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# Impact of Resources in Enterprise Resource Planning (ERP) Implementation Process on Users' Performance

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## Abstract

ERP is latest software meant for improving the business on the whole and its implementation methodologies are in the developing stage. ERP implementation involves amendments in business process and software configuration for better compatibility. Besides, ERP systems is not as much a technological exercise as it is an organizational revolution since it interacts with actors (users) of the organization. Hence, this study was undertaken that focuses on understanding the effect of different resources during ERP implementation on user performance. Data was collected from 67 manufacturing organizations that fulfilled the above criteria's and the sample of the study constituted of 750 individuals working in these manufacturing companies. Structural Equation Modeling through PLS software was used for the analysis. The study found that project management and hardware resources used during ERP implementation affect the employee performance of an organization.

**Keywords:** ERP Implementation, Hardware, Performance, Project Management

## 1. Introduction

ERP is latest software for companies and methods of implementation are still in the developing stage. ERP systems are required by an enterprise in order to function properly as an integrated coordinated business unit. Boudreau[11], Ragowsky and Gefen[69] and Yeh[89] define ERP system as, "A single integrated and packaged business information system. The aim of an ERP system is to seamlessly integrate and manage the different business processes and information flows within an enterprise". Yen et al.[90] described ERP as a software that is used to integrate information across all departments of an organization for automating corporate business processes. The main feature of ERP software is the integration between modules, data storing/retrieving processes, and management and analysis functionalities[41,59].

ERP has become a need of the hour for all manufacturing companies. According to Akkermans et al.[2], Klaus et al.[52] and Caruso[16] also, currently, a popular approach of the adoption of ERP, is becoming a dominant enterprise system and is all-encompassing across industry. Looking to the technical scenario of business environment and to remain competitive, companies were forced to be up-to-date with the new technology[3,67,78]. Also, the main characteristic of ERP applications which is to solve the software requirements of a specific industry has also motivated companies to purchase ERP system. Oliver and Romm[66] emphasized the improvement in image as a factor in ERP adoption. In particular, manufacturing companies used ERP due to three major reasons:

### 1.1 To Integrate Financial Data

Functional modules in business have their own modules for showing their involvement to revenues. Since ERP uses one single database, it can easily show the company's overall performance.

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### 1.2 To Standardize Manufacturing Processes

Functional modules across the manufacturing company manufacture the same product using different methods. Standardizing those processes, using single software will increase organizational performance and productivity.

### 1.3 To Standardize and Integrate Information

In manufacturing companies with multiple functional modules, information is not a unified, simple method for tracking records, which ERP does due to its integration abilities.

## 2. Rationale

Though ERP software is becoming a necessity in manufacturing companies, but its implementation requires major changes in business process and software configuration for effective execution[23,37,42] and if it is not implemented properly, it will lead to the user dissatisfaction. Also, performance appraisal is an initial and critical part of management[26], as it can clearly describe the past and current situations, and function as the reference for future management[82]. Therefore, in order to manage the system well, the enterprise must initially have a proper performance appraisal model to assess its system. According to Uwizeyemungu and Raymond[86] also, the ex-post evaluation of ERP systems is necessary to justify the expenses involved in installation of ERP systems and to better manage the benefits sought by organizations from these systems. Besides, an extensive study of research done with respect to ERP, points at the scarcity of studies on ERP and its effect on organizational performance in the post-implementation stage. Also, the empirical studies on the ERP are almost negligible and very few have focused mainly on pre-implementation. To fill this void, the present study is undertaken.

## 3. Research Objective

To determine the impact of resources in Enterprise Resource Planning (ERP) implementation process on users performance.

## 4. Literature Review

Karimi et al.[49] has the opinion that ERP implementation remains however one of the most significant challenges for IS practitioners in the past decade. Implementation related publications account for about one third of the articles reviewed and is the more developed research as far as the researchers related to ERP are concerned. Longinidis and Gotzamani[57] have recognized three major research areas with respect to ERP systems: examination of Critical Success Factors (CSF) for implementation, study of evaluating ERP systems and inspection of the obstacles and the sources of failure in ERP implementation. Tsai et al.[84] and Lui and Chan[58] also expressed that though ERP system are used around the world since many years, still there are many recent reports saying about the complexity and the difficulties in ERP implementation. Grabski et al.[38] developed taxonomy for ERP after an extensive review and suggested that critical success factors and their impact on organization as important ERP research area.

## 5. Resources in ERP Implementation

Rockart[71] defined Critical Success Factors (CSF) as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization". In the ERP context, Holland and Light[37] define them as the factors that are needed to make sure an ERP project is successful. Saini et al.[72] developed a conceptual model based on three factors namely people, organizational and technological for evaluation of critical success factors. Some of the factors related to ERP system which affect the temporary deterioration in firm performance and productivity are improper planning[12], a lack of understanding of the system by users, inadequate training and support for end-users to help them understand the newly adopted business processes and workflows, inadequate system testing and inadequate communication of system objectives[64]. Ineffective change management[60] and the severity of the implementation mode[60,65]. Various Critical Success Factors related to ERP has been analyzed by other scholars as given in the following table:

## 6. Measurement of User Performance

According to Amoako-Gyampah and Salam[6] and Ifinedo[44], management and users of ERP are two different groups. User satisfaction is regarded as the best surrogate measure

**Table 1.** Impact of Resources in Enterprise Resource Planning (ERP) Implementation Process on Users Performance

| | |
|---|---|
| Project champion | Saini et al.[72]; Somers and Nelson[79]; Akkermans and Helden[1]; Nah et al.[63] |
| Project team competence | Somers and Nelson[79]; Ewusi[27]; Akkermans and Helden1; Saini et al.[72] |
| Lack of application knowledge | Barki et al.[7]; Ewusi[27] |
| Project management resources and control | Ewusi[27]; Dewar and Dutton[24]; Scott and Vessey[74]; Somers et al.[80]; Peak[68]; Ehie and Madsen[25]; Kamhawi[48]; Muscatello and Chen[61]; Al-Mudimigh et al.[5] |
| Lack of effective project management methodology | Ewusi[27]; Keil and Montealegre[50]; Al-Mashari et al.[4]; Rainer et al.[70] |
| Capability of enterprise technical infrastructure | Ewusi[27] |
| Technology newness | Rainer et al.[70]; Boehm[10]; Barki et al.[7] |
| Technology complexity | Barki et al.[7] |
| Technology planning | Ewusi[27]; Keil and Montealegre[50] |
| Unable to comply with the standard which ERP software supports | Wright and Wright[87]; Sumner[81] |
| Technical factors | Scott and Kaindl, 2000; Siriginidi[78]; Lang et al.[55]; Light et al.[56]; Themistocleous et al.[83]; Saini et al.[72] |
| ERP software package selection | Somers and Nelson[79]; Akkermans et al.[1]; Al-Mudimigh et al.[47] |
| IT infrastructure | Jarrar et al.[47] |
| Data analysis and conversion accuracy | Somers and Nelson[79]; Zhang et al.[93] |
| Suitability of S/W and H/W | Zhang et al.[93] |
| Dedicated resources | Somers and Nelson[79]; Al-Mudimigh et al.[47]; Bingi et al.[9] |

of information system success[75]. In ERP context, Zviran et al.[95] examined the relations between user satisfaction and perceived usefulness. Calisir and Calisir[15] constructed an instrument that consisted of 28 items measuring six interface usability characteristics, namely system capability, compatibility, flexibility, user guidance; learn ability, minimal memory load for determining perceived usefulness and ease of use. Usability problems can hamper the extent to which a system can be used by its users to achieve a set of goals within a specified context of use[46,77]. Kositanurit et al.[53] acknowledged six factors which have an impact on user performance namely system quality, documentation, ease of use, reliability, authorization and utilization. Sedera et al.[76] measured the individual impact of ERP system implementation with four items namely learning, awareness/recall, decision-making effectiveness and individual productivity.

ERP system brings numerous benefits to users in the organizations by integrating information about their entire enterprises seamlessly, including customer orders, production, purchasing, inventory, distribution, human resources, and receipt of payments[21,30,51,54,62,95]. Zhang et al.[93] also stated different benefits of ERP which include improvement of customer service, better way for production scheduling and manufacturing cost reduction. ERP systems are multi-module application software that helps enterprises manage their important processes, including production planning, purchasing, inventory management, suppliers' management, etc. ERP systems facilitate the exchange of data among divisions. Consequently, ERP systems can reduce production and inventory costs, production demand and forecasting[39].

## 7. Research Methodology

The study is directed to companies that had already implemented an ERP system. Specifically, the survey was administered to employee of the manufacturing companies who were involved in implementation process and are now the end-users. Three criteria guided the selection of the cases: 1. The firm should be in manufacturing, 2. It must have been using an ERP system for at least 1 year, and 3. It must have been using the system in at least two core business processes.

Data was collected from 67 manufacturing organizations that fulfilled the above criteria's and the sample of the study constituted of 750 individuals working in these manufacturing companies. Using non-probabilistic judgmental sampling, a total of 900 surveys were collected, after several follow-up e-mails and phone calls. The reliability control has shown that 16.7 percent of respondents were unreliable, as some questions were left unattended. Moreover, in some cases, the observed responses were artificially inflated as a result of respondents' tendencies to respond in a consistent manner. The sample of 750

**Table 2.** Classification of Respondents Demographics Profile

| | | |
|---|---|---|
| Gender | Male | 547 |
| | Female | 203 |
| Age | 20-35 | 198 |
| | 36-50 | 422 |
| | 51-65 | 130 |
| Educational Qualification | Graduate | 221 |
| | Post Graduate | 467 |
| | Diploma | 62 |
| Position in company | Junior level | 160 |
| | Middle level | 485 |
| | Senior level | 105 |

respondents was finalized with respect to the following classifications:

Also, given that the phenomenon under study, effects of ERP, is complex and that one requires a deeper understanding of it in its actual context, a qualitative methodology is more appropriate (Bourlakis and Bourlakis, 2006). Hence, the focus of this paper will be on the operational and intangible gains resulting from ERP implementation (which will be operationalised by many variables tested in this study). The performance indicators chosen were actually taken by the managers and ERP vendors through the interviews, together with the literature review.

For measuring the effect of resources during ERP implementation on user performance, initially 12 items were formed. Because, the study incorporated tools that were new to IS research, further retesting of these tools was deemed necessary to assess their robustness to a different population of firms, and to derive confidence in subsequent analysis, a pilot survey was executed before conducting the main survey. The purpose of the pilot survey was to examine whether or not the proposed model was well developed and suitable to analyze user performance. The conceptual model and contents of the main survey were modified based on the results of the pilot survey and it provided 10 items that were selected for the submission to the panel of judges for assessing content and construct validities. The final list on the basis of the frequency of choices of the judges comprised of 9 items.

Subsequently, these 9 items of user performance were allocated into the three facets namely Employee's Job Performance (3), Employee's Job Satisfaction (2) and Adaptability and Growth (4). These indicators in the tool were employed on 7 point Semantic Differential scale ranging from very less to very high for both before ERP implementation and after ERP implementation.

For measuring the impact of resources used during ERP implementation, questions were developed after the extensive literature review of the critical factors. For measuring the success of ERP in implementation phase, the list of 25 items was formed. Screening by removing the irrelevant items and decision of the panel of judges comprised of 19 items. These items in the tool were employed on 5-point Likert scales ranging from strongly disagree to strongly agree. The 19 items were allocated into the four facets namely project management (11), hardware and networking (3), software (2) and database resources (3).

After ensuring the construct validities of the items selected, the reliability of the tool was determined by Cronbach's alpha method. Reliability coefficient alpha (α) was found to be 0.95 for critical factors and 0.94 for user performance indicators, showing excellent reliability of the tool. Hinton et al.[40] have suggested four cut-off points for reliability, which includes excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70) and low reliability (05.0 and below). The closer the alpha is to 1.00, the greater the internal consistency of items in the instrument being assessed[35]. When a tool is developed for a particular situation and no other standardized instrument is available, the reliability index based on reliability coefficient can be taken as equivalent to validity of the tool[33]. Since, the tool developed for the present study was unique in nature; the validity was taken to be reliability index.

PLS-Graph was used to test the hypothesized relationships among the study variables. The choice was motivated by several considerations. PLS is a non-parametric estimation procedure[88]. Its conceptual core is an iterative combination of principal components analysis relating measures to constructs, and path analysis capturing the structural model of constructs. The structural model represents the direct and indirect causal relationships among constructs. It can be used to estimate models that use both reflective and formative indicators, is more appropriate for analyzing moderating effects because traditional techniques cannot account for measurement error in exogenous constructs[31] allows for modeling latent constructs under conditions of non-normality, and is appropriate for small to medium sample sizes[17–19].

## 8. Results

The model was designed to study the effect of different components of ERP during implementation phase on the changes caused by ERP on user performance. To assess the psychometric properties of measurement model, individual item loadings, internal consistency, convergent validity, and discriminant validity were examined of the reflective first-order factors (database, project management, software and hardware resources).

The loadings of the measurement items on their respective factors were examined. Finally, the model included the items whose loading were above the threshold value of 0.70 on their respective factor and were statistically significant at the 0.001 level, which provides support for convergent validity (Figure 1). 4 items were deleted from project management resource which included Enough efforts for the estimation of project's scope and size were done, Proper employment of project management tools and techniques was done. Suitable Business Process Reengineering (BPR) was done before ERP implementation. During the ERP implementation, milestones were set with measurable results.

The study assessed convergent validity by examining composite reliability and average variance extracted from the measures. Although many studies have used 0.5 as the threshold reliability of the measures, 0.7 is a recommended value for a reliable construct[17,18]. For the reflective measures, rather than using Cronbach's alpha, which represents a lower bound estimate of internal consistency due to its assumption of equal weightings of items, a better estimate can be gained by using the composite reliability measure[20]. As shown in Table 3, the internal consistency of all reflective constructs clearly exceeded 0.70, suggesting strong reliability. For the average variance extracted by a measure, a score of 0.4 indicates acceptability[32]. From the table it is clear that AVE by all reflective measures (except User Performance) is higher than 0.4, which is above the acceptability value.

Finally, the study verified the discriminant validity of the instrument by comparing the Average Variance Extracted (AVE)[32]. It is clear from the Table 4 that the square root of the average variance extracted for each construct is greater than the levels of correlations with other constructs. The results of the inter-construct correlations also show that each construct shares larger variance with its own measures than with other measures.

**Table 3.** Verification of Convergent Validity.

| | AVE | Composite Reliability | Cronbachs Alpha |
|---|---|---|---|
| **Database** | 0.37694 | 0.642758 | 0.165475 |
| **Employee** | 0.463262 | 0.88357 | 0.849627 |
| **Hardware** | 0.683387 | 0.811901 | 0.536898 |
| **Project mgmt** | 0.450068 | 0.848922 | 0.791758 |
| **Software** | 0.454961 | 0.714344 | 0.402665 |

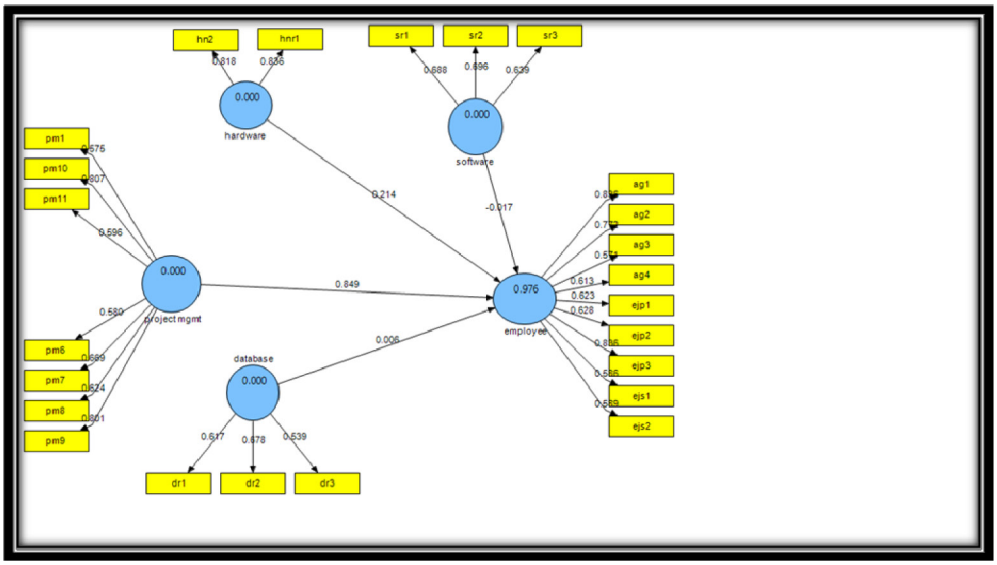


**Figure 1.** Model displaying relationship between components of implementation phase and change caused by ERP on user performance after removal of some items.

**Table 4.** Verification of Discriminant Validity.

| | Database | Hardware | Project mgmt | Software |
|---|---|---|---|---|
| **Database** | **0.6855655** | | | |
| **Hardware** | 0.351965 | **0.8246211** | | |
| **Project mgmt** | 0.648683 | 0.606737 | **0.6708204** | |
| **Software** | 0.434863 | 0.3278 | 0.54547 | **0.67082** |

Discriminant validity is also confirmed, when items related to a particular factor have the highest load on that factor and is higher than a difference of 0.2 on the other factor in the cross loadings table. When we look at the cross loadings table (Table 5.), we find that these conditions holds good (some cases difference is nearly equal to 0.2, which is acceptable).

The PLS modeling approach involved two steps - validating the measurement model and then fitting the structural model. The former is accomplished primarily by reliability and validity tests of the measurement model, followed by a test of the explanatory power of the overall model by assessing its explained variance, and the testing of the individual hypotheses (structural model). The model shows that the explanatory power for user performance is 97.6 %, which is considered excellent for the studies of this nature. Ifinedo and Nahar[45] also used SEM techniques and assessed the structural model and found that $R^2$ is 0.18, which suggests that the exogenous factors explained 18 percent of the variance in the ERP success construct.

**Table 5.** Cross Loadings Table.

| | Database | Hardware | Project mgmt | Software |
|---|---|---|---|---|
| **dr1** | 0.616906 | 0.114613 | 0.385072 | 0.346765 |
| **dr2** | 0.678297 | 0.248126 | 0.42622 | 0.40627 |
| **dr3** | 0.538665 | 0.282382 | 0.380267 | 0.028989 |
| **hn2** | 0.351648 | 0.81772 | 0.481547 | 0.269671 |
| **hnr1** | 0.23314 | 0.835529 | 0.520876 | 0.272337 |
| **pm1** | 0.445159 | 0.39407 | 0.574528 | 0.358609 |
| **pm10** | 0.421717 | 0.392359 | 0.806714 | 0.387201 |
| **pm11** | 0.448829 | 0.342991 | 0.595855 | 0.231883 |
| **pm6** | 0.342841 | 0.478415 | 0.580415 | 0.373188 |
| **pm7** | 0.404684 | 0.341744 | 0.668823 | 0.340753 |
| **pm8** | 0.386758 | 0.538878 | 0.623774 | 0.479591 |
| **pm9** | 0.589036 | 0.401069 | 0.80079 | 0.397329 |
| **sr1** | 0.272431 | 0.328523 | 0.383883 | 0.687504 |
| **sr2** | 0.267565 | 0.195741 | 0.368712 | 0.695764 |
| **sr3** | 0.348257 | 0.123507 | 0.350047 | 0.638852 |

For testing the individual hypotheses, a bootstrap re-sampling procedure was conducted and coefficients were estimated.

**$H_{01}$:** Project Management Resources during implementation phase of ERP system does not have an association with change caused by ERP system on user performance.
**$H_{02}$:** Hardware and Networking Resources during implementation phase of ERP system does not have an association with change caused by ERP system on user performance.
**$H_{03}$:** Software Resources during implementation phase of ERP system does not have an association with change caused by ERP system on user performance.
**$H_{04}$:** Database Resources during implementation phase of ERP system does not have an association with change caused by ERP system in post implementation phase on user performance.
**$H_{01}$ Stands Rejected:** The null hypothesis stands rejected at 5% level of significance because the calculated value of t is more than tabulated value (1.645). Thus, Project Management Resources are associated with changes caused by ERP on the user performance of an organization.
**$H_{02}$ Stands Rejected:** The null hypothesis stands rejected at 5% level of significance because the calculated value of t is more than tabulated value (1.645). Thus, Hardware and Networking Resources are associated with changes caused by ERP on the user performance of an organization.
**$H_{03}$ Stands Accepted:** We failed to reject the null hypothesis at 5% level of significance because the calculated value of t is less than tabulated value (1.645). Thus, Software Resources are not associated with changes caused by ERP on the user performance of an organization.
**$H_{04}$ Stands Accepted:** We failed to reject the null hypothesis at 5% level of significance because the calculated value of t is less than tabulated value (1.645). Thus, Database Resources are not associated with changes caused by ERP on the user performance of an organization.

## 9. Discussion

The result of the study showed that project management and hardware and networking resources are associated with changes caused by ERP on the user performance of an organization. In accordance with our study Fichman[29]

**Table 6.** Correlation between Different Components of ERP in Implementation Phase and User Performance of an Organization.

| | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | Standard Error (STERR) | T Statistics (\|O/STERR\|) |
|---|---|---|---|---|---|
| **Database -> employee** | 0.006192 | 0.006652 | 0.031557 | 0.031557 | 0.196215 |
| **Hardware -> employee** | 0.214035 | 0.208355 | 0.032551 | 0.032551 | 6.575355 |
| **Project mgmt -> employee** | 0.848701 | 0.850212 | 0.03429 | 0.03429 | 24.75091 |
| **Software -> employee** | -0.01746 | -0.01476 | 0.019302 | 0.019302 | 0.904698 |

assumed that innovations are beneficial, and the organizations that have a greater quantity of management support, knowledge, and resources are expected to exhibit greater efficiency, productivity improvement, or usage.

In accordance to our study, Brynjolfsson and Hitt[13] found that firms that invested more heavily in business process redesign and devoted more of their IT resources to increasing customer value (e.g. quality, timeliness, convenience) had greater productivity and business performance. All of this research suggests that there can be positive benefits from the automation, process redesign activities and increased timeliness or output quality associated with successful ERP system deployment, although these effects in the specific context of ERP have not been previously studied statistically. Managers have reported that one of the problems associated with implementing packaged software is the incompatibility of features with the organization's information needs and business processes. To achieve the greatest benefits provided by an ERP system, it is imperative that the business processes are aligned with the ERP system. For mid-sized organizations, the risks associated with implementing ERP may be greater than those for larger enterprises, not only because they lack the critical human and technical capabilities of larger organizations, but also because they have fewer resources to rely on in case of disaster. However, Sammon and Adam[73] noted that high rates of failure also exist in ERP project implementation due to combined effect of inadequate organizational analysis at the beginning of the project, the complexities of ERP market and complex implementation. Ferratt et al.[28] investigated more than 70 Enterprise-Resource-Planning (ERP) projects and found that greater success in implementation is related to greater adoption of the best practices. Bergstrorm and Stehn[8] survey indicates that ERP is not yet regarded as a way of supporting and improving core business strategies and it is the change processes aiming for organisation-wide improvements and the ERP approach adoption that will contribute.

The study indicated no association between database resources and effect of ERP on user's performance. However, in this context, it has often been argued that the quality of data/information is a major determinant of ERP success[34,43,91,92].

The study indicated that Software Resources did not contribute to ERP system success related to user performance. However, Umble and Umble[85] advocated the importance of software capabilities. They found that if the software capabilities and needs are mismatched with a company's business processes, this can lead the ERP implementation to failure. In contradiction to our study, Ziad et al.[94] study shows that there is a positive relationship between ERPs implementation success and employee satisfaction, also there is a statistical relationship between enhancement and ERPs success, weak relationship between ERPs success and ease of use and training factors as well as most of these companies depended on the internet. Daoud and Triki[22] results showed there was a significance impact from the user's satisfaction and enhancement factor on ERPs implementation success, while there was no significance impact from the ease of use and training on ERPs implementation success.

## 10. Conclusions

Our study provided managers, a clear view of the relative performance of the various parts of the enterprise,

which can be used to identify needed improvements and take advantage accordingly. Managers could periodically evaluate the performance indicators in the study, benchmark the results with the expected satisfaction levels and diagnose which factors are problematic and need further consideration. Organizations that have future designs will form a clear understanding of business requirements, gain more vision and acquire ability to expand knowledge and skills to better assimilate and utilize ERP system, and therefore minimize the risks associated with this particular investment.

Project Management involves, clear outlining of the milestones and critical paths along with the training and human resource plan and creation of a steering committee which includes top level management from diversified business functions. There should be an active monitoring of the status of milestones and targets in order to check the progress of an ERP project. ERP system is meant to improve organizational performance and productivity. Researches can also be focused upon ways to take the maximum usage of ERP system.

## 11. Limitations

This study was based on a self-administered exploratory survey, where only closed ended questions were used in the response sheet. This restricted the ability of researcher to ask open-ended questions, which may have assisted in offering a better understanding of effect of ERP on organizational performance and productivity. Managers may want an in-depth evaluation of ERP system in their organization. A case-study method might also have been adopted for an evaluation of effect of ERP system on single organization. Similar studies can also be carried on cross cultural domains to explore cultural dissimilarities and to explore whether effect of ERP system is constant across different cultures or not and there by conducting study in these areas, one can compare the results and look the gap in order to further investigate the effect of ERP system.

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