

FEASIBILITY ASSESSMENT MODEL FOR SUCCESSFUL ADOPTION OF INFORMATION SYSTEMS IN SMALL AND MEDIUM ENTERPRISES

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ABSTRACT

Small and Medium Enterprises (SME) have been recognized as an important strategic sector for promoting growth and social development in Sri Lanka. In the meantime IT has enabled the development of powerful and efficient Computer Based Information Systems (CBIS) which play a major role in business performance improvement. However, it can be seen that majority of SMEs have not adopted CBIS and also not all who have adopted have been successful. Therefore, this research is undertaken to develop a feasibility assessment model by which an SME that is considering adopting CBIS will be able to assess whether the adoption is feasible. Firstly, the influential factors at the phases of Pre-implementation, Implementation & Post-implementation and their level of significance were identified. The factors were evaluated and their importance and the level of influence caused were identified through a survey of SMEs which have already been implemented CBIS. Based on the results of the analysis a CBIS Feasibility Assessment Framework has been developed that would assist an SME to know its level of feasibility before adopting CBIS. Top management support and System Complexity proved to have impact in all three phases of CBIS adoption and mainly it was the Pre-implementation and/or Implementation capabilities that showed significant correlation with the system adoption success.

Keywords: SME; Computer Based Information Systems; Feasibility Assessment Framework

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INTRODUCTION

According to Organization for Economic Co-operation and Development (OECD), in all countries including the developed nations, Small & Medium Enterprises (SMEs) play an important role. Their dynamism has been recognized as an important contribution towards employment generation, revival of certain regions and technological progress. Hence, SMEs have been recognized as an important strategic sector for promoting economic growth and social development by means of generating high economic growth and reducing unemployment, poverty and inequality. However, still they are considered to be less dynamic and underdeveloped compared to large scale organizations (Task Force for SME Sector Development Program 2002). This could be due to the limitations they face in growth and expansion resulted by problems relating to product and factor market. Nevertheless, over the years SMEs have become a major source of income and employment generation. The SMEs cover a broad range of economic activities such as agriculture, manufacturing, health care, mining, construction and service sector.

With today's rapid technological development, Computer Based Information Systems (CBIS) have become an essential tool in the business world. Such systems can provide companies including SMEs with the ability to face competition successfully by equipping them with a wide range of possibilities for improving their competitiveness. However, it can be seen that not all SMEs have adopted CBIS and also not all who have adopted have been successful (Krauth 1999, Bronte-Stewart 1998). In many cases, these systems are used only for basic functionalities. In developed countries the situation is much favourable yet when compared with large scale firms, small and medium firms are far behind in using Information Systems (Fulantelli & Allegra 2003). Statistics have shown that in enterprises with more than 200 employees, an effective use of information and communication tools is more frequent.

Even though research finding shows that CBIS can play a major role in business performance improvement, it can be seen that majority of SMEs in Sri Lanka have not adopted CBIS and also not all who have adopted have been successful. Therefore, the objectives of this research are to assess factors that affect the successful implementation of CBIS in SMEs and to develop a feasibility assessment model by which an SME will be able to assess whether the adoption of CBIS is feasible.

Definition of SME

There is no universal definition for small and medium scale enterprises. SME definition can vary among different countries as well as within the country. There are mainly three criteria used to define SMEs.

- I. Number of employees
- II. Annual turnover
- III. Asset value

One or more of these criteria can be used to define SMEs. For the purpose of this research however, the definition used by the white paper on the National Strategy for Small and Medium Enterprise Sector Development in Sri Lanka is used with some amendments. The definition is illustrated in Table 1.

The main reason for this definition to be adopted is because it has been developed by the said white paper as a step in creating a national definition for SME. However, the definition has been amended mainly due to the fact that the above stated white paper has been published in 2002 and by now the inflation has changed the rupee value.

Table 1 – Definition of SME adopted in this Research

Criterion	Small Enterprises	Medium Enterprises
Employment	1-29 persons	30-150 persons
Assets Value (excluding land and building)	maximum assets value – Rs.35 million	maximum assets value – Rs.70 million

Computer Based Information Systems (CBIS)

Kimble and McLaughlin (1995) based on their study on implications of the use of Information Systems for managers' work, argue that the impact of information systems is not a single stable and predictable outcome but a non-linear ongoing process that changes and evolves over time. Therefore, the focus of this research is on information systems considered as tools to collect, classify and distribute information crucial for the smooth working of the enterprise and for proper decision making.

With the continuous enhancements in versatility, ease of use of hardware and software, greater computer literacy of end users and trend of providing more user oriented computing services, CBIS have more substantial value to organizations than in the past

(Kraemer *et al.* 1993). Moreover, in many organizations the quality of computer based information is considerably higher. The use of information systems provides improved quality and timely information for decision making while freeing up more time for other value adding activities in the organization (Dopson *et al.* 1993). A strong relationship was revealed between IS service quality and perceived performance of the organizations and safe use, interaction, accuracy and functional coverage were found to be the most impactful factors for IS service quality (Weerakoon & Wijayanayake 2013a, Weerakoon & Wijayanayake 2013b). Furthermore, since most of such system adoptions require new skills, it increases the capability of the organization as well.

IT/IS Adoption in SME

Today competition in the business world is much intensive. Furthermore, SMEs face the challenge of globalization which requires them to create new alliances and forms of cooperation. In such case, Information and Communication Technology (ICT) is an important tool that enables the integration at different organizational levels which enhances enterprise competitiveness (Ruvirini *et al.* 2005). The benefits offered by IT encourages IT growth in small firms (Fink 1998). However, in a lot of cases in SMEs in Italy, information technology is used only for basic functionalities and not to improve internal and external communication or to activate new information services (Fulantelli & Allegra 2003). Meanwhile several surveys carried out during the nineties have showed that IT often did not deliver what was expected by small and medium organizations (Krauth 1999).

Previous studies have identified certain factors that affect Information Technology (IT) / Information Systems (IS) adoption in the general context as well as specifically in the SME sector (Montazemi 2006, Baki & Cakar 2005, Yap *et al.* 1992, Fink 1998, Esteves-Sousa & Pastor-Collado 2000, Krauth 1999, Thong & Yap 1995, Cragg & King 1993). Furthermore, there are few studies that identified factors affecting Information Systems in Sri Lankan context (Vithanage & Wijayanayake 2006, Vithanage and Wijayanayake 2007, Dassanayake & Wijayanayake 2008). According to these findings, the presence or absence of these factors can lead to success or failure of CBIS adoption. Most of these factors have been considered for this research study as well.

Some of the factors identified are common to many studies. Further analysis of these research papers indicate that many Asian studies have focused more on the CEO's role in IT adoption. The CEO's characteristics, his knowledge on IT and his attitudes towards IT have been identified to have major influence. Moreover, these studies identify financial resources and size of the firm as important influences as well. The fact that the definition of SME is different in these studies may have been one reason for the differences in the factors recognized (Montazemi 2006, Baki & Cakar 2005, Yap *et al.* 1992, Fink 1998, Esteves-Sousa & Pastor-Collado 2000, Krauth 1999, Thong & Yap 1995, Cragg & King 1993)

RESEARCH METHODOLOGY

Initially, factors influencing successful CBIS adoption by SMEs were identified through a literature review. For successful adoption of CBIS, not only readiness but successful implementation and maintenance are important (Nicolaou 2004, Schneider & Sarker 2005), therefore, factors influencing at pre-implementation, implementation and post-implementation stages were identified. The literature available mainly focused on developed countries; hence applicability of these factors in developing countries may become an issue. Moreover, there could be other factors that may not have been identified in earlier studies yet have influence especially from the cultural and social perspective. Therefore, an expert opinion survey was conducted to improve the validity of the research.

Six experts with expertise in computer based information systems and experience in the local SME sector contributed to the expert opinion survey. The sample of experts included; 2 Academia, 2 IT Project Managers and 2 IT Consultants.

With the results of the expert opinion survey and literature review findings the conceptual model was developed (Figure 1). The main influential factor dimensions were identified as;

- Organizational – *organizational characteristics and capabilities of the firm*
- System – *characteristics of the CBIS to be adopted*
- Technological – *technological capabilities of the company*
- Human Resource (HR) – *characteristics and capabilities of the company*

HR

- External – external environmental factors / characteristics

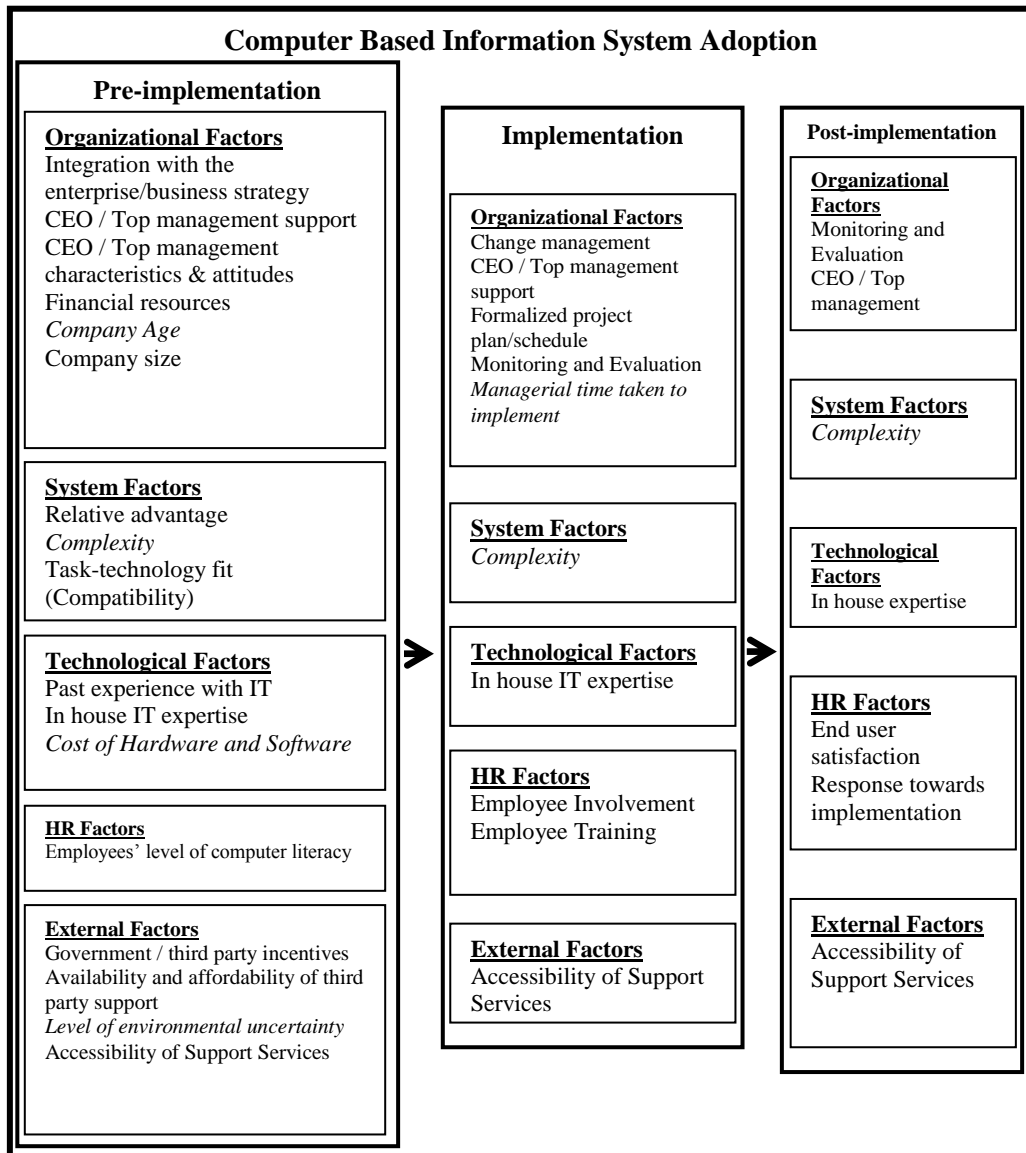


Figure 1: The Conceptual Model

According to Thong & Yap (1995), Organizational characteristics are found to have influence on CBIS adoption and its success. As Organizational factors, Integration with the enterprise/business strategy, CEO / Top management support, CEO / Top management characteristics & attitudes, Financial resources, Company age, Company size, Change management, Formalized project plan/schedule, Monitoring

and evaluation and Managerial time taken to implement were highlighted in the expert opinion survey to have major impact.

Technological factors are another important aspect that influences CBIS adoption success (Montazemi 2006). Past research by Fink (1998) has revealed that Past experience with IT, In house IT expertise and Cost of Hardware (HW) and Software (SW) have high influence and the local experts participated in the survey were of the same opinion. According to Montezemi (2006), Individual domain or HR characteristics also play a major role in CBIS adoption. The main factors considered for this study are Employees' level of computer literacy, Employee involvement, Employee training, End user satisfaction and Response towards implementation.

The System factor category was identified in the expert survey to have significant impact on CBIS adoption and its success. The main causes identified were Relative advantage, Complexity and Task-technology fit (Compatibility). External environmental factors are also a major cause for CBIS adoption (Fink, 1998). The main external environmental factors identified to have influence were Government / third party incentives, Availability and affordability of third party support, Level of environmental uncertainty and Accessibility of Support Services.

The three phases considered in the model can be explained as thus;

Pre-implementation – The phase in which the organization considers the possibility of implementing a CBIS (till the final decision is taken).

Implementation – The period after deciding on a CBIS till the implementation has completed. This would include requirement specification period, design phase, instalment and testing phases.

Post-implementation – Post-implementation stage is the period after all testing and modifications have taken place till the system is obsolete and replaced.

The research model was built based on a literature review and a perception survey; hence the factors and their importance may not necessarily be the same in the real world scenario. Therefore, the model was validated further through a survey of SMEs already having information systems in order to verify whether in the practical scenario these factors are really influencing CBIS adoption success.

Population & Sample

SME population consists of thousands of companies but the proportion of IS users is quite small as there are only six SMEs out of thirty SMEs provided by SMED (Small and Medium Enterprise Development Project in Sri Lanka) for this research study have information systems. Therefore, a sample that would represent the population's key characteristics as much as possible has been selected for this study. The sample for the survey had been selected such that it included,

- Small enterprises & Medium enterprises
- Managerial level & Non Managerial level employees
- Companies belonging to Manufacturing, Trading & Services sectors

A total of eleven companies participated in the SME study. From each firm, at least two employees from managerial and non-managerial levels were selected for the survey. The total number of participants therefore had been thirty.

Variables & Measures

In order to test the relationship between factors identified and the success of system adoption, each factor measurable variable/s were selected. Derivation of variables was based on well known books, articles and research papers. (Fink 1998, Montazemi 2006). For variables identified, associated weights were also extracted. For some factors more than one variable has been identified and therefore, weights had to be used for compounding of feedback before the data analysis phase to create an aggregate value to represent the factor response. The following criteria were used to measure CBIS adoption success as previously used by (Fernandez & Thomas 2008):

- 1) Whether the intended business performance improvements were achieved
- 2) Completion of system adoption within the budget
- 3) Completion of system adoption within time
- 4) Reliability of the system

Data Collection Procedure

A questionnaire was used as the data collection tool for the SME survey. For this, the variables identified for each factor were mapped into simple questions to be used in the questionnaire. However, it was facilitated by personal interview mainly to eliminate the drawbacks of using just a questionnaire, such as ambiguous interpretations and misunderstanding. This ensured that all distributed questionnaires were collected, technical jargons were clearly and meaningfully interpreted and all questionnaires were completely and accurately filled.

Data Analysis Techniques

For each factor identified from the literature review and the expert survey, the strength of its relationship with system adoption success was tested. The collected data is qualitative and therefore, non parametric correlation has been used. The non parametric correlation method used for this study is Spearman's Rank Correlation Coefficient also known as Rank-Order Correlation.

DATA ANALYSIS

Sample Statistics

The survey sample consists of Manufacturing, Service and Trading sectors. The majority had been from the Manufacturing Sector (50%) while 33% belonged to Service Sector and 17% were from Trading. 67% of the sample was companies with 30 – 150 employees and the balance 33% have less than 30 employees while 58% possessed an asset value of Rs.35 million to 70 million and the balance 42% possessed less than Rs. 35 million.

From each company both managerial level employees as well as non managerial employees participated in the survey with the total number being 26. 54% of the participants were of managerial level while the remaining 46% were non managerial employees. Furthermore, the sample included a variety of information systems such as HR systems, Accounts systems, Marketing/Sales systems, Inventory systems and integrated systems etc.

Analysis of Factors

Each factor of the conceptual model was analyzed using Spearman Correlation Coefficient, a non parametric method with SPSS 10.0 package. The factors and the assigned variable names are given in Table 2. The resulted correlation coefficients for the factors are depicted in Table 3, Table 4 and Table 5.

Table 2: Factors and variable names

PRE IMPLEMENTATION			
CBIS Adoption	A01	Complexity	V09
Integration with business strategy	V01	In house expertise	V10
Top management support	V02	Past experience with IT	V11
CEO characteristics and attitudes	V03	Cost of HW and SW	V12
Financial resources	V04	Employee computer literacy	V13
Company age	V05	Availability and affordability of third party support	V14
Company size	V06	Government/third party incentives	V15
Relative advantage	V07	Environmental uncertainty	V16
Compatibility	V08	Accessibility of support services	V17
IMPLEMENTATION			
Change management	V18	Complexity	V09
Top management support	V19	In house IT expertise	V23
Monitoring and evaluation	V20	Employee training	V24
formalized plan	V21	Employee involvement	V25
Managerial time taken to implement	V22	Accessibility of support services	V26
POST IMPLEMENTATION			
Top management support	V27	End user satisfaction	V30
Monitoring and evaluation	V28	Response towards implementation	V31
In house IT expertise	V29	Accessibility of support services	V32
Complexity	V9		

Among the factors identified through literature review and expert opinion survey to have influence in the pre-implementation stage, at 0.01 significance level, Integration with business strategy, Top management support, CEO characteristics and attitudes, Relative advantage, Complexity and Availability & affordability of third party support proved to have significant positive correlation with CBIS adoption success while Cost of HW and SW and Company size and complexity depicted strong

negative correlation with CBIS adoption success. At 0.01 significance level, Top management support and Employee training proved to be strongly correlated positively with CBIS adoption success while Change management and Employee involvement have strong positive correlation with CBIS adoption success at 0.05 significance level among the implementation factors. Among the post implementation factors, End user satisfaction had the highest correlation of 0.686 with CBIS adoption success at 0.01 significance level while Top management support and Response towards implementation proved to be strongly correlated with CBIS adoption success at 0.05 significance level.

Company Age showed a weak negative correlation of -0.228 with CBIS adoption success. One reason could be that the sample did not comprise of firms with more than 50 years of age or it could be that with time, even the more established old firms have the capability of converting from their traditional manual practices to IT oriented systems.

Table 3: Correlation Coefficient Matrix for Pre-implementation Factors

	A1	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17
A1	1																	
V1	.548	1																
V2	.544	.505	1															
V3	.588	.448	.644	1														
V4	.407	.605	.511	.586	1													
V5	-.228	-.029	-.163	-.126	-.392	1												
V6	-.489	.098	-.242	-.204	-.141	-.008	1											
V7	.575	.568	.683	.730	.567	.006	-.420	1										
V8	.477	.396	.305	.288	-.001	.038	.017	.079	1									
V9	-.457	-.521	-.373	-.553	-.619	.163	.244	-.612	-.157	1								
V10	.065	.644	.243	.434	.481	.135	.530	.409	-.028	-.347	1							
V11	-.039	.414	.026	-.065	.288	-.078	.633	-.110	.066	-.040	.559	1						
V12	-.620	.020	-.213	-.216	.156	-.208	.894	-.364	-.190	.129	.470	.612	1					
V13	.305	.373	.509	.397	.214	.204	.218	.369	.166	-.166	.523	.289	.104	1				
V14	.420	.280	.282	.502	.363	.190	-.524	.569	.043	-.403	.130	-.405	-.442	.024	1			
V15	.072	.225	.327	.188	-.081	.350	.268	.066	.371	.015	.185	.313	.142	.202	-.149	1		
V16	-.055	.339	-.191	.329	.238	.138	.274	.297	-.133	-.355	.556	.101	.288	-.102	.267	.014	1	
V17	.227	.516	.261	.469	.356	.159	.037	.553	-.094	-.496	.623	-.002	-.059	.344	.482	-.045	.663	1

Table 4 - Correlation Coefficient Matrix for Implementation Factors

	A1	V18	V19	V20	V21	V22	V9	V23	V24	V25	V26
A1	1										
V18	.397	1									
V19	.506	.477	1								
V20	.233	.368	.482	1							
V21	.173	.485	.492	.535	1						
V22	-.034	.104	.093	-.187	.368	1					
V9	-.457	-.174	-.502	-.154	-.077	-.118	1				
V23	.065	.362	.414	.307	.577	.422	-.347	1			
V24	.547	.278	.316	.361	.274	.133	-.187	-.119	1		
V25	.389	.355	.429	.219	.239	.227	-.267	.435	.234	1	
V26	.227	.218	.502	.113	.523	.476	-.496	.623	-.137	.300	1

Table 5: Correlation Coefficient Matrix for Post-implementation

	A1	V27	V28	V29	V9	V30	V31	V32
A1	1							
V27	.351	1						
V28	.123	.541	1					
V29	.299	.426	.264	1				
V9	-.457	-.445	.019	-.204	1			
V30	.686	.453	.105	.190	-.586	1		
V31	.438	.466	-.053	.294	-.416	.347	1	
V32	.301	.690	.201	.409	-.402	.264	.585	1

Many of the companies participated in the survey had not had previous experience in CBIS and yet they proved to have successfully implemented CBIS and are satisfied with their information systems. Even the firms which had unpleasant previous experience with IT, still tended to look at IT in a positive attitude attributing their previous failures to other causes than the characteristics of IT and CBIS.

Even having internal IT expertise proved to have no strong effect on CBIS adoption success at all three phases since many of the SME system developments, implementations and maintenances were combined efforts of internal IT experts and external IT experts while some were carried out completely by outside entities. It could be noted that especially the SMEs that have good relationship with the outside developers/implementers/maintainers were successful.

Employees' computer literacy also showed a relatively weak correlation of 0.305 with CBIS adoption success. This may be attributed to the fact that although the employees may not have much computer literacy at first, once the system is implemented, they are trained to use the system, and then they may perform well.

Availability of government or other third party incentives showed no significant correlation with CBIS adoption success; mainly attributing to the fact that almost all of the firms participated in the survey had not received such incentives. Environmental uncertainty also showed no strong correlation since many of the participant firms had not considered the volatility of the industry, economy of the country etc. when adopting CBIS but have managed successful adoption.

Many of the cases in the survey had not adopted a formal plan or a schedule for implementation. Furthermore, although monitoring and evaluation of the system was done by many of the companies, it did not significantly contribute towards adoption success at both implementation stage as well as in the post implementation stage. This may be because the monitoring and evaluation techniques that those companies implemented were not suitable for the type of CBIS they had adopted.

Feasibility Assessment Framework

Considering the statistical analysis of the survey results, the factors that did not depict significant correlation with the CBIS adoption success were excluded from the model and only the ones having strong impact were retained. Therefore, it can be seen that in the pre-implementation stage Organizational, Technological, System and External factors have influence while in the implementation phase and post-implementation phase the influencing factors are Organizational factors, System factors and HR Factors. The finalized model is illustrated in Figure 2. The factors are in the descending order of absolute correlation coefficient value.

With accordance to the finalized research model, the Feasibility Assessment Framework has been developed (Figure 3). A company adopting an information system should first assess its pre-implementation capabilities and if it is satisfactory, it then should assess its implementation capability. Once the implementation capability is found to be high, the company can proceed with the CBIS adoption. However, it should be ensured that adequate attention is given to post-implementation factors.

These factors affect the CBIS adoption success but cannot be evaluated prior to implementation. Nevertheless, the company should consider them when implementation is taking place.

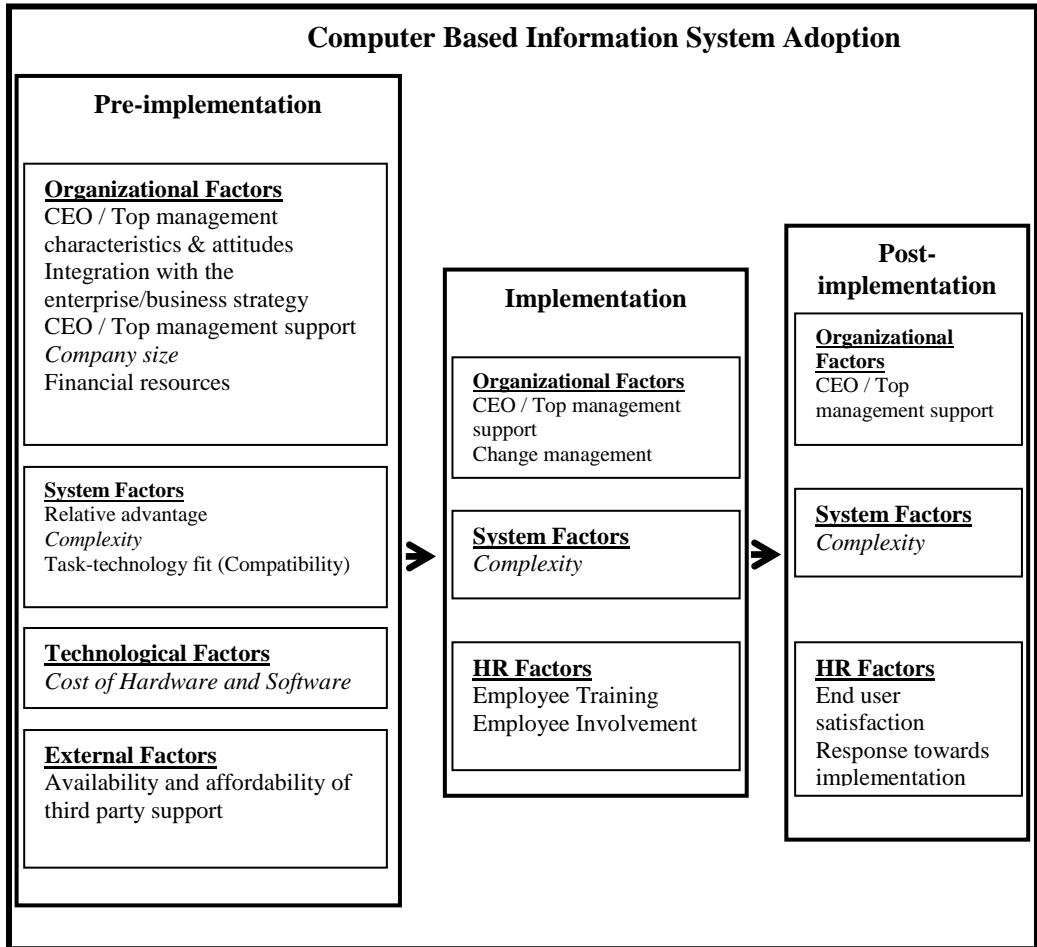


Figure 2: Finalized Research Model

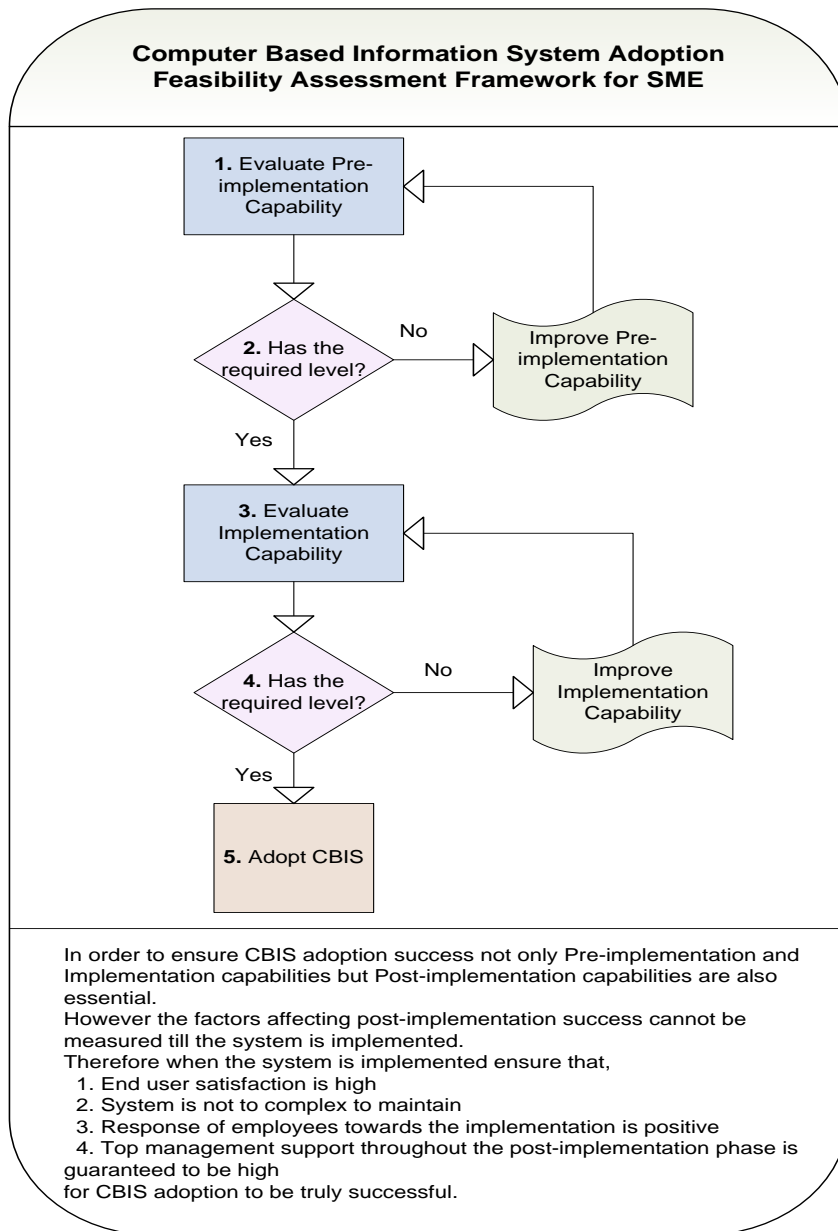


Figure 3: Feasibility Assessment Framework

CONCLUSION

This research identified that Organizational, System, Technological, HR and External Factors to have influence on SMEs' Computer-based Information System adoption success. Different factors that belong to the above factor dimensions would have impact on CBIS adoption in pre-implementation, implementation and post-

implementation stages. Top management support and Complexity of the CBIS were found to be the factors that would influence throughout all three stages.

It was revealed that in the Pre-implementation stage, Organizational, System, Technological and External factors have influence on CBIS adoption by SMEs. At this stage it is the cost of HW and SW and CEO characteristics and attitudes that pose major impact. In the Implementation and Post-implementation stages Organizational, System and HR factors have impact. Employee training has the highest influence on CBIS success in the Implementation stage while End user satisfaction has the highest influence in the Post-implementation. The presence of most of factors has positive influence on CBIS adoption by SMEs. However, the Company size, Complexity of the system and Cost of HW & SW pose negative impact.

Recommendations

Since Top management support and Complexity have been proved to have impact in all three phases of CBIS adoption, it is recommended not to proceed with the intended system adoption unless the company is confident that its top management will provide the necessary support and the complexity of the system intended to be adopted is tolerable.

Furthermore, SMEs are highly advised not to proceed with the adoption of CBIS if they do not have adequate Pre-implementation and/or Implementation capabilities since the influential factors have showed significant correlation with the system adoption success. In the case where the firm is found to be weak in any of the phases, it is advisable to improve its capabilities and reevaluate the phase capability if improvements can be done in the short term. However if the improvements to be made are long term it is advisable to postpone the CBIS adoption.

Limitations & Future Direction

The whole SME population may not have been represented by the sample used since the number of SME using CBIS had been small. Although the survey included companies from Manufacturing, Services and Trading sectors, within these sectors not all industries could be covered. Furthermore, since the age of all companies

participated in the survey had been less than fifty years; hence the research findings may not be depicting the situation of companies with longer history.

This framework can be extended to include feasibility improvement tools which will be useful for a firm to assess whether it could improve its pre-implementation and implementation capabilities and how to do so. Addition of such tools would make the framework more comprehensive. Furthermore, this research has created avenues for more research as the factors identified can be further analyzed in various ways. In-depth studies on individual factors and possible interrelationships between these factors may lead to the discovery of important research findings that will be beneficial to the SME sector.

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