Gap Analysis between ERP procedures and Construction procedures

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Abstract. Although Enterprise Resource Planning (ERP) offers many benefits to the construction industry, construction companies still hesitate to adopt ERP systems. This may be due to long-term practiced ad-hoc behaviors in the construction industry, which do not match with the standard procedures embedded in ERP systems. Therefore, through this research, it is expected to evaluate the gap between construction procedures and ERP procedures technically. Hence, to obtain indicative data for the study, a questionnaire was designed and distributed to selected 210 individuals among contractors, subcontractors, and clients in the Sri-Lankan construction industry who have used ERP. In total, 174 completed questionnaires were returned and then statistically analyzed using Chi-Square test with the Mini tab tool. It is concluded that there is a significant gap between the construction procedures and ERP procedures in identified fields related to the construction industry. The highest significant gap exists in the field of Inventory management with Chi-Square $158.766 > 9.48$. And HRM (142.366), Asset Management (130.264), Finance Management (126.267), Site Operation (103.793), Project management (53.88), Purchases (34.324), Petty cash (28.337), Estimating and Tendering (22.148), Sub-Contractor management (0.492) respectively. Ultimately with the identified gaps, a framework was established to meet the organizational processes and ERP processes.

1 Introduction

Before ERP came in to play Information technology/ Information systems (IT/IS) used by the construction industry was very less, as the construction industry had its unique features [1,12,13]. However, with the technological development, companies moved towards computerization, and because of that in the past few decades, ERP has been drawing the full attention of the construction industry.

The main purpose of an ERP is the standardization of the system and integration of the organizational functions. Task uncertainty and task interdependence combine with standardization. Task uncertainty is the “difference between information needed to complete a task and amount of information already present.” Low task uncertainty leads to create a good fit between the systems. “Task interdependence is the degree to which activities are connected to each other” According to previous research it has been noted that the ERP system is having a high level of task interdependence [3,9]. It is difficult to predict that ERP will fit in with an organization with Adcock behaviors and unformalized structures, as it contradicts with both the ERP literature and task uncertainty contingencies. But some of the companies are capable of customizing the ERP system according to their requirements so that they do not have to change their working environment much. However, these customization processes are costly and risky [1,4, 15,20].

Normally, an enterprise system is developed in four steps. In the first step, the company’s IT team collects and generates requirements for an ERP system. Then the company sends out a request for a proposal (RFP) to IT companies who develop enterprise resource planning systems [2,5]. Afterward, the company will receive proposals from IT companies, and they will evaluate the suitability of the proposed system using the “Request for Proposal” (RFP) guidelines. Finally, they select the system. However, though they select the system using the RFP guidelines a gap remains. This “Perception gap” indicates the difference between the system required by the construction company and the system developed by the IT Company [7,10]. According to the recommendations, main reasons for this gap are identified as high fragmentation of construction organizations and the prevailing of remote construction sites other than the main functional buildings [6,10].

This perception gap creates the misfit between the ERP and Organizational structure of any company. Misfits can be considered as the external manifestations of the differences between organizational needs and system capabilities. To analyze that misfit, carrying out a “FIT-GAP” is a closer look at reality. Most of the ERP packages are purchased or leased (Cloud-based) from ERP vendors. As it is done in such a way, the ERP system is developed already without identifying the system functionalities and own organizational procedures [11,13]. ERP systems are bundled with predefined, already built-in assumptions, and

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with the predictions on how it could work [8,10]. Nevertheless, it may not practically adapt according to the real situation with on-going company operations. So, most of the time companies change their procedures to match

with the ERP procedures [12,15,20]. After analyzing the previous literature, it is identified that there is a considerable number of research which were carried out to find out the reasons for this gap.

Table 1. Issues in implementing ERP in construction projects according to previous literature.

Organizational	Technological	Social
Lack of senior executives and management involvement [15,22]	Technological complexity [15,22]	Staff resistance to change [11]
Lack of flexibility [9]	Incompatibility of technical resources [2,16]	Insufficient training for end users [2,26]
Incompatible business process and strategic goals [1,13]	Standardization [10,9,26]	Organizational culture [6,16]
Failure to redesign the business process [2,16]	Lack of Hardware and Software [2,16,26]	The absence of a balanced combination in the project teams [9,16,22]
Misunderstanding of change requirement [9,16,22]	Lack of Technical staff and Technical knowledge [10,9,26]	Lack of awareness about ERP [2,26]

2 Methodology

The principal method used to collect information for this study was the questionnaire survey. Alternatively, a semi-structured interview was carried out to analyze the data qualitatively. The Questionnaire was developed based on criteria in PMBOK, ICTAD [14,16] namely Inventory Management, Finance Management, Site Operation, Estimating and Tendering, Sub-Contractor Management, Petty Cash Management, Asset Management, Human Resource Management, Purchases Management, Project Management. The Questionnaire was distributed among 210 selected individuals who used ERP, such as contractors, subcontractors and clients in the Sri-Lankan construction industry (From C1-C5 graded Construction Companies). The targeted people were the Top Management (CEO/Director, GM, PM, Engineer, Technical Manager), Technical Officer/IT officer, Quantity Surveyor, Data entry operator, a Stock Keeper. The Selected fields are described in Table 2. As Sri-Lanka is a developing country, people working in the construction industry resist to the adapting of the ERP implementation. Most of the small-scale construction organizations do not have the capacity to implement ERP systems [18,21].

Furthermore, the competency level of the engineers and the top management, regarding IT knowledge is comparatively low in those companies [17]. Thus, it is concluded that conducting a questionnaire survey among C1-C5 (552 Population Size) companies will be the most suitable option. For the sample size, the confidence interval was considered as 90% with $Z=1.65$, Standard deviation ± 0.5 , Marginal error 5%. The sample size 210 (Required sample=182) is considered adequate for the analysis and is comparable to the response rate for ERP systems available in mid-sized organizations in Sri-Lanka.

In order to measure the criterions, they need to be operationalized with measurable indicators. In the operationalization process, main criteria were divided into the sub-variables (Likert scale was used as the main scale of measurement). After conducting the survey, 174 completed questionnaires were returned in total and then analyzed statistically using Chi-Square [31] with the Mini tab tool. Having identified the criteria where a significant gap exists, a framework was developed. It identified which processes should be aligned with the ERP procedures before the ERP implementation.

But most of those research were based on non-technical factors. They have identified the reasons for this misalignment in three ways; organizational misfit, technological misfit and social misfit. (See Table 1). Thus, this research was done to identify the gap between those two procedures mainly considering the incompatibility between the business structure and the organizational structure.

3 Discussion

3.1 Identification of the gap

As per the research conducted by Eli Husted, Moutaz Haddara and Baldwin Kavenes, it is concluded that an aperture always exists between organizational practice and the way an ERP system works, regardless of the organization [18,22]. However from this research results, it is identified that this gap is significant concerning the construction industry as it is difficult to satisfy their requirements. Further the results are verified by the research carried out by Chijoo and Chiheon [23] mentioning that "Perception gap" which often exists between the proposed system by ERP vendors and construction organizations [19,21].

After the statistical analysis it is concluded that there is a significant gap between construction procedures and ERP procedures in every field related to the construction industry.

Table 2. Description of the selected modules

Module	Description
Inventory Management [14,16]	This module represents the change in the inventory: such as reorder level, purchases, delivery of goods etc. of the organization.
Finance Management [14,16]	This module constitutes the operational aspects of the general accounting and financial information for the business unit.
Site Operation [16]	This module handles all the operations regarding the sites: such as Report generation, Scheduling of sites, Progress handling etc.
Estimating and Tendering [14]	This handles the BOQ before it is submitted to the tender process. Once it is accepted this is converted into the live project.
Subcontractor Management [16]	This module handles how the subcontractor selection is done, how the payments are done and how the working progresses of subcontractors are managed.
Petty Cash Management [14]	This module includes all transactions related to petty cash handling of the construction sites.
Human Resource Management [14,16]	This module includes all business processes required to efficiently manage the organization's human resource needs: such as personal, payroll, recruiting, time management, training, benefits, workforce development and analytics.
Purchases Management [14]	This module includes the handling of purchases and suppliers.
Project Management [14,16]	This module handles all aspects of activities of the construction organization.
Asset Management [14,15]	This module handles all aspects of Assets throughout its life cycle. (Including Purchasing, Transfer, Maintenance and Release)

The highest significant gap exists in the field of Inventory management with Chi-Square $158.766 > 9.48$. And HRM (142.366), Asset Management (130.264), Finance Management (126.267), Site Operation (103.793), Project management (53.88), Purchases (34.324), Petty Cash (28.337), Estimating and Tendering (22.148), Sub-Contractor management (0.492) respectively.

3.2. Framework Development

The main objective of this research was to develop a framework which meets organizational procedures and ERP procedures, having identified the conflicting areas which creates the GAP between ERP procedures and construction practices. Table 3 shows the main gap areas and the recommendations to reduce those gaps.

Table 3. Development of the framework

Criteria	Reasons for Gap	Recommendation
Inventory Management	The Existence of several item codes	Standardize a unique item code
	Deficiency in the generation of MR, PO and GRN	On-time generation of MR, PO and GRN
	The incorrect sequence of purchasing procedure	Practicing the correct circulation of procedures up to the payment
	Ad-hoc behaviors in Payment method	Appropriate top management involvement
	The absence of Re-Order level	Continuous Stock Updating
Finance	Delays in the authorization of payment	Initiation of online payment method
	Immoral reconciliation of transactions	Instantaneous actions for re-correction
	Long-term practiced erroneous accounting system	Maintain transparent and systematic accounting practice
Site Operation	Generation of Redundant reports	Identification of reports according to the requirement
	Malpractices in report generation	Restriction of passing random data to the system
	Lack of required data in the reports for decision making	Appropriate Top management involvement in the report generation
	The inadequacy of capturing necessary data	Proper planning when structuring the report
	Ad-hoc behaviors in scheduling	Proper scheduling about expected scenarios concerning the environmental situations like weather conditions
	Extreme Over usage or under usage of resources	Maintain proper resource usage record and correct planning of resource usage
Estimating and tendering	Inability to compare Planned, budgeted and actual costing	Adherence to generate cost accordance with BOQ items
	Malpractices in rate analysis	Standardize the rates used within the construction projects
	The inability to achieve the profit goal	Activation of the realistic approach for estimation and tendering

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	Excess of Variations	Hiring proper cost estimators to limit the variation
Subcontractor management	Biased ways of selecting subcontractors	Carry out background analysis of subcontractors in the selection process
	Lack of tracking the work done	Manipulating working progress according to the BOQ items
	Mixing up of subcontractor type	Analyzing the variation and initiating the requires method to handle
	Ad-hoc practices in Subcontractor payment	Produce a systematic way of payment
Petty cash	No proper estimation of petty cash usage	Allocating fixed and adequate petty cash after a proper feasible study
	Inappropriate usage of petty cash	Carrying out proper estimation of resource usage
	Ad-hoc reimburse practices and poor control over petty cash	Carrying out a proper estimation of resource usage
	Immoral reconciliation of transactions	Carrying out transparent account practices
	Issues in authorization	Initiation of online authorization system
Asset Management	Malpractices in purchasing an asset	Call for quotations
	No periodical maintenance of machinery and plants	Maintain standard records
	No record on valuation methods	Maintaining a systematic way of valuating assets
	No proper monitoring of the utilization of assets	Implementing a proper schedule on asset usage
	The absence of systematic ways to transfer assets	Implementing a proper schedule on asset usage
HRM	Poor Communication between Top management and the Employees	Introducing flat hierarchy level
	Inefficiency in carrying out activities	Implementing a proper schedule on HR allocation
	Ad-hoc leave allocations	Initiation of <u>a systematic</u> approach to leave allocation
	Lack of technical training for employees	Arranging periodical training sessions
	No proper measurement of employee performance	Introducing <u>a rewarding</u> system
Purchases	Delays in approval and authorization processes	Initiation of <u>the online</u> system
	Biased method of selecting suppliers	Carry out a background analysis of the supplier in the selection process
	Malpractices in purchasing resources	Call for Quotations
	Displacement of MR, PO	Proper documentation
Project management	Inability to carry out cost variance analysis	Adherence to generate <u>cost in accordance with</u> BOQ items
	Manipulation of calculations	Providing the required level of authorization to access the information
	Malpractices in rate analysis	Standardize the rates used within the construction projects
	Inappropriate Practices in report generation	Restricting the pass in random data to the system
	Lack of scheduling, monitoring and controlling activities	Usage of proper management tools
	Scattered data among projects	Implementing integrating tools

4 Conclusion

The gap was followed because of the specific demands on functionality in construction organizations, that were outside the standards of the ERP system [22,23]. Apart from that, laws, regulations, and norms of the industry strictly lead to the creation of a considerable gap between construction procedures and ERP procedures [24,28]. However, according to this study, it is concluded that the incompatibility between two procedures are created mainly because the way the construction industry is operating, and the way modules are standardized in ERPs. Because of that, a significant gap could be seen in each module of ERP with the construction practice.

Reasons for the significant gap are identified in the stage of framework development as per the Table 3. The variations are mostly seen in the inventory management, and least in Sub-contractor management, according to the research analysis. After identifying the most critical criterions, necessary actions to eliminate the gap are recommended, using sub-variables and their significant differences as per Table 3.

By identifying the module with its significant difference, construction companies can concentrate more on modification requirements at the customization processes. Customization is the processes of fitting the chosen ERP software to the needs of a specific organization. A high level of customization may require a high cost as well as longer time [25,27]. Because of that, it is worth to identify the critical area which needs

the modification and make adjustments more appropriately. The framework developed in this research will help the construction companies to identify the area of the gap, and minimize the customization required at the implementation stage of the ERP system.

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