Evaluation Framework for an ERP System using Balanced Scorecard Approach

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"The reporting patterns within the ERP system is required to be so powerful that a "weekly dashboard' would be established and it can be used by executives throughout the month to monitor the key indicators"

- Bradford & Roberts, 2001

Abstract

The overall purpose of this study is to explore whether BSC can be a better indicator to measure ERP system performance and how the initial objectives of ERP implementation affect the later ERP performance. In addition to this the study analyzes, the relations between financial and non-financial perspectives in an ERP Environment.

Introduction

With the enhanced Business requirement the Enterprise Resource Planning (ERP) system emerged out as the customized yet standard Application Software which blends the business solutions for the core business with the key administrative function of an enterprise. Traditionally, ERP Key Performance Indicators (KPI) based on financial aspect of the company which tends to reflect on past performance. But with value addition in the terms of the non-financial.

Enterprise Resource Planning (ERP) systems are commercial software systems that can be defined as customizable, standard application software which integrates business solutions for the core processes and the main administration function of an enterprise. Traditionally, ERP Performance measures focus on financial indicators which tend to reflect on past performance. Moreover, we empirically investigated Indian Companies with ERP System implementation to explore whether different corporate ERP objectives could have affected the post- ERP performance and could translate a company's vision and strategy through all levels of organization. Adopting the Balanced Scorecard increases the completeness and the quality of ERP Implementation reports and raises the awareness for relevant factors. Based on the research finding, we

provided a regression model to measure the performance of ERP systems and found that financial perspectives have closed relationship with non-financial perspectives.

The overall purpose of this study is to explore whether BSC can be a better indicator to measure ERP system performance and how the initial objectives of ERP implementation affect the later ERP performance. In addition, this study examines, in the ERP context, the relations between financial and non-financial perspectives including customer perceptive, Internal Perspective and Innovation & Learning Perspectives.

Review of Literature

ERP systems can push an organization towards generic processes even when customized processes may be a source of competitive advantage (Davenport, 1998). Some researchers (Pliskin and Zarotski, 2000; Rosemann and Wiese, 1999) argued that by adopting an ERP package, an organization takes the risk of losing competitive advantage. A survey of Fortune 1000 companies regarding ERP customization policies indicates that 41 % of the companies re-engineer their business to fit the application. 37% of the companies choose applications that fit their business and customize a bit, and only 5% customize the application to fit their business (Fang and Lin, 2006).
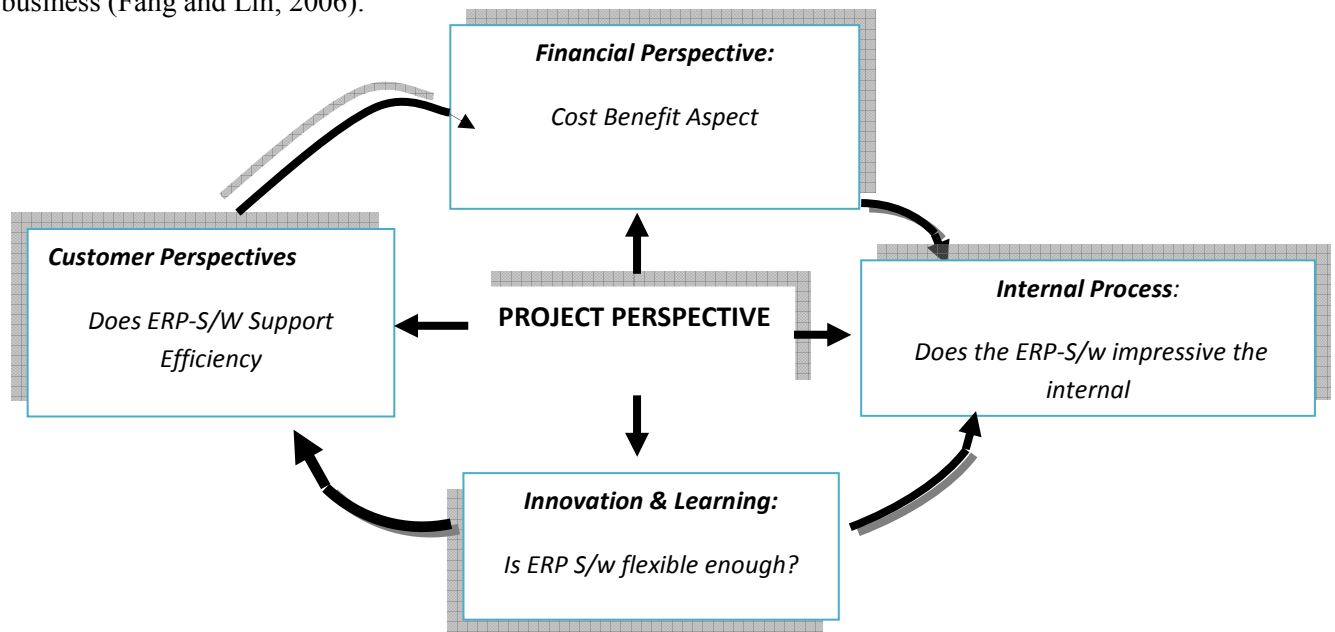
In the survey conducted by Renaissance Solutions in association with Robert Kaplan of the Harvard Business School, it was found that 90% of the surveyed companies believed that a clear, action- oriented understanding of an organization's strategy could have significantly influence organization's success of implementing ERP system. However, the same survey showed that less than 60 percent of senior managers and less than 10 percent of the total personnel believed that they had a clear understanding of their company's strategy. In addition, less than 30 percent of the senior managers who understood their company's strategy believed that it had been effectively implemented. The findings of this study raise a series of key issues for

major ERP companies need to be addressed such as the objectives of implementing ERP system could affect the post-ERP performance. Because ERP implementation is not only a data processing but a vision communication between all employees levels so as to inspire internal workers turning the corporate strategy into action (Edwards, 2001). It is obvious that implementation an ERP system causes massive change that needs to be carefully managed to reap the benefits of an ERP solution. The critical initial objective of why enterprise implements the ERP systems could have significantly impact to ensure successful ERP implementation. Many researchers has investigated the critical reasons for enterprise to implement ERP packages (1) Reengineering of the existing processes (2) Requirement of the Supply chain management (3) Requirement of e-commerce. (4) Integrating the ERP with other business information system; (5) Reducing existing inventory cost (6) changing existing legacy system; (7) Requirement of multinational enterprise competiveness; (8) Enhancing enterprise images; (9) evolution of e-Business. In addition to improving implementation success itself these ERP implementation objective factors influence later ERP performance.

Kaplan and Norton divide the BSC into four quadrants for measuring the strategic dimensions like: Financial, Customer, Internal business processes and Innovation & learning as shown in Table 1.Adoptation of measures from the four quadrants are not mandatory, rather it is the need to establish measures that link to an organization's strategy. Rosemann and Wiese (1999) further addressed two reasons motivate the use of the Balance Scorecard for controlling and evaluating an ERP implementation.

Table I : ERP Stretegic Measurements from BSC		
Strategy Perspectives	**ERP Effectiveness**	**Strategic Measures**
Financial Perspective	Reduce corporate operating cost. (Brynjolfsson and Hitt. 1995)	A/R Turnover rate (Davenport,1998) Inventory Turnover rate (Sweat,1998) Procurement Cost(Maloni & Benson, 1997)
	Increase revenue growth (Mabert & Venkataramanan,2000)	Operating Net Income (Davenport,1998) Returns on Investment(Bradfordand Roberts,2001) Sales Growth Rate(Stratopaulos & Dehming,2000) Earnings Per Share
Customer Perspective	Reduce Transaction Time(Alam,1997)	Rate of Delivery on Time (Appleton,1998) Product delivery on time (Sweat,1998)
	Customer Satisfaction	Corporate Image (Thomas N Devenport,2001) Frequency of Customer Complaints(Grover and Davenport,2001) Customer's Relating time(Grover and Davenport,2001) Customer's Satisfaction (Grover and Davenport,2001) Customer Retention
Internal Perspective	Internal Working flow from submits (Mabert and Venkatraman, 2000)	Invoice Process effectiveness (Thomas H Davenport, 2001) Number of problems with standard reports Accuracy of Inventory Records (from Interview) Financial reports on demand (Rosemann & Wiese 1999)

	Avoidance of Operational Bottlenecks (Rosemann & Wiese, 1999)	Emergency Response time in order processing (Thomas N Devenport,2001) ERP system availability(Rosemann and Weise,1999) Purchasing Time(Mirani et al.,1998) Response Time to upgrade ERP System (Delottie Consulting, 1999) Average response time in delivery processing (Davenport,2000)
Innovation & Learning Perspective	Enhancing employee productivity (Brynjolfsson & Hitt, 1995,1996)	Task Complexity Employee retention rate (Brynjolfsson and Hitt, 1995) Frequency of Computer Usage Productivity per employee (from interview) Service error rate Organization flows(Deloitte Consulting, 1999) Employee training hours Employee loyalty (Deloitte Consulting, 1999)
	Reliability of the Software	Number of releases per year(Grover and Davenport, 2001)

Source :(Fang.M.Y & Lin.Fengyi, 2006)

Traditionally, ERP performance measures focus the ERP investment on very obvious selected indicators only which were often financial in nature. While financial indicators are important, they tend to reflect on past performance rather than indicating future position. Regarding the extent of an ERP project, a comprehensive set of key performance indicators that not only looks backwards but also evaluates all critical measures is necessary (Rosemann & Weise, 1999). Only the simultaneous evaluation of financial, customer, internal process and innovation and learning including the integration of requirements of future developments guarantees a comprehensive analysis.

Research Design

In India, there are four major ERP Vendors (ORACLE, SAP, BaaN, PeopleSoft) to provide the ERP solutions to service and manufacturing industry.

Our survey is based on prototype study conducted by Lin & Taipei, 2006. The 130 Questionnaire sets was send to the ERP supervisors of companies using ERP systems, under with both the service and manufacturing companies were covered. The Questionnaire contains five parts; the first four parts collected the BSC characteristics of financial customer, internal process, and innovation & learning perspectives after each individual company implementing its ERP system. The fifth part collected both the characteristics of organization and the original implementing objectives of the ERP systems of the 130 questionnaire mailed to the responses and 108 were received of which 23 respondents were removed due to errors in completing the answer sheets. Therefore the effective sample size was 85 (= 108-23)

Descriptive analysis

This research explores the performance measures of ERP systems implementation with Kaplan and Norton's balanced scorecard. From the questionnaire of the study, we chose the mean values of the four BSC performance indicators over 3.5 to evaluate ERP systems performance. The mean value of each dimension was derived by SPSS 16.0 for Windows Vista and for the means of performance measures value above 3.5 is summarized in Table 2. This Study then used indicators to perform further analysis.

Table 2 : Performance Measures in Context to Norton and Kaplan's Balance Score Card (BSC)

Financial		Customer		Internal		Innovation & Learning	
Measures	Means	Measures	Means	Measures	Means	Measures	Means
Procurement Cost	3.71	Customers' Satisfaction	3.96	Accuracy of Inventory Records	4.21	Service error rate	3.98
A/R Turnover rate	3.68	Products Delivery on time	3.93	Financial reports on demand	4.12	Number of releases per year	3.98
Inventory turnover rate	3.65	Customer Retention	3.91	Number of Problems with Standards report	4.06	Frequency of Computer Usage	3.86
Operating net Income	3.61	Rate of delivery on time	3.91	Average time to upgrade ERP System	4.04	Organization flows	3.86
Returns of Investment	3.59	Frequency of Customers' Complaints	3.85	Response time in Order processing	3.99	Employee Training Hours	3.86
EPS	3.54	Corporate Image	3.85	Average response time in delivery processing	3.99	Task Complexity	3.85
Sales Growth Rate	3.53	Customers' Reacting time	3.84	Purchase time	3.98	Productivity per employee	3.72
				Invoice process effectiveness	3.93	Employee loyalty	3.52
				Emergency response time in order processing	3.87		
				ERP System Availability	3.81		

ERP implementing objective with BSC performance measures

Implementation an ERP causes massive change that needs to carefully manage to reap the benefits of an ERP solution. The critical objective issues that must be carefully considered in order to ensure successful ERP implementation including (1) Reengineering of the existing processes; (2) Requirement of supply chain management, (3) Requirement of e-commerce (4) Integrating the ERP with other business information system; (5) Reducing existing inventory cost; (6) Changing existing legacy system; (7) Requirements for multinational enterprise competitiveness; (8) Enhancing enterprise images (9) evolution of e-Business.

Table 3 : The Critical Objective Issues of ERP system affected the financial Perspectives

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A11	Operating net Income		**	***		**				**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A21	Returns of investment	*	*		***					***
A31	sales growth	*	**		**					**
A41	Earnings per shares				***		*		*	***
A51	Inventory turnover Rate		*		**		*			
A61	A/R turnover rate		**							
A71	Procurement Cost			*	**					**

* ** *** indicate significant at 0.05, 0.01 and 0.001 levels, respectively

Of the 85 sample data, 60 companies indicated the Reengineering of the existing processes as one of the company's objectives of implementing ERP system from the financial perspectives. The overall ERP companies financial measures including "Operating Net Income", "Returns of Investment", "Sales growth rate", "Earning per share", "Inventory turnover rate", "A/R turnover rate", "Procurement Cost" which were indicated on the table 1 of the empirical result. ANOVA results of the financial perspective summarized at Table 3. On the respect of the above financial measures, the result showed that the "Operating Net Income" and "Return of Investment" have significantly influence on the ERP objective issues such as (2) Requirement of supply chain management, (3) Requirement of e-commerce, (5) Reducing existing inventory costs, and (9) Evolution of e-business. Most of the financial measures were strongly affected by the ERP implementing objectives of requirement of e-commerce and inventory cost reduction.

The overall ERP companies' customer measures including "Corporate image", "Products delivery on time", "Frequency of Customers' Complaints", "Customer' reacting time", "Rate of delivery on time", "Customer Satisfaction" and "Customer retention" which were indicated in Table 1 from the survey results. ANOVA results of the customer perspective strongly influenced by the ERP implementing objectives such as (3) Requirement of e-commerce. (4) Integrating ERP with other business information system, and (8) Enhancing enterprise images. Based on those customer measures, one can learn whether the system meets the expectations and goals that were intended with the implementation and the configuration of the system.

Table 4 : The Critical Objective Issues of ERP system affected the Customer Perspectives
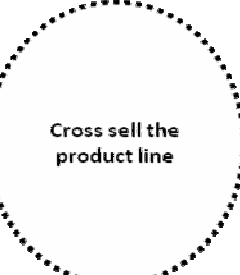
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
B11	Corporate Image	***		*	*			**	***	
B21	Products delivery on time	**	*	**	*					
B31	Frequency of Customers' Complaints	*		*	**					
B41	Customer's reacting time	*			**				*	*
B51	Rate of delivery on time		*	**	**				*	*
B61	Customer's satisfaction			**	*				*	
B71	Customer retention					*		*	**	*

* ** *** indicate significant at 0.05, 0.01 and 0.001 levels, respectively

Mapping a Strategic Theme

A strategic theme groups together different corporate level objectives, measures, and initiatives across the various perspectives of the balanced scorecard framework. The first column shows for each perspective how the value-creating objectives are linked to the theme. The next column shows for each perspective the measures and targets needed to realize the appropriate aspects of the theme's objectives. The final column lists specific cross unit or cross-functional projects aimed at realizing synergies for each perspective and the budget for them.

Table : Interrelationship between Strategic Mapping, Balance ScoreCard and related Action Plan

	STRATEGIC MAP	BALANCED SCORECARD		ACTION PLAN	
		MEASURE	*TARGET*	*INITIATIVE*	*BUDGET*
FINANCIAL PERSPECTIVE	increase revenues and margins				
		* Revenue Mix	+ 10 %		
		* Revenue growth	+ 25 %		
CUSTOMER PERSPECTIVE	increase share of customers' financial transactions				
		* Share of segment	25 %	* Segmentation initiative	$ / Rs.XXXX
		* Share of Wallet	50 %		
		* Customer Satisfaction	90 %	* Satisfaction Survey	$ / Rs.XXXX
PROCESS PERSPECTIVE	Cross sell the product line				
		* Cross - Sell Ratio	2.5	* Financial Planning initiative	$ / Rs.XXXX
		* Hours with High potential Customers	1 hr/ Q	* Integrated Product offering	$ / Rs.XXXX
LEARNING & GROWTH PERSPECTIVE	Create Organizational readiness	* Human Capital Readiness	100 %	* Relationship management	$ / Rs.XXXX
				* Certified Financial Planner	$ / Rs.XXXX

	* Strategic Application Readiness	100 %	* Integrated Customer file	$ / Rs.XXXX
			* Portfolio Planning Application	$ / Rs.XXXX
	* Goals linked to BSC	100 %	* MBO update	$ / Rs.XXXX
			* Incentive Compensation	$ / Rs.XXXX
			TOTAL BUDGET	**$ / Rs.XXXX**

Source: Robert S. Kaplan & David P. Norton

The internal perspective reports on the efficiency of internal processes and procedures. It encompasses matrices such as "Invoice process effectiveness", "Number of problem with standard report", "Accuracy of inventory records", "Financial reports on demand", "Emergency response time in order processing", "ERP System availability", "Purchasing time", "Response time in order processing", "Average response time in delivery" and "Average time to upgrade ERP system". Table 5 showed the ANOVA results from internal perspective. The initial objectives of implementing ERP systems have significantly influence on most of the BSC internal perspective. Measurement in the internal perspective can be used to communicate not simply control (Edwards, 2001). BSC is the language that gives clarity to vague concepts and the process of building a scorecard. It develops consensus and teamwork throughout the organization.

Table 5 : The Critical Objective Issues of ERP system affected the Internal Perspectives

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
C11	Invoice process effectiveness	*	*	**	**					**
C21	Number of problem with standards report		*	***	*	*				**
C31	Accuracy of Inventory records	*		**	**				*	
C41	Financial reports on demand	**		**		**				**
C51	Emergency response time in order processing	**	**	***	*	**		*		***
C61	ERP system availability	**	*	**		***		**	*	***
C71	Purchasing time	*	**	**	*	**				*
C81	Response time in order processing	*	**	***	**	***				*
C91	Average response time in delivery processing	**	**	***	**	**		*		
C101	Average time to upgrade ERP system	**	*	**	**	*		*	**	**

* ** *** indicate significant at 0.05, 0.01 and 0.001 levels, respectively

Finally, the innovation and learning perspective deals with employees issues. Indicators here might contain items such as "Employee retention rate", "Productivity per employee", "Number of releases per year", "Service error rate", "Organization flows", "Employee training hours", and so on. ANOVA results of the innovation & learning perspective summarized at Table 6. On the respect of these measures, the results showed that most of the indicators were strongly influenced by the ERP implementing objectives such as (1) Reengineering of the existing processes, (4) Integrating the ERP with other business information system and (9) Evolution of e-Business.

Table 6 : The Critical Objective Issues of ERP system affected the innovation & learning Perspectives

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D11	number of releases per year	*			***					*
D21	Productivity per employee		*	**		**				**
D31	Number of releases per year	**	*	***	**			*		**
D41	Service error rate	**	*	**	*					*
D51	Organization flows	***	*	***	**			*		**
D61	Employee training hours	***	*		*				*	**
D71	Employee Loyalty	***			***					*
D81	Frequency of Computer usage	*								
D91	Task Complexity									***

* ** *** indicate significant at 0.05, 0.01 and 0.001 levels, respectively

The Balanced Scorecard measures across these four perspectives indicate how the ERP original implemented objectives could have significantly influence on the corporate performance. However, the measures that make up a scorecard do not exist in isolation from each other. They release to a set of objectives that are themselves linked, the final link usually relating to a financial result of one form to another.

The relationship between BSC financial and nonfinancial variables

The Balanced Scorecard is a strategic tool which not only includes measures but also targets leading indicators. The rationale for this is that if the leading indicators are good, then the financial measures will reflect this for future activity. Another way of expressing this is that the scorecard focuses on the drivers of future rather than past profitability. In order to further analyze and interpret variation in the dimension of financial perspectives, stop wise regression is applied to examine the independent variables of three BSC non-financial perspectives which are customers perspective (7 vectors as shown at Table 4, from B11 to B71), Internal perspective (10 vectors as shown at Table 5, from C11 to C101), innovation 7 learning perspective (9 vectors as shown at Table 6, from D11 to D91). The techniques were derived through SPSS 16.0 for Window Vista and the empirical results are summarized in Table 7.

The multiple correlation coefficients of the four independent dimensions in Table 7 of "Operating net income" are 0.754, it explain 56.8% variation of operating net income. And the explanatory power of "Rate of

delivery on time" is 36.9%, which is the highest out of the four independent dimensions. The standardize regression equation of operating net income for the sample tested in 2007 are eq. 1

$$A11= 0.24\ B51 + 0.347D21 + 0.26C41 + 0.198\ B11 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ \text{Eq. 1}$$

The multiple correlation coefficient of the three independent dimension in table 7 are 0.712, it explains 50.7% variation of "Returns of investment" and the explanatory power of "Customer retention" is 40.7%, which is the highest one among the three independent dimensions. The second one is 7.5% for "emergency response time in order processing", and the last one is 1.5% for "Productivity per employee". The standardized regression equation of "Returns of investment" for the sample tested in 2007 is eq. 2

$$A21= 0.446\ B71 + 0.223C51 + 0.203D21 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{Eq. 2}$$

Similarly, the standardized regression model of "Sales growth rate", "Earnings per share", "inventory turnover rate", "A/R turnover rate" and "Procurement Cost" are shown below:

$$A31= 0.199B71 + 0.241C101 + 0.242B11 + 0.297D21 + 0.502C11 + 0.207C41 + 0.281C21 \ldots.\text{Eq.3}$$

$$A41= 0.352D21 + 0.307B71 + 0.245C41\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{Eq.4}$$

$$A51=0.514\ B51+0.258\ C41\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{Eq.5}$$

$$A61= 0.15\ B51 + 0.317\ C41 + 0.276\ B41\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\text{Eq.6}$$

$$A71=0.439D21 + 0.368B51\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\text{Eq.7}$$

The regression analysis above showed that BSC's financial perspectives have closed relationship with non financial perspectives (customer, internal, as well as innovation & learning). The benefit that accrues from the BSC approach that they are aligned with the vision in the way not only empowers employees and customers, but also ensures that they are aligned with the vision and goals of the organization. Financial measures reflect past decisions, they tend not to focus on factors that create value. It can be concluded from the above that the measurement must be linked to strategy and that observations on achievement must be fed back to the strategy.

Discussion and Conclusion

Currently, the Enterprise resource Planning initiative is for many companies a large IT investment that radically redesigns the entire IT landscape. Past research has suggested that, on average, ERP outcomes appear to be positive are the organizational level. However, the effects of ERP vary considerably from company to company. Regarding the extent of critical measures is necessary (Rosemann & Weise, 1999). Consequently, an ERP implementation performance which only

Implementing an ERP causes changes that need to be carefully managed to reap the benefits of an ERP solution. The critical objective issues that must be carefully considered to endure successfully ERP implementation. Our study showed that the Balanced Scorecard measures across these four perspectives indicate how the ERP original implemented objectives could significantly influences the corporate

performance. On the respect of the overall 4 perspectives of balanced scorecard, the results showed that the "Requirement of supply chain management", "Requirement of e-commerce", "Reducing existing inventory cost" and "Requirements for multinational enterprise" of the ERP implementation system is a radical logistical innovation for post-ERP performance.

The finding of the present study illustrates the complexity of financial perspectives interactions among customer, internal, and innovation & learning perspectives. The focus of this study was limited to the subjective perceptions of ERP industry, which contains most of telecommunication industry. A future research study could explore the interactions between the different industries. Most ERP systems are only used in internal process integration and have not had significant collaboration with outstanding suppliers and customers; however, ERP is now moving to EERP. EERP is more focused on supply chain management. CRM and e-Commerce rather than internal business process. We suggest future researchers could discuss the performance with integration EERP systems.

By and large, Many companies are choosing to analyze ERP results, the majority the companies aren't putting mechanisms in place to realize their system's true potential. The major reasons are as :

1. The ERP was replacing traditional Management Information systems, so the initiative was more of a technical necessity.
2. The ERP was adopted to stay competitive.
3. The measurement process was considered arbitrary and specific metrics too difficult to quantify.

Reference

Kaplan, R. S., & Norton, D. P. (March 2006). How to implement a New Strategy without Disrupting your Organization. *Harward Business Review* , 100-109.

Appleton.E. (1998). *How to Survive ERP* . Datamation.

Bradford, M., & Robert, D. Does Your ERP Measures Up? . In *Strategic Finance* (pp. 30-34).

Brynjolfsson, E., & Hitt, L. (1995). Information Technology as a factor of Production : the role of differences among firms. In *Economics of innovation and New Technology* (pp. 183-200).

Brynjolfsson, E., & Hitt, L. (1996). Paradox lost ? Firm-level evidence on the to information systems. In *Management Science* (pp. 541-558).

Brynjolfsson, E., & Hitt, L. (2000). Paradox lost ? Firm-level evidence on the to information systems. In *Management Science* (pp. 541-558).

Fang,M.Y., & Lin.F. (2006). Measuring the performance of ERP System- from the Balanced Scorecard Perspectives.

Davenport,T. & Short,J (1998). Putting the Enterprise into the Enterprise System, Harward Business Review, july-August(pp.121-130)

Davenport,T. & Short,J (1998). Serving up ERP Value, COI Magazine. Vol I (pp 26-29)

Davenport,T. H (2000). Mission .Critical : Realizing the Promise of Enterpise Systems, Boston. MA,Harvard Business School Press.

Rosemann, M and Wises.J (1999),Measuring the Performance of ERP Software- a Balanced Scorecard Approach, AMR Research