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AN EXPLORATORY STUDY OF ENTERPRISE RESOURCE PLANNING IMPLEMENTATION ISSUES IN MANUFACTURING AND SERVICE INDUSTRIES OF NORTH-KARNATAKA

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ABSTRACT

Globalization has literally transformed the way of carrying out business, industries irrespective of the nature and size are striving hard to sustain and stay ahead in the competition. Prior to globalization 5M's namely machines, materials, manpower, methods and measures constituted as the vital resources of any organization. With the advent of information technology another resource was included along with 5M's which is known as 'information'. Industries should be equipped with all these resources to stay in tune with the global competition and succeed in the same. As a result the industries are adopting different tools to keep abreast with technological advancements; one among them is Enterprise resource planning (ERP). ERP implementation project is much more than any IT project. ERP results in integration and automation of different business processes and provides a common database across the enterprise. It requires business process of an organization to be matched with the ERP package selected. A number of issues need to be focused during and after implementation for the success of the project. The main purpose of this study is to identify the parameters affecting ERP implementation project. An instrument (questionnaire) was developed and sent to manufacturing and service industries of North-Karnataka who have implemented ERP. A total of 232 responses were used for analysis and Exploratory Factor Analysis (EFA) SPSS 16.0 was used for data analysis which identified 7 factors crucial for ERP implementation.

Keywords: Globalization, Information Technology, Enterprise Resource Planning, Business Process, Database, Enterprise.

INTRODUCTION

The evolution of ERP (Enterprise Resource Planning) has its origin back in1960's, where-in inventory management and control was in existence. It mainly focused on the inventory requirements, replenishment techniques, monitoring the items, reporting the inventory status etc. This system merely covered the activities involved in the inventory system with no focus on the other processes of the manufacturing firm. Therefore failed to cover the other functions of the manufacturing organization and the integration was incomplete. From inventory management and control, MRP (Materials Requirement Planning) emerged in mid

1970's which expanded its scope to production management and control. MRP was a perfect answer for ordering of materials for a manufacturing firm. It makes use of Master Production Schedule (MPS), Bill of Materials (BOM) and inventory records and thereby figures out the materials or items to be produced. But MRP was merely a closed loop system, which focused only the activities related assessment of materials. It failed to support other functions such as sales planning, forecasting, capacity planning etc. The improvised version of MRP was MRP-II which helped to overcome the closed looped nature of MRP. It supported the planning of the business functions and resources of the manufacturing firm. MRP-II linked the functions such as sales and operation planning, production planning, master scheduling, materials requirements planning, capacity requirements planning etc. So it covered almost all the processes from production planning, parts purchasing, inventory control, sales and distribution etc.

The final step in the evolution is the emergence of ERP which is similar to MRP-II but broader in scope in the sense that integration is better and tighter with accounting and finance functions. It covers enterprise-wide functions such as marketing, logistics, sales, marketing, purchase, human resources, it even integrates the supply chain partners the customer and the supplier. This integration of supply chain is accomplished in the form of Customer Relationship Management (CRM) and Supplier Relationship Management (SRM) and thereby extends its support across the company's boundaries. As ERP emerged from MRP and MRP-II, therefore it includes all the capabilities of MRP-II. ERP evolved from normal legacy systems and now it has spread its wings to more flexible and reliable technology known as client-server architecture. ERP software systems comes in different modules to support the different functions of an organization such as marketing, finance, human resource, materials management, project management etc.

SIGNIFICANCE OF THE STUDY

The economic reforms that evolved in the globalization phase have paved the way for rapid industrial growth and on the contrary firms worldwide felt the heat of competing on a common platform. Companies in India and worldwide started coming up with different tools and techniques to stay ahead with the competition and emergence of ERP was not an exception. Although ERP tackled many problems prevalent in the organization, there were many issues that came under the way of implementing ERP. This research aids the firms to identify the issues of implementation so that they can be taken care of.

LITERATURE REVIEW

Enterprise resource planning (ERP) systems integrate and streamline the business processes of an organization across departmental and geographical borders, besides having fully integrated databases of business data; they automate and support the business functions with modules for functional areas like finance and materials management (Gulla and Terje, 2002).

An ERP system streamlines business processes by creating an enterprise-wide transaction structure that integrates the key functions of different departments within an integrated information system platform (Liang-chaun Wu et al., 2008). ERP systems specifically address the need for integration of application programs for various business functions or

processes in a manufacturing firm, such as sales, accounting and manufacturing (Wang and Chen, 2006).

An ERP system is an integrated information technology (IT) that uses common databases and consistent cross-functional information flow to allow organizations to integrate information from different departments and locations (Wenn-Hsein Tsai et al., 2012). The direct relation between financial flows and materials flows is at the heart of ERP for manufacturing companies, which directly link inputs and outputs; this often leads to identifying ERP as an extension of MRP II (Manufacturing Resource Planning), for services, materials can often be considered as an indirect cost, and is not linked directly to activities (Valerie and Millet, 2006).

Many enterprises are adopting enterprise resource planning (ERP) systems for improving information flow and order processing efficiency. In the past, ERP was generally adopted by larger enterprises (S.C.L.Koh *et. al.,* 2006). Jau-Rong Chen (2009) from his study derived four distinct stages of ERP implementation, including: linking ERP implementation with organizational development, acquiring resource form related business groups ,aligning ERP implementation with ISO, ICA, and corporate governance and employing IT governance in leveraging ERP value. Over the last two decades, organizations, including small-and-medium size enterprises (SMEs) have moved to implementing some kind of enterprise resource planning (ERP) systems. ERP systems are business software packages that enable organizations to: Integrate their business functions (sales, production, human resources, financial, purchasing, etc.) throughout the enterprise, using integrated application modules based on business processes of best-business practices (Premaratne, 2009).

An enterprise resource planning (ERP) system is an integrated enterprise computing system that lets an enterprise automate the flow of material, information, and financial resources among all functions within the enterprise on a common database, share common data and practices across the enterprise, and produce and access information in a real-time environment (Vathsala and Gunavardana,2010).While ERP had its origins in manufacturing and production planning systems, the scope of ERP offerings expanded in mid-1990 to include other "back-office" functions such as purchase order management, financial management, asset management and human resource management (McAdam and Alan, 2005).

Nowadays, the latest generation of ERP system is more effective in multiple business units including sales and operations, planning, inventory/materials management, manufacturing, purchasing, order processing, accounting and finance, human resource, customer relationship management and more (E.W.T.Ngai *et. al.,* 2008).Globalization has made today's business more challenging with increasing competition, rising customer expectations and expanding markets, this places pressure on companies to reduce cost across supply chain, reduce inventory, improve logistics operations, expand product variety, improve delivery schedules, improve quality and reduce material flow time (Prasanta *et. al.,* 2010).ERP systems are large and complex and often require fundamental changes to the way the organizations perform processes (Mary C Jones *et. al.,* 2006). Customizations might occur as a form of maintenance because those in the consumer organization see it as necessary or desirable due to the nature

of package software industry (Ben Light, 2005). In ERP projects, minimal customization has been associated with successful ERP implementations, whereas in portal projects, process integration by adapting the portal solution to business is far more important (Ulrich Remus, 2007). Stuart Maguire et al., (2010) from their study revealed, that stakeholders involvement at an early stage of development helped in paying dividends and facilitated an effective system development process which in turn, led to a successful implementation. The employees of an organization play a key role in the implementation and utilization of ERP systems, in order for ERP technology to enable a business to run more smoothly, employee patterns must change, which introduces social risk factors (Liang-chaun Wu *et. al.,* 2008). In ERP context, the user's perceived a high quality of ERP system would surely have a positive impact on their attitudes toward system (Adel M. Aladwani, 2001). Hong Seng Woo (2007) identified top management, project team, project management, process change, education and training and communication as critical success factors (CSF's) through his study. The success of integration of ERP is due to consistent and tough support from top management, excellent project planning and team work (Claire and Georges, 2005).

Maditinos *et. al.,* (2011) developed a conceptual framework for their study; it suggests that top management, user support and consultant support are positively related with ERP system effective implementation, through communication effectiveness, conflict resolution and knowledge transfer. Consultants who care for the client and are sufficiently knowledgeable should also be able to communicate more effectively with users, reducing the potential for misunderstanding and increasing user engagement in system implementation (Wang and Chen, 2006). Brent Snider et al., (2010) suggests that implementation should ensure that both technical and business expertise is integrated during software testing. Organization fit to ERP package is proven to be the most important determinant of ERP implementation success, top management support positively affects implementation through improving organizational fit to package keeping eye on effective project management (Kemp and Low, 2008). Among the most important attributes of ERP are its abilities to automate and integrate an organization's processes, share common data and practices across the enterprise and produce and access information in a real time environment (Fiona Fui-Hoon Nah *et. al.,* 2001). The benefits from ERP system, according to user's perceptions focus on three dimensions in the following order: managerial, operational and information technology (IT) infrastructure (Spathis and John, 2005).

ERP systems can reduce production and inventory costs, production demand and forecasting among others, nevertheless the cost involved in such a large scale investment are only justifiable if a good understanding on what to implement, how to implement and all pre-ERP implementation are clear(Maruf Hasan et al., 2011). ERP systems are extensive, integrated software systems supporting the internal operations of an enterprise; they bring about enormous investments in software and in package customization (Claude Doom et al., 2010). ERP implementations have always been extremely complex projects that are very difficult to control, despite abundant body of literature one cannot always guarantee that an implementation will be commissioned on time, on budget and with quality level that was initially envisaged (Oliver Francoise et al., 2009).

PROBLEM STATEMENT

ERP implementation has improved the way of carrying out business. But the firms implementing ERP are facing many issues during the course of implementation, the identification of these issues is crucial for any organization to succeed. This research makes an attempt to identify and highlight the issues of implementation at all three stages pre-implementation, implementation and post-implementation.

OBJECTIVES OF THE RESEARCH

1. To investigate the parameters affecting ERP implementation.

2. To identify the implementation issues in all the three phases of implementation namely pre-implementation phase, implementation phase and post-implementation phase.

3. To combine the identified parameters into groups to evolve meaning dimensions.

RESEARCH METHODOLOGY

The methodology includes literature survey, questionnaire surveys among the firms that have implemented and that are in the process of implementation of ERP. The procedure involved for data collection includes structured interviews, e-mail, telephonic survey, mail and in person. Structured interviews were held with ERP consultants, project team, managers who were actually involved in ERP implementation project. Questionnaires were sent to manufacturing and service firms of North-Karnataka (India) who has implemented ERP and some of ERP consultant firms other than North- Karnataka region were included as they are involved in consulting ERP implementation in and around Karnataka. A total of 232 responses were usable in nature and therefore considered for analysis. Statistical tool factor analysis was used to analyze the data and 7 factors evolved from factor analysis

RESULTS AND DISCUSSION

In order to identify the various parameters that influence ERP implementation, a questionnaire was developed based on the literature survey. The questionnaire was evaluated to improve clarity by rephrasing the items and evaluation was done by the project team who involved in implementation and eminent ERP consultants. The questionnaire consisted of 52 items under 17conceptual dimensions that came under 3 different heads namely critical success factors, critical failure factors and risks involved in ERP. Likert's 5 point scale is used, where strongly agree was labeled 5 and strongly disagree was labeled 1.

Once the instrument was developed, the questionnaires were administered by post, telephonic survey, e-mail and in person by the scholar. The survey covered the organizations in North-Karnataka region; those have implemented ERP, in the process of implementation of ERP. The data collected was analyzed using Statistical software SPSS 16.0.

Table 1 given below depicts the demographic classification of respondents in the survey. A total of 232 responses were taken for analysis, out of which 82 responses were from service sector and 150 responses from manufacturing sector. After the data collection, the next step is to analyze the data. The data collected is analyzed using Statistical software SPSS 16.0. In order to understand attribute level analysis and map the same to ERP implementation issues,

it requires further enquiry into the mutual interrelationship and valid underlying structure among them and this can be done using Factor analysis. Factor analysis is an interdependence technique whose primary purpose is to define the underlying structure among the variables in the analysis, it provides the tools for analyzing the structure of interrelationships (correlations) among a large number of variables by defining sets of variables that are highly interrelated known as factors (Hair *et. al.,* 2010) .

Table 1: The demographic profile of respondents

Characteristics	Frequency	Percentage
Type of firm		
Service	82	35.34
Manufacturing Firms	150	64.66
Number of employees		
Less than 100	122	52.59
Less than 300	57	24.56
500-1000	19	8.19
1000 and above	34	14.66
Experience		
1-10 years	181	78.01
11-20 years	36	15.52
20-30 years	13	5.61
Above 30 years	02	0.86
Qualification		
Ph.D	1	0.43
Post Graduate degree	31	13.36
Bachelor's degree	162	69.83
Diploma	36	15.52
Others	2	0.86

The Kaiser-Meyer-Olkin (KMO) is a measure of sample adequacy and it is an index used to examine the appropriateness of factor analysis. The index ranges from 0 to 1, reaching 1 when each variable is perfectly predicted without error by other variables. The measure can be interpreted with the following guidelines; 0.80 or above, meritorious; 0.70 or above, middling; 0.60 or above, mediocre; 0.50 or above, miserable; below 0.5, not acceptable (Hair et al., 2010). The KMO value for the data was found to be 0.901 as shown in table 2 and considered to be meritorious for applying factor analysis.

The Bartlett's test of Sphericity is a statistical test for measure the presence of correlations among the variables and the significance of 0.05 is acceptable. The significance level was found to be 0.00 for the data under consideration which is less than 0.05. This clearly revealed the presence of correlation between the variables. Therefore the values of KMO as well as the Bartlett's test of Sphericity indicate that the data under consideration for factor analysis has sufficient number of observations and can proceed with factor analysis.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.901
Barlett's Test of approx.Chi square sphericity	4.034E3
Degrees of freedom	595
Significance	0.00

Table 3: Reliability Statistics

Number of variables/items	52
Cronbach's alpha	0.957

Cronbach's alpha (α), the measure of reliability that ranges from 0 to1, with values of 0.6 to 0.7deemed the lower limit of acceptability (Hair et al., 2010). The Cronbach's alpha (α) of the instrument is found to be 0.957 which is higher than 0.6 as shown in table 3. Hence the instrument is found to be reliable. Cronbach's alpha (α) of the 7 factors evolved in factor analysis is given in table 3. In order to determine the construct validity, each factor was subjected to an individual principal components factor analysis to check for unifactoriality. This analysis shows that all seven factors were unifactorial. Variance extracted is also calculated which indicates whether the constructs variance can be explained from chosen indicators. The recommended values are 0.5 i.e. the indicators accounts for more than 50% of the variance. The variance explained is shown in table 5 and indicates that these values satisfy the requirements for all of the constructs.

The Exploratory factor analysis was conducted using principal component analysis as the extraction method and varimax as the rotation method. The Scree test is derived by plotting latent roots against the number of factors in the order of extraction. The point at which the curve first begins to straighten out is considered to indicate the maximum number of factors to extract as shown in fig.1(Hair et al., 2010). So the matrix revealed the presence of 7 factors and these factors in all explains 61.063 % of the total variance as shown in table 4. In contrast in social sciences where the information is not uncommon to consider a solution that accounts for 60% of total variance deemed to be sufficient. Content validity subjectively assesses the correspondence between the individual items and the concept through the ratings by expert judges, pretests with multiple subpopulation or others (Hair *et al.*, 2010).

The content validity of the variables was based on the extensive literature survey and on the opinions of the experts like ERP consultants, project teams and CEO's of the companies who were actually involved in ERP implementation. Therefore it is ascertained that factors evolved had content validity.

Table 4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings					
	Total	% of Variance	Cumulative %		Total	% of Variance	Cumulative %		
1	11.769	33.625	33.625	11.769	33.625	33.625	6.698	19.136	19.136
2	2.601	7.432	41.057	2.601	7.432	41.057	3.066	8.759	27.895
3	1.796	5.132	46.19	1.796	5.132	46.19	2.885	8.242	36.137
4	1.533	4.381	50.57	1.533	4.381	50.57	2.476	7.074	43.211
5	1.364	3.896	54.466	1.364	3.896	54.466	2.454	7.012	50.223
6	1.225	3.499	57.965	1.225	3.499	57.965	2.443	6.979	57.202
7	1.084	3.098	61.063	1.084	3.098	61.063	1.351	3.861	61.063

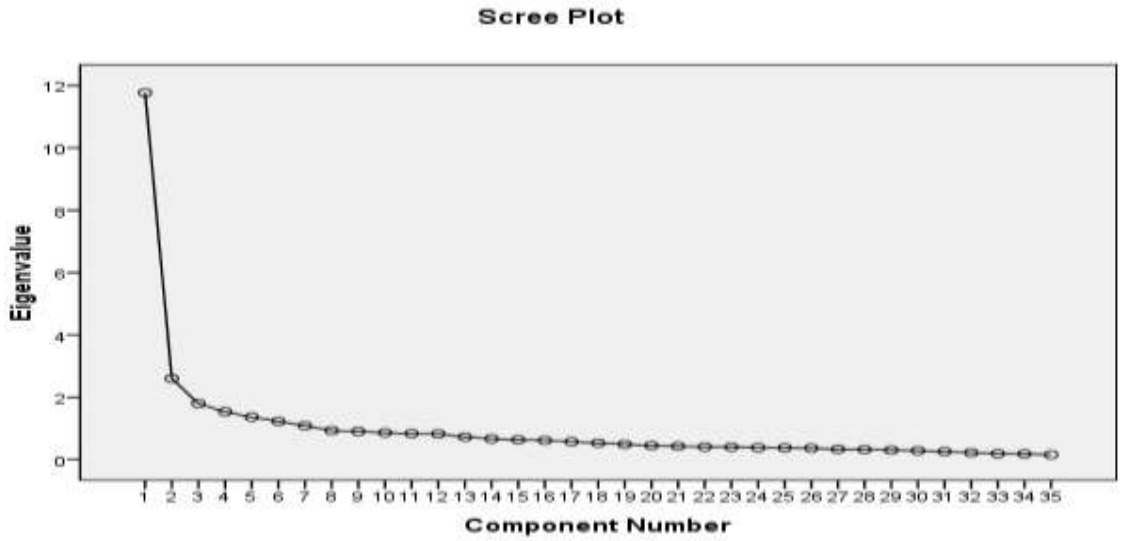

Fig. 1: Scree Plot

Convergent validity assesses the degree to which two measures of the same concept are correlated; high correlations here indicate that the scale is measuring its intended concept (Hair *et al.,* 2010). The size of the factor loading is vital in case of convergent validity and the standardized loading should be 0.5 or higher. The factor loading ranges from 0.536-0.761 which is significant as shown in table 5. Variance extracted is also calculated which indicates whether the constructs variance can be explained from chosen indicators. After arriving at the factor solution, next is assign some meaning to the pattern of factor loadings i.e. labeling the factors. Variables with higher factor loadings are considered more important and thought to have a greater influence on the label selected to represent the factor.

Factor 1: Risk Management

ERP implementation involves many risks such as financial, technical, technological and people risks and the sources of risks include lack of top management support, schedule overrun, employee turnover, inadequate resources, lack of change management etc. The identification, quantification and mitigation of risks are very crucial for hassle free implementation of ERP. The factor encompasses aspects such as investment on ERP package, business process reengineering, cultural changes, budget and schedule, learning abilities of employees, hence named risk management.

Factor 2: Project management

Many ERP projects have failed because of schedule and budget overruns, improper planning and irregular monitoring of project. Project management takes care of all the above mentioned issues; hence project management plays a crucial role in ERP project. Project management takes care of project by monitoring overall progress of the project, by conducting training sessions for all the stakeholders, by conducting evaluation review; mitigate risks by developing contingency plans to take care of the same. The factor encompasses the aspects such as training, periodic monitoring of project, clear scope of implementation, hence named project management.

Factor 3: Pre-implementation planning

For any project to succeed planning becomes very essential, so is the case with ERP project. Prior to implementation some sort of preparation in the form of planning is a must, it is termed as Pre-implementation planning. Pre-implementation planning includes activities such as selection of project team, decision on the time schedule number of modules to be implemented, selection of vendors and consultants. If these aspects of the projects are taken care of, then the project can be carried out with minimum hindrances. The factor encompasses aspects such as planning, project schedule, and requirement definition, hence named Pre-implementation planning.

Factor 4: External support

Other than in-house experts some experts external to the organization, in the form of consultants and vendors are essential to assist the organization in every phase of project. External support signifies the support of consultants and vendors, who play a key role in selection of the appropriate ERP package that suits the organization requirements, training the stakeholders and in customization of the package. The factor encompasses aspects such as consultant and vendor support, competence of vendor and consultant, hence named external support.

Factor 5: Post-implementation support

The activities that take place after ERP implementation is known as post-implementation phase, the support that is provided to the implementing organization during this phase is termed as post-implementation support. The post-implementation support covers the range of activities that include establishment of user-help desk, refresher training, problem resolution mechanism, knowledge transfer from vendors and consultants, evaluation, pinpointing the gaps etc. The factor encompasses aspects such as identification of gaps, refresher training, knowledge transfer, evaluation of project, hence named post-implementation support.

Factor 6: Organization culture

During the course of ERP implementation, it is a usual practice to incorporate changes in the organization with respect to technology, process, and human resource as a whole. So it is an organization wide challenge, so the organization should accept the change and top management should initiate actions to make the things happen in this regard. The organization culture bears influence on the ERP implementation, the culture that is conducive to change yields positive results. The factor encompasses aspects as culture of organization, top management involvement, hence named organization culture.

Factor 7: Assessment of resources and schedule

The resources in the form of infrastructure, software, hardware, human resource are essentials of any project and ERP project is not an exception to it. Schedule plays a key role in the project, as many of ERP projects suffer from schedule overrun. Therefore the allocation of resources and schedule becomes the order of the day and cannot be overlooked. The factor encompasses aspects such as resources, schedule and deadlines, hence named assessment of resources and schedule.

Table 5: Factor loadings, reliability and validity

Factor Name and Variable ID	Standard Loading	AVE	Cronbach α
Risk Management		0.51	0.92
Or-4	0.761		
Ec-2	0.713		
Lcm-2	0.699		
Lcm-1	0.688		
Cm-3	0.681		
Cm-2	0.681		
Or-3	0.665		
Ea-2	0.661		
Bpr-1	0.637		
Ea-1	0.624		
Pmr-1	0.620		
Tms-2	0.582		
Or-1	0.568		
Project Management		0.54	0.72
Te-3	0.675		
Pt-2	0.663		
Cis-1	0.658		
Pt-3	0.579		
Pre-implementation planning		0.59	0.77
Pl-1	0.758		
Lit-1	0.756		
Lit-2	0.630		
Pl-4	0.613		
Cm-4	0.495		
External support		0.76	0.70
Ec-2	0.796		
Ec-1	0.533		
Post-implementation support		0.6	0.78
Po-4	0.646		
Po-2	0.634		
Po-3	0.574		
Po-5	0.536		
Organization culture		0.62	0.70
Cm-4	0.715		
Tms-4	0.628		
Or-5	0.596		
Assessment of resources and schedule		0.74	0.66
Ir-1	0.698		
Pt-1	0.547		

Table 6: Extracted components and their variables

Component Name	Variable ID	Variable
Risk Management	Or-4	Investment on ERP package
	Ec-2	Altering business process.
	Lcm-2	Altering processes and technology
	Lcm-1	Incorporation of changes in different areas
	Cm-3	Business process reengineering (BPR)
	Cm-2	Requirement of cultural change
	Or-3	Employee exposure to IT skills
	Ea-2	Learning abilities of employees
	Bpr-1	Reduction of complexity by BPR adoption
	Ea-1	Positive attitude of employees
	Pmr-1	Budget and schedule overruns
	Tms-2	Top management role
	Or-1	User resistance to change
Project Management	Te-3	Training of stakeholders on new system
	Pt-2	Periodic monitoring of project
	Cis-1	Clear scope of implementation
	Pt-3	Project team training
Pre-implementation planning	Pl-1	Planning on requirements definition, identification of project manager, project planning.
	Lit-1	Over customization, improper project planning, ineffective periodic monitoring.
	Lit-2	Consequences of schedule overruns
	Pl-4	Accurate requirement definition
External support	Cv-2	Competence and experience of vendor and consultant
	Cv-1	Consultant and vendor support
Post-implementation support	Po-4	Identification of gaps
	Po-2	Refresher training during post-implementation phase
	Po-3	Knowledge transfer from vendor and consultant
	Po-5	Appropriate and in time evaluation
Organization culture	Cm-4	Culture of the organization
	Tms-4	Top management participation, co-operation and co- ordination
	Or-5	Consequences of lack of Top management support
Assessment of resources and schedule	Ir-1	Resources as essentials of project
	Pt-1	Assessment of schedule, deadline, budget

CONCLUSION

It is evident from the discussions that ERP is much more than a mere software package. ERP implementation requires organization wide attention and evaluation has to be carried out on level of preparedness of organization before undergoing implementation. An effective project management is essential for successful implementation as it plays a significant role in all phases of implementation i.e. in requirement definition, pre-implementation and post-implementation phases. The parameters that affect ERP implementation are vast and diverse in nature ranging from managerial to technical, human resource, hardware, software, financial etc.

This paper discusses the issues affecting ERP implementation project which includes critical success factors, critical failure factors and risks involved in implementation. Factor analysis resulted in seven factors, these seven factors evolved from factor analysis gives a clear picture of main aspects that should be focused on for successful ERP implementation. This study also assists organizations implementing ERP to focus on the issues discussed and to evaluate their status and to pinpoint gaps if any. The consultants and vendors can focus on these parameters before implementing ERP.

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