TENDENCY OF SRI LANKAN CONSTRUCTION ORGANISATIONS IN ADOPTING ENTERPRISE RESOURCE PLANNING SYSTEMS

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ABSTRACT

The popularity of Enterprise Resource Planning (ERP) system is increasing in many industries. Many researchers have conducted studies on ERP in relation with construction industry as well. The observations of some of the researches were contradictory, while most of them are observing positive tendency among the contractors. Nevertheless, the tendency of Sri Lankan contracting organisations to implement ERP systems has not been studied. Hence, this research aimed to find the tendency of Sri Lankan contracting organisations to implement ERP systems.

A mixed research approach along with an extensive literature review has been carried out to pursue the aim of this research. The concept of ERP has been identified along with the driving and restraining factors in implementing ERP system to contracting organisations.

It has been identified that ERP system is popular among the Sri Lankan construction industry professionals since most of them at least heard about the system. Nevertheless, as per the conclusion, even though there is a positive tendency among global contractors to implement ERP system to their organisations, Sri Lankan contracting organisations are still lacking in confidence to implement the system.

Keywords: *Construction Industry; Driving Factors; Enterprise Resource Planning (ERP); Restraining Factors.*

1. INTRODUCTION

Providing accurate information in timely manner within the organizations is a long remaining challenge (Monk & Wagner, 2009). To maintain the competitive advantage for a longer period the integration of operation flows are necessary, while fully utilizing information technology and scarce resources of the organization (Tamboycers, 2012). In addition, Sutar et al. (2016) stated that proper management of resources is vital for the success of the companies irrespective of being external or internal.

Estébanez et al. (2016) depicted that to uplift the management, performance and competitiveness; the companies now have a trend to implement their systems based on the information and communication technologies. Klaus et al. (2000) emphasised that Enterprise Resource Planning (ERP) is a comprehensive software package, which seeks to integrate the total array of business process and its functions. Standardisation and synchronisation of information is the basic philosophy behind ERP (Chung et al., 2008).

According to Ahmed et al. (2003), construction industry is a highly fragmented industry due to its project-based structure. Consequently, projects have resulted in poor productivity improvement within the industry (Sutar et al., 2016). Al Marri (2014) mentioned that project-based businesses must implement innovative technologies to survive in the market. On the other hand, ERP is used by construction firms to improve the ability of decision making, reduce the project time, reduce the data redundancy, minimise cost, improve quality and system integrity (Kadoli et al., 2014; Sutar et al., 2016; Al Marri, 2014). Nevertheless, Yang et al. (2007) have mentioned that the implementation of ERP to a firm require enormous investments in respect of time, money and resources. Thus, implementation of ERP must be carried out in a careful manner.

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According to Chung (2007), many engineering sector companies hesitate to implement an ERP system even though they are well aware of the benefits they could reap out through implementation. Lee and Lee (2017) specified that there is a gap between the construction firms' need and the offered service of information technology companies. Ahmed et al. (2003) have mentioned that the researches on implementation of ERP in construction industry are very few. Particularly for contracting organisations, this fact is even stronger. Even though several researchers have conducted researches on ERP and construction companies in global context, the absence of researches on tendency of ERP implementation in Sri Lankan context has produced this research gap. Hence, this research aimed to identify the tendency of Sri Lankan construction organisations in implementing ERP systems.

2. LITERATURE FINDINGS

2.1. ENTERPRISE RESOURCE PLANNING

ERP is one of the greatest inventions in Information Technology (IT) industries in 1990s (Al-Mashari, 2002). It is a set of software packages, integrated and designed to manage business processes (Shehab et al., 2004). Kumar and Van Hillegersberg (2000) defined ERP as an adaptable software, which has been designed to integrate information and information-based processes of an organisation. Furthermore, Choudhury (2009) has stated that ERP is a commercial software suite, which integrates modular software applications so that the functions of an enterprise will be in accordance. ERP helps an organisation to run its functions under a common database by automating and integrating all business processes of the departments (Vlachopoulou & Manthou, 2006; Jackson, 2010). According to Bathorpe et al. (2004), these predecessors of ERP were known as material requirement planning (MRP) and manufacturing resource planning (MRPII). MRP had been used to ensure the material and capacity to be in accordance with the master plan, while MRPII, which had been evolved from MRP, used to integrate the manufacturing process. Chen (2001) has identified the key deviation of ERP from MRPII is the planning and scheduling of the supplier resources in consumer perspective.

2.2. ERP IN GLOBAL CONSTRUCTION INDUSTRY

Nowadays, construction industries seeking solutions from IT to solve the issues caused due to its fragmentation (Nitithamyong & Skibniewski, 2004). The literature has identified several key ERP vendors; SAP, Oracle, PeopleSoft, JD Edwards, Microsoft Dynamics, Infor ERP and Baan (Łobaziewicz, 2015; Al Mari, 2014; Tatari et al., 2008; Shehab et al., 2004; Tarn et al., 2002; Mabert et al., 2000; Klaus et al., 2000). According to Klaus et al. (2000) and Shehab et al. (2004), SAP, Oracle, JD Edwards, PeopleSoft and Baan are considered as "Big Five" of ERP market with more than 70% of the market share. However, these systems are originally intended to manufacturing industry and not primarily to the construction industry, therefore these vendors failed to reach construction industry (Tatari et al., 2008; Shi and Halpin 2003).

According to Shi and Halpin (2003), construction industry based ERP systems need to assist effectively the construction industry-based functions; project-based estimating, scheduling, planning, procurement etc. Subsequently, major ERP vendors SAP and Oracle invented construction-based ERP systems keep considering market saturation of the industries (Tatari et al., 2008). They have named these construction specific ERP systems as C-ERP which are different from the basic ERP systems. Nevertheless, some of the construction functions are still in the infant stage (Chung, 2007). However, adapting and integrating advanced technologies are essential for the fragmented industries while focusing and developing specific solutions (Al-Marri, 2014; Chung, 2007).

2.3. DRIVING FACTORS OF CONSTRUCTION COMPANIES TO ADOPT ERP SYSTEMS

Even though the implementation percentage of ERP in construction companies are low, according to the views of certain researches, it is certainly rising. For such increase in the popularity of the system, there must be certain driving factors or clear objectives to implement the system in contracting organisations. The following Table 1 represents the identified driving factors.

Table 1: Driving Factors of Construction Companies to adapt ERP

	Driving Factors	Al-Marri (2014)	Ahmed et al. (2003)	Sutar et al. (2016)	Tarn et al. (2002)	Hadidi et al. (2017)	Choudhry (2009)	Tambovcevs (2012)	Xu et al. (2006)
D1	Improvement of customer responsiveness	✓	✓	✓					✓
D2	Strengthening of supply chain partnerships	✓	✓	✓					✓
D3	Enhancement of organizational flexibility	✓	✓	✓		✓	✓		
D4	Improvement of decision-making capabilities	✓	✓	✓	✓	✓	✓		
D5	Reduction of working capital					✓	✓	✓	✓
D6	Reduction of project completion time and cost	✓	✓	✓		✓			
D7	Reduction of data redundancy	✓		✓				✓	
D8	Improvement in quality						✓		
D9	Just in time information/ real time data				✓			✓	
D10	Efficient communication	✓		✓	✓		✓		✓
D11	Improved user satisfaction					✓			
D12	Increased global competitiveness	✓			✓		✓	✓	✓
D13	Business efficiency					✓		✓	
D14	Economy of Resources							✓	✓
D15	Higher utilisation of employees				✓			✓	

2.4. RESTRAINING FACTORS OF ERP IMPLEMENTATION IN CONSTRUCTION INDUSTRY

Restraining factors of ERP implementation in construction industry are hardly found. However, Momoh et al. (2010) have identified critical failure factors (CFF) of ERP implementation in general, which are cited by several researchers. The author considers CFF as restraining factors for this study, since cause of failures also are reasons for reluctance of implementation. The following Table 2 represents the identified Restraining factors (CFF).

Table 2: Restraining Factors of ERP Implementation in Construction Companies

	Restraining Factors (CFF)	Number of Instances cited in Literature
R1	Excessive customisation	13
R2	Dilemma of internal integration	8
R3	Poor understanding of business implications and requirements	7
R4	Lack of change Management	12
R5	Misalignment of IT with the business	9
R6	Hidden costs	3
R7	Limited Training	3
R8	Lack of top management support	4
R9	Poor data quality	5

(Adapted from: Momoh et al., 2010)

3. RESEARCH METHODOLOGY

This research was initiated with a literature survey to review the concept of ERP system. Thereafter, the driving (objectives) factors of ERP identified specifically to the construction industry and restraining (CFF) factors were identified in general. Based on the comprehensive literature review and the background study, following research problems were developed.

- How far are the Sri Lankan construction professionals aware of the ERP system?
- Who are the most popular ERP vendors among the Sri Lankan construction industry professionals?
- What is the impact of the driving (objectives) and restraining (CFF) factors identified through literature on implementing ERP systems to the Sri Lankan construction industry?

According to Pinsonneault and Kraemer (1993) out of the two main research approaches, quantitative approach tends to relate more towards the positivism than interpretivism. Nevertheless, according to Fellows and Lui (2003), the qualitative approach assists the researcher in studying beliefs, understandings, opinions and views of people. Since, in the research it is required to understand the experience of individuals in relation with the ERP usage, a mixed approach was taken.

In order to validate the findings of the literature to the Sri Lankan context a preliminary interview was conducted among five (05) IT professionals who possess experience of at least one ERP implementation in construction companies. Then 75 questionnaires were distributed among construction industry professionals based on the purposive sampling method to rate the effect of the driving and restraining factors on ERP implementation in relation with construction organisations to understand the tendency of ERP implementation in such organisation. Out of the 75 distributed questionnaires, only 35 were returned by giving a hint on the exposure of construction industry professionals on ERP systems. The following Table 3 shows the details of respondents.

Table 3: Details of the Questionnaire Survey Respondents

Designation	**Work experience (Years)**					
	0-5	6-10	11-15	16-20	More than 21	**Total**
Directors	-	-	02	01	01	**04**
Engineers	01	02	01	01	01	**06**
Quantity Surveyors	02	04	05	02	01	**14**
Accountants	**-**	04	03	02	02	**11**
Total	**03**	**10**	**11**	**06**	**05**	**35**

The respondents of the questionnaire were asked to rate the effect based on five point likert scale, "3" being considered as moderate value. Thereafter collected data were analysed based on Relative Importance Index (RII) using MS Excel. In addition, one tailed t tests was done to evaluate the validity of the sample with the population. Thereafter a force field analysis was done to assess the tendency proposed by Kart Lewin (Burnes, 2004).

4. RESEARCH FINDINGS AND DISCUSSION

4.1. AWARENESS OF SRI LANKAN CONSTRUCTION PROFESSIONALS ON ERP SYSTEMS

Five options were given to the respondents to rank their familiarity on ERP systems. Table 4 represents the level of ERP awareness among Sri Lankan construction professionals. As per the survey respondents, 86% of professionals have heard of the systems. Notably, 57 % of respondents are practicing ERP in their organisations and 6% of respondents are hoping to implement ERP systems. This shows a positive impact on ERP among Sri Lankan construction.

Table 4: Level of ERP Awareness

Level of Awareness	Percentage
Using an ERP System	28 %
Have used an ERP system	29 %
Hoping to implement an ERP system	06 %
Heard of ERP systems	23 %
Never heard of ERP systems	14 %

4.2. POPULARITY OF ERP VENDORS AMONG SRI LANKAN CONSTRUCTION PROFESSIONALS

To identify the most popular ERP vendor in Sri Lankan construction industry, the respondents were asked to rank the popularity of ERP vendors based on their familiarity. The following Table 5 represents the popularity percentage of ERP vendors. SAP is the most popular ERP vendor among Sri Lankan construction with 30 % of popularity percentage among eight (08) vendors. Proprietary and J.D Edwards are second and third popular vendors with 17% and 13% of popularity percentage. Oracle, Microsoft dynamic and BAN are ranked fourth popular vendor with 10 % of popularity percentage. However, People soft is not a considerable level of popular in Sri Lankan construction.

Table 5: Popularity of ERP vendors in Sri Lanka

ERP vendors	Popularity percentage
People soft	03 %
Infor ERP	07 %
Oracle	10 %
Microsoft dynamics	10 %
BAN	10 %
J. D. Edwards	13 %
Proprietary	17 %
SAP	30 %

The literature review identified a gap between construction companies' service requirement and offered service of IT companies, this fact is justified to the Sri Lankan context as well. Whereas, SAP is identified as the most popular vendor in the global context also. Notably, SAP has developed their custom made C-ERP systems (Tatari et al., 2008).

4.3. THE TENDENCY OF CONTRACTING ORGANISATIONS IN IMPLEMENTING ERP SYSTEM

The identified literature on the driving and restraining factors of ERP were validated to the Sri Lankan construction industry through a preliminary interview. All the interviewees agreed with the identified driving factors. In addition, the interviewees also agreed CFF as restraining factors of ERP implementation. In addition as per them, even though the restraining factors were identified in general, those restraining factors are common to the construction also. Moreover, the interviewees have suggested six (R10, R11, R12, R13, R14 and R15) additional restraining factors.

Thereafter, to identify the tendency of Sri Lankan contracting organisations on ERP implementation, the respondents were asked to rate the impact of each driving and restraining factor. Further, it has been processed with one tailed t tests and each factor received a value more than 0.05. Hence, with a confidence interval of 95%, all the factors including six additional factors found through preliminary interview are considered important in ERP implementation to the contracting organisations.

4.3.1. FORCE FIELD ANALYSIS

Driving and restraining factors of ERP were asked by the respondents of the questionnaire to rate against the impact during implementation process. Thereafter weight was calculated by multiplying the RII value by 10 and rounding off to the nearest whole number.

Total Weight of Driving Factors

Table 6 shows the weighted values of each driving factors. All the driving factors has got the RII value more than 0.5, therefore it can be said that, all the driving factors has got considerable level of impact in implementing ERP in contracting organisations. According to the participants, efficient communication (D10) considered as the highest driving factor and just in time information/ real time data (D9) perceived second highest driving value. However, customer responsiveness (D1) perceived the least weighted value (5) among all the driving factors. Nevertheless, since the weighted values of all the factors other than D1 are greater than 7, driving factors of ERP showing a positive impact on implementation.

Table 6: Total Weight of Driving Factors

	Driving Factors	RII	Weight
D1	Improvement of customer responsiveness	0.527	5
D2	Strengthening of supply chain partnerships	0.753	8
D3	Enhancement of organizational flexibility	0.707	7
D4	Improvement of decision-making capabilities	0.813	8
D5	Reduction of working capital	0.700	7
D6	Reduction of project completion time and cost	0.707	7
D7	Reduction of data redundancy	0.753	8
D8	Improvement in quality	0.833	8
D9	Just in time information/ real time data	0.860	9
D10	Efficient communication	0.887	9
D11	Improved user satisfaction	0.820	8
D12	Increased global competitiveness	0.760	8
D13	Business efficiency	0.843	8
D14	Economy of Resources	0.807	8
D15	Higher utilisation of employees	0.833	8
	Total Weight of Driving Factors		**116**

Total Weight of Restraining Factors

Table 7 shows the weighted values of each restraining factor. Lack of top management support (R8) considered as the extreme restraining factor. Excessive customisation (R1) and lack of change management practices (R 4) were considered as second and third restraining factors. However, poor data quality perceived weighted value of five (5), which is considered as the least restraining factor. On the other hand it could be said that ERP is an effective tool to ensure data quality.

Table 7: Total Weight of Restraining Factors

	Restraining Factors	RII	Weight
R1	Excessive customisation	0.860	9
R2	Dilemma of internal integration	0.667	7
R3	Poor understanding of business implications and requirements	0.780	8
R4	Lack of change Management	0.843	8
R5	Misalignment of IT with the business	0.793	8
R6	Hidden costs	0.840	8
R7	Limited Training	0.813	8
R8	Lack of top management support	0.867	9
R9	Poor data quality	0.527	5
R10	High implementation cost	0.840	8
R11	Inability of the system to thrive on little data available	0.760	8
R12	Unwillingness to share information	0.767	8

	Restraining Factors	RII	Weight
R13	Short term project time	0.667	7
R14	Unwillingness to move forward from traditional systems	0.767	8
R15	Time consumption for implementation	0.813	8
	Total Weight of Restraining Factors		**117**

Tendency = Weight of Driving Factors – Weight of Restraining Factors Eq. (01)

= 116 – 117

= **(-1)**

The result of the force field analysis shows that, the weight difference between driving and restraining factors were merely neutral. However, the literature identified, in other countries C-ERP systems has shown a positive impact to effectively assist the construction industry-based functions (Shi & Halpin, 2003). It is apparent that the construction organisations in Sri Lanka are still lack in confidence to implement ERP systems. Therefore, further studies has to be done in reducing the impact of restraining factors, whilst giving focus on increasing driving factors.

5. CONCLUSIONS AND RECOMMENDATIONS

The ERP system is a mean to automate and integrate all the functions of an organisation. It provides a central platform to carry out all the business activities within the organisation. ERP system being a huge and long-term investment to the organisations. Therefore, organizations tend to be reluctant in implementing it.

According to the interviewees, the ERP implementation is less in construction industries. The basic reason for this is, the ERP systems were not originally designed for construction industry and such system required major customisation with its unique characteristics.

The force field analysis was done based on Sri Lankan context. According to the results, Sri Lankan construction organisations are still lack in confidence to implement ERP systems. The construction companies still think the driving factors of ERP implementation are not enough to supersede the effect of restraining factors.

Therefore, it is recommended to reduce the effect of restraining factors identified in this research and make the path easier for ERP system to penetrate into Sri Lankan construction organisations. The major restraining factors identified are lack of top management support and excessive customisations needed for construction organisations. Therefore, the needs should be identified clearly with less customisation to get maximum support from the top management. On the contrary, the major ERP vendors need to develop systems with respect to the requirements of their clients instead of allowing them to customise.

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