored in a way that it can be later accessed by different departments within the Organisation in order to perform various actions. He defined ERP systems as “commercial software packages that promise the seamless integration of all the information flowing throughout a company”.

The use of an ERP system within an Organisation covers a whole range of processes that is needed in order to integrate together all operations and processes, from designing products (design engineering) to actually creating them and marketing them. An ERP system enhances the operations of an Organisation through various means, but most notably through consolidation and integration of data and providing a wide range of benefits that allow the Organisation (be it a public body or a commercial
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enterprise) to perform at its maximum capacity, taking advantage of all its resources as best as possible (Maditinos, Chatzoudes, & Tsairidis, 2012).

There are two main issues associated with the purchase and use of an ERP system:

a. The selection of the most appropriate ERP system to buy. In order for such a system to be useful, and to actually achieve any of the benefits associated with its implementation, the Organisation must identify and select software packages that provide the most usability and functionality according to the Organisation’s specific needs.

b. The implementation of the selected ERP in a way that it will maximise the benefits for the organisation.

For the selection of the most appropriate ERP package the interested reader can find in the literature many references. For example, in (Chun-Chin, Chen-Fu, & Mao-Jiun, 2005) a “selection framework” for the Organisations implementing an ERP is presented. In it, the authors propose a framework that will enable the organisations to prioritize their needs and select the most appropriate packages and optimise the cost / benefit ratio for its investment.

The implementation of a new ERP system in an Organisation is an equally important and critical issue as the selection of the package. It requires a complex, costly, and dedicated work on the outcome of which the whole success of the installation, and thus of the overall investment, is depended.

This paper deals solely with the issue of ERP implementation and the definition of the so called “Critical Success Factors - CSFs” for ERP implementation. These CSFs are organisational, functional, or institutional elements of an enterprise's operation that must be observed by an organisation in order to ensure a successful application of the ERP and maximisation of the benefits. For the so called, Small or Medium sized Enterprises (SMEs), i.e. Organizations that typically employ up to 500 persons, where resources for the purchase and implementation of ERP systems are relatively scarce and cannot be easily justified to the shareholders, the importance of observing these CSFs becomes evident and even critical if one takes into account the current conditions of economic instability and, in some countries, crisis.

The problem is that the great majority of the work so far, in this field, focuses on the large organisations which provided the bulk of ERP implementations in the 90’s and 00’s. There is relatively very little on SME implementations. It is therefore important, to examine the applicability and usefulness of such CSFs for SMEs and try to define the issues or factors that are of “critical” importance to a successful implementation in the context of these small and medium sized organisations especially under the current economic conditions.

So, the research question can be stated as: What are the Critical Success Factors that must be in place for an ERP implementation to be cost-effective and benefit maximising in the case of small and medium sized organisations under the current economic conditions?

This paper tries to answer this question and presents the results of a relevant research work that was started at Brunel University, London, in 2009 and was completed recently by the author.

Summary literature review

Several researchers have worked on the issue of the “critical success factors” for the implementation of new ERP systems but this work refers, in its great majority, to medium and large sized enterprises. These “factors” are determined by streamlining the evidence and the experience of successful ERP implementations and formulating it in terms of simple guidelines to follow. They usually depend on several characteristics of the implementing Organisation including its size and business complexity (Laukkanen, Sarpola, & Hallikainen, 2007).

1 A typical ERP cost, for a full package, in the case of an SME is of the order of 30 – 60 000 Euros depending on configuration. The benefits will result from optimizing the operation of the Organisation in a number of areas: technical, Managerial, Business related, Organizational, and customer service related.

2 The work was carried out in two stages. The first, was conducted while the author was doing his MSc study at Brunel University as part of the Thesis requirements in the degree Business Systems Integration (with SAP technology) in the School of Information Systems, Computing and Mathematics of Brunel University (Giannopoulos, 2011). The second stage, in which an expanded survey was carried out, was completed later while the author works in his current position.
The critical success factors identified in (Bingi, Sharma, & Godla, 1999) were:

A. Top management commitment (in order to drive the implementation process).
B. Re-engineering of business processes (in order to obtain maximum benefit from implementing an ERP system).
C. Integration (i.e. the seamless integration of the ERP system with other specialized software used, and the elimination of any “silo” effects in the different information flows that exist between departments).
D. Implementation time and cost (customizing the ERP system in order to match the needs of the Organization).
E. Selecting and training the end-users.

A similar selection was made by (Shang & Seddon, 2000) who stated especially the importance of properly selecting and training the end-users as a key success factor.

Ben Light and Christopher Polland (Polland & Light, 1999) proposed a framework that can be used by managers in order to assist in the formulation of an ERP implementation strategy and helping them identify the correlation between different critical success factors and the overall project outcome.

They created two categories of critical factors:

- strategic (legacy systems, and the ERP implementation strategy), and
- tactical factors (client consultation, monitoring and feedback, communication, training, project management principals, personnel and client acceptance, business process reengineering and software configuration).

H. J. Roberts and P.R.N. Barrar (Roberts & Barrar, 1992), working on MRP (Material Requirements Planning) system1, identified seven main critical success factors for their implementation. In this research 13 MRP implementations were analysed from different Organisations throughout the UK from a variety of industries. As a result, a list of seven critical success factors were proposed as most relevant. They were:

a. Antecedence, i.e. the "history" of the Organisation (the study showed that Organizations that have previously been successful in other areas of their business are more likely to succeed in the implementation of MRPs and realize the full spectrum of benefits).
b. Project missions, i.e. the ability of the Organisation to relate project objectives with the business needs that it has.
c. Top management support, to drive the implementation process and motivate the parties involved ensuring proper monitoring and control.
d. Organisational culture, able to maintain and enforce certain standards and procedures.
e. Technical aspects, i.e. the amount of customization that goes into the system.
f. Education, i.e. training users to use an ERP system and to experience it firsthand in its totality.
g. Monitoring and evaluation, i.e. effective and efficient active monitoring through the means of milestones and goals, as well as evaluation and controlling of the project’s progress.

As already mentioned, the majority of the literature references examines ERP applications in large (or medium) sized organisations. For Small and Medium sized ones4 there are less references found and this is mainly due to the fact that until recently small and medium sized Organisations did not implement ERP systems so much as the larger ones. Today things have changed, and in the drive to cut down on costs and increase productivity even “small” Organisations purchase and implement ERPs so the subject of ERP implementation in SME Organisations has an increased interest and academic importance with several recent papers devoted to it (Ganesh & Mehta, 2010), (Sternad, Bobek, Dezelak,

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1 Although material requirements planning systems differ substantially from ERP systems we must remember that the latter evolved from MRP systems.

4 The exact definition of "SME" Organisations varies, but mainly it is made on the basis of the number of employees (we have adopted here an indicative threshold of 500 employees). This issue, however i.e. of the exact definition of an SME, is not of critical importance and we have accepted the use of the term SME by the various references examined, as compatible with our own definition here without challenging their results and conclusions on the basis of this issue.
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The work by Ganesh and Mehta (Ganesh & Mehta, 2010), focuses on “identifying and ranking the critical success factors that influence the success of ERP implementations in Indian SMEs. The authors specified four different categories of critical success factors: “vendor”, “enterprise”, “technology”, and “end-user”. They state that although these factors were found relevant for both organisation sizes (i.e. SME’s as well as large Organisations) they are ranked differently, and their weight is different, in each case. They suggested that the three highest ranking critical success factors for ERP implementation in SME’s, were:

- clear business plan and vision, required by an Organisation prior and during the implementation of the ERP;
- top management commitment and support;
- changing the management processes to suit the ERP requirements.

Another study by Sternad, Bobek, Dezelak, & Lampret (Sternad, Bobek, Dezelak, & Lampret, 2009), and to a certain extend the concurrent one by T. Federici (Federici, 2009) examined a number of critical success factors in the case of small and medium sized Organisations, and compared them with those in larger Organisations.

They found differences in the classification and ranking of the relevant CSFs as well as their applicability according to the implementation stage.

In the case of the Sternad et al study, the authors suggest that in the case of SMEs the 4 most relevant critical success factors were (in sequence from highest to lowest influence):

- clear goals, objectives and scope for the implementation;
- implementation project team competence and organization;
- top management support; and
- user involvement at all stages of the implementation.

In the context of a large Organisation, the same study identified as top ranking influencing factors: top management support - user involvement - project team competence and Organisation, and - clear goals, objectives and scope.

An earlier work by Buonanno et al, which specifically compared the different factors affecting ERP implementation between large and small and medium sized companies, (G. Buonanno, 2005), points to the fact that differences do exist in the weight and priorities given, and that for large Organisations: top management support and commitment seems to be the most important factor, while others such as changing of the management process and clear business plan and vision comes next.

The relevance and general applicability of the work so far, in the field of ERP applications in SME Organisations, leaves room for more work to be done and this is why this work focused specifically on SMEs.

Methodology used in this study

The research being reported in this paper, used a “hybrid” methodology approach which consisted of both a quantitative and a qualitative data analysis as recommended by (Bryman, 2008). In such a methodological approach there are three components:

a. Literature review and identification of an initial set of evidence or rules concerning the system that we study.

b. Gathering specific data for the system that we study by following both qualitative and quantitative approaches, and

c. Evaluation-prioritization of the results in order to formulate final conclusions.

The “tools” that can be used in order to achieve well substantiated results within this methodological approach are described in a number of references e.g. (Saaty, 1980), (Stratman, 2007), (Thurston, 2006), (Baray, Hameed, & Badii, 2008).
The combined (quantitative – qualitative) approach was selected to be used for this study for the following reasons:

a. There is a limited ability to collect enough hard data for a quantitative analysis because of the information protection and non-disclosure policies followed by many organisations.

b. Many of the factors simply cannot be quantified. These, can only be found through interviews in which the accumulated experience of persons who have implemented ERP systems is utilized.

c. The conclusions from the quantitative analysis that (because of the limited possibility to gather data) can only be tentative can be supplemented by using the qualitative results.

Following the above considerations the specific methodology used in the research reported in this paper for defining critical success factors (CSF) for the implementation of ERP systems in small and medium sized Organisations, consisted of 5 steps, as shown below:

A. Literature review.
B. Identification of the most relevant CSFs that apply for small and medium sized Organisations, through a questionnaire survey. This survey was conducted among a number of SME organisations, in the service and light manufacturing sectors, selected through a stratified sampling process that took into account size, and type of business (service, production).
C. Analysis of the questionnaire survey results, in both qualitative and quantitative terms.
D. Testing of the preliminary CSFs that resulted from the questionnaire and the literature review, on a “model” Organisation that has recently implemented an ERP in order to see if they reflected correctly on the implementation experience of this organisation.
E. Drawing of the generic and general conclusions.

The questionnaire survey

The survey, used a simple questionnaire that consisted of 10 questions that were to be answered by choosing from a number of given answers but the respondent had the possibility to also put down his/her own choice of answer. The questions, referred to the basic characteristics of the Organisation, the type of the ERP implemented, the estimation of the benefits derived from the ERP implementation, and the factors that influenced the success of this implementation. The questionnaire provided a number of 20 possible such factors next to each of which the respondent had the possibility to rate their “criticality” on a scale from 1: “indifferent”, to 5: “critical”). The list of the 20 success factors that were put forward to the interviewees was the following and is given here as an example of the most common success factors for ERP implementations:

1. Education and training on ERP systems of end users.
2. Initial data accuracy and initialization conditions.
3. Effective communication between all involved throughout all stages.
4. Post implementation audit.
5. Testing and troubleshooting mechanism (to also continue after implementation).
6. Cost/Budget available for the implementation.
7. Extend of customization/modification of the ERP package.
10. Monitoring and evaluation of performance before and after the implementation process.
11. Existing IT infrastructure.
12. Change-management culture (i.e. the ability to accept change and to adopt a culture of openness to change).
14. Clear understanding of the strategic goals set by the Organisation.
15. Support by outside consulting vs own implementation team.
16. Use of project management techniques to monitor progress.
17. Top management support.
18. (End) User involvement in the implementation process.
20. ERP implementation teamwork and implementation team composition.

The completion of the questionnaire was made on-line via the web. If necessary a follow up phone call was initiated in order to clarify any loose points or to provide some extra insights for the specific installation.

The choice of the Organisations to whom the questionnaire was sent, was primarily based on their size in terms of personnel (i.e. below 500 employees - SMEs), the existence of an ERP system, and the type of their business. It was evident that it would not be possible to cover all types of Organisations (due to the limited resources) and it decided to concentrated on a homogeneous and representative set of SME Organisations in the specific areas of:

- “service” sector, and
- light manufacturing.

The basic data necessary for the choice was found through internet based searches plus data from business and commercial registries. First, a letter (or e-mail) was sent to the management explaining the scope and objectives of the study and requesting whether the Organisation had recently implemented an ERP and whether they would be willing to participate in the survey. Then, upon a positive answer, the full questionnaire internet address was sent together with instructions for its completion.

The total number of Organisations initially contacted was more than 500. Of these a total of 95 agreed to participate in the survey and of these we finally obtained 47 completed questionnaires as shown in Table 1. The Organisations that responded in the survey are based in 4 countries: Greece, Turkey, Italy, and Germany.

Table 1: Split of the surveyed Organisations according to size

<table>
<thead>
<tr>
<th>How many people are currently employed by your Organisation? (approx.)</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-100</td>
<td>36,0%</td>
<td>17</td>
</tr>
<tr>
<td>101-250</td>
<td>48,9%</td>
<td>23</td>
</tr>
<tr>
<td>251-500</td>
<td>12,7%</td>
<td>6</td>
</tr>
<tr>
<td>501-</td>
<td>2,1%</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>47</td>
</tr>
</tbody>
</table>

Analysis of the survey data and results

A. Qualitative results

From the answers to the survey questionnaire it was possible to identify the following Critical Success Factors as most important (using as criterion the frequency with which the answers spotted these CSFs as "critical" or "near critical").

The most frequently selected factor was top management support. This is a factor that reflects the amount of involvement that the top management of the Organisation has devoted in solving problems and facilitating the implementation of the ERP system.

The second most frequent factor that was stated was user involvement, i.e. the degree of involvement of all the different “parties” that will be using the system after its implementation.

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5 The internet based platformSurveyMonkey was used.
6 The whole survey procedure took place in two stages: one during the MSc work of the author at Brunel University, London, and one after graduation during his current professional engagement with his current employer.
throughout all the different phases of the implementation. The involvement of these “future users” of the system during its implementation, ensures that all opinions about the ERP system are heard and all concerns and problems that end users may have are dealt with during the system initialization and adaptation.

The third most important factor was the need to provide education and training to the end users. This factor reflects the need for training the end users to acquaint them with the system and enable them to feel confident in using it. At the same time they become facilitating agents and drivers of the change between the old and the new system.

Then a number of other factors emerged as important (but rated below 4 in the scale 1-5). These are the following:

1. Initial data accuracy and Initialization conditions (this is the need to providing accurate input data, and a complete initialization of conditions, i.e. entering the data for the pre-existing conditions. This can be a lengthy and tedious process which if not completed properly can render the results of the whole ERP implementation ineffective and useless);
2. Existence of a proper business plan and vision (the need to provide a credible business plan and future vision for the Organisation’s performance with the ERP system in place);
3. Cost/budget provided (the cost of the implementation process and the budget allocated for it);
4. Effective communication with all parties involved, throughout all the stages of the implementation;
5. Existing IT infrastructure (the existence of the appropriate IT infrastructure within the Organisation); and finally
6. Permanent mechanism of Testing and Troubleshooting (i.e. existence of a mechanism for proper testing and troubleshooting on a permanent basis).

Some critical success factors which were not in the list presented to the interviewees, are worth mentioning here. These were:

1. Localization, i.e. the ability of the ERP to adapt to the country’s fiscal legislation especially when implementing financial related modules. This was seen as quite important because the fiscal legislation of the country is defining in many senses the way that the ERP will be factored and initialized to work for the specific legal system in existence in the country.
2. Need to provide a competent “local” team to do the implementation. This suggestion came in connection to the need to train and devote at least one IT specialist in the systems operation and maintenance is seen as important in the case of small Organisations.

Finally, the survey revealed a number of limiting factors (problems) that are pertinent to ERP applications in SMEs. These are the following:

1. Cost of ERP package purchase and implementation. Cost is always a limiting factor when we consider small and medium sized Organisations. Naturally, it has to be seen in the light of the corresponding benefits in a proper cost / benefit analysis, but this is not always possible as there may exist usually also problems of cash flow and other fiscal restrictions that have to be observed.
2. Work culture inertias. The work culture and the inertia involved in a change seem to be, in small and medium sized Organisations, quite similar to those of a larger Organisation. However, in the latter the work culture tends to accept more easily the need for an ERP system because this is perceived as “inevitable” due to the size of the Organisation. Thus in a n SME the “inertia” tends to be higher.
3. Lack of other advanced IT infrastructures able to support a full ERP. This is mainly a problem in small Organisations where the need to install an ERP usually means buying and maintaining additional IT infrastructures.
4. The complexity of installing an off-the-shelf ERP poses, for an SME Organisation the important and sometimes difficult to solve dilemma: should the Organisation adapt its processes and system of management to the ERP’s modules, or try and modify – customise it so that it meets
the requirements of the Organisation’s existing system. In the small and medium sized Organisations one normally follows the first case i.e. the organisation is expected to change. This is seen by many, inside the Organisation, as a weakness and a “nuisance” of the ERP system.

5. The benefits of an ERP take longer times to be felt in the case of a small and medium sized Organisation because of the smaller number of transactions made via the system, the smaller size of turnovers involved, and the general magnitude of the Organisation’s finances.

Finally, two more qualitative findings need to be mentioned:

1. The main reason for implementing an ERP system in the first place, was found to be: “Internal Business Processes” i.e. the need to improve and re-engineer the internal business processes of the Organisation.

2. The second most important reason for implementing an ERP was “Competition” i.e. the need to gain a competitive advantage over the others (see Table 2, Figure 1).

3. The ERP modules most frequently implemented, were the following in order of descending frequency (see Table 3, Figure 2):
   a. “Operations and Logistics”
   b. “Financials”
   c. “Sales and Marketing”.

B. Quantitative results

The quantitative analysis of the rankings given to the various questions relevant to ERP implementation criteria (CSFs) had the following characteristics (see also Table 4 and Figure 3):

a. The values of the standard deviations were generally rather high giving the sense of wide variations in the answers supplied for each CSF.

b. The average values were calculated as weighted averages using as weight the number representing the rate given i.e. 5 for “Critical”, 1 for “indifferent”, and so on. In this way the weighted average can be taken as representing the overall rate given to a specific CSF from all surveyed participants.

c. The “median” values, were also calculated and shown in Table 4.

d. Finally, the kurtosis values are also shown as a comparison of the peakedness in comparison to the normal distribution (last column of Table 4).

The relatively high variability in the answers, maybe due to the fact that there is a number of “special features” that are at work in each Organisation and which can change the importance and ranking of the CSFs in each particular case. These “features” maybe related to the:

a. legacy system that the new ERP replaces;

b. workforce environment of the Organisation;

c. management culture,

d. legal and statutory environment in the country, and the

e. IT infrastructure available.

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7 Kurtosis characterizes the relative peakedness or flatness of a distribution compared with the normal distribution. Positive kurtosis indicates a relatively peaked distribution. Negative kurtosis indicates a relatively flat distribution. Based on this, we can assess the results of table 4 in terms of their closeness to the normal distribution.
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Table 2: Main reasons for implementing the ERP

Which were in your understanding, the main reasons for the implementation of the ERP system? (top 4 answers presented)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>42,55%</td>
<td>20</td>
</tr>
<tr>
<td>Market conditions</td>
<td>17,0%</td>
<td>8</td>
</tr>
<tr>
<td>Internal business processes</td>
<td>74,5%</td>
<td>35</td>
</tr>
<tr>
<td>Customers demand</td>
<td>10,6%</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3: ERP modules implemented

Which ERP modules have been implemented by your Organisation?

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response Percent</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial (Asset Accounting, Account Receivable and Payable, Cost-Element and Cost-Center Accounting etc.)</td>
<td>82,9%</td>
<td>39</td>
</tr>
<tr>
<td>Human Resource (Personnel Planning, Payroll, Travel Expenses etc.)</td>
<td>36,2%</td>
<td>17</td>
</tr>
<tr>
<td>Operations and Logistics (Inventory Management, Material Requirements Planning, Plant Maintenance, etc.)</td>
<td>83,0%</td>
<td>40</td>
</tr>
<tr>
<td>Sales and Marketing (Order Management, Sales Planning, Sales Management, Pricing, etc.)</td>
<td>63,8%</td>
<td>30</td>
</tr>
<tr>
<td>All of the above</td>
<td>10,6%</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4: CSF’s ranking and statistical analysis (complete list of)

According to your knowledge and experience working with the system, which of the criteria below would you consider to be critical for the successful selection, implementation, and (if applicable) further customization of the ERP system.

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Weighted Average</th>
<th>Standard Deviation</th>
<th>Median</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top management support</td>
<td>5,25</td>
<td>2,45</td>
<td>1,50</td>
<td>-0,30</td>
</tr>
<tr>
<td>Project management principles (for example the use of)</td>
<td>3,75</td>
<td>1,79</td>
<td>1,50</td>
<td>0,59</td>
</tr>
<tr>
<td>Feasibility/evaluation of the ERP project</td>
<td>3,58</td>
<td>2,28</td>
<td>1,50</td>
<td>1,26</td>
</tr>
<tr>
<td>Cost/Budget</td>
<td>3,83</td>
<td>1,41</td>
<td>2,00</td>
<td>-0,30</td>
</tr>
<tr>
<td>IT infrastructure</td>
<td>3,25</td>
<td>2,10</td>
<td>1,50</td>
<td>-1,55</td>
</tr>
<tr>
<td>Business Process Re-engineering</td>
<td>3,58</td>
<td>1,67</td>
<td>1,50</td>
<td>-1,79</td>
</tr>
<tr>
<td>Consulting services</td>
<td>3,17</td>
<td>1,90</td>
<td>2,00</td>
<td>-2,69</td>
</tr>
<tr>
<td>Change management program and culture (for)</td>
<td>3,75</td>
<td>1,79</td>
<td>1,50</td>
<td>0,59</td>
</tr>
<tr>
<td>Minimum customization/modification of the ERP</td>
<td>3,58</td>
<td>2,10</td>
<td>1,50</td>
<td>-1,55</td>
</tr>
<tr>
<td>Testing and troubleshooting (in the case of further)</td>
<td>3,75</td>
<td>2,68</td>
<td>1,00</td>
<td>-2,66</td>
</tr>
<tr>
<td>Monitoring and evaluation of performance in the ERP</td>
<td>3,58</td>
<td>1,67</td>
<td>1,50</td>
<td>-1,79</td>
</tr>
<tr>
<td>ERP teamwork and composition</td>
<td>4,17</td>
<td>2,53</td>
<td>1,00</td>
<td>-0,78</td>
</tr>
<tr>
<td>Business plan and vision</td>
<td>4,50</td>
<td>1,90</td>
<td>2,00</td>
<td>-0,99</td>
</tr>
<tr>
<td>Effective communication throughout all the stages</td>
<td>4,17</td>
<td>1,67</td>
<td>1,50</td>
<td>-1,79</td>
</tr>
<tr>
<td>Clear understanding of the strategic goals set by the</td>
<td>4,67</td>
<td>2,68</td>
<td>1,00</td>
<td>-2,66</td>
</tr>
<tr>
<td>Data accuracy</td>
<td>3,75</td>
<td>2,28</td>
<td>1,50</td>
<td>1,26</td>
</tr>
<tr>
<td>Education and training of end users</td>
<td>4,67</td>
<td>2,00</td>
<td>2,00</td>
<td>-1,18</td>
</tr>
<tr>
<td>Focused performance measures to monitor</td>
<td>3,67</td>
<td>2,00</td>
<td>1,00</td>
<td>-1,18</td>
</tr>
<tr>
<td>Post implementation audit</td>
<td>3,17</td>
<td>1,26</td>
<td>1,50</td>
<td>-0,78</td>
</tr>
<tr>
<td>User involvement</td>
<td>4,75</td>
<td>2,45</td>
<td>1,00</td>
<td>-2,17</td>
</tr>
</tbody>
</table>
Critical Success Factors in ERP Systems Implementation: the case of medium and small sized Enterprises

Figure 1: Histogramme of answers for reasons for implementing ERP

Which were in your understanding, the main reasons for the implementation of the ERP system?

- Competition: 41.7%
- Market conditions: 16.7%
- Internal business processes: 75.0%
- Customers: 8.3%

Figure 2: Histogramme of answers for ERP modules implemented

Which ERP modules have been implemented by your company?

- Financial (Asset Accounting, Accounts Receivable, and Payable, Cost/El.): 68.3%
- Operations and Logistics (Inventory Management, Material Requirements): 25.0%
- Sales and Manufacturing (Order Management, Sales Planning, Sales Management): 50.0%
- All of the above: 8.3%
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Figure 3: Ranking of CSFs for ERP implementation (based on the weighted average ranking of the survey of Table 4)

Testing the survey results in a case study

The aim of this “test application” of the findings of the survey to a case study Organisation was found necessary for the following reasons:

a. As a comprehensive test of the validity of the survey findings through discussing them in length during repeated “in situ” interviews with the experienced personnel of the IT department of the case study Organisation who implemented their ERP system and are acting now as maintenance and troubleshooting team.

b. To help consolidate the findings of the survey so that they can lead to more generic and general conclusions,

c. To enable some additional data collection and the formulation of further recommendations.

The Organisation chosen as case study was the Center for Research and Technology Hellas – CERTH, an Organisation of 480 personnel dealing with research. As an Organisation, CERTH, resembles any major private firm or corporation in that it has “departments” specializing in a certain process or product (its Institutes) and each such department is subdivided into sections (labs), which undertake specific research projects resulting in either a research prototype product, or service.

The ERP system of CERTH, focuses primarily on financial issues such as cost-element and cost-center accounting, asset accounting, accounts receivable and accounts payable. Its main features include:

- Electronic management and processing of all financial acts,
- Monitoring of budget implementations in real-time,
- Correct management and usage of all financial resources,

The Greek National research and technological development center in Northern Greece (Thessaloniki).
• Recording of assets using a barcode system,
• Introduction of set procedures for conducting business.

In addition to the above-mentioned functionality – which is provided by the acquired “of-the-shelf” ERP package – CERTH has further customized the system by creating a comprehensive user interface platform called MyCerth. This platform works in cooperation with the main ERP in order to support the fully automated and complete management of personnel and project files, supplies and expenditures, and other elements in relation to the projects that are or have been undertaken by the Organisation.

The implementation of the ERP package and its add-on (MyCerth) was performed by a “local” team, i.e. personnel of the Center who after installation remained in the IT department as the ERP support and troubleshooting team. The author performed a number of lengthy interviews with this team as well as with the management of the Organisation. During these interviews a detailed evaluation, validation, and examination of the survey findings took place, and where possible the qualitative examination was supported by data collection and analysis.

The case study investigation, revealed that:
1. The top three CSFs that were found from the survey as most important i.e. top management support – end user involvement - and education and training, were confirmed as playing a critical role in the case of CERTH, too.
2. Of the other CSFs, that emerged from the survey, a number of them were confirmed as particularly applicable in the case of CERTH and these were the following:
   a. Effective communication, i.e. the ability to, and the ease with which members of the Organisation communicate with each other and with top management about the progress and difficulties they face during the implementation.
   b. Morale and motivation, i.e. creating the “mood for change” and the need for everyone to understand, cope, and accept the new system.
   c. Creation of a competent local team, to carry out the implementation and later for testing and troubleshooting. This was found very important because the initial ERP system vendor can only be present, under its contract support obligation, for a limited time period. The alternative would be to have outside consulting services available, but this is usually prohibitively expensive.
   d. The need for proper and comprehensive customization / initialization. Proper customization and initialization can make the difference between success and failure for the whole implementation. The more back in time legacy data are input during initialization, the better.
   e. Proper customization of the system is also critical. SME Organisations are more capable of adapting to the different changes in processes and organizational structures that are necessary to make the maximum of their new ERP system and the experience of CERTH shows that this should clearly be attempted. It is characteristic that in the case of CERTH, throughout the period that the customization was taking place, pilot changes were being introduced in the information flows and relations between the different departments (Institutes) in order to try to understand which changes actually would maximize employee productivity, assisting them in carrying out their business processes with the ERP.
3. There is a need to consider the “special features” of the Organisation under consideration and to analyze their effect on the ERP implementation and successful operation. This analysis is necessary prior to the implementation, and is in itself a critical success factor. In the case of CERTH, this was done by creating efficient communication channels and methods for communication both “morale” and “motivation” towards the new system were created and they were used in order to bring the employees to report on progress and the different problems that they faced.

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9 In this case the SAP.
10 By creating efficient channels and methods for communication both “morale” and “motivation” towards the new system were created and they were used in order to bring the employees to report on progress and the different problems that they faced.
CERTH, these special features (that in retrospect played an important role in the success of the implementation) were:

- The quality of the workforce of the Organisation, this being researchers and scientists, i.e. familiar with such types of tools.
- The fact that there was no “legacy system” i.e. a system that existed before so no significant adaptation was necessary.
- The management structure, which was quite lean (direct decision making by the chairman of the Board who reported afterwards and informed the Board of Directors).

Discussion

ERP implementation for small and medium sized Organisations (defined in this paper as Organisations with up to 500 employees) is an issue that merits particular attention because the success or failure of the implementation of such a system can make - for an SME – the difference between success and failure of the whole Organisation. The methodological basis of this study, that consists of a combined approach based on data collection by use of a survey and confirmation – validation of the survey results by a more detailed case study, allowed us to draw a number of general conclusions which can be made also as generic recommendations in the sense that they can be taken as first indicators of success which can then be “customized” to the case of the Organisation being considered.

Therefore, one of the critical findings of this work is the realization that there can be no rigid lists of CSFs applicable to all cases. Each particular Organisation has its own characteristics which differentiate it from the others and this must be taken into account in the weight and priority of each critical success factor that is to be applied. In other words, all of the CSFs that were found as important in the previous sections (and being summarised in the section below) should be considered as equally important and weighted against features and characteristics of the specific Organisation. The main features and characteristics to be taken into account, are the following:

a. Type of business;
b. The legacy system that the new ERP replaces;
c. Workforce environment of the Organisation;
d. Management culture;
e. Legal and statutory environment in the country; and finally
f. The available IT infrastructures and the availability of new ones.

Our survey revealed a number of limiting factors that apply specifically to SMEs, and these merit further discussion here. These factors were identified as, the:

- Cost of the ERP package purchase and implementation;
- Complexity of installing an off-the-shelf ERP;
- Time horizon in which the ERP benefits materialize;
- The types of ERP modules that are most frequently implemented in SME Organisations.

In an SME situation, obviously the cost of the whole implementation of the ERP system (very much as the cost of purchasing it) plays an important role. This however, cannot be considered as a “critical success factor – CSF” in the sense that we use it here, because this cost normally has to be added to the cost of purchase and together they have to be considered in the initial go –no go decision which will be the result of the cost - benefit analysis that has to be done at the beginning i.e. before the whole decision to go ahead with the installation of a new ERP system.

For the same reason the “complexity of installing an off-the-shelf ERP cannot be considered as a CSF but only as a limiting factor that has to be weighted at the beginning against the capabilities of the Organisation and its potential to react and restructure positively. This capability is related to the “workforce environment”, and the “management culture” characteristics of the Organisation that were mentioned earlier. Obviously, the more well established is the IT culture of the workforce and the more comprehensive the structure of the Organisation, the better this “capability” will be.
As regards the time horizon, this limiting factor has to do with the fact that in an SME situation the tangible benefits of the ERP system take longer times to materialize and become evident, as compared to larger Organisations. This is due to the fact that the economies of scale are smaller, and the diseconomies too, and the smaller the Organisation and the leaner its structures the less “room for improvement” exists. This comment, here, must be seen as fully justifying the finding of this work (see conclusions below) that one of the most important critical success factors that an SME must observe is the need to have a proper business plan and vision for the performance of the Organisation with the ERP system in place. Such plan and vision is by definition long-term and it is in that time scale that most of the benefits seem likely to accrue.

Finally, the types of ERP modules that are implemented may be a “limiting factor” in the sense that some of these modules may render themselves more to a successful implementation than others. This however, has to be considered in relation to the future expansion of the ERP system to more modules and here again the existence of a future business plan and vision becomes useful and necessary for the proper evaluation of the whole implementation plan.

Of interest would also be some comments on the applicability and representativeness of the survey. The sample size used, as a percentage to the total population of potential participants in this survey, is obviously small. It could not be made otherwise, and this is about the size used in other similar works too. However, all care was taken to cover a homogeneous and representative set of SME Organisations in the specific areas examined (i.e. Organisations in the “service” sector, and light manufacturing). A larger sample, besides the fact that would obviously be prohibitive in terms of the available resources, would mainly enhance the statistical – i.e. quantitative – results of the work and not so much the qualitatively ones. In order to secure further these qualitative results the study methodology included also the “Case Study” i.e. the in-depth consideration and testing of the survey results in a specific SME that was not part of the survey.

Conclusions

The main conclusions of the work point first to the need to properly plan the implementation through the construction of an implementation business plan and “vision”. Such implementation business plan would define the specific actions to be taken during implementation, their timing and focus, the stakeholders to be involved, and of course the Critical Success Factors that need to be observed for this particular Organisation. It would also reveal and focus the long term benefits of the whole implementation.

Of critical importance (not only for the success of the implementation itself but of the future performance of the ERP system as a whole) is the existence of a dedicated “local” team that will undertake the implementation, i.e. with personnel from the Organisation itself who will remain as maintenance and troubleshooting team throughout the life of the ERP system. If this is not possible, then some form of external help should be sought but again the long term interests of the Organisation lie on the formulation of a small dedicated “local team” that will implement and maintain the system.

The initialization process which takes place within the implementation procedures and especially the quality and extend of the initial data that represent the previous time periods are also a very important CSF. This can really make the difference between success and failure for the whole implementation. It involves the input of all the data that refer to the previous periods (the legacy situation) so that the system can start by building on the past and providing comprehensive coverage of the Organisations past transactions. The more data one can import for previous time periods, during the initialization process, the better and the more successful the system’s implementation will be.

Of relevance to the previous one, but a separate CSF, has been mentioned as proper customization of the system. This refers to all the possible (and desirable) adaptations to the operation and functional structure of the Organisation that will be made in order to better adapt and utilize the benefits from the new ERP system. SME Organisations are more capable of adapting to the different changes in processes and organizational structures that are necessary in order to make the maximum of
the new ERP system, than larger Organisations, and it is recommended that they do so during the ERP implementation period. It is very important to realize, that in order to reap the benefits of a new ERP system, an Organisation must be prepared to effect changes in its operation too and in doing so to also properly customize the ERP to fit best this changed operating environment.

Other critical success factors that were found as relevant to SMEs and which were mentioned as important in the survey and confirmed in the case study that followed, are the following:

1. Top Management Support (i.e. the amount of involvement of top management during implementation);
2. End user Involvement (the involvement of all the different ERP users throughout all the different phases of implementation);
3. Education and Training (on the ERP system being implemented) of the end users;
4. Effective communication, with top management during the implementation.
5. Morale and motivation, i.e. the “mood for change” and the need for everyone to understand, cope, and accept the new system.

As a concluding remark, using CSFs takes increased importance in the case of small or medium sized Organisations. They can provide a useful guide for the (normally inexperienced) local implementation team as well as for the management and can reduce the cost of implementation by avoiding costly mistakes and delays.

This study we hope that provided the interested ERP user, with a useful insight for successful ERP applications in Small and Medium sized Enterprises. In the future, we hope that the work will be continued (in terms of expanding the types of Organisations considered, and the number of questionnaires used) and we will be reporting on new findings as necessary.

References

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