Risk and Control in ERP Implementation

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Abstract-This project study firstly examines the current literature concerning to ERP related issues during the development and implementation time and analyze the probable cause of the problem. Then Identify the main risk behind the ERP system failure by using multiple research study and its discussion describes why risk mitigation is important while implementation phase. The aim of this project is to define the new controls and strategies to mitigate the implementation risk and to know what are the best practices are being using during the software development. Some of the main challenges have been find out which incorporated with business process re-engineering, poor management response, the issues of using external consultant and integrating their application specific knowledge. The recommendation will help to frame a risk prevention and mitigation tactics.

Keywords- *Risk, Enterprise Resources Planning, ERP, Control, Types of Risk, Risk Mitigation, BPR*

I. INTRODUCTION

An Enterprise Resource Planning (ERP) system is mostly an integrated software solution that supports the extensive integration of all the information flowing through the different department of a company such as financial, supply chain, human resource and customer support. Prior research has proved that ERP implementation is a very complex and tedious process and its unsuccessful implementation would have major impacts on business performance.

It has been seen that the mismatch between the ERP and organizations requirement can have a direct impact on its adoption and it could be the main reason of its implementation failure [4]. So in order to prevent these failure Consulting firms are using techniques such as providing guidance, training and knowledge creation deeds to direct client to the necessary knowledge required for the successful implementation

II. ERP RISKS

Risk is defined as a likelihood problem or adverse effect that might occur in future which may cause of loss, delay and failure of the system. The word risk is often used in the combined term of probability (likelihood) and consequences. According to the article of *Deborah Hartmann*, only 29% of projects could get finished successfully, 18% of the projects failed without giving any delivery, and the rest 53% of the projects could finished with overtime and over budget. The report says that the causes for failure of the projects related to rapid technology changes and in-flux business requirements.

Table 1
Risk factor determination

MAIN RISK ISSUES	
Risk Group	**Software Risk Issues**
Project Level	1. Excessive, Immature, unrealistic or unsuitable requirements 2. Lack of User Involvement 3. Underestimation of Project Quality
Project Attributes	1. Performance shortfall (includes errors and quality)
	2. Unrealistic cost and schedule
Engineering	1. Ineffective integration, assembly and test, quality and control 2. Specialty engineering or system engineering 3. Unanticipated problems incorporated with the user interface

Management	1. Ineffective management of project (multiple level possible)
Work Environment	1. Immature or untried design, process or technologies selected 2. Inadequate configuration control or work plans 3. Inappropriate methods and tool selection
Other	1. Unanticipated maintenance or support costs 2. Legal or contractual issues like malpractice, litigation etc. 3. Unanticipated problems with subcontracted items

III. NEED OF RISK ASSESSMENT

Boehm suggested four main causes for implementing software risk management [1].

1. To avoid software project disasters, it may have schedules, defect- ridden software, and operational failures plans.
2. It helps in reducing rework which can be created by erroneous, missing and ambiguous requirements of design, which consider almost 40-50% of the total cost of software development.
3. Reducing over cost with detection and prevention methodology in areas of minimum or no risk.

In risk assessment the analyst often attempts to answer the following three questions: What can go wrong? What is the likelihood that it would go wrong? What are the consequences? Answers to these questions help risk analysts identify measure, quantify, and evaluate the consequences and impacts of risks. The remaining risk analysis builds on the risk assessment process by seeking answers to a second set of questions: What can be done? What options are available? What are their associated trades-offs in terms of all costs, benefits, and risks? And what are the impacts of current management decisions on future options? Only when these questions are addressed in the broader context of management can total risk management be realized.

IV. A SURVEY RESEARCH STUDY

The three cases were drawn based on the following criteria: first, the companies had completed the ERP implementation; Second, they encountered failures or problems and the ERP systems could not able to support their business functions after the ERP "go-live"; third, the top management and project team members were willing to share the problems they faced during the ERP implementation and identify what they considered were their critical failure factors in implementation for our research.

Table 2
Time required for implementation of activities

Contents	**Alpha**	**Beta**	**Gama**	**Delta**
Business Profile Speaker	Multi-national Electronic Component Manufacturing company (listed in Fortune 500)	Furniture manufacturing company	Electronic component manufacturing company	Multimedia manufacturing Company
Sales Turnover	Around 400 m$	Around 140m$	Around 10m$	Around 10m$
Budgeted Reserve for ERP Implementation	1. 3m	1m	0. 2m	0. 18m

contd. . .

Planned Implementation Period	6 months	6 months	12 months	4-6 months
Actual Implementation Period	12 months	18 months	18 months	18 months

V. DETERMINATION OF CRITICAL FAILURE FACTORS

Understanding the ERP implementation process and a relative comparison of the most important critical failure factors from the information given by participants evidence and CIO's.

The fourteen critical failure factors were identified as in table 3.

Based on the research study there are four main factors that can be summarized as poor quality of BPR, Poor management effectiveness, ERP system misfit and Poor consultant effectiveness and detailed explanation can be given as:

A. Poor Quality of BPR

Most of the ERP system could not fulfill users or stake holder's requirement due to the wrong identification and analysis of BPR process (i. e. "As is" to "To be" analysis of the business). The project team members said that they had an unclear vision why they are conducting BPR and how they would conduct it for Alpha and Beta category, and their consultants also could not provide any professional assistance for conducting BPR. Project team members found difficulties to join with BPR and the poor quality of BPR led to demand incorrect system Requirements and configuration problems. So business processes could not successfully reengineer to fit with the ERP systems. In fact at

Table 3
Critical Failure Factors

S.N	Critical Failures Factors for ERP	Alpha	Beta	Gama	Delta
	Implementation				
1.	ERP System misfit	✓	✓	✓	✓
2.	High turnover rate of project team members		✓		
3.	Over-reliance on heavy customization			✓	✓
4.	Poor consultant effectiveness	✓	✓	✓	✓
5.	Poor IT infrastructure	✓			
6.	Poor knowledge transfer		✓		✓
7.	Poor project management effectiveness	✓	✓	✓	✓
8.	Poor quality of Business Process Re- engineering (BPR)	✓	✓	✓	✓
9.	Poor quality of Testing	✓		✓	✓
10.	Poor top management Support	✓	✓	✓	
11.	Too tight project schedule	✓	✓		✓
12.	Unclear concept of the nature and use of ERP system from the users' perspective	✓		✓	✓
13.	Unrealistic expectations from top management concerning the ERP System	✓			
14.	User's resistance change		✓	✓	

the time of Reengineering, consultants did not conduct BPR mapping which help in the analysis of software functionalities with business requirements, and this led to a huge mismatch between ERP functionalities and business processes. The situation is changed in Gamma, for Gamma, as their ERP vendor adopted customization techniques and provide a short BPR consulting service and all BPR expertise and implementation process with testing had been not present.

Whereas for Delta section, the project team mentioned that mapping was conducted in a hurry due to scarcity of time. The flow diagram for high level business process was absent and the BPR system which were free from diagrams are not sufficient enough for project team to understand the business process reengineering the business. This creates a problem in understanding the business need and gap analysis and led to project uncertainty and risks of giving desired output.

B. Poor Management Effectiveness

Management commitment and effective evolution plays a very crucial role in the ERP system development and implementation. Due to limited ERP understanding, capability and poor project management, none of the company's project managers could exercise effective project management for its implementation. According to respondents the ERP system was complex, and it is required that the top management should collaborate with the project team members, different departments, users and consultants during implementation process. For Beta, Gamma and Delta, the over-tight project time schedule and insufficient resources demoralized the project team members in coping with the ERP implementation. All important phase's activities could not conducted thoroughly (e. g. testing and system configuration were conducted in a rush). The new system is not user friendly i. e. the system could not be understood by users easily and is a hard task for the new business process within the over-tight program. It is point of notice that a project manager should manage the consultant, for example when conducting BPR and when checking system performance. In fact, in this research, most of the company's project team members were lacked with the ERP experience. So in order to get targeted result first top management and project managers should have sufficient knowledge and understanding about the business and the requirement for ERP systems.

C. ERP System Nonconformist

Because of improper selection & evaluation process, it was hard for ERP software to make suitable matching with the requirement of business. For example, for high volume product master's files, ERP system was found inefficient to managing it and was unable in case of designing materials' complicated bills. The project teams relied on heavy customization to tackle these problems.

D. Poor Consultant Effectiveness

Sometime due to language constraint alpha's Consultants couldn't effectively communicate during the project phase and only suggests overview of the system without applying professional skills to bridge the gap between ERP systems and business requirements. A detailed plan and guidelines were not suggested to the project team. In Beta, the training quality was poor by the consultants (very brief like a pre-sales demonstration), and delivered a poor quality management reports because of insufficient industrial experience. Similarly for Gamma, consultants gave only two days in training and configuring the ERP systems. The project team claimed that the service was dissatisfactory and unprofessional. The consultants were new and inexperienced in ERP consulting for Delta category so they followed their formal implementation methodology during only first two months as they were not satisfied with the consulting fee received for the project irrespective

of the project volume so the BPR was poorly constructed which affected the success.

E. High Turnover Rate of Project Team

Many times some project team members could not afford the work stress and high work load when coping with the implementation which led the project in uncertainty and if it developed then with lack of errors and functionalities and this increase the high turnover rate burden on the project manager.

F. Unrealistic Expectation from Top Management Concerning The ERP System

The top management assumed that the implementation of an ERP system could provide great solutions without knowing the complexity of it, the implementation processes and the associated risks. This misconception led to superficial project planning, unrealistic expectations of the users and an overestimation of budget and resource allocation would always give a failure in ERP implementation.

G. Too Tight Project Schedule

In order to reduce the budget of the ERP system the project managers and top management set too tight project schedule. So all the implementation and development activities like project planning, BPR, training, testing and so on were conducted in a rush to meet the project deadline. The project teams were overloaded with work and thus they might have had higher resistance to change. Some users were absent from training as they were too exhausted. It resulted in poor knowledge transfer.

H. Users Resistance to Change

Due to a limited ERP system knowledge and complex business processes and work overload during the implementation process, users were resistant to change. This contributed to user resistance to participating in BPR, a lack of use of the ERP system, and poor quality of data entered into the system.

I. Poor Quality of Testing

The reason behind poor quality of ERP functioning is insufficient information, over rigid project schedule & execution of ERP system in quickly manner. Project team accepted that the success of ERP testing is an indicator for enlightening the promptness of the ERP system to "go live". They also mentioned that it is not necessary to find out the solution of all problems with the systems goes live, and reason behind this was improper prediction about complicacy of problems. So for correct configuration of ERP system and examining IT infrastructure capacity, people should equip with adequate knowledge and skills, and data of superior quality.

J. Poor Top Management Support

It is the responsibility of the top management to provide sufficient financial and human resource, supports in the areas of committing to the project, and the decision related to political problems if needed. This inadequate financial support contributed to a quick ERP implementation process results overload of work over project team members and thus high staff turnover rate was notice which cause productive knowledge transfer and this factor works as a barrier in the ERP implementation process.

K. Risk Management and Control

Risk management is the methodologies, processes and tools that are used to deal with the identified problems in the software going down through software development life cycle (SDLC) in software development. It is a cyclic process and is defined as the activity that identifies a risk; assesses the risk and defines the policies or strategies to alleviate (mitigate) the risks. Risk management is simply a practice of systematically deciding cost effective approaches for minimizing the outcome of threat realization to the organization.

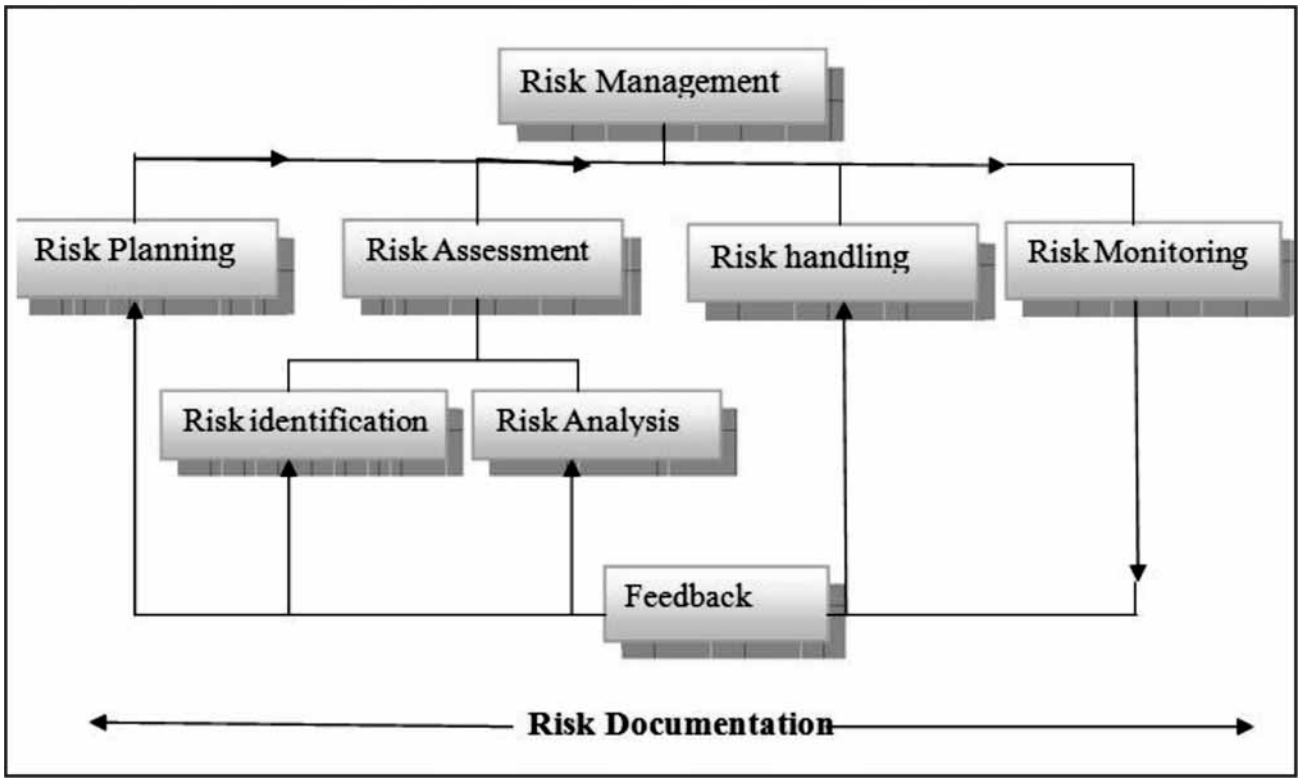

Fig. 1 A Risk management best practice consists of planning, assessment, handling, and monitoring cyclic steps performed iteratively throughout the program's life.

L. Common Defficiencies

Four risk management weaknesses have been observed in the software development program. First, the risk management processes of both the buyer like stakeholder and seller (such as contractor) often are weakly structured or "ad hoc." Second, there are no clearly delineated mechanism in place for managing program risk (such as organizational responsibilities, analysis and product configuration), or if a risk management process exists then it would be on paper only or weakly implemented.

Next, the risk assessment process normally stress the probability associated with a specific event and gives less attention to its consequence. However, the risk is a combination of an event's probability and consequence. Therefore we must analyze and track both factors over time. Fourth, program risk management plans are often prepared on an as-needed basis, with limited tracking against key program milestones.

Several approaches to software risk management have since been proposed and used in the software implementation context. According to [5] two approaches to software project management can be identified, traditional and risk-oriented. The traditional approach is reactive in nature and deals with problems generic to all software projects systemically and project specific problems as they arise. The later approach however is proactive as the name indicates it seeks to identify and manage unique aspects of a specific project before they impact the whole project. A poor risk assessment methodology can introduce many doubt as to the accuracy and value of the results.

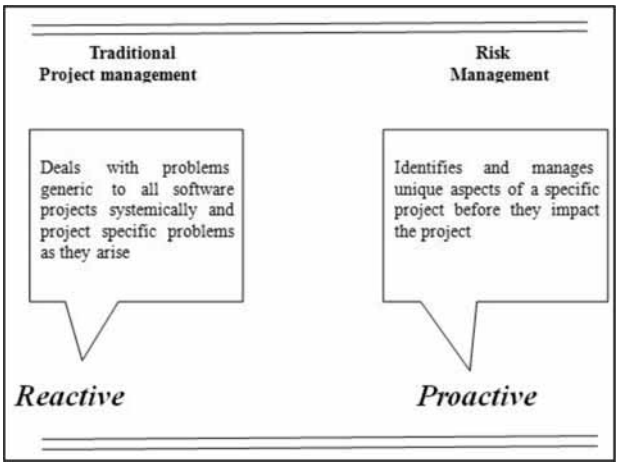

Fig. 2 Approaches to Project management

Risk management focuses to assess the probability of risk occurring, risk event drivers, risk events, the probability of impact and the impact drivers before the risk actually takes place. This is in fact called, proactive risk management.

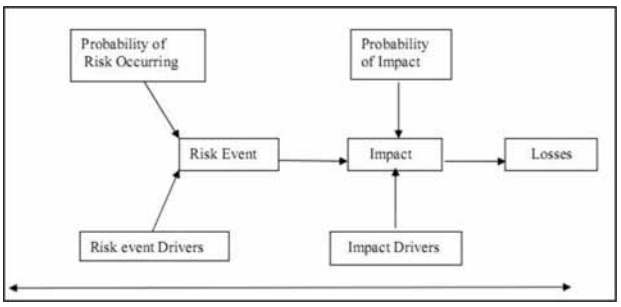

Fig. 3 Proactive risk management

One of the challenges to accurately manage risk analysis is to use automated tools to store, organize and process data into meaningful knowledge Boehm et al (1989). Nowadays, software communities are striving to develop commercial software in order to stay viable. Many software projects when deployed displayed an excessive error and very low reliability. Yet, while software industry is actively using software risk management techniques to improve their risk management practices, only few reports on designing visualization tools are available for managing software risks.

Nowadays some best practices such as PMBOK, CMMI and Risk Guide are used to prevent these above discussed risks in the implementation of an ERP solution. These best practices are incorporated with software development methodologies like agile methodology, Iterative & prototype model approach for high functionalities software and spiral model approach for complex and tedious ERP system. These all method can be used for software development according to complexities, functionalities and Time duration of the software.

While interviewing IBM SAP advisory G. M. we could get to know that one of the leading ERP & SAP vendor IBM are more focused in software quality and continuous testing method for software implementation. We would like to recommend a “funnel or Cone” type approach to resolve the risk issues in which they should first make a blue print of the desired system with all the required functionalities, interfaces and requirements. After analyzing all the risks associated with it at different stages according to their probability of occurrence, ranks and likelihood, they start to develop the software system and at each stage they first make a proper treatment of the associated risks (i. e. first resolve the associated risk problem) and then do a testing after mitigating the risk and then move into the second stage. One important thing is that it is common that many problems with a company’s legacy existing system are more related to inaccurate data than to faulty systems. So in order to prevent these errors they tested it by putting excessive data in the system and after ensuring the desired output they turn to the next level. Here again repeating the same process with the risk respected treatment plan with continue testing. So by the deployment of blue print method they successfully implement the risk free ERP system.

The probability of occurrence (PO), the cost of occurrence (CO), the cost of correcting the damage i. e. the cost of mitigation (CM), the probability the risk continues to occur (PR) and the cost of continued occurrence (CR) are the characteristics of project risks.

Two quantities are used to analyze the risks. Impact (I) of the risk which is the product of the cost (C) and probability (P):

$$I = C \times P$$

With the rankings of above five characteristics, one may calculate for each risk the impact before mitigation (IB) and the impact after mitigation (IA) which is also know as the residual impact.

$$IA = CR \times PR$$
$$IB = CO \times PO$$

Now with these impacts one can calculate the risk reduction leverage (RRL), the second quantity used to analyze the risks. It is used to prioritize the risk elimination actions.

$$RRL = IB – IA/ CM$$

Also this approach helps us to take any number of risks into account and can rank each risk separately and can determine the effect of each risk individually. The cost contingency is determined by adding the impacts of all risks above a certain RRL.

VI. COCOMO II

COCOMO II takes project risks into account by defining a risk factor characterizing each module to be developed *Boehm et al[1]).* The total risk (TR) of each module is the sum of the risk levels (RL) of six types of risk (see table: Project Risk)

$$TR = \sum (RLn)$$
$$n=1. . . 6$$

Project Risk
• Schedule Risk
• Personnel Risk
• Platform Risk
• Product Risk
• Process Risk Reuse Risk

The risk factor (R) of each module is determined by:

$$R = (TR / 373)*100$$

This approach allows us to consider types of project risks at a module level. A risk like “Change of technology”, however, would have to be allocated to more than one of these risk types, which would make it difficult to adjust its threat. Probabilities are not taken into account.

“Expert COCOMO”, an extension to COCOMO II, “helps in project planning by prioritizing, identifying, quantifying and categorizing project risks”. It is a heuristic method that asks to analyze risks on the basis of cost factor information. This makes it even clearer to identify the influence of a specific project risk and its probability of happenings because we need a relationship between the project risk and its effect on the cost of a module.

VII. RISK RADAR ENTERPRISE

Risk Radar Enterprises (RRE) is an American commercial web-based application for enterprise-wise project risk management using MS Access database. It is used to manage project costs, technical, schedule and performance risk within a common enterprise framework. RRE gives the visibility to proactively identify, analyze, track, control, mitigate, and report risks. It has a supportive guidance from the PMI PMBOK and SEI CMMI.

VIII. RECOMMENDATIONS

Some of the unique challenges in managing ERP projects which are highlighted through the above findings talks about the investment in recruiting and retaining ERP system developers, business analysts who combine technology and business skills, redesigning of business process including the challenges of using external consultants plus integrating their application-specific knowledge and technical expertise.

One of the best hedges against the risk is the use of proven methodologies. Going into the battle without a strong plan of attack will invite more

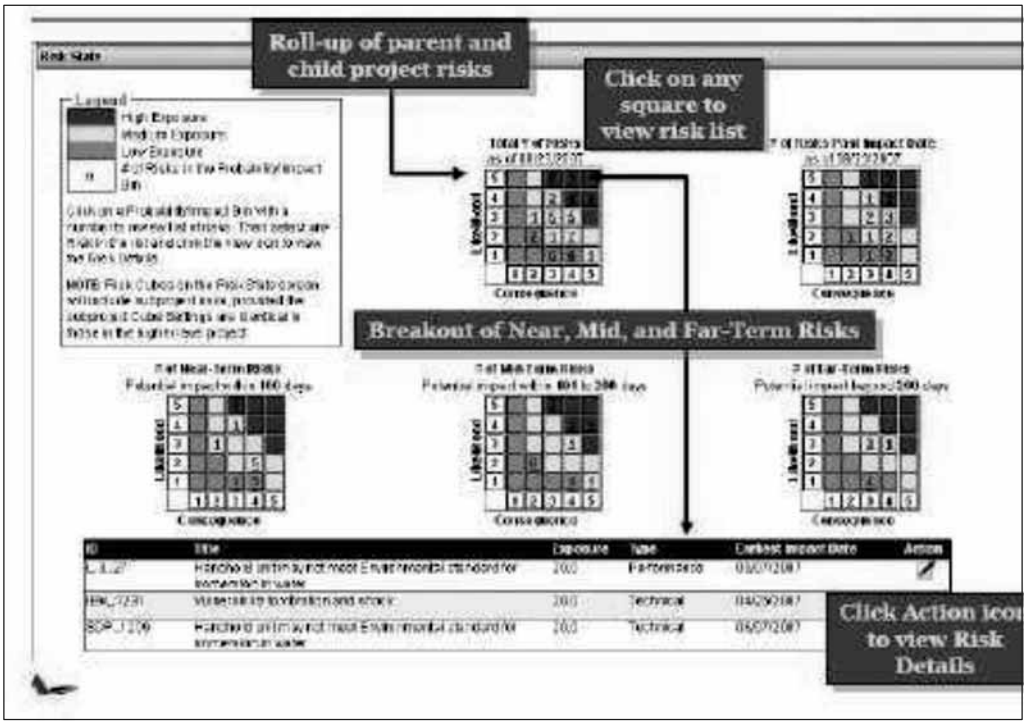

Fig. 4 Example of RRE Risk State Screen

trouble only from your side. Therefore this one may be a better option.

Below mentioned strategies can be used to minimize these risk factors

Table 4

Risk and strategies for minimizing risk

Types of Risk	Strategies for minimizing risk
Organizational fit	• Commitment to Redesigning business processes • Top management Commitment to restructuring and following an enterprise wide design which support data integration
Skill mix	• Effective use of strategies for recruiting and retaining specialized technical personnel • Effective re skilling of the existing workforce • Obtaining business analyst with knowledge of application specific module • Effective use of external consultant on project teams
Management Structure & strategy	• Obtaining top management support • Established a centralized project management structure
Software System Design	• Commitment to using project management methodologies • Best practices specified by vendor • Compliance with software Specification • Full time commitment of users
User involvement and training	• Effective user training and Communication • Analyzing the users valid functionality need in the software
Technology planning and integration	• Acquiring vendor support for capacity planning and upgrading • Planning for client–server implementation including client Workstations • Acquiring technical expertise

IX. DISCUSSION

This research paper which is mainly concerns with ERP performance and tryout the main factors which cause failure and also involves in disclosing the solution of failure causing factors in ERP implementation.

ERP consultation is considered as third parties who are play role of gap filling agent between capability and transfer information. They always involve in providing expertise which are concern with project planning, ERP systems & BPR while ERP are implemented [6]. From above discussion, it was found that consultants are not much effective as gap filling agent (such as interacting with members of project team and acquisition of users for business necessities & training so that professional can deliver). And because of these factors members of project team are unable to learn sufficient knowledge which is required for use & implementation of ERP system. Apart from knowledge of systems, the consultants should be expert in knowledge of industries, should be able to demonstrate professional communication skills, and also in analytical skills related to business. Therefore, before ERP implementation a project manager should always evaluate the capabilities of consultant.

As per above points, a project managers should always make it clear that management of ERP project is effective for making knowledge transfer most effective.

In addition, prior to selecting the process of ERP system, there should be an inclusive evaluation of capabilities of candidates of ERP systems and consulting firms. Before selecting an ERP System process, all the necessities related to various departments such as accounting, sales, purchasing & production departments should be clarified and properly recorded.

All of the above discussed points may helps in minimizing the chances of errors in ERP system. Top management, the project team, and users should receive effective education/training concerning "what" ERP is and "how" to implement ERP systems, the processes involved in conducting BPR, explaining the potential which is associated with risks and its importance on collaboration with the external consultants.

In order to minimize user's resistance to change, effective change management must be introduced during the ERP life cycle. During the chartering phase of ERP implementation, a project manager should always formulate a complete and possible project plan which consists of complete tasks which will be performed by the consultants and set objectives which will be achieved in the guidance of consultants. The project schedule should be feasible and workload should be low. IT infrastructure should be designed as such that it can meet business capacity needs and prior to the "go-live" date, a complete testing should be organized for ensuring that organization is ready prior to the "go-live" date. At the end, it should be notice that a mindset of customization should not be adopted by top management and also should not over rely on it for solving problem related to ERP misfit. It might be possible that ERP systems consist best practices and is a complete package system, still for mapping the business requirement with ERP system an assured degree of BPR might be required [8].

X. CONCLUSION

These types of implementation projects require companies to keep a balance between the desires to satisfy everyone's functionality needs and the need to keep things simple enough to ensure success that's why implementation phase of any system plays a crucial role in the success of any achievements whether it's a complex system consisting many functionalities or a sophisticated customized system for specific functionalities with 100% accuracy. Thus, there is a requirement for risk management tools in a software project since the complexity of risks increases with the complexity of the developed system. Therefore

it can not be denied that an ERP system cannot be developed and implemented in a totally risk free environment. The only thing that differentiates successful and unsuccessful implementations is the way in which the risk were handled, anticipated and mitigated with the utmost support of the top management.

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