

Evaluating Factors Influencing Information Quality in Large Firms

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Abstract—Information quality is a major performance measure for an Enterprise Resource Planning (ERP) system of any firm. This study identifies various critical success factors of information quality. The effect of various critical success factors like project management, reengineering efforts and interdepartmental communications on information quality is analyzed using a multiple regression model. Here quantitative data are collected from respondents from various firms through structured questionnaire for assessment of the information quality, project management, reengineering efforts and interdepartmental communications. The validity and reliability of the data are ensured using techniques like factor analysis, computing of Cronbach's alpha. This study gives relative importance of each of the critical success factors. The findings suggest that among the various factors influencing information quality careful reengineering efforts are the most influencing factor. This paper gives clear insight to managers and practitioners regarding the relative importance of critical success factors influencing information quality so that they can formulate a strategy at the beginning of ERP system implementation.

Keywords—Enterprise resource planning, information systems, multiple regression, information quality.

I. INTRODUCTION

INFORMATION systems play a vital role in the coordination of various information resources within an organization, as well as ensure the connectivity of the organization with the outside world. ERP systems are efficiently playing this role of coordination of enterprise resources if implemented judiciously, carefully and considering the prior experiences of implementation by various firms. Hence, it is highly essential to conduct post implementation studies related to ERP implementation in order to understand the impact of various critical success factors on the performance of ERP systems [1]. Information quality achieved due to ERP implementation is one of the major important performance measures of any ERP system [2]-[5].

Efficient project management, efficient reengineering efforts and improved interdepartmental communications significantly affect performance of any ERP system [6]. Umble et al. [7] stated that inefficient project management,

insufficient data accuracy and negligence towards adoption of performance measures can result into the failure of ERP systems. Their study reveals the importance of a post implementation audit.

Very few studies are conducted which assess the relationship of various critical success factors on the performance measures of ERP systems. This research investigates the effect of efficient project management, efficient reengineering efforts and improved interdepartmental communications on information quality with reference to ERP system implementations with the help of a cross sectional field survey of various firms adopting ERP systems in India. A relevant research model is developed. Three important hypotheses for assessment of the effect of the project management, reengineering efforts and interdepartmental communications on information quality were put forth and tested using multiple regression technique.

II. LITERATURE REVIEW

Implementation of an ERP system in any firm is complex, time consuming and a costly affair [6]. Careful implementation of ERP systems considering the prior experiences of various firms can result in successful ERP implementation. Poor project management, neglecting past experiences, can result in the failure of an ERP system [8].

Information quality is a very important performance measure of any ERP system. It includes various aspects like understandability of information, relevancy of information, timely availability of information and accuracy of information. There is no universally agreed opinion about which critical success factors influence various performance measures of ERP systems.

Ngai et al. [9] studied various critical factors through previous literature and concluded the presence of country related critical success factors for successful implementation of ERP. Their findings suggest that ERP implementations should be evaluated critically for each country and region due to the unique business conditions, culture and government standards in different countries. Their findings clearly suggest great potential for maximizing the impact of research findings in countries like India. Their findings also suggest the importance of business process reengineering, communications, and top management support as some of the very important critical success factors, as compared to others. These factors are therefore included in the current investigation. Their findings suggest the presence of different critical success factors affecting different performance measures in different manners in different countries. This

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provided motivation and rationale to conduct research in the Indian environment. Altuwaijri and Khorsheed states that efficient project management and communications are important critical success factors for any ERP system, especially in the deployment phase [8]. Bradley considered efficient project management as one of the important critical success factors in their study [10]. Law et al. considered communication and coordination as one of the important critical success factor in implementation of an ERP system [11]. This indicates the importance of interdepartmental communication and coordination as one of the important critical success factors which significantly influence the performance of an ERP system. Project management and business processes reengineering (BPR) are important critical success factors which significantly influence a successful ERP system [3], [12], [13].

Velcu studied the impact of strategic alignment of ERP implementation stages on success of ERP through empirical investigation using a survey-based technique. This study revealed a positive relationship between strategic alignment, business process reengineering, project management and internal efficiency on ERP benefits [14]. Their findings provided a baseline in the selection of various critical success factors in our investigation. King and Burgess found the positive effect of interdepartmental communications, top management support, project management, and interdepartmental communications especially on quality in ERP systems. Their findings suggest that if desired performance measures are met, then top management continues their support including hire rate and incentives, and will hence affect the individual, workgroup and the organization. Again, their dynamic model clearly suggests the impact of interdepartmental communications, project management and process management on quality aspects [15]. Investigations in this paper are also directed at analyzing this impact of various factors on information quality.

Umble et al. identified critical success factors influencing software selection and implementation through qualitative investigation supported by a case study of Huck International, which is a firm involved in design, manufacturing of proprietary commercial, industrial and aerospace fastening systems. In this case study the firm switched over from the MRP-II legacy system to Baan. They considered various critical success factors in their study like top management support, project management, change management, interdepartmental coordination, data accuracy and training. The findings from the case study reveal that poor interdepartmental communications have resulted into poor information quality [7]. This shows that interdepartmental communications have significant impact on information quality. This path is hypothesized in this investigation and tested using multiple regression technique in this paper.

Curko et al. suggested five important critical success factors as business plan and vision, top management support, project management, change management program and implementation strategy influencing ERP implementation. Their findings also indicate importance of tactical factors like

project teams, business processes modeling with minimum customization project controlling and evaluation and legacy system. Their findings suggest that one should be selective about critical success factors to be emphasized as it is difficult to pay attention towards all critical success factors equally [16]. Their findings provided motivation for this investigation to identify the set of critical success factors influencing information quality which is major performance measure of any ERP system.

Gracia-Sanchez and Perez-Bernel studied various critical success factors in implementation of ERP systems in Mexican enterprises. Their findings suggest that all critical success factors in other countries are also relevant in Mexican enterprises. But the importance of each critical success factor differs with countries especially in culture specific issues. For example-more external support is required in Mexican environment than eastern countries. These indicate that external support has different weightage in different countries. Their findings clearly reveal the importance of various critical success factors like project management, BPR as well as performance metrics in country specific environment [17]. This provided motivation to analyze the impact of various critical success factors on information quality in Indian context in our investigation.

Savage et al. analyzed the relationship of BPR and Chief Executive Officers (CEO's) involvement in ERP performance measures in Chinese context. Their findings suggest that both CEO's involvement and BPR are strongly related to the ERP effectiveness and post system integration. Integration is positively related to quality of information also. Their findings also suggest that post implementation integration is positively related to operational performance. This indicates that BPR is positively related to operational performance and improves post implementation integration of all modules like material management, purchase module, supply chain management module(SCM). This essentially suggests impact of BPR [18].

Love and Gunasekaran considered information technology (IT) as major enabler for BPR along with human resources and total quality management [19]. Gunasekaran and Nath also agree with the same. IT supports and enables BPR in all aspects like product, technology, CAD/CAE, CMIS, EDI, accounting and personnel and other aspects. Their findings suggest that efficient BPR can be enabled by accurate, timely information system indicating relationship of BPR and information quality [20]. This is major hypothesized path in the investigation in this paper. Now majority of author suggest BPR as enabler of successful ERP system implementation.

Mandal and Gunasekaran [21] analyzed SAP R/3 implementation through an investigation of its implementation at a corporation in Australia. Their findings also indicate that BPR is a major enabler of ERP system implementation. They also suggest that one has to account for intangible and non-financial performance measures in performance analysis [21]. Their study provided motivation to analyze these measures in the investigations in this paper.

Santamaria-Sanchez et al. investigated the reason for the extra time required for value chain modules. They stated that

the value chain module involves complex interdependencies creating a need for interdepartmental communications, control and information coordination. In other words, interdepartmental communications help in timely availability and increasing quality of information [22]. This possible interaction is investigated in the investigation in this paper through empirical analysis and supports the hypothesized relationship in this study.

Nelson et al. studied antecedents of information quality with the help of empirical examination of 465 data warehouse users [23]. Their work majorly focuses on information quality. Nelson et al. suggested an opportunity to tap the technological characteristics influencing quality of information [23]. This provided the motivation to our study which aims at examining various factors influencing information quality.

Deng and Chi studied post adoptive behaviors in information systems. They studied complex and dynamic phenomenon of system use problems for ERP systems [24]. Their study provides motivation to this research to study post ERP implementation aspects especially with respect to information quality.

Constantinides et al. provides a pragmatic framework for the ends of information systems research. Their findings indicate that information systems should meet not only instrumental rationality aspects but also should meet value rationality [25]. Overall procedure and findings in this research are inspired by their pragmatic redefinitions of research. Their pragmatic view suggests that generalizable knowledge about the topic is possible and desirable. Our research aims at determining the extent of the impact of several factors on information quality.

Several authors analyzed relationship between performance measures, especially in post implementation studies related to ERP system implementations. However, the relationships of various critical success factors with performance measures, such as information quality, are not empirically studied to that much extent. This research develops quantitative relationship between various critical success factors with information quality which is very important performance measure of any ERP system. Here aim is to analyze relative magnitude of impact of each critical success factor on information quality.

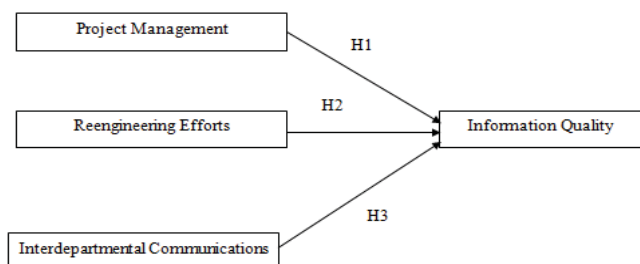


Fig. 1 Model showing Hypothesized Paths

III. PROPOSED MODEL AND HYPOTHESES

All the above discussion in literature states importance of improved project management, reengineering efforts and improved interdepartmental communications in context with

ERP system implementations. Several authors agreed on importance of information quality as performance measures of ERP system. Fig. 1 shows presented research model showing hypothesized paths under study.

Model showing Hypothesized Paths Terms used in this model are described in brief as:

- **Project Management:** Project involves series of various interlinked activities to complete any task. Management of any project requires many resources which may be in any form like human resources, machines, software. Complexity of integration and needs to meet information quality makes project management with respect to ERP implementation more challenging. Here project management involves various aspects like quality management, risk management, cost management, time management, and human resource management.

- **Reengineering efforts:** Hammer and Champy defined reengineering as

“Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed.” [26].

While implementing ERP systems in many firms, essentially old legacy systems are replaced or modified by modern information systems. This essentially requires a great deal of reengineering effort. Efficient reengineering efforts are considered as enablers of successful ERP system implementations.

- **Interdepartmental communications:** ERP system implementation involves integration of various departments within an organization. Hence, it is highly essential to have proper communication among various departments within an organization to map various cross-departmental and interlinked processes. Excellent interdepartmental communications always help to understand cross functional needs and difficulties. Efficient management of interdepartmental communications helps to expedite ERP implementation with desired quality. To achieve better interdepartmental communications employees should understand the impact of their action on other functional areas.

- **Information Quality:** Nelson et al. provided four important information quality dimensions as accuracy, completeness, currency and format [23]. DeLone and McLean considered information quality as major success dimension for any information system [2]. According to Ifinedo [1] higher information quality helps to improve individual productivity.

Table I shows several hypotheses put forth with reference to research the model proposed in earlier Section III.

H1: Higher Level of project management is positively related to information quality.

As discussed earlier, project management with respect to ERP involves various aspects like quality management, risk management, cost management, time management, and human resource management. Understanding of cross functional

needs make project management more challenging with respect to ERP implementation. This hypothesis is directed to check whether project management positively influences information quality. Also, the magnitude of impact of project management, as compared to other factors, needs to be analyzed as it is difficult to pay attention to all critical success factors equally, as suggested by Curko et al. [16].

TABLE I
RESEARCH OBJECTIVES AND RELEVANT HYPOTHESES

Sr. No.	Research objective/Question	Hypothesis
1	To identify influence of project management on information quality in context with ERP implementation	H1: Higher Level of project management is positively related to information quality.
2	To identify influence of reengineering efforts on information quality achieved in context with ERP implementation	H2: Higher Level of Reengineering efforts is positively related to information quality
3	To identify influence of inter departmental communications on information quality achieved in context with ERP implementation	H3: Higher Level of Interdepartmental communications is positively related to information quality.

H2: Higher Level of reengineering efforts is positively related to information quality.

Reengineering involved in ERP implementation is very significant, as an organization moves from a legacy system to a modern information system. Discussion in previous literature clearly provides motivation to find the impact of reengineering efforts on information quality. IT and reengineering efforts are complementary to each other [19], [20]. It is highly essential to measure impact of reengineering efforts on information quality. This research question is hypothesized here.

H3: Higher Level of Interdepartmental communications is positively related to information quality.

Umble et al., through the case study of a firm, found that poor interdepartmental communications have resulted in poor information, reducing its quality. The complexity of interactions within the business processes involved in ERP implementation essentially requires efficient interdepartmental communications. It is essential to quantify the effect of interdepartmental communications on information quality [7]. This research question is hypothesized here.

IV. RESEARCH DESIGN/METHODOLOGY

A. Survey Design

In this research, survey methodology is used employing a sampling technique with the help of structured data collections. The survey design used is the cross-sectional survey design, as it has many benefits in the aspects of representativeness and bias.

Data were collected through a structured questionnaire. The objective of the questionnaire was to translate the information needed into a specific set of information. Data were collected on five-point scale.

Data related to various critical success factors like project management and reengineering efforts, as well as for

performance measures like information quality, were collected through a structured questionnaire consisting of close ended questions.

B. Details of Constructs Used in This Study

Table II gives constructs used in this study with reference to previous literature.

TABLE II
CONSTRUCTS FOR PROJECT MANAGEMENT, REENGINEERING EFFORTS, INTER DEPARTMENTAL COMMUNICATIONS AND INFORMATION QUALITY

3	Factor No.	Measure	Literature base/ Authors
Project Management (PM)	PM1	Presence of appropriate deadlines or milestones	[13]
	PM2	Presence of detailed project plan	
	PM3	Stepwise implementation was carried	
	PM4	Involvement of persons with strong knowledge of key core processes	
Re-engineering Efforts (BPR)	BPR1	Sufficient time was spent in reengineering business processes prior to ERP implementation	[6] [13]
	BPR2	Significant efforts were required by organization to make ERP package suitable for our business processes	
	BPR3	Business processes were standardised to the maximum extent	
Inter Departmental Communications (IDC)	IDC1	There were excellent communications between IT staff and ERP user group	Finalized in discussion with key people involved in ERP implementations
	IDC2	Cross functional impact of actions was clearly understood by employees	
	IDC3	There was frequent cross functional meeting within different departments.	
Information Quality (IQ)	IQ1	Availability of timely information	[1] [27]
	IQ2	Understandability of Information available from ERP	
	IQ3	Relevancy of information available from ERP.	
	IQ4	Accuracy of information available from ERP.	

C. Sampling Method

The target population in this research is all firms which implemented ERP systems in India. Respondents were key persons involved in ERP implementation and usage. Data is collected through a structured questionnaire from elements (respondents). A sampling frame is chosen from multiple resources like the directory of corporate firms in India, from websites of firms and ERP users, as well as through personal contacts. Multiple resources were used in order to reduce sampling frame error.

The sampling size is determined keeping the aspects of generalization and desired power in mind. Hair et al. recommended a minimum five observations for each independent variable, but the desired numbers of observations are 15 to 20 observations per independent variable [28]. Out of a total of 367 questionnaires sent, only 357 questionnaires were

considered. Other questionnaires were discarded due to missing values. The sample size of 357 is sufficient to generalize the findings of this study in Indian context.

Constructs for measurement of above the factors and measures were identified through literature and in consultation with experts from academia and industry who are actively associated with ERP implementation. Data were collected on five-point scale.

V. VALIDITY AND RELIABILITY

The questionnaire was pilot tested with several key people from academia and industry who are closely related to ERP implementation to ensure face and content validity. Feedback from the pilot testing was considered and accordingly the questionnaire was modified by adding or removing of items as necessary.

Principal component analysis by varimax rotation with Kaiser Normalization was conducted to ensure that items are not cross loading on multiple factors ensuring unidimensionality. This means that items under each factor are closely associated with each other and represent a single concept.

Details of loading and cross loadings are shown in Table III. Table III clearly indicates the unidimensionality of each measure.

TABLE III
ROTATED COMPONENT MATRIX SHOWING LOADINGS AND CROSS LOADINGS

	Component		
	1	2	3
PM1	.033	.024	.722
PM2	-.025	-.171	.708
PM3	.283	.011	.615
PM4	.149	.083	.695
BPR1	.879	.018	.064
BPR2	.857	-.100	.176
BPR3	.971	-.041	.135
IDC1	-.030	.824	-.084
IDC2	-.032	.912	-.002
IDC3	-.038	.747	.044

TABLE IV
SUMMARY OF VALIDITY AND RELIABILITY ANALYSIS

Variable	Cronbach's Alpha	Eigen Value
Project Management (PM)	0.642	1.85
Independent Variables		
Reengineering Efforts (BPR)	0.900	2.58
Interdepartmental Communications (IDC)	0.774	2.13
Dependent Variable		
Information Quality(IQ)	0.834	2.70

Data reliability analysis is carried out by calculating Cronbach's alpha. Table IV gives details of Cronbach's alpha regarding the data. Table IV gives details of validity and reliability aspects.

The higher value of Cronbach's alpha clearly indicates the reliability of the data and internal consistency. Internal consistency indicates that individual items or indicators of the scale measure the same construct and hence are highly

correlated [28].

The scree analysis and eigenvalue analysis clearly indicate the items are loading on the respective factors, and the details of principal component analysis ensured convergent and discriminant validity.

VI. TESTING HYPOTHESES WITH MULTIPLE REGRESSION TECHNIQUES

Summated scale is first calculated by averaging the items under each factor. Hair *et al.* suggested that ensuring the unidimensionality of items underlying each summated scale is essential before opting for a summated scale [28]. Here, this unidimensionality of the items underlying each summated scale is ensured with the help of principal component analysis, as discussed earlier. Multiple regression was carried out to test the hypotheses. Table V gives the details of results of multiple regression analysis.

TABLE V
SUMMARY OF RESULTS OF MULTIPLE REGRESSION ANALYSIS

Model	Standardized Coefficients Beta	T	Sig.	Collinearity Statistics	
				Tolerance	VIF
PM	.269	5.492	0.000	0.919	1.088
1 BPR	0.293	5.964	0.000	0.915	1.093
IDC	0.186	3.946	0.000	0.992	1.008

The R square value of 0.216 indicates that 21.6% of the total variation in information quality (IQ) is explained by this regression model with three dependent variables i.e. project management, reengineering efforts (BPR) and interdepartmental communications. Positive high standardized beta coefficients clearly indicate a significant relationship between the independent and dependent variables.

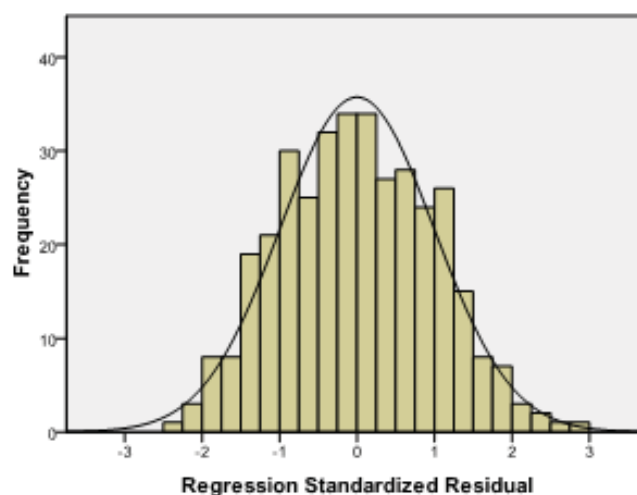


Fig. 2 Histogram showing frequency of regression standardized residuals

The value of variance inflation factors (VIF) is less than 10 in all cases, which indicates that multi-co linearity is not the problem associated with this data. Multi-co linearity is the serious defect which has an adverse effect on predictive ability

of regression model, estimation of regression coefficients and their statistical test [28]. The normality of the standardized residuals is ensured by plotting a histogram showing the frequency of regression standardized residuals. The histogram is given in Fig. 2. Distribution in Fig. 2 clearly seems closer to normality ensuring the fundamental statistical assumption underlying the multiple regression techniques are satisfied.

The ANOVA (Analysis of Variance) analysis in multiple regression is an important statistical test which comments on the overall model fit by using F ratio. The results of this test are tabularized in Table VI.

TABLE VI
 ANOVA ANALYSIS SHOWING SIGNIFICANT REDUCTION IN THE SQUARED ERROR

ANOVA					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	79.004	003	26.335	33.70	0.000
Residual	275.229	353	0.780		
Total	354.232	356			

Predictors: (Constant), IDC, BPR, PM
 b. Dependent Variable: IQ

The squared error, if we use only the mean of the dependent variable for prediction, is 354.232. But if we use this regression model to predict IQ, this error is reduced by 22.30%. This reduction was found to be statistically significant with the F-ratio of 33.776 and a significance level of zero. The positive Beta values of project management, reengineering efforts and interdepartmental communications with a significance value less than 0.01, indicate that all relations suggested by the hypotheses are supported.

VII. RESULTS AND DISCUSSION

The above analysis clearly indicates that all relations suggested by the hypotheses are supported. The results of the analysis are summarized in Table VII. Table VII clearly indicates that efficient project management, reengineering efforts and improved interdepartmental communications significantly affect the quality of information. Among all these factors, reengineering efforts ($\beta=0.293$) significantly impact IQ. Improved interdepartmental communications help to identify cross functional need and ensures usable, vital information ensuring availability and quality of information.

TABLE VII
 RESULTS OBTAINED FROM HYPOTHESIS TESTING

Sr. No.	Hypothesis	Result of hypothesis testing
1	H1: Higher Level of project management is positively related to information quality.	Hypothesis is supported
2	H2: Higher Level of Reengineering efforts is positively related to information quality.	Hypothesis is supported
3	H3: Higher Level of Interdepartmental communications is positively related to information quality.	Hypothesis is supported

Quottrone and Hopper suggested changing the nature of IT across the time and space environment [29]. Ngai et al. suggested the presence of country related specific critical success factors affecting various performance measures [9].

Their findings suggest the need to investigate the effect of various performance measures like information quality in a developing country like India. This issue has been tackled in this paper by identifying the set of critical success factors impacting information quality. On the same ground, Motwani et al. stated immense need to identify various critical success factors affecting performance measures by collecting data from several firms, as well, findings should not be based on a single case study or the case studies of few firms [30]. This particular gap has been bridged in our study by conducting an investigation through empirical testing which relies on data from several firms. Our empirical investigation clearly suggests the impact of project management, BPR and interdepartmental communications, on IQ, which is a major performance measure of any firm. These findings will be extremely useful for firms which target IQ as major performance measure, as compared to others. As Curko et al. suggested, one should be selective about critical success factors to be emphasized as it is difficult to pay attention towards all critical success factors equally [16]. This holds true for performance measures also. Thus, if any firm has IQ as a priority, then the findings of this investigation will be useful to them. Our findings suggest the importance of efficient project management, reengineering efforts and improved interdepartmental communications with respect to their impact on IQ.

We have found significant interdependency of interdepartmental communications and information quality. Our findings support those of Santamaria-Sanchez et al. [22]. Their findings suggest that value chain modules require more time to implement than business support modules, as these modules involve complex interdependencies creating the need for interdepartmental communications. In other words, interdepartmental communications help in the timely availability of information increasing IQ. Our findings exactly support their findings in this context. Umble et al., through a case study of a firm, found that poor interdepartmental communications resulted in poor information reducing IQ. This shows that interdepartmental communications have significant impact on IQ [7]. This path is hypothesized in the investigation in this paper and tested using multiple regression technique and supports the findings.

Gattiker and Goodhue analyzed ERP implementation through the case study of a firm which is involved in the transformation of logs into sheets of veneer. According to them, tightly coupled systems produce significant benefits as compared to the loosely coupled old legacy system. BPR helps to couple systems tightly and improve the quality of information [31]. We have tested this in our empirical investigations and support the findings that a tightly coupled system improves information quality. Mandal and Gunasekaran suggested the necessity to account for intangible and non-financial performance measures [21]. Our study fulfils this gap to some extent, as we have included IQ as a performance measure in our analysis, which in non-financial in nature, but is of extreme importance to any firm adopting the ERP system. Garcia-Sanchez and Perez-Bernal, Bhatti and

Curko et al., also found the significant impact of reengineering efforts, project management and communications on ERP implementation success [17], [32], [16]. Finney and Corbett emphasized the immense need to conduct an in-depth study related to change management [33]. Our research satisfies this need. Yahaya et al. studied ERP implementations in China and suggested that careful reengineering efforts can be an effective solution for many of the difficulties in information systems implementations [34]. Our research indicates that their findings are equally true in the context of ERP implementation in India.

IT is a key enabler for business process reengineering [19], [20]. Now it is the business process reengineering which is enabling the success metric with respect to ERP systems, especially in the context of IQ. It is still a matter of debate whether one should reengineer the processes to suit the information system or customize information systems to suit the business processes. The golden mean of both should be considered and accordingly BPR should be carried out carefully. This essentially requires careful and efficient change management. Efficient change management is the outcome of efficient project management. In order to achieve efficient change management and efficient project management it is essential to have effective interdepartmental communications in order to identify cross departmental and cross functional needs. Thus all three factors are closely related to each other, as well as related to IQ which is an important metric for the success of any ERP system implementation.

VIII. IMPLICATIONS AND LIMITATIONS

This study contributes to the knowledge of Information quality analysis in the following ways:

1. This study identified important factors influencing the quality of information.
2. This study provided the relative strength of each factor in relation to its influence on achieving IQ.

As suggested by Curko et al., one should be selective about the critical success factors to be emphasized as it is difficult to pay attention to all critical success factors equally [16]. This research fulfills this requirement by developing a quantitative relationship between efficient project management, efficient reengineering efforts, effective interdepartmental communications and IQ.

Especially in the Indian context, this analysis clearly suggests the priority of each critical success factor influencing IQ. This research can prove immensely useful for Indian firms targeting improved IQ as the outcome of information system implementation. Reengineering efforts are influencing information quality greatly. This model is useful for managers to shape ERP implementation right from the starting phase by suggesting appropriate areas on which attention needs to be paid.

The limitations of any survey based research are applicable in this case also. In this research, data were mainly collected from manufacturing, construction, energy and IT firms in India. Hence, the findings from this research should be exercised with care for other industries like the service

industry. Future studies could include data from more firms from various fields like the service industry, government firms, and educational institutes and the results can be analysed segment-wise. Qualitative investigation with the help of detailed case studies of two to three firms especially with respect to IQ can provide support to our findings.

IX. CONCLUSIONS

Based on above study, we can conclude that efficient project management, efficient reengineering efforts and effective interdepartmental communications have significant impact on quality of information. Among them reengineering efforts have the highest impact ($\beta=0.293$), next is efficient project management ($\beta=0.269$), and then interdepartmental communications ($\beta=0.186$). This research hence suggests the priority of critical success factors influencing IQ. This knowledge of priority is extremely essential, as it is difficult to pay attention to each factor equally as suggested by Curko et al. [16]. Overall we think that knowledge of each factor and its impact on IQ discussed in this paper will help managers and key individuals involved in ERP implementation to achieve the desired IQ. The discussion in this paper will also help researchers to understand the factors influencing IQ.

ACKNOWLEDGMENT

The authors would like to thank all respondents who participated in the survey. They would also like to thank all the experts/working professionals in the IS field who helped in the survey design.

REFERENCES

- [1] Ifinedo, P., Rapp, B., Ifinedo, A., and Sundberg, K., (2010), "Relationship among ERP post implementation constructs: An analysis at the organizational level", *Computers in Human Behaviour*, Vol.26, pp.1136-1148.
- [2] DeLone, W. H., and McLean, E.R. (1992), "Information systems success: The quest for the dependent variable", *Information Systems Research*, Vol.3, No. 1, pp.60-95.
- [3] Zhang, Z., Lee, M.K.O., Huang, P., Zhang, L., and Huang, X., (2005), "A framework of ERP systems implementation Success in China: An empirical study", *International Journal of Production Economics*, Vol. 98, pp.56-80.
- [4] Chien, S.W., and Tsaur, S.M., (2007), "Investigating the success of ERP systems: Case studies in three Taiwanese high-tech industries", *Computers in Industry*, Vol.58, pp.783-793.
- [5] Tsai, W.H., Lee, P.L., Shen, Y.S., and Lin, H.L., (2012), "A comprehensive study of the relationship between enterprise resource planning selection criteria and enterprise resource planning success", *Information & Management*, Volume 49, No.1, pp.36-46.
- [6] Bradford, M., and Florin, J., (2003), "Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems", *International Journal of Accounting Information Systems*, Vol.4, pp.205-225.
- [7] Umble, E.J., Haft, R. R., and Umble, M.M., (2003), "Enterprise Resource Planning: Implementation procedures and critical success factors", *European Journal of Operational Research*, Vol.146, pp.241-257.
- [8] Altuwaijri, M.M., and Khorsheed, M.S., (2012), "InnoDiff: A project – based model for successful IT innovation diffusion", *International Journal of Project Management*, Vol.30, pp.37-47.
- [9] Ngai, E.W.T., Law, C.C.H., and Wat, F.K.T., (2008), "Examining the critical success factors in the adoption of enterprise resource planning", *Computers in Industry*, Vol.59, pp.548-564.

- [10] Bradley, J., (2008), "Management based critical success factors in the implementation of enterprise resource planning systems", *International Journal of Accounting Information Systems*, Vol. 9, pp.175-200.
- [11] Law, C.C.H., Chen, C.C., and Wu, B. J. P., (2010), "Managing the full ERP life-cycle: Considerations of maintenance and support requirements and IT governance practice as integral elements of the formula for successful ERP adoption", *Computers in Industry*, Vol.61, pp.297-308.
- [12] Koh, S., Gunasekaran, A., and Goodman, T., (2011), "Drivers, barriers and critical success factors for ERP II implementation in Supply chains: A critical analysis", *Journal of Strategic Information Systems*, Vol.20, pp.385-402.
- [13] Ehie, I. C., and Madsen, M., (2005), "Identifying critical issues in enterprise resource planning (ERP) implementation", *Computers in Industry*, Vol.56, pp.545-557.
- [14] Velcu, O., (2010), "Strategic alignment of ERP implementation stages: An empirical investigation", *Information and Management*, Vol.47, pp. 158-166
- [15] King, S.F., and Burgess, T. F., (2006), "Beyond critical success factors: A dynamic model of enterprise system innovation", *International Journal of Information Management*, Vol.26, pp.59-69.
- [16] Curko, K., Stepanic, D., and Varga, M., (2012), "Strategic & tactical success factors in ERP system implementation", *International Journal of Computers*, Vol.6, No.4, pp.206-214.
- [17] Garcia-Sanchez, N., and Perez-Bernel, L., (2007), "Determination of Critical Success Factors in implementing an ERP system: A field study in Mexican Enterprises", *Information Technology for Development*, Vol.13, No.3, pp.293-309.
- [18] Savage A., Callaghan J., Dang, Li., and Sun, Y., (2010), "Operating performance in the wake of ERP implementation: Triangulating results for Chinese manufacturing companies", *Discussion paper series, 2010-03, McColl School of Business, Queens University of Charlotte*.
- [19] Love, P., and Gunasekaran, A., (1997), "Process Engineering: A review of enablers", *International Journal of Production Economics*, Vol.50, pp.183-197.
- [20] Gunasekaran, A., and Nath, B., (1997), "The role of information technology in business processes reengineering", *International Journal of Production Economics*, Vol.50, pp.91-104.
- [21] Mandal, P., and Gunasekaran, A., (2002), "Application of SAP R/3 in on-line inventory control", *International Journal of Production Economics*, Vol.75, pp.47-55.
- [22] Santamaria-Sanchez, L., Nunez Nickel, M., and Gago-Rodriguez, S., (2010), "The role played by interdependences in ERP implementations: An empirical analysis of critical factors that minimize elapsed time", *Information and Management*, Vol.47, No.2, pp.87-95.
- [23] Nelson, R. R., Todd, P. A., and Wixom, B. H. (2005), "Antecedents of Information and System Quality: An Empirical Examination Within the Context of Data Warehousing", *Journal of Management Information Systems*, Vol.21, No.4, pp.199-235.
- [24] Deng, X., and Chi L., (2012-13), "Understanding Post adoptive Behaviors in Information Systems Use: A Longitudinal Analysis of System Use Problems in the Business Intelligence Context", *Journal of Management Information Systems*, Vol.29, No.3, pp.291-325.
- [25] Constantinides, P., Chiasson, M.W., and Introna, L.D. (2012), "The Ends of Information Systems Research: A Pragmatic Framework", *MIS Quarterly*, Vol.36, pp.1-19.
- [26] Hammer, M., Champy, J., (1993), *Reengineering the Corporation: A Manifesto for Business Revolution*, Harper Collins, London.
- [27] Ifinedo, P., (2011), "Examining the influences of external expertise and in-house computer/IT knowledge on ERP system success", *The Journal of Systems and Software*, Vol.84, pp. 2065-2078.
- [28] Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., and Tatham, R.L., (2007). *Multivariate Data Analysis. Sixth edition, Pearson Education, New Delhi*.
- [29] Quattrone, P., and Hopper, T., (2006), "What is IT? SAP, accounting, and visibility in a multinational organisation", *Information and Organization*, Vol. 16, pp.212-250.
- [30] Motwani, J., Subramanian, R., and Gopalakrishna, P., (2005), "Critical factors for successful ERP implementation: Exploratory findings from four case studies", *Computers in Industry*, Vol.56, pp.529-544.
- [31] Gattiker, T., and Goodhue, D., (2004), "Understanding the local- level costs and benefits of ERP through organizational information processing theory", *Information and Management*, Vol.41, pp.431-443.
- [32] Bhatti, T., (2005), "Critical Success factors for the implementation of Enterprise Resource Planning (ERP): empirical validation", paper presented at the second international conference on *Innovation in Information Technology* (IIT'05), pp.1-10.
- [33] Finney, S., and Corbett, M., (2007), "ERP implementation a compilation and analysis of critical success factors", *Business Process Management*, Vol.13, No.3, pp.329-347.
- [34] Yahaya, Y., and Gunasekaran, A., and Canglin, W., (2006), "Implementation of Enterprise Resource Planning in China", *Technovation*, Vol.26, pp.1324-1336.

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