Study on Factors Influencing Selection and Implementation of ERP Systems

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Abstract: Because of the complex nature of Enterprise Resource Planning (ERP) systems by way of integration of various business processes and activities across multiple divisions and functions of an organization, the issues of selection of right ERP system to suit the organizational requirements and its implementation to achieve proper synchronization stand as challenging ones in managing ERP projects. Several studies derived critical success factors for the success of ERP systems. This study attempts to measure the success as experienced and expressed by pure technical people like project leaders and managers who actually monitor, analyze and manage ERP systems in organizations. A survey was conducted around four big software companies which are agressively dealing with ERP solutions and the feedback of their technical people was collected and analyzed. Statistical factor analysis was carried out to identify major and essential factors that influence the phases of selection and implementation of ERP systems in organizations.

Key words: ERP systems, information systems, project management, statistical analysis, enterprise solutions, India

INTRODUCTION

Data is the raw material required to produce information about any activity, event or process and right and timely information is the key to perform good decision making which in turn is the key to organizational survival in a global environment. An information system is made up of several components such as hardware, software, communications systems, people and the data itself. Currently, every organization uses different kinds of information systems to carry out their day to day business activities effectively, efficiently and swiftly and hence information systems became a critical component of any successful organization. In business and management, different information systems are being developed in the form of Transaction Processing System (TPS), Management Information System (MIS), Decision Support System (DSS), Expert System (ES), etc. Apart from processing the data to generate information, an information system can store and manage both the data and information properly to generate timely and needful reports. Information systems provide a high level of computer automation to support such business functions as accounting, finance, marketing, customer service, human resource management and operations. They also play a vital role in the primary and secondary activities of the organization's value chain (Porter and Millar, 1985).

To gain competitive advantage, business organizations have been continuously reorganizing and restructuring their business processes to align properly with the new technology in order to deliver the products and services to the market in right time. In this process, the business organization and their business processes are becoming more complex. This is due to an increased layer of management hierarchy and an increased level of coordination across departments. The role of each staff under each management layer has different information needs and requirements and hence no single information system can support all of them. To keep pace with the prevailing market dynamics and challenges, the business continuously undergoes changes and enhancements. To support such dynamic environment, wide variety of information systems with suitable computer architecture configurations are being developed with different features and scope and playing a vital role in transforming the business.

Today's competitive business environment is cross-functional, dynamic and global and becoming more customer-focused and cost-efficient and ultimately demanding cross-functional integration among the various departments and divisions of an organization. This scenario created the need for enterprise systems to support the multifunctional integration and coordination of the organization. Enterprise Resource Planning (ERP) system is an integrated information system that helps an organization integrate various functions, make optimum utilization of management resources and improve its process efficiency by addressing the needs of, not just one or two departments/functions but the entire range of functions like manufacturing, marketing, human resources,

finance, logistics, etc. in an organization. The data entered in any one of the functional modules is made available to other modules that need the data and the consistency and integrity of data will be improved. ERP uses the process view of an organization rather than functional view that is used by traditional enterprise software. The functional view narrows the focus to a particular functional area and serves some specific needs whereas the process view emphasises a broad understanding of the entire organization and its systems and procedures.

ERP software eliminates the need to obtain a different application for each of the business needs. Enterprise Resource Planning (ERP) systems consist of a series of functional modules that are integrated through standard business processes and include all the data and information about vendors, customers, employees and products and services. Many researchers like Boykin (2001), Chen (2001) and Yen *et al.* (2002) interpreted that ERP system is a business management system that comprises integrated sets of comprehensive software which can be used when successfully implemented to manage and integrate all the business functions within an organization; these sets usually include a set of mature business applications and tools for financial and cost accounting, sales and distribution, materials management, human resource, production planning and computer integrated manufacturing, supply chain and customer information. In the absence of ERP systems, organizations use separate applications to automate these business functions but experience a lot of problems to integrate such diverse applications and get cross-functional picture of whole organization. Hence ERP is an integrated software approach designed to efficiently manage the transactions and track the status of day to day activities from any point within an organization. According to Miller, the key parts of an ERP system are integrated modules allowing business processes that cross business functional areas; one large real-time database that allows for a single entry and repository for information across business functions and seamless business transactions across business functions. According to Gupta *et al.* (2004), ERP systems by coordinating business functions and processes are suggested to lower costs in its entire supply chain by either shortening throughput times; lowering inventory or by providing quality service.

According to Siriginidi (2000), the tangible benefits due to ERP adoption include: reduction of lead time by 60, 99% on-time shipments, increased business, increase of inventory turn over by 30%, reduction in cycle time by 80% and work in progress reduced to 70%; the intangible benefits include: better customer satisfaction, improved vendor performance, increased flexibility, reduced quality

costs, improved resource utility, improved information accuracy and improved decision-making capability. Shehab *et al.* (2004) states that ERP system solutions are currently in high demand by both manufacturing and service organizations because they provide a tightly integrated solution to an organization's information system needs and during the last decade, they have received a significant amount of attention from researchers and practitioners from a variety of functional disciplines. Mentioning that ERP systems have been expanded beyond manufacturing and introduced to the finance, health care, hotel chains, education, insurance, retail and telecommunications sectors, Adam and O'Doherty (2000) described the ERP projects as large, costly and difficult ones that require large investment in capital and staff and management time.

Implementation of an ERP solution in an organization is a strategic matter and needs proper planning, otherwise failed ERP solution may turn even profit making companies into loss making ones. There should be a perfect fit between the ERP application and the organization's requirements and hence before going in for an ERP package, any organization should analyze its needs like integration between different business functions, quick flow of information between business partners, quick and more effective decision making, elimination of manual documentation work, etc. According to Shehab *et al.* (2004), the deployment of ERP for an organization has two important issues namely selection and implementation. The first issue deals with selection of right ERP solution in accordance with the needs of an organization and the second one deals with implementation of the selected ERP solution to meet the needs of the organization. Both selection and implementation phases are part of ERP project life cycle and their successful management will be the major objective of ERP project management. The present study focuses on the critical success factors that contribute to the success of those two phases.

ERP selection: Once the organization decides to go for an ERP solution, the foremost important task is to select the suitable ERP package and an appropriate vendor. The organization should decide whether to buy a module of ERP such as marketing, finance, etc. or the whole package depending on the scope of its requirements. Once the ERP package has been decided, the organization needs to clearly outline the features and benefits that it expects from the ERP implementation. Since the ERP application package will impact the organization's market presence, life span and quality of operations, its selection based on the organization's needs can be a challenging task and

reaching a corporate-wide decision to go for it may take further a long time. While most ERP packages have similarities, they also have fundamental design differences. The selection involves listening to the views of various people whose involvement would be essential and the criteria to go beyond technical issues such as proven experience of the supplier in the desired industry, along with support infrastructure (Shehab *et al.*, 2004). But the selection of an appropriate Enterprise Resource Planning (ERP) solution remains a complicated task. Since the fundamental role of an ERP solution is to support corporate operations, one key consideration that would seem necessary is the alignment of the ERP solution's capabilities with the operational goals of the firm (Bendoly and Jacobs, 2004).

A number of researchers (Bernroider and Koch, 2001; Chen, 2001; Van Everdingen *et al.*, 2000; Rao, 2000; Siriginidi, 2000; Sprott, 2000; Verville and Halingten, 2002) well documented the various selection criteria of ERP systems. From the clients view point, the selection factors to be considered as addressed by Siriginidi (2000) include the stability and history of the ERP supplier, last 12 month track record of ERP sales, implementation support from suppliers and improvement in ERP packages.

In another study, Bernroider and Koch (2001) discussed the results from an empirical study of Austrian companies concerning differences in the characteristics of the ERP system selection process between small or medium and large sized organizations. In particular, they addressed the fields of software packages considered and chosen, the weights assigned to different selection criteria, the size and structure of the team responsible for the decision, the methods employed and the effort expended.

The analysis conducted showed that there is a significant influence of organizational size on the software package selected. SAP R/3 systems are selected more often by large organizations while small or medium sized companies often choose software supplied by Baan. Bernroider and Koch (2001) identified a total of 29 different ERP selection criteria; the adaptability and flexibility of the software is more highly valued by smaller organizations as these advantages may be unique business processes that need to be preserved. A short implementation time and therefore, lower costs are also given more importance as resources are a bigger issue in selection of ERP solution.

Van Everdingen *et al.* (2000) in an empirical study of European midsize companies, identified the high importance attributed to fit with current business procedures, flexibility, costs, user-friendliness of the system and short implementation.

ERP implementation: ERP implementation is not just about making the organization Information Technology (IT)-enabled; it is much broader in scope and involves change management and integration of the organization. An organization can implement the ERP system using either the Big Bang approach or the Phased approach. In the Big Bang approach, all the modules of the ERP package are implemented at one go in a department or the organization as a whole. In a phased approach, the ERP implementation project is divided into logical phases and the phases are implemented one at a time. Each phase focuses on a particular key area and before progressing to the next phase, the management ensures that the previous phase has been successfully implemented and the users have started using the system. At the end of the project, the system is tested to ensure that all the modules of the system are well integrated. Most organizations prefer phased implementation because the risks can be more easily controlled in this approach.

The ERP packages offered by vendors like SAP, Oracle, JD Edwards, etc. are complex and take months of effort to implement. Hence ERP systems are complex and implementing one can be a difficult, time-consuming and expensive project for a company. For instance, the ERP adoption time, typically, takes from a few months for firms accepting all default settings to years for firms needing to make major modifications. It costs tens of millions of dollars for a medium sized company and $300-500 million for large international corporations (Mabert *et al.*, 2001). According to Wood and Caldas (2001), complex thinking is needed in ERP system implementation.

The successful implementation of an ERP system increases competitiveness by increasing quality, reducing redundancy, speeding up processes, reducing lead times and inventory levels and increasing customer satisfaction (Gupta, 2000). It has become increasingly clear that implementing an ERP system requires extensive efforts to transform the organization's processes. ERP systems are supposedly based on best practice generic business processes. Therefore, when purchasing an off-the-shelf ERP system, organizations obtain these practices and subsequently are pushed into the direction of implementing them (Kremers and van Dissel, 2000). Implementing an ERP packages offers several advantages, direct and indirect, to the organization and they include lead time reduction, punctuality in shipment, reduction in cycle time, improved supplier performance, flexibility and reduction in quality cost, reduced costs for maintaining quality, improved resource utility, etc. According to Coffey >70% of Fortune 1000 companies had either begun the implementation of an ERP system or plan to do so in the next few years. Another positive aspect is that smaller firms that are very dependent on large ones are going to

be forced into ERP packages to stay compliant with larger organizations ERP systems. Failures of ERP system implementation projects have been known to lead to organizational bankruptcy (Davenport, 1998; Markus *et al.*, 2000b). Implementing ERP systems is now the most common IT strategy for all organizations. From a management perspective, the nature of the ERP implementation problem includes strategic, organizational and technical dimensions. Therefore, ERP implementation involves a mix of Business Process Change (BPC) and software configuration to align the software with the business processes (Holland and Light, 1999).

Although, companies spend millions on ERP packages and their implementation process, there is extensive evidence that they experience considerable problems, particularly during the actual implementation project. In response to these problems, there has been a developing body of academic literature (Bancroft *et al.*, 1998; Holland and Light, 1999; Markus *et al.*, 2000b; Motwani *et al.*, 2002; Nah *et al.*, 2001; Parr and Shanks, 2000) which addresses the difficulties of ERP implementation by proposing Critical Success Factors (CSFs) and process models of the implementation. Both are aimed at better planning and hence more successful ERP implementation. Bancroft *et al.* (1998) provided Critical Success Factors (CSFs) for ERP implementation, including top management support, the presence of a champion, good communication with stakeholders and effective project management.

The factors specific to ERP implementation include re-engineering business processes, understanding corporate cultural change and using business analysts on the project team. In another study, Holland and Light (1999) developed a CSFs framework to help managers successfully plan and implement an ERP project. Their CSFs model includes strategic factors such as the overall implementation strategy and tactical factors such as technical software configuration and project management variables. Several reports (Davenport, 1998; Bancroft *et al.*, 1998; Rao, 2000; Somers and Nelson, 2001) identified the issue of top management support as the most important and crucial success factor in ERP system implementation projects.

Researchers like Somers and Nelson (2001) and Cooke and Peterson (1998) reported that change management is also a primary concern in those projects. Rigorous training to the end-user is also very much needed to operate the ERP system because of the extremely complex nature of those systems (Welti, 1999). According to Welti (1999), the components of the project scope, namely project difinition, objectives and strategy are compulsory to create a clear project vision.

Al-Mudimigh *et al.* (2001) divided the ERP system implementation into three levels: strategic, tactical and operational and analyzed the different critical factors in each level. Nah *et al.* (2001) discussed about research conducted on the critical factors for initial and ongoing ERP implementation success. They identified 11 factors to be critical to ERP implementation success: ERP teamwork and composition; change management program and culture; top management support; business plan and vision; BPR with minimum customization; project management; monitoring and evaluation of performance; effective communication; software development, testing and troubleshooting; project champion; appropriate business and IT legacy systems.

Markus *et al.* (2000a), in their study of the complexity of multi-site ERP implementation, claimed that implementing ERP systems can be quite straight forward when organizations are simply structured and operated in one or a few locations. The research of Kumar *et al.* (2003) explores the key considerations and successful strategies in an ERP implementation projects such as selection of project manager, ERP vendor and implementation partners; constitution of project team, challenges in training and upgrading the infrastructure, ongoing project management, quality assurance and stabilization of ERP.

MATERIALS AND METHODS

Because ERP systems are complex, they often require a large investment of money and time. An ERP system implementation impacts a large number of people, both inside (employees) and outside (customers, vendors, business partners, etc.) the organization. It also requires both carefully crafted business needs and a comprehensive change management strategy. Organizations considering an investment in ERP systems should be educated not only on enterprise systems components and architecture but also the several issues that influence the success of ERP selection and implementation phases. The short-and long-term impacts of those issues on the organization's business and policies should be forecasted and managed properly while organizations adopt ERP solution.

The comprehensive nature of Enterprise Resource Planning (ERP) made the ERP systems as complex and large systems that require coordination among several activities and processes and also participation across so many functional areas within an organization. Such coordination and participation across different activities, processes and functions became the foremost challenge to be met in implementation of ERP systems in organizations and because of this fact, the implementations are reported to have fluctuating record of success. By studying the success of ERP systems in the

perspective of financial executives internal to the organizations, Peslak (2006) reported that ERP systems are generally viewed as moderately successful. Barker and Frolick (2003), Scott and Vessey (2002) and Martin (1998) highlighted the fact that most of the ERP implementations are failures and the success rate is very meager. According to Ho *et al.* (2004), current industry demand to implement the ERP system is growing fast but currently there are relatively few success stories. Al-Mashari (2003) says that research in the ERP area is still lacking and the gap in the ERP literature is huge. Hence the exploration of the success issue of ERP systems in organizations deserves significant research attention.

With the background of different research reports available about different sets of critical success factors that influence the selection and implementation issues of ERP systems in organizations, the present research attempted an independent study and targeted especially the technical people like the Project Managers and Project Leaders as audience who are actually working on ERP systems. Survey was conducted around such audience present in four large and internationally reputed IT firms situated in Hyderabad and Andhra Pradesh state in India.

To draw valuable and relevant data and information about the critical successful factors, two different questionnaires for both selection and implementation processes have been designed and distributed among them. After scrutinizing the responses, the reliable sample size came down to 40.

The data thus collected from the surveys has been analysed using statistical techniques namely graphical and factor analysis. SPSS software has been used to carry out factor analysis. From the factor analysis, the critical success factors for both selection and implementation of the ERP systems have been derived. These derived factors provide lot of scope for understanding the practical difficulties and the success factors that can overcome such difficulties.

Even though the prioritization of the success factors may be quite different from some literature reports, the present research did all that analysis and prioritization of factors from the valuable data collected from the actual working people of ERP systems and from their actual practical experience.

Hence the present research reviews the ERP success from yet another perspective, the internal assessment by technical people within a firm itself. Such assessments have been collected and analysed thoroughly using statistical techniques. The results have been generated from an independent study involving field survey and analysis and throw light on further analysis of the critical

success factors that contribute to the successful selection and implementation of ERP solutions in organizations. The study has been carried out with the following objectives:

- To identify and study the common critical success factors which influence the successful selection and implementation of ERP solutions in organizations
- Based on the analysis of secondary data, to conduct independent survey of concerned technical people to assess the significance and priority of each influencing issue
- To focus on the feedback and assessment of the software technical professionals about ERP systems
- To analyse the data collected from surveys using relevant statistical technique
- To come out with a consolidated list of critical success factors for both selection and implementation of ERP solution
- To comprehend different managerial, technical and social factors which decide the success of ERP systems in organizations

The study followed a systematic methodology starting from secondary data collected from literature to understand various issues that influence the successful adoption of ERP solutions, collecting necessary useful data through surveys and analyzing the data using factor analysis.

That is after doing secondary data analysis, a fixed set of salient issues that influence both selection and implementation of ERP solution has been created, questionnaires developed and distributed among ERP software professionals as a part of primary and independent research. The primary data has been collected and analysed in detail. Therefore, basically, the whole study has been divided into three phases.

First phase: Initial research on secondary data to identify various influencing issues: The study was initiated with the secondary data by thoroughly reviewing the available literature reports and case studies on the Critical Success Factors (CSFs) for the success of ERP systems in organizations and grouping the relevant common critical success factors under selection and implementation phases of ERP systems separately. All these common factors have been treated as salient influencing issues in each phase.

The list of common critical success issues (collected from the literature reports) that influence the selection of ERP solutions are shown in Table 1 and those that influence the implementation shown in Table 2.

Table 1: List of common critical success issues that influence selection of ERP solution

Common critical success issue	Description
Alignment of ERP capabilities	The alignment of the ERP solution's capabilities with the operational goals of the firm
Need analysis of ERP	Need analysis of an ERP solution-what extent does the organization require an ERP solution and the associated benefits it would gain
Support infrastructure	The importance of support infrastructure as a basis for evaluation of a vendor for ERP selection that is the infrastructure of the vendor
Change management	The change management-how well the company can cope with all changes, once an ERP selection is made
Stakeholder involvement	The stakeholder involvement in selection of an ERP package. Key stakeholders are the top management, project team, project management, package vendor, etc
Physical influences	Physical influences like capability of the vendor to support the client's geographically-dispersed operations
Technological influences	Technological influences like replacing obsolete systems with new technology
Cultural influences	Cultural influences like those that affect the ability of the management to implement organizational change through process redesign
Legal influences	Legal influences like legal issue of code ownership
Organizational influences	Organizational influences-external references (from other organizations), project management techniques, new management, single vendor solution and cost

Table 2: List of common critical success issues that influence implementation of ERP solution

Common critical success issue	Description
Change management and training	Motivating and managing the employees by building awareness of the changes going to take place with the advent of ERP solution and providing necessary training to handle the solution
ERP teamwork and composition	Creating the ERP team with necessary management and technical skills and inculcating collaboration within the team
Organization culture	The workplace environment formulated for the employees to interact and operate
Top management support	Support of the top management to enable the ERP solution implemented and operated by employees to cater to the needs of the organization
Business plan and vision	ERP solution's alignment with the business plan and vision of the organization
Business process re-engineering	Business Process Re-engineering (BPR) with minimum customization
Significance of IT skills	Skills of the staff need to be updated with upgradation of technology
ERP education	Education about ERP and the implemented ERP solution with which to work
Human resource planning	Planning the human resources properly to support the implementation and operation of the ERP solution
Commitment	Commitment of the organization to successful implementation of ERP solution by releasing the right people and other needful resources
Infrastructure resources planning	Planning the necessary infrastructure resources like network servers, desktop systems, etc.

Second phase: Primary research through field study/survey: To have a clear understanding of the views of technical people on the importance and contribution of each of the common critical success issues thus identified in the first phase, an independent field study has been taken up around four big software companies and the respective ERP project managers and project leaders were contacted and questionnaires were distributed to them to collect the needful data and information. The reliable sample size became 40.

Third phase: Graphical and factor analysis to analyse the critical success factors: In the final phase, both graphical and factor analysis techniques have been applied to the data collected from the surveys of second phase. Graphical analysis is used to understand the significance of each influencing issue in both selection and implementation of ERP solution. To carry out more in-depth analysis with the help of SPSS statistical software and using the statistical technique, factor analysis, the common critical success issues for both selection and implementation phases of ERP solutions have been further consolidated into a short list of major influencing factors. The study used two types of statistical techniques. One technique is the graphical

analysis in the form of generating histograms for the significance as perceived by the respondents about each and every influencing issue. The second technique is the factor analysis performed to reduce the data into limited number of factors.

According to the different salient issues identified from literature survey for successful selection and implementation of ERP solution as discussed earlier, survey was carried out by meeting the concerned technical people who have good experience in working with ERP systems. The overall questionnaire included 10 questions on selection of an ERP solution and 11 questions on implementation of ERP solution. The respondents were asked to rate every issue of the questionnaire on a Likert scale of 1-5; 5 being the highly significant issue and 1 for not at all a significant issue. The format of the two sets of questionnaires is shown in the Appendix-1. After collecting the filled-in questionnaires received from different respondents and further scrutinizing them, it was found that the questionnaires received from 40 respondents are reliable and genuine.

Based on the data collected through the two questionnaires, as a first step, the significance of each and every salient issue under both selection and

implementation aspects of ERP solution has been measured and graphically represented. Next, statistical factor analysis has been carried out for both activities and all the results obtained from using SPSS software have been presented. Since the graphs developed are simple histograms and are common whereas the factor analysis is one unique and very useful statistical technique, its introduction is given below.

Factor analysis is used to reduce a large number of variables into fewer numbers of factors by extracting maximum common variance from all variables and putting them into a common score. The factor analysis seeks to discover if the observed variables can be explained largely or entirely in terms of a much smaller number of variables called factors. This study uses the Principal Component Analysis (PCA) which is the most common method of factor analysis and also uses the Varimax rotation method which is helpful to understand the output with more reliability. The study considers the eigenvalues which represent the extent of coverage of the critical factors included in the factor anlaysis >1.

RESULTS AND DISCUSSION

Since the study has taken up the analysis of collected data in two ways namely graphical analysis and factor analysis, the results are basically classified into two categories: one is graphical representation of significance of influencing issues in both selection and implementation activities of ERP solution and the second one is generating short list of factors using statistical factor analysis. Both methods used the same data that was collected from different project managers and project leaders.

Graphical analysis: Based on the significance level assigned by the respondents for each issue, a graph is developed using histograms to easily understand the percentage of respondents. Such significance of issues converted into histogram graphs has been separately dealt with in each phase that is selection and implementation of ERP solution.

Significance of issues that influence the selection of ERP solution: The significance expressed by the respondents has been converted into percentages representing each of the five levels: Highly Significant, Significant, Neutral, Not so significant and Not at all Significant. All the results have been consolidated in a tabular form as shown in Table 3. About 70% of the respondents treated the issue of alignment of ERP solution in the organization as significant meaning that the ERP solution has to integrate

Table 3: Consolidation of responses on significance of critical success issues of ERP selection

Critical success issue	Percentage of responses on significance of issue				
	Highly significant	Significant	Neutral	Not so significant	Not at all significant
Alignment of ERP	26	70	4	0	0
Need analysis of ERP	41	52	7	0	0
Support infrastructure	30	37	33	0	0
Change management	22	59	19	0	0
Stakeholder involvement	37	37	22	4	0
Physical influences	7	67	26	0	0
Technological influences	22	70	7	0	0
Cultural influences	11	41	33	11	4
Legal influences	15	33	48	4	0
Organizational influences	7	48	30	15	0

several business processes and their information within and across different functional departments and hence there should be proper alignment of ERP solution supporting that integration. Since, getting an ERP solution is an expensive affair for an organization, before going for an ERP solution, the organization has to analyse its needs according to the proposed business requirements and also financial capabilities of the organization. It is found that about 40% of respondents treated the need-analysis as a highly significant issue and above 50% respondents treated it as significant. It is also found that about every one-third of the respondents perceived equally the two issues namely infrastructure that can support an ERP solution and the involvement of stakeholder who has interest in the solution and its benefits as highly significant, significant and normal.

When the organization decides to get ERP solution for their requirements, the organization should have a vision about the changes that may take place in the operation of business processes and their related information and should ensure that those changes can be managed systematically. The changes have different perspectives like employee, business process, etc. About 60% of the respondents treated the issue of change management as the significant issue. Nearly 70% of the respondents assigned significance to the issue of physical influences whereas 26% became neutral. When an organization is either technically experienced and knowledgeable or ignorant, in either case, usually the organization takes the help of external entities like ERP consultants, vendors of ERP packages, etc. ERP consultants study the existing information systems in the organization in the background of organizational requirements and problems and suggest whether it can go

for ERP application by supplying needful analytical information. Vendors that supply the ERP package also contribute in selecting the suitable ERP package. Hence, all these physical influences usually contribute a lot in selection of ERP solution.

In the case of technological influences, 70% of respondents treated it as a significant issue whereas 22% treated as highly significant. Since the users of the new information system that is ERP application should come out of their adoption with the legacy systems and a technological ground is to be prepared to welcome the new system, the technological influences play a vital role in selection of suitable ERP solution.

The last three issues of cultural, legal and organizational influences were perceived as significant by about 40%, one-third and about 50% of the respondents, respectively whereas neutral response was given by one-third, about 50% and about one-third of respondents respectively.

Since the respondents are purely technical people, they may not be fully aware of the legal and other cultural and organizational issues but they may understand their overall impact to some extent.

Consolidating all the results, it can be observed that of all the ten influencing issues of ERP selection, considerable neutral response has been received in the case of five issues-support infrastructure (33%), physical influences (26%), cultural influences (33%), legal influences (48%) and organizational influences (30%), mostly in the case of legal influences. Very good positive response in the form of assigning Significance level has been received in respect of six issues-Alignment of ERP (70%), Need analysis of ERP (52%), Change management (59%), Physical influences (67%), Technological influences (70%) and Organizational influences (48%). Considerable response by assigning High Significance level is shown on mainly two issues, namely Need Analysis of ERP with 41% and Stakeholder involvement with 37% of respondents.

Significance of issues that influence the Implementation of ERP solution: A total of 11 issues that influence the implementation of the ERP solution along with the responses collected through survey have been consolidated in a tabular form as shown in Table 4. From these results, it can be observed that in the case of influence of organization culture, most of the respondents (44%) maintained silence without expressing any form of significance to it. Similar trend is observed with 26% of respondents in two other issues namely, Business Process Re-engineering and Infrastructure resources planning.

Table 4: Consolidation of responses on significance of critical success issues of ERP Implementation

Critical success issue	Percentage of responses on significance of issue				
	Highly significant	Significant	Neutral	Not so significant	Not at all significant
Change management and training	30	63	7	0	0
ERP teamwork and composition	22	56	19	4	0
Organization culture	22	30	44	4	0
Top management support	44	41	11	4	0
Business plan and vision	44	37	19	0	0
Business process re-engineering	15	56	26	4	0
Significance of IT skills	7	81	11	0	0
ERP education	22	67	11	0	0
Human resource planning	26	59	15	0	0
Commitment	41	41	15	4	0
Infrastructure resources planning	26	48	26	0	0

Above 40% of respondents treated the three issues, namely, Top management support, Business plan and vision and Commitment as most significant ones followed by some considerable response expressed by 30% on the issue of Change management and Training, 22% on ERP teamwork and composition, Organization culture and ERP education and by 26% of respondents on two issues, namely, Human resource planning and Infrastructure resources planning.

Good response has been received with significance level assigned in the case of seven issues, namely, Change Management and Training (63%), ERP teamwork and composition (56%), Business Process Re-engineering (56%), Significance of IT skills (81% the highest response), ERP education (67%), Human resource planning (59%) and Infrastructure resources planning (48%). Considerable response has been received by treating the remaining four issues, namely, Organization culture (30%), Top management support (41%), Business plan and vision (37%) and Commitment (41%) as significant ones.

Factor analysis: Using the SPSS statistical software, the technique of factor analysis is applied to the data collected from the surveys. The results obtained for each of the two phases namely selection and implementation of ERP systems have been analysed and discussed in detail.

Selection of ERP solution: Using the Kaiser-Meyer-Olkin (KMO) and Bartlett's test, the measure of sampling adequacy is found as above 0.5 and hence the sample size

Table 5: Factor analysis of selection of ERP systems

Scale items	Factor loading			
	Factor 1	Factor 2	Factor 3	Factor 4
Alignment of ERP	-	0.725	-	-
Need analysis of ERP	-	0.824	-	-
Support infrastructure	-	0.669	-	-
Change management	0.654	-	-	-
Stakeholder involvement	-	-	0.721	-
Physical influences	-	-	-	0.826
Technological influences	-	-	-	-0.679
Cultural influences	-	-	0.776	-
Legal influences	0.875	-	-	-
Organizational influences	0.810	-	-	-
Eigenvalues	2.646	1.942	1.280	1.187

is satisfactory. From factor analysis, it is found that only four components out of the ten items have an eigen value >1. Hence those four components have been taken as the factors that influence the phase of ERP selection. The four factors contribute to >70% of the total variance. The factor loadings of different variables or scale items have been shown in Table 5 along with eigenvalues. The four factors with different loadings finally obtained from the rotated component matrix can be named and interpreted as follows:

Factor 1-Operating environment: This factor comprises of three issues namely, change management, legal influences and organizational influences. All these three issues strengthen the operating environment for selecting suitable ERP solution for the requirements of the organization. The organization should be aware the changes that may take place in the working environment, business activities and processes and accordingly enlighten the employees about such changes and prepare them to be able to welcome and accommodate with those changes and benefit the organization. The organization should motivate and train employees and all end-users of the proposed ERP system. All the queries raised by the employees and end-users should be talked well and appropriate information be shared. At the same time, the organization should follow the standards to orient the business in line with adoption of ERP system.

Factor 2-Need and strategy: This factor is composed of alignment of three issues, namely, alignment of ERP, Need analysis of ERP and support infrastructure. All these issues positively make up the factor. An important characteristic of the ERP selection methodology is its emphasis on the evaluation process as an iterative process of continuous adaptation. The final output for the organization is a choice of ERP system and vendor that is appropriately aligned with clearly defined business and IT strategies and defined and aligned business and IT processes and infrastructure. When the features of the

ERP solution do not correctly fit the business requirements, the organization faces a difficult choice of either changing the business processes to fit the software with minimum customization or to modify the software to fit the processes. ERP selection starts and ends with understanding customer needs. Once the business needs are identified, that process should be followed to identify ERP solutions that meet organization's current and foreseeable future needs. It is to be ensured that as much of existing infrastructure as possible is used and the necessary availability of support staff is in place.

Factor 3-Culture: This factor is comprised of two issues, namely, stakeholder involvement and cultural influences. These two issues strengthen the overall culture of the organization to select the suitable ERP solution. Organizational culture is known to be important in the success of project involving significant organizational change. According to Beretta (2002), the key issues impacting ERP selection and adoption is that they generally suffer from a widespread lack of culture. The ERP system selection has to be a team decision and it is imperative to involve as many end-users and stakeholders as possible either directly or indirectly in understanding the needs and expectations. An ERP affects everyone in the organization and therefore, participation from every stakeholder is a must. Hence it is necessary to involve the stakeholders to build interest and optimism about the new system and invite suggestions from everyone.

Factor 4-Physical and technological influences: This factor comprises of both physical and technological issues and deals with the vendor's ability to support the geographically spread operations and to replace the obsolete existing technology and systems with ERP solution. ERP selection criteria include both physical and technical items. The changes in the physical environment and technology will impact the selection of appropriate ERP solution.

Implementation of ERP solution: The implementation of an ERP system takes a significantly longer time and level of resource than the selection phase. However, the extent of implementation will be profoundly influenced by the level of resource and objectivity within the selection phase.

For the implementation phase of ERP solution, total 11 questions have been supplied to the respondents and their feedback collected. For factor analysis, the sample size is found to be reasonably adequate. Total five factors with different loadings have been finally obtained from the rotated component matrix. Table 6 shows the factor

Table 6: Factor Analysis of Implementation of ERP systems

Scale items	Factor loading				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Change management and training	-	-	-	-	0.88
ERP teamwork and composition	-	-	-	0.960	-
Organization culture	0.658	-	-	-	-
Top management support	0.481	-	-	-	-
Business plan and vision	-	-	0.796	-	-
Business process re-engineering	-0.606	-	-	-	-
Significance of IT skills	-	-	0.799	-	-
ERP education	-	0.877	-	-	-
Human resource planning	0.821	-	-	-	-
Commitment	0.743	-	-	-	-
Infrastructure resources planning	-	-0.565	-	-	-
Eigenvalues	2.756	1.744	1.419	1.209	1.131

loadings of different scale items along with eigenvalues. The five factors can be suitably named and interpreted as follows:

Factor 1-Organizational transition: This factor comprises of four issues, namely, Organization culture, Business Process Re-engineering (BPR), Human resource planning and Commitment. The three issues namely, Organization culture, Human resource planning and Commitment strengthen the factor for implementing the ERP solution but BPR to re-structure and re-organize the business processes to adopt the ERP solution in the organization will become a challenge and this supports the negative loading of BPR issue.

Once the project is implemented, all departments or branches are interconnected and the employees in all the departments need to be consistent in their working. In case an employee fails to enter the movement of goods into the system correctly, it could result in problems for the employees at the next level in the hierarchy and so on. Frequent reengineering of business processes will negatively affect the organizational transition. Hong and Kim (2002) found in their research that ERP implementation success significantly depends on the organizational fit of ERP. Thavapragasam (2003) reports that while implementing ERP systems, in many cases, organizational culture is often overlooked. In-depth study of culture of an organization helps the technical people in its gentle tranformation to accommodate ERP solution.

Factor 2-Knowledge: This factor is composed of alignment of two issues namely, ERP education and Infrastructure resources planning. ERP education enhances this factor but the infrastructure resource planning, if fails, creates lot of gaps in proper understanding and operation of ERP solution. Hence, the

organization should create needful knowledge about the ERP and its infrastructure resources planning. Sometimes, employees expect too many benefits from the new system either because the management has failed to communicate the benefits properly or because they themselves have misunderstood the system. Therefore, after the implementation, if their expectations are not met, they may be dissatisfied.

It is therefore, important for the management to communicate the exact benefits to its employees in the form of educating them. Many analysts report that the most important problem in ERP implementation is the failure of organization to understand what ERP is all about and what exactly is required for implementing the project effectively. ERP education encapsulates not only the navigational path to be followed to access the system to create, view or change documents but also the security issues, integration of activities and users, etc. Since the ERP solution is cross-functional, every user must have a clear knowledge about the sequence of activities, users of those activities and the objective of that business process.

Factor 3-Vision and skills: This factor is comprised of two issues namely, Business plan and vision and Significance of IT skills. These two issues strengthen the overall vision and development skills of ERP solution. Organizations should develop clear vision about the business plan and the skills needed. Many organizations fail to take into account the costs associated with implementing the ERP project as the vendors do not reveal them initially and this results in increased costs for the organization. Analysts say that organizations fail to plan the project implementation details and this leads to confusion and delays in implementation. Hence organization should have vision about the ERP implementation. Further, even if minor problems appear in one are of the ERP system, they affect the operations in other areas of the company.

The time taken for implementing the project may sometimes be too long and organizations may skip some necessary procedures while implementing ERP system. Hence, proper planning and vision are required for implementing the ERP project accurately. According to researchers like Sarkis and Sundarraj (2000) and McAfee (2002), firms recognize that benefits may be gained from the elimination of redundant processes, increased information accuracy and quicker response to customer requirements. Clear vision and skills will effectively maintain all these functions within the organization for successful implementation of ERP solution.

Factor 4-team: This factor is made up by only one issue, namely, ERP teamwork and composition. ERP team strengths depend on how the ERP team is composed and how the team cooperates and collaborates. Hence ERP team which is the integration of people that develop, manage and operate the ERP systems is very important for the successful implementation of ERP solution. Usually, the ERP project team in any organization is made up with not only technically skilled people but also people having good functional knowledge and experience and also the actual users who are supposed to operate the system regularly. Such balanced teams add value to the successful implementation of ERP solution in the organization.

Factor 5-Change management: This factor is also made up by only one issue, namely, Change management and training. When the users of the ERP system are properly motivated and trained about the changes that are going to take place with the implementation of ERP solution, the organizational transition with the help of ERP will take place smoothly and successfully. Organizations need to bring about changes in their long-standing culture before implementing ERP package. Employees need to change their focus from their own jobs to the organization as a whole as their negligence could have an effect on the entire organization. However, this is very difficult to achieve. The other problem that is encountered by most companies is training their employees so as to enable them to work on the new system and this is one challenging task for the organization.

Eventhough the survey has technical perspective, it is evident from the results that organizational culture and change management have been very much contributing to successful selection and implementation of ERP systems. From these results, it can be interpreted that the organizational environment and culture should be so condusive for the technical people that they can be able to take up the challenges and invite changes in technology and its integration.

CONCLUSION

This study focused on two important issues related to management of ERP projects-selection of right ERP solution and its implementation and analyzed the success of ERP systems in those two directions by targeting only the technical people who actually monitor and manage ERP systems. Based on literature support to collect various common critical success factors that influence the success of ERP systems, two separate survey questionnaires have been developed and distributed to project managers and project leaders working in four big software companies to collect their feedback around those common critical success factors that were treated as variables.

About 2 statistical techniques, namely, Graphical analysis and Factor analysis have been used to analyse the data collected from the surveys. Graphical analysis made it easy to see the percentage of respondents assessing the significance level of each influencing issue. The feedback of the technical people on the common critical success factors has been further analyzed by using the factor analysis technique. From factor analysis applied to successful selection of ERP solution, four important factors have been found, Operating environment, Need and Strategy, Culture and Physical and Technological influences. From application of factor analysis to successful implementation of ERP solution, five important factors have been identified, Organizational Transition, (Knowledge, Vision and skills, Team and Change management. All these identified factors mean the ultimate classification of important critical success factors in both selection and implementation phases of ERP projects. In both cases, the issues of organizational culture and change management have been very much highlighted.

LIMITATIONS

The study has several limitations like:

- Geographical limitation, since the survey has been confined to the four big software companies existing in Hyderabad city only
- Respondents limitations because the target audience are ERP technical people and it does not include other functional people like functional managers, financial analysts, etc
- Limitation on statistical techniques as the project work used only two statistical techniques namely graphical analysis and factor analysis
- Sample size limitation because the study could get only 40 reliable responses from the field survey. Future research will focus on enhancing the sample size by surveying different reputed software companies across geographical boundaries both nationally and internationally including different functional people as target audience for appropriate analysis and also applying other relevant analytical techniques in addition to the two reported in this study to identify the influencing factors for both selection and implementation of ERP solution

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