IMPLEMENTATION AND ADAPTATION FRAMEWORK FOR ERP SYSTEMS IN SRI LANKAN ORGANISATIONS

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ABSTRACT

There is an increasing need to implement a total business solution, which supports major functionalities of a business. ERP software is designed to meet this need, and has been adopted by many of the large-scale organizations in Sri Lanka. Currently, ERP system implementation remains in its infancy in Sri Lankan manufacturing, services and financial sector.

Quite a few researches have been conducted to compare the implementation practices of ERP in Sri Lanka. This research shows that ERP technology faces additional challenges in Sri Lanka related to organizational, technological, cultural and basic infrastructure issues. In this research, an attempt has been made to study the methods and practices followed by Sri Lankan organizations in ERP implementation and adaptation. Research was designed to test the validity of Leonard-Barton model in the Sri Lankan context that emphasizes that successful achievement of the objectives of ERP depends on proper alignment of three dimensions namely Technology, Delivery System and Performance Criteria.

The combined methodology approach was used in this research. The case study approach was the main methodology and it was supported by the survey approach. ERP implementation criteria of four successful Sri Lankan companies were studied in-depth in order to get a comprehensive idea about the whole process. The study extended through a questionnaire survey covering another 20 organizations, which had implemented standard ERP system. The case study and results of the questionnaire data analysis clearly confirms the validity of Leonard-Barton model in Sri Lankan context. It was clearly evident that the organization must incorporate lot of planning, energy and efforts in order to align three dimensions of technology, delivery system and performance criteria which will ultimately justify the investment assuring the ultimate benefits of ERP.

INTRODUCTION

Background

Today most businesses are changing from being function driven to being process driven entities and the integration of business processes is achieved through Enterprise Resource Planning (ERP). An ERP system gets right information to the right people at the right time that results in high performance levels. (Rosario, 2000) "ERP is not a system, but a framework that includes administrative applications (finance, accounting), human resource applications (payroll, benefits), and manufacturing resource planning (MRP) applications (procurement, production planning). ERP unites major business process-order processing, general ledger, payroll, production-within single family of software modules." (Koch, 2001). Typical ERP system now

includes training, global support, an extensive list of software services and technology partners. "ERP comprises of a commercial software package that promises the seamless integration of all the information flowing through the company - financial, accounting, human resources, supply chain and customer information " (Davenport, 1998).

It must be remembered that ERP is an opportunity for business re-engineering. One gets the opportunity to restructure and reorganize people and departments to meet new challenges and global competition. (Holland, 1999) Information is a vital factor along with quality, cost, and delivery to establish competitive advantage. Today, in Sri Lanka's context, many of the organisations are facing challenging competition from global players especially due to globalisation and the open economy. Therefore, there is a rising trend in many of the services, financial and manufacturing organisations in the country to implement ERP solutions to gain competitive advantage. (Samarathunga, 2003) There are more than fifty private sector organizations that have already implemented ERP solutions within the country, (i.e., either standard systems or in-house developed systems). Today many of the leading organisations in Sri Lanka are facing problems with their existing business process structures, which are not flexible enough to perform shoulder to shoulder with their competitors in the global market.

Companies have spent fortunes on ERP software and implementation only to find that business performance has not improved at all. These large investments and negative ROIs (Return on Investment) have created a whirlpool of controversy, rampant company politics and even a number of lawsuits. The trade press has reported many negative ERP stories, and even annual reports have pointed the finger at ERP for earnings lower than expected earnings. For some, this has created a higher level of fear about making a big ERP mistake. Most of the time, ERP software vendors are the targets to blame when anticipated results do not materialize. (Joseph, 2003)

Are the ERP vendors that sold the software, the real culprits to blame for the lack of business performance improvement? The answer is, often in the negative. Certainly, it can often be argued that ERP system logic is sometimes illogical, functionality is less and so on. But accountability for ERP software selection and implementation usually lies in varying degrees with internal personnel and often with external consultants. Selecting and implementing a new ERP system, and the process changes that go with it, is unquestionably a complex undertaking. Regardless of the size and perceived resources, an ERP implementation is not something that should be approached without a great deal of careful planning. (Rosario, 2000)

Implementing an ERP means substantially changing the way of working throughout the organisation from the CEO (Chief Executive Officer) to the shop floor level employee. Unavoidably, this leads to new sets of issues in the organisation, especially because of the heavy impact on the behaviour of the entire organisation. Expected outcome will heavily depend on how the organisation would align best with organisational practices suggested by the ERP. ERP implementation in Sri Lankan organisations has started in early 1990's. Therefore ERP implementation experience in Sri Lanka is still not matured. Hence research in this arena would be highly beneficial for successful implementation and adaptation of ERP systems in Sri Lankan organisations.

THE RESEARCH PROBLEM

"Since the ERP system is a type of package software, little room exists for changing the overall technological specifics, once the technology vendor is finalized. Accordingly, how does a manager design, an implementation and adaptation framework for the successful achievement of the implementation goals of the ERP system"

RESEARCH OBJECTIVES

The objectives of this research are
- To gather, analyze and disseminate information on ERP implementation and adaptation criteria in Sri Lankan organisations.
- To understand the issues that arise during the implementation and adaptation of ERP systems in Sri Lankan organisations
- To develop a framework, which could assist corporate management in better implementation and adaptation of ERP systems in their organisations.

It is found that implementation and adaptation efforts of ERP in many of the organisations have resulted in a partial failure or in some cases total abandonment. It is found that 40 percent of all ERP installations only achieve partial implementation and that nearly 20 percent are scrapped as total failures. Others suggest that failure rate may be even higher (Trunk, 1999).

Today in Sri Lanka's scenario many of the organisations become a victim of bandwagon of ERP implementation, in their business model. As a result most of the companies go for ERP systems without properly evaluating their capabilities and competencies to ensure maximum utilisation of the new system. There are only a few companies who implement ERP, with a full understanding of the total scenario. This research study will result in a pool of facts, data, information, and opinions regarding implementation and adaptation issues in the Sri Lankan organisations. Therefore, these research findings will create opportunity for Sri Lankan organisations to be proactive on those issues and to be well equipped to face them successfully.

SCOPE OF THE STUDY

In the initial study carried out it was revealed that only the medium and large scale service and manufacturing sector organisations in Sri Lanka have implemented either standard ERP packages or in-house developed software systems. This research is confined only to organisations that have implemented standard ERP systems. There is a substantial difference in the way of implementation and adaptation criteria between standard ERP systems and in-house developed system. (Rowley, 2002) Most of the cases of in-house developed systems are developed to suit existing organisational practices and requirements. Standard ERP systems are developed to suit best organisational practices and requirements in the developed world. Being a

third world country it is obvious that systems, procedures and practices of Sri Lankan services and manufacturing organisations are not developed on par with the developed nations. Therefore, it is essential to study separately only the organisations, which have implemented standard ERP systems for the purpose of generalisation. Apart from that organisations, which have implemented three or more modules, were considered for the study.

CONCEPTUALIZATION AND FRAMEWORK FOR STUDY

Conceptual Framework

Leonard-Barton Model (Figure 2.1)

ERP is often a dynamic process of mutual adaptation between IT and the surrounding environment. Within the dynamic implementation process, the adaptation is essential because it is rare for an ERP system to match perfectly the environment of its users. Given the slim possibility of achieving a perfect match between technology and organization, misalignment can occur. Such misalignment can be rectified through technological measures, organizational measures, or a combination of both. (Leonard-Barton, 1988)
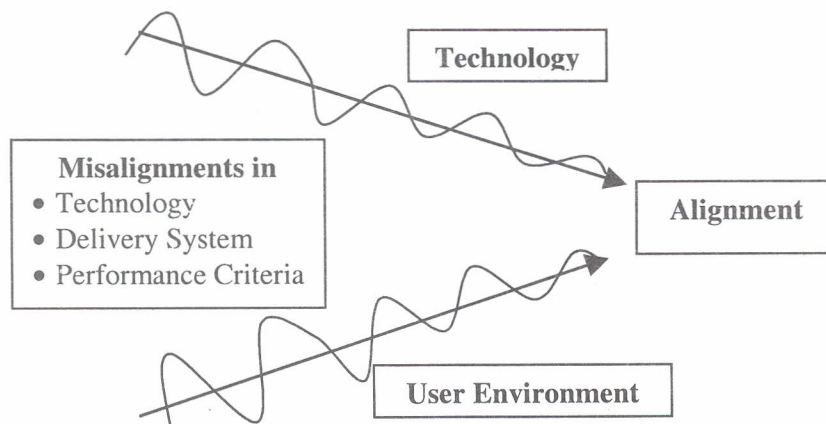
Figure 2.1. Leonard-Barton Misalignment Model in ERP Implementation and Adaptation Process. (Leonard-Barton, 1988)

Technology: This dimension is concerned with, how far, built in knowledge & applications of the new system match the competency & capability level of users of the organisation. This includes the technology with its original specifications or with the service or production process into which it is introduced and the extent of possibility of integrating the new ERP system with legacy systems. (Leonard-Barton, 1988)

Delivery system: This dimension has a major impact on ERP success. The technology with user organization infrastructure, human resources, managerial techniques and entire behaviour of the organisation is covered under this dimension. Mainly the actual project implementation stage is covered under this dimension. Project management, involvement of consultants, upper management support, user training, IT infrastructure, new systems-procedures establishment, etc, are considered. (Leonard-Barton, 1988)

Performance Criteria: Performance measuring criteria of the user organization. This dimension mainly concerns about the ways in which organisation measure its performance and to which extent new ERP system has helped to improve the performance. (Leonard-Barton, 1988)

This adaptation process is viewed in terms of cycles of misalignments and it adjusts itself to compensate for minor defection in misalignment mainly through the continuous alignment within. The adaptation process evolves over time in response to interruptions from technology, delivery system, and performance criteria, and the interaction between technology and users' environment displays a recursive cycle. The Leonard-Barton model depicts that types of misalignment can be rectified from the large or small cycles until the final alignment status is reached. Further, these three dimensions are classified into set of key critical factors as shown in Table1 (Chin-Fu & Hsiung, 2003). Survey questionnaire was mainly designed based on these critical factors.

Additionally, any given dimension of misalignment is featured with an automatic adaptation mechanism. However, the ERP system belongs to a type of package software, and the available configuration and process parameters do not permit modification of the basic system framework. Moreover, ERP is quite a complicated system, and the technology, delivery system and performance criteria all influence one another in its implementation. The successful implementation of ERP benefits significantly from the harmonious interaction among these three dimensions, but not from the adaptation of any single dimension. For example, consultancies must understand ERP system and organizational performance criteria well enough to implement ERP smoothly. In fact, effective linkage among technology, delivery system and performance criteria is the responsibility of management. The implementation of highly complex organizational innovation is a process of internal diffusion. That is, the implementation requires the participation of numerous organizational members to be successful. Management must provide an environment conducive to innovation and focus their attention on members' acceptance of innovation (Leonard-Barton and Descamps, 1988). Consequently, management must exert its influence to address the issues related to the technology, delivery system and performance criteria inorder to align them (illustrated in Figure 2.2), resulting successful achievement of the objectives of the ERP system.

DIMENSION	CRITICAL ISSUE	CRITICAL FACTOR
Technology (X)	Adequacy for specification (X1)	* Technical specification (Leonard-Barton, 1988) * Customization (Holland and Light, 1999, Somers and Nelson, 2001)
	User's maturity for the application of new technology (X2)	*User's maturity against the application of new technology (Leonard-Barton, 1988; Cole-Gomoiski, 1998)
	Evaluation and integration for legacy system (X3)	Evaluation and integration of legacy system (Holland and Light, 1999; Sprott, 2000)
Delivery system (Y)	Role of the MIS / IT department in organization (Y1)	* IT infrastructure (Leonard-Barton, 1988; Caron, 1994; Broadbent , 1999; Holland and Light, 1999) * Enterprise vision and strategic goals (Holland and Light, 1999)
	Process adaptation (Y2)	* Information transparency business process redesign (Hammer and Champy, 1993; Bingi, 1999; Somers and Nelson, 2001)
	Harmonious implementation (Y3)	* Upper management support for implementation (Somers and Nelson, 2001)
	System establishment (Y4)	*Implementation tools and methodologies (Holland and Light, 1999;)
	Project management (Y5)	* Project team ability (Somers and Nelson, 2001) * Project management (Ryan, 1999; Somers and Nelson, 2001)
	Employee education and training (Y6)	Employee education and training (Leonard-Barton, 1988; Davenport, 1998; Bingi, 1999)
	External partner support (Y7)	* Software vendor support (Bingi , 1999) * The ability of consultancy (Bingi ., 1999), The collaboration of external partner (Bingi , 1999)
	Internal staff involvement (Y8)	* Participation and coordination of internal staff (Grover et al., 1995; Bingi, 1999; Kumar and Hillegersberg, 2000) * Quality and suitability of internal staff, and human resource management (Appleton, 1997)
Performance criteria (Z)	Performance evaluation (Z1)	* Impact of performance criteria on technology and delivery system (Leonard-Barton, 1988) * Assessment of system performance (Leonard-Barton 1988)

Table 1 . Critical Factors of ERP Implementation and Adaptation.
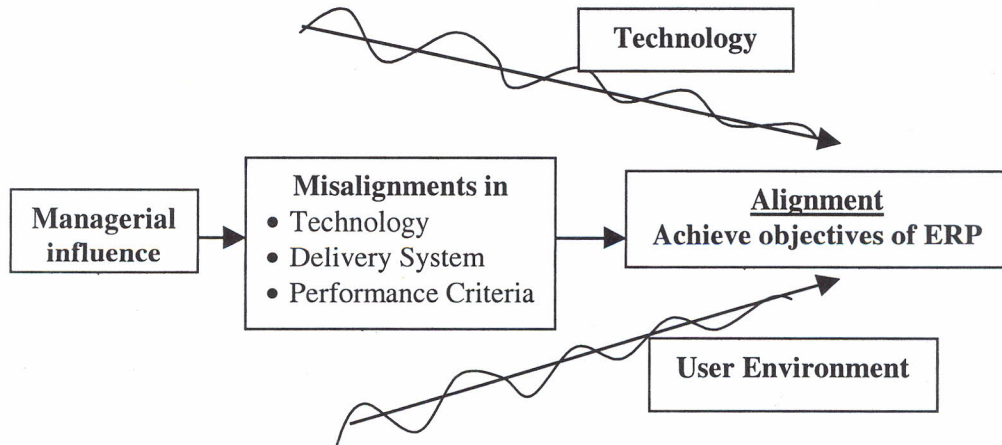
Figure 2.2. Achieving Objectives of ERP Through Alignment of Three Dimensions of ERP Implementation.

RESEARCH DESIGN AND METHODOLOGY

Combined methodology approach has been applied for the research, namely: case study method and survey method. The case study methodology is supported by results from the survey methodology. Four cases have been in-depth analyzed with the guide of the conceptual model.

Case Study Methodology

Currently, ERP system implementation remains in its infancy in Sri Lankan manufacturing and services sector. Both, mature theory development and support from empirical studies continue to be required. The analogy of falling short of theoretical support can also be applied to Sri Lanka. Moreover, implementing ERP systems can influence the entire organization; thus leading to a large set of variables being required to address implementation and adaptation related issues. Given such consideration, case study approach is the most suitable research methodology.

Case Selection

All four organisations selected for in-depth analysis are from the manufacturing sector due to the following reasons.

1. Majority of the ERP implementation has taken place in manufacturing sector organisations in Sri Lanka
2. Most successful cases can be found in manufacturing sector
3. These companies use renowned ERP systems
4. Easy accessibility of data and information

Collection of Data

To expand the scope of the study and minimize any data bias, a triangulation approach was adopted. Primary data has been collected through questionnaire-cum-semi-structured interviews and observations.

Multiple methods were used to collect data for this study. These methods included direct participation of one organisation and only observations of another three organisations by author. Freedom was given to access historical documents and other records including financial data, and non-personnel related operations statistics. Author was a core team member of the ERP project implementation team and participated in all the ERP strategy level meetings to regularly scheduled project-team meetings. Ongoing, open-ended interviews were also held with corporate officers, divisional managers, project-leaders, super-users, consultants and various project team members both during and after the implementation of the ERP projects. These interviews permitted to identify and frame the important issues and factors that affect ERP implementation success as suggested by Leonard-Barton (1988).

Questionnaire Survey

The field survey involved the investigation of ERP implementation from a large array of services and manufacturing industries: chemical, garments, cement, glass, services, milk products, financial etc. Most of the organizations were large or mid-sized.
Questionnaire was created based on already established Leonard-Barton's models and survey of literature. Questionnaire was first pre-tested running a pilot survey on six organisations from the actual sample to be interviewed for checking its reliability and content validity.

DATA ANALYSIS

Questionnaire Survey Data Analysis

Data from twenty organisations were considered for the analysis. Points were allocated for each question and final score sheet was shown in Table 2.

Mainly the Likert technique was used to capture the response for the questions in the questionnaire. Respondents were asked to express agreement or disagreement in five-point scale (i.e. 1,2,3,4,5 depending on the choice ranging from 1 for strongly disagree, 2 for tend to disagree, 3 for neutral, 4 for tend to agree and 5 for strongly agree). Each degree of agreement is given a numerical value from one to five.

	Organisation	Technology (X)	Delivery system (Y)	Performance criteria (Z)	ERP measure of Success (S)
1	A	89	85	87	89
2	B	91	81	83	82
3	C	87	73	87	84
4	D	87	85	80	80
5	E	73	71	73	76
6	F	82	83	80	82
7	G	78	80	73	76
8	H	84	78	93	93
9	I	89	84	77	80
10	J	82	80	77	78
11	K	89	74	80	82
12	L	87	80	73	76
13	M	82	74	83	82
14	N	84	74	70	76
15	O	73	68	63	69
16	P	71	75	63	67
17	Q	76	78	73	78
18	R	69	65	60	64
19	S	56	63	60	64
20	T	67	65	57	62

Table 2. Values of X, Y, Z and S

With the help of experts in ERP arena, minimum expected level of score for each of the question in the questionnaire was determined. Thus the minimum score for successful implementation of each dimension is calculated and shown in Table 3. Each dimension must be scored above their respective minimum levels to get identified as successful implementation.

	No of questions in the questionnaire	Minimum expected scores
1. Technology (X)	9	73
2. Delivery system (Y)	16	70
3. Performance criteria (Z)	7	70
4. ERP Measure of Success (S)	9	71

Table 3. Minimum Expected Scores for X, Y, Z and S

As per Table 2, except organisations No.16, 18, 19 & 20 all others have scored above the minimum level of score for technology dimension and except organisations No. 15, 18, 19 & 20 all others have scored above the minimum level of score for delivery system dimension and except organisations No. 15, 16, 18, 19 & 20 all others have scored above the minimum level of score for performance criteria dimension. Out of the 20 organisations, 15 organizations have been successful in aligning all three dimensions resulting success in ERP implementation and

adaptation. Two organizations namely No.15 & 16 has failed in aligning two dimensions and one dimension respectively, and both the organisations not succeeded in ERP implementation. Organisations No. 18, 19 & 20 have failed aligning any of the dimensions and also ended up as unsuccessful ERP projects.

Statistical Analysis of Data

Regression Analysis

As in this research study, author considered one dependent variable, (i.e., Measure of ERP Success) and three independent variables (i.e. 1. Technology Dimension, 2. Delivery System Dimension and 3. Performance Criteria Dimension). Those variables were measured by allocating of points as per the structured questionnaire.

The First-order Multiple Regression Model with three independent variables can be represented theoretically as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i \quad \text{where,}$$

Y_i denotes Measure of ERP Success X_i denotes Technology Dimension
X_2 denotes Delivery System Dimension X_3 denotes Performance Criteria Dimension

X_{1i}, X_{2i} are the values of effective factors of technology and issues of technology respectively for a SME or an Organization in the ith trial. β_0, β_1, β_2 and β_3 are the parameters and ε_i is the error term.
Further, the multiple regression models with (p-1) independent variables can be represented as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots\dots\dots\dots \beta_{(p-1)i} X_{(p-1)i} + \varepsilon_i$$

(Draper, N.R. and Smith, H, 1990).

Correlation Analysis

To measure the strength of the linear association between two variables is the correlation analysis, and for that purpose the Pearson Correlation Coefficient, r, can be used. Author has calculated Pearson Correlation coefficient between dependent variable (i.e. ERP Success) and to each of the independent variables. (i.e.1. Technology Dimension, 2. Delivery System Dimension and 3. Performance Criteria Dimension).

The Pearson Correlation Coefficient, r, lies between –1 and 1, and with 1, -1 indicating perfect positive and negative associations respectively (Mood, A.M. and Boes, D, 1985).

Data Analysis Through Statistical Software, Minitab 13.20

Variable are defined following manner.
     Y_i denotes Measure of ERP Success X_i denotes Technology Dimension

X_2 denotes Delivery System Dimension X_3 denotes Performance Criteria Dimension

	X1	X2	X3
X2	0.786		
X3	0.806	0.686	
Yi	0.814	0.717	0.983

Table 4. Pearson Correlations: X1, X2, X3 and Yi

Regression Analysis: Yi versus X1, X2, X3

Predictor	Coefficient
Constant	12.594
X1	0.01096
X2	0.09320
X3	0.75694

Table 5. Regression Analysis Data

R-Sq = 97.0%

The regression equation is:
$Y_i = 12.6 + 0.0110\ X1 + 0.0932\ X2 + 0.757\ X3$

Evaluation of Findings

On the regression analysis for Measure of ERP Success revealed its coefficients of determination, $R^2 = 97.0\%$. This shows that 97.0 % of the total variance in the case of ERP Success is determined by the Technology Dimension, Delivery System Dimension and Performance Criteria Dimension. Rest of the 3% is determined by the other factors, which were not explained under this survey study and the conceptual model.

In other words, this proposed conceptual model predicts that 97.0 % of the Success of ERP depends on the Technology Dimension, Delivery System Dimension and Performance Criteria Dimension. The balance of 3.0 % in the case of Success of ERP may be determined by the other factors like the political, social, cultural & the readiness of technological implications etc.

DISCUSSION OF THE CASE STUDY

The four companies under in-depth study are manufacturing organisations with annual turnover ranging from SLR 1 billion to SLR 6 billion. The companies also had different prior experiences

with operations integrating IT technologies such as MRP/ MRPII. Four companies under study use three different ERP solutions namely SAP R 3, PRMS and MFG-Pro.

Evaluation of the Model With Reference to Four Organisations under Study

Technology Dimension

Findings based on case studies of those four companies indicated that learning of a built-in management mechanism is an important phenomenon in the implementation process. For example, process redesigns in procurement management, warehousing management, and delivery management in company A, the redesign in order processing in company B and company C, and the redesign in material procurement in company D, were all attributed to the impact of learning. The choice of ERP system made by company A and company C was based partly on their legacy systems operated platforms, besides their consideration of manufacturing functions. On the other hand, the legacy systems of company B and company D were focused on database function.

In the four case studies presented here in, the companies assessed the ERP system functions and the best methods of integrating their legacy systems based on their individual perspectives. An ERP system was selected for implementation based on this process of evaluation.

Delivery System Dimension

The case studies presented here indicate that BPR (Business Process Reengineering) is critical to process integration. Company A, Company C and Company D learned to use the built-in management mechanism of the ERP system as a guide to modify their processes, but only followed the advice of consultants and did no effective preparation on their own initiative before implementing BPR. The lack of initiative in their learning process caused turbulence during their implementation of ERP. Although learning the built-in management mechanism was part of the BPR effort, company B redesigned the processes according to its own requirements while learning the ERP system.

Well-planned adaptation of company B was associated with smoother process integration than what was achieved by the other three companies, as well as with other benefits such as reduced implementation time.

For company A, C and D outside consultants directed ERP implementation, while the IT departments played a supporting role. Then the task of IT departments thus was limited to evaluating ERP system and providing administrative support for the implementation project. The IT departments lacked the power to guide the project. In comparison, the IT department of company B was fully authorized for IT transfer and steering committee was formed for ERP

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implementation and adaptation process. Prior to implementation, the CEO of the company B established its strategic plan for IT implementation. As a part of the strategy one of the assistant production manager from the production division was appointed as the ERP project champion and released full time for the ERP implementation project. During the implementation process, the IT department helped to enhance internal business processes by learning from the built-in management mechanism of the ERP system. Therefore, the IT department of company B exerted a better ability to coordinate the ERP implementation than done by the departments of company A, company C and company D. Accordingly, company B enjoyed smoother BPR process and shorter implementation time compared to the other three companies.

In all four cases, all the companies used standard project management methodologies. Project team members were dedicative and task oriented. Project promotion should consider timing and organization skills. Change that is associated with strong pressure from upper levels of the hierarchy is likely be challenged by employees, while a well-planned approach to change, which reserves room for negotiation, will meet with less resistance.

The top management in company B has provided comparatively higher support for the implementation project. Furthermore, the IT department in company B has obtained delegation of authority to direct ERP implementation. Therefore, the project management team of company B exerted a better ability to coordinate the ERP implementation than its counterparts in company A, C and D. Accordingly, company B enjoyed smoother BPR process and shorter implementation time compared to the other three companies.

The case study companies generally believed that the training of KUs (Key Users) and their instructional role in the work place significantly helped organizational learning atmosphere. All four companies followed a similar pattern. Outside consultants first engaged in knowledge transfer to the IT department's personnel and KUs through formal training. KUs returned to their various departments and passed their experiences onto their colleagues through formal or informal training. The case results suggested that KU has become a mentor performing ERP related knowledge transmission, leading to creation of a new learning atmosphere in the organization.

Performance Criteria Dimension
Learning the built-in management mechanism combined with process reengineering was achieved into accepTable level by all four cases. Combining both ERP system and process reengineering factors helps to form a managerial adaptation mechanism, contributing to process integration and eventually improving organizational performance.

All four cases clearly have shown the system performances are remarkable and impacted on improving the core competencies of each organisation.

Common Traits from the Cases

Analysing the data from these four cases reveals the following four common characteristics:
(1) Learning business processes embedded in ERP system provides foundation for technology adaptation of each company

Clearly, process reengineering in individual companies depends on learning the built-in ERP process. Because in Sri Lankan context, the existing working practices, working culture is substantially different from that of from developed nations. This feature of process reengineering is totally different from the traditional enterprise information implementation in which the implemented software is modified based on previously defined user requirement for business process, thus supporting processes unique to a particular company. Conversely, the implementation of the ERP system focuses   following the best practices embedded in the system software, which are based on industry domain knowledge.

(2) The coordination function of the IT department and KU's guiding help to promote organizational learning

Learning exists in the system delivery process in all four cases. The purpose of learning is to provide training in learning the ERP system and to provide preparation for BPR. The importance of the IT department lies particularly in its coordination function, which provides administrative support for both training and BPR. The KU can furnish guidance for individual department users. The formal and informal channels form the organizational learning environment, whereas the IT department serves the former and the KU provides the latter.

(3) Solution for system inadequacy

Since the ERP package may not satisfy all the requirements of a business, companies can develop their own solutions or adopt plug-in programs to compensate for the inadequacy of system functions. This customization approach seems to be a common practice because each ERP has a close centralized system framework, and direct modification of the program source codes, which causes maintenance difficulty. Consequently, whether self-development or plug-in solutions are adopted, the customization of ERP systems always employs the module-based approach to ensure the system maintainability.

(4) System migration and organization resistance

When the legacy system is migrated into the ERP system, data inconsistencies can occur when transferring old data to the new system, because of differences in data formats. System migration also tends to cause organizational resistance because of the built-in system processes disrupting current business processes and thus changing corporate power structure. Following the ERP system requirement, the standardization of input data solves the problem of data inconsistency. In all four cases the problem of organizational resistance was resolved or minimized by CEO support and effective coordination from the IT department. Additionally, the KUs fulfil an informal role in reducing organizational resistance since they can penetrate deep into each department and interact with the staff.

CONCLUSIONS

Finding through the questionnaire data analysis and findings of case discussion are brought together with a view to arrive at final conclusions.

Deep analysis was done on the criteria followed by the four organisations to handle the issues relating to technology dimension, delivery system dimension and performance evaluation dimension during ERP implementation and adaptation process.

It is interesting to see the results of data analysis of the 20 organisations data collected through the questionnaire survey. Out of the 20 organisations, 15 organisations have been successful in aligning all three dimensions resulting success in ERP implementation and adaptation. One organisation has failed in aligning one dimension and also failed in ERP implementation. Another organisation has failed in aligning two dimensions and also not success in ERP implementation. Three organisations have failed aligning any of the dimensions ending up with an unsuccessful ERP project. This is a very clear evidence to say all three dimensions need to be aligned altogether for success in ERP implementation and adaptation as mentioned in Leonard-Barton model.

Therefore both the case study and results of the questionnaire data analysis clearly confirm the validity of Leonard-Barton model in Sri Lankan context which emphasis that successful achievement of the objectives of ERP depends on proper alignment of three dimensions of Technology, Delivery System and Performance Criteria one another in ERP system implementation and adaptation process.

RECOMMENDATIONS

Implementation and Adaptation Framework for ERP

The implementation of ERP system itself is often costly, hence whether the project results match with the implementation purpose must be considered. To relieve the constraints imposed by the ERP system, enterprises must assess the technological and organizational dimensions. The technological compatibility between ERP and organizations should be considered, as should the organizational BPR problem. Managerial adaptation in the management endeavours dedicated to eliminate discrepancies between these two dimensions. Strategies for managerial adaptation in Sri Lankan context can be based on the proven model in this research.

Technology Dimension: Misalignment in the technological dimension is mainly caused by constraints based related to the design goals and application domains of the ERP system. This intern indicates the importance of the system compatibility problem and the issue of the learning

management mechanism. This study argues that the compatibility between ERP system specifications and organizational requirement and the learning of the suggested management mechanism of organization management tend to have a positive relationship with process integration, leading to improvement in organizational performance.

Delivery System Dimension: The misalignment in the delivery system dimension is mainly because of the difference between the best practices suggested by the ERP system and existing business processes, combined with the process changes implemented by the ERP system. Consequently, the ability to manage organizational change, the coordination function of the IT department, and KU's role in knowledge sharing and distribution become important issues. This study argues that the capability to manage organizational change, the coordination function of the IT department, top manager support and KU's role in knowledge diffusion tend to be positively related to process integration.

Performance Criteria Dimension: The managerial adaptation mechanism is based on the system compatibility and suggested best practice factors in the ERP system dimension, and the reengineering factors in the delivery system dimension. The synergy is the improvement achieved through IT-enabled business process integration and change management approach to ERP implementation. Successful implementation of the ERP system will produce an environment where IT efficiently supports streamlined business processes.

Teamwork and composition in the ERP implementer-vendor-consultant partnership is a key factor influencing ERP implementation success. Good coordination and communication between the implementation partners need to be improved. Since ERP covers a wide range of functional areas, it is also important to have a cross-functional ERP core team. It is extremely critical that partnership trust is present and the team members are working well together. This is one of the missing features experienced in Sri Lankan scenario. The change management program and influence on cultural changes also play a key role. Change agents should also play a major role in the implementation to facilitate change and communication and to leverage the corporate culture. First of all, change agents need to change themselves and must be convinced on the new system.

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