ORAGANIZATIONAL PROCEDURES AND ENTERPRISE RESOURCE PLANNING (ERP) PROCEDURES IN CONSTRUCTION ORGANIZATIONS

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Declaration

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Abstract

Enterprise Resource Planning system (ERP) is a business management software that allows an organization to use a system of integrated applications to manage the business. Thus, an ERP in an organization provides much needed up to date information for decision making. All the organisations are increasing the range of technology usage related to information systems, as such ERP has attracted attention of top management in almost all organisations including construction organisations. This is evident from the installation ERPs in construction organisations particularly during decade starting 2010. However, construction organisations have faced many challenges in implementing ERPs due complex functions related estimating and tendering, site operations, asset management, finance management, human resource management and other business functions. Therefore, a systematic study of the gap between typical ERP business functions and business functions of construction organisations is vital for the successful implementation of ERPs.

ERP had attracted many research studies and those are mainly related to the resistance of people, issues related to organizational management and issues related to technological factors. However, there is a lack in research related to the business functions with in construction and general ERP business functions. Hence, the main objective of this study is to evaluate the gap between organizational procedures and Enterprise Resource Planning procedures (ERP) and to establish a framework to meet the organizational processes with according to the ERP. The research was carried out using methods related to quantitative as well as qualitative analysis. A questionnaire survey was carried out for quantitative analysis and data collected through a semi structured interviews was used for qualitative analysis. Further, chi square test was used as the analysing tool.

It is established that there is a significant gap between construction procedures and ERP procedures in most of the business functions related to construction industry. The highest significant gap exists in the area of inventory management. Then the other areas such as Human Resource Management (HRM), Finance Management, Site Operation, Project Management, Purchases, Petty Cash, Estimating and Tendering, Subcontractor Management show a significant gap level respectively.

Ultimately, a framework was developed with suggested options to reduce this gap in the above identified areas. Thus, this framework will contribute to align the construction process and ERP processes as much as possible to have a better management via ERP implementation throughout the construction industry.

Keyword: Enterprise Resource Planning, Construction Industry, ERP Procedures, Construction Procedures, Gap Analysis

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LIST OF ABBREVIATIONS

Abbreviation	Description
ERP	Enterprise Resource Planning
HRM	Human Resource Management
IT	Information Technology
PMBOK	Project Management Body of Knowledge
ICTAD	Institution of construction Training and Development
PID	Project initiation document
BOQ	Bill of Quantities
HR	Human Resource
MR	Material Request
GRN	Good Receive Note
PO	Purchase Order
CEO	Chief Executive Officer
GM	General Manager
PM	Project Manager
CCP	Current construction Project
LAN	Land Area Network

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1 INTRODUCTION

This Chapter consists with a briefing on the background of the study. It further explains the problem statement, objectives of the study, significance of the study and the methodology in brief and main findings.

1.1 Background

Enterprise Resource Planning (ERP) systems are complex software packages that integrate information and business processes within and across the functional areas of businesses (Josep, 2014). It covers areas like business management, planning, manufacturing, sales, marketing, distribution, accounting, financial, human resources management, project management, inventory management, service and maintenance, transportation, e-business etc (Daniela, Maria, & Lucia, 2016). Therefore, global market for ERP system has registered a significant growth within the last few decades (Madapusia & D'Souzab, 2012). ERP provides lots of advantages to an organization than that of a company who doesn't have a system. ERP can show one clear picture of whole business using a single database where all business transactions are entered, recorded, processed, monitored and reported. Increasing managerial flexibility, lowering the cost in the entire supply chain, increasing the efficiency, improving the business productivity are some of the major benefits which can be achieved through ERP implementation (Josep, 2014),(Andreas & Somnath, 2005). In spite of ERP's significant benefits to the industry, there are number of challengers that a company may encounter when implementing ERP (Ehie & Madsen, 2005), (Babae, Gholami, & Soudabeh, 2015). Those barriers can be categorized mainly in to two aspects namely functional barriers and non functional barriers. Functional barriers are arised due to the handling of functions with in the system while non-functional brriers are arised due to the other external factors.

Mainly, the issues related to external factors (Non functional factors) are based on managerial problems, human resource problems and techinical problems. But the issues related to functions are happened due to the oraganizational processes and processes in the ERP system itself. This issue is more related to construction industry. It has long term practised non standard practises than other industries such as manufacturing, hospitality,

airline, education etc. Hence, it is vital to carry out a study to identify the functional barriers in the construction organizations to match the ERP with construction procedures.

ERP has attracted many research studies related to barriers and challenges of implementing ERP systems. However, most of the previous researches were based on non-functional issues and there is a lack in researches based on functional issues. Therefore, the objective of my research is to carry out a gap analysis between construction procedures & ERP procedures and to develop a framework to minimize the gap.

Construction is a industry which has geographically disperate locations than other industries. Hence, they have to operate in a dynamic environment where parties are dissolved in various locations and it has its own way of carrying out operations in those separate locations. On the other hand, ERP manufactures are IT related people who have no idea about the operational activites ofthe construction industry. This mismatch leads to have the gap between the constrcution processes and ERP processes. The Gap indicates the difference between the system needed by the construction company and the system created by the IT company (Hustad, Haddara, & Kalvenes, 2016). However, it is challengable to overcome this mismatch completely. One way of avoiding this mismatch is "customizing" or "tailoring" the software (Haddara, 2014). Tailoring is the process of adjusting the ERP software according to the requirement of the constrcution industry. Too much of tailoring leads to increse the cost and implementation time drastically. Therefore, it is better to ajust the constrcution industry according to the ERP systems which developed based on standards like PMBOK (A guide to the Project Management Body Of Knowledge) and ICTAD Specifications.

Thus, this research aim to identify those non standard methods which exsists with in the constcution industry and replace those with the standards in ERP system by developing a framework.

1.2 Research Problem

Construction industry shows significant varaitions compared to other industries like maufacturing, hospitalty, airline and etc in business process handling. There are unique operations in the construction organizations because of its decentralized construction projects in various geographical locations. Hence, they have to operate in a dynamic environment where parties are dissolved in various locations and they have their own ways of carrying out operations in separate locations. Because of this situation, it is queit

challengable to implement computerised systems like ERP which is developed according to the standards in the field of constrcution.

However, most of the organizations moved towards the computerization with the fourth industrial revelution. Therefore, construction organizations also had to shift there operations in to computerized formates. Lots of issues were arised with the implementation of ERP and lot of failures were recorded at the initial stage.

Therefore, researchers have focused on the barriers of ERP implementation and they have addressed so many issues. But still there are issues due to complex functions related to estimating and tendering, site operations, asset management, finance management, human resource management etc. Therefore, a systematic study of gap between typical ERP business functions and business functions of construction organisations is vital for the successful implementation of ERPs.

1.3 Objectives

The objective of the research is to evaluate the gap between construction procedures and Enterprise Resource Planning (ERP) procedures and to establish a framework to reduce the gap.

- To identify the issues in construction industry related to business processes when implementing ERP systems.
- To identify the conflicting areas which creates the gap between ERP procedures and construction practices.
- To establish a framework which meets organizational procedures and ERP procedures.

1.4 Research Methodology

The research plan was adapted to achieve above objectives. In depth literature review was carried out to identify the current situation of ERP implementation in the construction industry (challenges faced, benefits obtained, how other industries adapted ERP in Sri-Lanka, existing situation of construction industry with IT, why ERP is challenging in construction industry, reasons to generate a gap between ERP and construction procedures, tailoring methods etc). The research was done quantitatively. Further, qualitative analysis was carried out to verify the results obtained from quantitative analysis. Primary data was

collected from a Questionnaire (Questionnaire was developed based on Inventory Management, Finance Management, Site Operation, Estimating and Tendering, Sub-Contractor Management, Petty Cash Management, Asset Management, Human Resource Management, Purchases Management, Project Management using PMBOK guidelines, ICTAD specification and Literature review). Moreover, a semi structured interviews were carried out to improve the reliability of the data collection.

Manufacturing industry was taken into consideration to identify the differences between construction practises and other industry practises. ERP processes were identified using the ERP systems prevailed in the Sri-Lankan construction industry. Data was analysed using CHI-SQUARE test (Mini-Tab tool) and the significance of the gap was measured for the identified criteria above. Having identifying the criteria where a significant gap exists, a frame work was developed. It empathized which processes should be aligned with the ERP procedures before the ERP implementation. Please refer Chapter 3 for the detailed methodology.

1.5 Main Findings

Construction industry is generally focussed on the production of a single and unique product. The construction process consists with six distinct stages such as concepts, contracts and bid documents, bidding, construction, construction payment and completion. In these stages, construction companies have to carry out business operations in the fields of Inventory management, Finance management, Site operations, Humana resource management, Estimating and Tendering, Subcontractor management and etc. However, when the process of construction industry is compared to other industries such as manufacturing, it is clearly seen that there are significant differences between the processes of those two companies. As manufacturing companies are pioneers of using ERP systems in their operations, it is possible to identify the issues with construction companies to implement ERP systems. Based on that assumption qualitative analysis was carried out using semi structured interviews to compare the features of construction companies and manufacturing companies and following are the key findings.

- It is difficult to implement ERP system in construction companies due to the nature of projects that they are involved with.
- Construction companies have number of simultaneous projects with different life cycles and handling such kind of situation is complex with ERP systems.

- In construction companies, each project is unique due to the uncertainties attached with the projects.
- Construction projects are isolated from one another geographically. Most of the sites are in remote areas without enough technical facilities and network connections to implement ERP systems
- In constrcution project the situations are unpredictble. Majorly, weather creates uncertainty for any construction project.
- Technical competency of the construction companies are very much less compared to other industries.
- There is a high probability of occurring emergency situations in the construction industry.
- In construction sites there are several places of storage and it is very difficult to monitor the inventory transactions.

The results of the gap analysis can be established as another research outcome. Gap was identified in ten fields of Inventory management, Human Resource management, Finance management, Asset management, Site operations, Project management, Purchases management, Petty ash, Estimating and Tendering and Subcontractor management. It is identified that there is a significant difference between construction procedures and ERP procedures according to the selected fields (See Table 1). Highest gap is shown in inventory management and lowest is shown in sub-contractor management.

Table 1: Gap analysis of various modules

Module	Chi-Square	Chi-Square (Critical)	P Value	S/NS
Inventory Management	158.766	9.488	<0.05	S
HRM	142.336	9.488	<0.05	S
Asset Management	130.264	9.488	<0.05	S
Finance Management	126.267	9.488	<0.05	S
Site Operations	103.793	9.488	<0.05	S
project Management	53.88	9.488	<0.05	S
Purchases	34.324	9.488	<0.05	S
Petty Cash	28.337	9.488	<0.05	S

Estimating and tendering	22.148	9.488	<0.05	S
Sub-Contractor management	0.492	9.488	>0.05	NS

As the ultimate outcome of the research, a framework was developed after identifying the fields where significant gap exists. Table 2 shows the main gap areas and the suggested solutions to reduce those gaps.

Table 2: Framework Development

Criteria	Reasons for Gap	Suggested solutions
Inventory Management	Existence of several item codes	Standardize a unique item code
	Deficiency in generation of MR, PO and GRN	On-time generation of MR, PO and GRN
	Incorrect sequence of purchasing procedure	Practicing the correct circulation of procedures up to the payment
	Ad-hock behaviours in Payment method	Appropriate Top management involvement
	Absence of Re-Order level	Continuous Stock Updating
Finance	Delays in 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	Restricting the pass in random data to the system
	Lack of required data in the reports for the decision making	Appropriate Top management involvement in the report generation
	Inadequacy of capturing necessary data	Proper planning when structuring the repot
	Ad-hock behaviours in scheduling	Proper scheduling with regard to 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

Criteria	Reasons for Gap	Suggested solutions
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 with in the construction projects
	Inabilityof achieving the profit goal	Activation of realistic approach for estimation and tendering
	Excess of Variations	Hiring proper cost estimators to limit the variation
Sub-contractor management	Bias ways of selecting sub-contractors	Carry out background analysis of subcontractors in the selection process
	Lack of tracking the work done	Manipulating working progress with according to the BOQ items
	Mixing up of subcontractor type	Analysing the variation and initiating the requires method to handle
	Ad-hock practices in Sub contractor payment	Produce systematic way of payment
Petty cash	No proper estimation on petty cash usage	Allocating fixed and adequate petty cash after proper feasible study
	Inappropriate usage of petty cash	Carrying out proper estimation on resource usage
	Ad-hock reimburse practices and poor controlling over petty cash	Carrying out proper estimation on resource usage
	Immoral reconciliation of transactions	Carrying out transparent account practices
	Issues in authorization	Initiation of online authorization system
Asset Management	Malpractices in purchasing asset	Call for Quotations
	No periodical maintenance of machineries and plants	Maintain standard records
	No record on valuation methods	Maintaining systematic way of valuating assets
	No proper monitoring on utilization of assets	Implementing a proper schedule on asset usage
	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

Criteria	Reasons for Gap	Suggested solutions
	Inefficiency in carrying out activities	Implementing a proper schedule on HR allocation
	Ad-hock leave allocations	initiation of systematic approach to leave allocation
	Lack of technical training for employees	Arranging periodical training sessions
	No proper measurement for employee performance	Introducing rewarding system
Purchases	Delays in approval and authorization processes	Initiation of online system
	Bias method of selecting suppliers	Carry out background analysis of supplier in the selection process
	Malpractices in purchasing resources	Call for Quotations
	Misplacement of MR,PO	Proper documentation
Project management	Inability to carry out cost variance analysis	Adherence to generate cost accordance with BOQ items
	Manipulation of calculations	Providing the required level of authorization to access the information
	Mal practices in rate analysis	Standardize the rates used with in 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 tool
	Scattered data among projects	Implementing integrating tool

1.6 Guide to thesis

This research report consists of Chapter 1 with a briefing on the background of the study. Chapter 1 further explains the problem statement, objectives of the study, significance of the study and the methodology used.

Second chapter revises the literature review in terms of thoroughness, the extent of support of previous studies on the present research and link the previous studies to the present study.

Third chapter describes framework of the study used in this research. Conceptualization and operationalization of the research methodology and research design and data collection methods are mentioned in this chapter.

Fourth chapter presents the data analysis. Graphical and statistical outputs of data are presented together with relevant explanations.

Finally, chapter five discusses the researcher's conclusion and recommendation.

2 LITERATURE REVIEW

This chapter explains the literature review related to the research in terms of thoroughness, the extent of support of previous studies on the present research and link the previous studies to the present study. This consists with research overview, functionalities of the construction industry in terms of estimating and tendering, finance management, construction processes, and human resource management. Further, this includes theory behind general process vs construction processes, PMBOK and ICTAD specification guidelines, challenges in construction organization, enterprise resource planning system and functional analysis of organizations, ERP & Organizational misfits.

2.1 Overview

Enterprise Resource Planning (ERP) system is a software which can automate and replace the existing system, integrate all departments and functions across the company into a single information system by running on one database. Hence, seperate departments can more easily interchange information and communicate with each other using ERP systems (Gabriela, Silvia, & Carmen, 2016). ERP helps for a company in decision making by providing the right information on right time at right place. It eliminates repetitive processes, and it solves the problem of disintegration & fragmentation of information system (Botta-Genoulaz & Millet, 2005).

Hospitality industry & medical services, airline industry, manufacturing industry are the pioneers of using ERP (Botta-Genoulaz & Millet, 2005). They use ERP systems to upgrade the quality of their operations and services. As they have routine business process, implementation of ERP systems for those organizations are much easier than construction organizations. Therefore, it is advisable to investigate how other industries take advantage of ERP before applying it to the construction industry.

There are lots of benefits of using ERP even for a construction organization. As a result of that, it has attracted construction organizations with in past few decades (Haddara, 2014). Furthermore, sharing information among heterogeneous system has gone up and integrated systems like ERP have secured their position with the fourth industrial revolution (IHS, 2010). However, it is established that adaptation of constrcution oraganizations for ERP

systems are much slower than other industries. It can be clearly seen when analysing the Sri lankan constrcution industry and its adaptation of ERP systems.

In the Sri Lankan Construction industry, implementation of ERP systems is not matured compared to other developed countries in the world. Though 63% named as "Success" according to the data from whole world wide, this rate is much lower in construction organizations in developing countries (Daniela, Maria, & Lucia, 2016). On the other hand, there is a huge effect for any organization if they invest for a computer solution like ERP (EconomyWatch, 2010). So that, Sri Lankan construction firms are reluctant to invest in ERP systems. Moreover, according to the other countries' post implementation conclusions, the main reason lead to an unsuccessful implementation is the improper planning at the initial stage (IHS, 2010). Therefore, most of the companies could not achieve pre-determined co-operated goals, and they were unable to achieve what they have expected from integrated software (Ike C & Mogens, 2005). This could be more predominant in the construction organizations. Organizational barriers, lack of resources and technological barriers, individual factors like lack of senior executive involvement, project management, incompatible business processes and human related problems such as resistance to change (Jaafar, Aziz, Ramayah, & Saad, 2007), organizational culture are some of the other challenges faced by developing countries like Sri-Lanka (Daniela, Maria, & Lucia, 2016). As mentioned above there are lot of external factors which decelerate the implementatin of ERP. Apart from these issuess, mismatch of constrcution procedures and ERP procedures have resulted to give up the ERP at the middle of the processes to a larger extent (Jyh-Bin Yang & Tsai, 2007).

Many researches have paid their attention to overcome the issues of ERP implementation. Most of them have addressed the issues related to external factors such as Organizational factors, Technical factors, Human resource factors andetc. But there is a lack in researches which have investigated about the functionalities of the ERP systems and the mismatch of those functionalies with the organizational procedures (Josep, 2014). Therefore, through this research it is expected to identify the gap between ERP procedures and the constrcution procedures and to develop a framework to reduce the gap with refernce to the Sri-Lankan constrcution industry.

2.2 Functionalities of the construction industry

In general, every project has a well-defined life cycle despite of its special characteristics. The project life cycle explains the stages where project goes through as it progresses from begin to end. The standard life cycle brings order and structure to the project. The structure could be described using five basic stages (Lester, 2017).

Project initiation:

During the first phase, the objective and the feasibility of carrying out the project are established. This is a critical stage of the whole procedure, since it can show whether this project is a suitable one to implement. If necessary, a feasibility study is carried out and determined on its feedback. Then, a recommended solution or plan is released. Once everything is discussed and determined, a project initiation document (PID) is initiated. The project initiation documents provide the bottom-line work for the construction schedule and the plan. Because of that this is very important to carry out the project successfully.

Planning phase:

In the project planning phase, project team decides the works to be carried out in the future. However, it has to be carried out throughout the project. That means it is an ongoing activity from the beginning to the end of the project. In this stage, the team is more concentrate on three bottom line of the project, time, cost and resources.

A well-developed project plan guide to have adequate amount of resources. E.g. It will allow to identify the required amount of financial capacity to buy materials. Further, it gives the team the direction for producing quality outputs, and handling risk, creating acceptance, communicating benefits to stakeholders and managing suppliers. Moreover, the plan leads the company to manage problems which may occur due to external factors and support to find out the solutions regarded to cost, scope and timeframe.

Project execution:

In execution phase, the main function is to build the deliverables according to the client's requirement. In this phase, project team has to allocate enough materials and human resources for the assigned task. Execution is basically depending on the works done in the planning phase. Because the activities which are carried out in the execution phase is derived from the project plan.

Project monitoring and control:

This is sometimes combined with the execution phase as both activities are occurring at the same time. When the project plan is executed as a project, monitoring the project should be done. It will guarantee the delivery of what was promised. The organization need to monitor the tasks to prevent the drastic changes in the scope, calculate key performance indicators and highlight the variations from allocated cost and time. The constant monitoring helps to keep the project moving forward smoothly.

Project closure:

Organization close a project after the completion of project deliverables. It is officially closed when they handover the finished project to the customer, communicating completion to stakeholders and releasing resources to other projects. Final deliverables which are considered at the closure are as follows.

- Handing over project documentation to the business
- Termination of suppliers' contracts
- Releasing project resources
- Communicate the closure of the project to all stake holders

This critical step in the project lifecycle help them to evaluate, document the project and move on to the next project, using previous project mistakes. This will lead to build a stronger processes and more successful project.

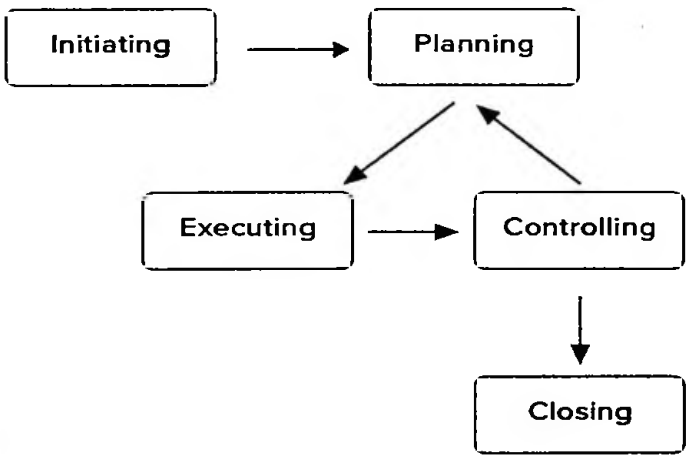

Figure 1: Project life cycle of a construction organization
Source: (PMI, 2017)

In order to complete a successful project, construction organizations have to go through each stage mentioned above. In that, there are four basic functionalities which carry out throughout this project life cycle. They are Estimating and Tendering, Finance Management, Construction Processes and Human Resources management.

2.2.1 Estimating and Tendering

Estimating Process:

Estimation is the technical process of the predicting the cost of construction. It starts after receiving the tender document by the company. The estimator is considered as the primary character of the total estimation process. He is initiating his work after he obtains the contract drawings, specifications and relevant Bill of Quantities.

The estimation process informs the top management to take actions during the progress of the project after comparing the estimated document and the actual situation of the project. In other word, estimation is a document which provide the basis for the preparation of the budget to the management. However, the effectiveness and the efficiency of the total estimation procedure depends on the way the process is considered in the execution phase. If the estimation is not properly used in the execution stage it is a waste to prepare them at the initial stage.

It is a normal practise to add up or subtract certain percentage on the cost of the items which is prepared by the estimate to fix the finalized price of the BOQ item. Once the estimator completes the BOQ with cost of items it is finalized by the manger after adding a margin. This percentage is commonly known as the management mark-up value. In most of the time this mark-up value is not determined according to a proper strategy or scientific calculation. It is just calculated according to a rule of thumb or expert judgement. However, this will lead to create problems in the final bid and increase the risk of tender becoming overestimated or under estimated. As this is out of the control of the estimator, tender price may have huge variations.

Client want to prepare a cost estimation to know the expected project cost and allocate enough financial amount. With out this allocation of money for the project, project will not be initiated. Usually contractors prepare cost estimation to win the tender and occupy a project or them. That is why they keep a satisfactory profit margin for them. But this many not match with the client's requirement. Therefore, client need to prepare a separate cost

estimation to identify the actual price of budget allocation and cross check the quantities and rates which is supplied by the contractors. Then they can understand whether contactors have overpriced or under-priced.(Routledge, 2008)

Tendering Process:

Tender is a document which is offered to a contractor by a client to execute and complete a certain task and adjust defects appropriately as per the terms and conditions mentioned in the Letter of Acceptance. Tendering process is known as a complex and comprehensive process in the construction industry as it is very expensive for both parties, tenderer and the employer. Specially in big projects contractor as well as employer have to spend lot of money on this process. However, the benefits of this tendering process can be obtained if the targets are achieved at the end of the project. According to the views of the expertise in the fields tendering process provided two basic advantages. (a) The employer may able to obtain competitive and realistic price for the work he is going to do. (b) The contractor may able to get a full understanding of the nature of the work and the deliverable before the implementation.

The time on preparation of the tender will help contractor to identify the nature of the project and it will allow to finish the work within the allocated time period. Further, the tender will give the idea about the risks that may encounter with the project execution and add a value to overcome those unexpected risks.

There are various types of tendering methods. One such prominent method is "Traditional Method". In here, client decided the procurement methods at an earlier stage prior to the start of Tendering processes. Client complete all the designs and all tender documents including Bill of Quantities with the help of a professional team "consultant" before hiring contractor. Then consultant fully complete the designs and keep them with him.

Types of Tendering Process:

a) **Open Tenders:**

In open tendering process, public advertisement and e-tendering websites are used to advertise the tender. In there, the contractor who is known as the tenderer has to prove his skills, capacity with resources, experience and strength to carry out the project. This tendering process is mostly used in small types of projects. As this call upon lots of tenderers, the client may able to attract the most economic tender to carry out his task.

However, the cost of the process may go up due to the high administration cost. On the other hand, as client have to select most economical tender, the tenderer who won the bid may not have proven his capability of doing the project.

b) Selective Tenders:

In selective tendering process, client invites for limited number of contactors who have proven a good track record with their previous works. Tenderers are selected from a list of pre-approved contractors who are already qualified for a special task. The approved contractors are chosen for "Pre-Qualifications" and it is done with respect to the skills and experiences they have encountered before with similar projects.

Client reviews the previous activities and the records of the performance. As they are chosen based on specific criterions client may able to select the specialist for the specific task. The cost of the tendering process may less due to the low administrative cost. However, the client has to pay higher price for the contractor as they are selected form smaller number of competitors.

c) Invited Tenders:

This is a process used for emergency situations. Smaller number of contractors participate to the process based on their experience and capability. So, the sorting procedure is not too long, and administrative cost is low.

d) Serial Tendering:

In this tendering method Client or the Investor negotiates with the Contractor in order to give them number of similar projects.

e) Two stage Tendering:

In here, the contractor engages in the primary stage of the project. Contractor prepare the design and all other documents at the preliminary stage and parties agree with a fix price to complete the work as a design and built project. The employer informs five to six potential contractors about the price overheads, profits and preliminaries of the project. Then the contractors propose suggestions to carry out the project. Based on the contractor's options client decide the contractor to move forward. The they move on to the next stage. That is called as "post-contract "work. Therefore, this method gives benefits to the client in term of

cost, reliability and time. There are several other advantages of this process. According to the contractor's point of view, contractor able to be a part of employer's design team and he is paid at the beginning. As they can actively participate, resource allocation can be done very effectively. Contractors are able to provide their expertise knowledge at the beginning of the project and avoid unnecessary circumstances. On the other hand, the disadvantage of involving contractor at the beginning of the project is losing of competition. That results employer to pay more for the contractor. To avoid this situation contractor and the employer must adhere to the conditions of contract properly.

Soon after obtaining the tender documents tenderers starts bidding. In this stage tenderers can sort out their quarries related to the drawings, specifications, and bill of quantities etc. And also, the employer can do adjustment to the tender document. Anyway, at this state both parties should visit the site of the project.

Tenders Submission and Opening of the Tender:

This is the final stage when Tenderers submits their tender offer before dead line stated in the invitation of the tender document; along with require tender security to the Employer. The opening of tender in most cases happens at a predetermined time and date which is mentioned in the tender document. The Client opens the tender bids with or without presence of the Contractor.

Award of the contract:

Usually, the contract is awarded for the lowest bid. However, in some cases client search for quality, whole life cycle costing, duration etc. Because of that based on the client requirement contract is offered.

Current Estimation Methodology:

Cost plan (Consists with Material, Labor, Plant) is used at the initial stage of the project and this gives good understanding about the project execution. In the early stages, there were lots of tradition cost estimation methods. With the development of technology all traditional approaches were faded away and many scientific methods have come in to play. After that, construction industry used to adopt for software to estimate the unit rate prices for the tendering process. In this regard, (Akintoye and Fitzgerald, 2000) in their study about UK

current cost estimation practices reported that the standard estimation procedure is a widely used method in construction companies, followed by comparison of similar project completed by the company and with the help of personnel experience on similar projects. Estimators face lots of troubles when preparing cost estimation with the competition in the market, discrepancy in specification, time duration, changes in scope of works, error in contract drawings, non-availability of similar project data, personnel experience on similar project, unforeseen change in material price (Waqur, 2017).

2.2.2 Finance Management

Financial Management is the process of planning, organizing, controlling and monitoring financial resources with a view to achieve organizational goals and objectives. Handing of finance is very important in construction sector as it vulnerable to economic changes, especially during recession periods due to the high capital outlays, cost flexibility and high competition limiting the price. The variation of business environment, related to shortage of funds, exchange rate fluctuation and political instability are creating financial risks for construction projects. Apart from that interest rate of credit, liquidity and currency generate highest risk for construction organizations. As per (Hlaing et al., 2008) the most relevant risk factors regarding finance management in construction industry are (a) The lack of financial resources of the contractor (b) The financial stability of the client (c) The costs overruns (d) Financial stability.

Further, construction companies sometime tend to lower the bidding price in the bidding process to win the tender. This results to create lots of financial problem as it can be subjected to unexpected events during the project. The lack of cash during the project may lead to delays, penalties and loss of opportunities which are reflected in the health of projects and organizations (Purnuş and Bodea, 2014).

Financial process of the project consists with financial planing. In here, it is requierd to identify the financial needs and contract requirements. Further, estimation of finacial costs, establishment of financial points, sensitivity analysis, development and testing of financial project plan, financial controlling of the project and mainitainig of administartion and records are done (Purnus & Augustin, 2015).

In construction companies, financial manager is responsible for accounting or tracking how the company's financial resources are used, including the following:

- Check whether the project and general overheads are monitored and tracked within the accounting system.
- Make sure that company maintain proper and standard accounting practices.
- Forecasting the cost at completion and check whether the unbilled amount is included in that.
- Ensure that the individual projects are on cost (Whether they are over budgeted or under budgeted).
- Ensure that needed financial statements have been prepared.
- Review the financial stamen and control the financial issues in the beginning to prevent large crisis.

Apart from resource handling, finance manager of a construction company needs to manage subcontractor payments, petty cash payments, timely retention and progress payments. If not, construction companies may go out of the business. Therefore, construction companies have to operate their finance sector properly to achieve their profit margins.

2.2.3 Construction Process

The construction process can be described by three components mainly. They are Design, Built and Maintenance. Design is a process of creating a new facility by detailed plans and specifications. Construction planning is a process of identifying activities and resources required to make the design. Once the designing is over by architects and engineer, contractor is ready to build the structure. In the design stage of a building, following activities are carried out. Various alternatives are investigated under the guidance of value Engineering. Value engineering can be defined as a systematic approach to recognize unnecessary costs in the construction and propose alternative options such as construction design or construction technology to decrease the cost without compromising the quality or the requirement of the client. Then, a review of designs with regard to their constructability is carried out as the project progress from the planning stage to design. In that, feasibility analysis such as Technical feasibility, Environmental feasibility, Social feasibility are done to stabilize the alternative. On that process risk is assed for the unforeseen conditions and testing are done to minimize the risks. Geotechnical tests are done to find out the suitability of the soil conditions after visiting the site.

In European practise, client have the conceptual design of the project with him. Then the contractor prepares the detailed design which will be checked by the client's engineer. Those shop drawings represent the assembly details for erecting a structure which should reflect the intent and rationale of the original structural design. They are prepared by the construction contractor and reviewed by the design professional. However, according to the contract agreement (Design and Built contract, Fixed price contract and etc) the party who is preparing the drawings can be vary.

After handing over the construction drawings and other contractual documents, contractor starts to build up the structure. Then, project manager of the organization coordinates the work, monitor cost and scheduling and review the construction work performed by the contractor. Further, designers are informed about the progress of the project. The variations, unexpected delays, and changes in working schedules should be carefully managed with the working progress of the project.

After the completion of the structure, contract has to be closed. Project closure is done after (a) Assurance that all the works has been completed (b). Assurance that all agreed upon project management process have been executed (c) Formal recognition of the completion of a project is completed. However, after closing the contract there is one-year warranty period after the date of substantial completion. During this time period if there are deficiencies in the project, they should be reported to the relevant parties (PMI, 2017).

2.2.4 Human Resource Management

Work force is one of the most important assets for an organization to carry out the functions efficiently and smoothly. This is very true for construction industry as it is a very labor-intensive industry. Therefore, labor resource is a mandatory requirement to complete a construction project successfully. It has been observed that human workforce in an organization create complex situations to manage. Therefore, human resource professionals in the construction industry face lots of challenges when implementing and enforcing policies with in a construction organization.(Yung & Siew, 2014).

One of the most challengeable issue in the construction industry related to the human resource management is finding of skilled labour. Construction organizations have to seek for employees who have professional experience on a project specific basis, since each project is different. Finding the right people for the job will often take lots of time and effort. This is much trickier in construction projects as the construction works is starting

with in a short period of time once the bidding process is over. Further, there is a shortage of skilled labour in construction sector with the infrastructural growth. Most of the construction companies face difficulties with the completion of projects because of the non-availability of sufficient skilled labors and staff to carry out the work efficiently. With the nature of the industry, shortage of the labour in all trade and all levels such as supervisors, foremen, engineers and managers including workers can be happened because of unforeseen political situations. This situation can be handled by several approaches.

The first option is to reduce the requirement of the labor. For that introduction of processes like prefabrication, standardization and modularization can be done. But to operate these process, redesigning of construction processes is required. The second option is to enhance the supply of labors. For that, it is required to retain existing labors, develop multi skilled labours and motivate the existing labours (Othman & Napiah, 2016).

The other issue is related to the skill of the employees. To improve and upgrade the skill and knowledge of the employee it is mandatory to implement training programs within the organization. However, it was observed that many construction companies do not have specific training module and program for the workforce. It was also discussed about the barrier they are facing in order to have an integrated training program to upgrade the skill. Some of the basic barriers in integrated training program for staff are as follows: (a) Higher cost for construction training programs (b) Short term service period of workers (c) Large number of learning places (d) Low attention of the client about the skill of the labors in a project (e) High time requirement to carry out the process (f) Lack of motivation among the workers

Above mentioned problems should be eliminated from the industry in order to carry out the operation of the construction industries. However, the training of the employees should include not only the technical matters but also the health and safety trainings (Malkani & Kambeka, 2013).

One of other issue in the industry is the difficulty in retaining employees with in a one company. As construction industry is running on project basis, payment schemes should be developed accordingly. Clients should focus on incentive-based bonus to retain the employees. When project milestones are reached along with project-based incentives and benefits such as accommodations, vehicles and other allowance should be provided for the employees. If not, employees tend to move quickly as possible once they get a higher benefit than the current situation (Malkani & Kambeka, 2013).

2.3 General process Vs Construction processes

Construction companies are unique from most of other companies and face many challenges and problems which are not encountered by them. It produces buildings, roads and other structures as the outputs which are different from the output of other industries. Because of these unique characteristics of the construction industry Estimating and Tendering process, Financial management principles, Execution of Operations and Human resource Management procedures applied to other product-producing industries often need to be modified before they are applied to the construction industry, otherwise they are useless.

The production method of manufacturing companies is considered as process oriented while the production method of construction companies is project oriented. Because of this reason manufacturing companies produce only limited range of products with slight variations. For construction companies, each product is unique and often products are different. It is not uncommon for construction companies to be working on a high-rise building, fire station or an apartment with in same period. Further, even though the project is similar in nature, the construction practices may be different according to the site conditions and location which may directly affect to the utilization of resources and labors.

Therefore, it is clearly seen that the operations related to the construction industry are much different than operations relating to other industries.

When it comes to **estimating and tendering process** of a construction company, there is a specific methodology to follow. However, it is hardly seen a manufacturing company who is following estimating and tendering procedures. Instead, they are moving with sales and marketing processes. In construction, one project is awarded to a contractor after going through a hectic program called Bidding. In there, construction organizations who are willing to take up the project participate and submit an estimate prior to the bidding. After the biding process client-the owner of the project hand over the construction to the contractor who is able to complete the requirement with lowest price. In manufacturing industry, the sales strategy is totally different from construction industry. They have to market the product with in the targeted group and they have followed several types of strategies to survive with in the market and compete with the competitors. The marketing concepts of the manufacturing companies should satisfy customer needs, increase sales, maximize profit and beat the competitors. The marketing strategies of the manufacturing company is associated with Production concept (Consumers will like products that are available and highly affordable), Product concept (Consumers will like products that offer

the most in quality, performance and innovative features), Selling concept (Consumers will not buy enough of the firm's products unless it undertakes a large-scale selling and promotion effort) , Marketing concept (Achieving organizational goals depend on knowing the needs and wants of target markets and delivering the desired satisfactions better than competitors do) and Social marketing concept (Marketing strategy should deliver value to customers in a way that maintains or improves both the consumer's and society's well-being) (Ota, 1997)

When it comes to **finance management** following differences can be seen in construction industry than other industries. Manufacturing companies have limited number of products and they produce the same thing with same process. Therefore, it is easier for them to decide their production cost and predict the future costs relating to the production process. But in construction companies, client has to estimate the price of a product which is unique for each customer and consists with different features. Further, construction projects with in the same company also have huge variations in cost due to the location of site, contractors involved in the project and subcontractors involved in the project. Not like manufacturing industry, construction projects are built in one specific location and handover to the client in the same location. The manufacturing companies distribute the same product to large customer locations. Therefore, handling of finance in these two types of industries are quite different. In manufacturing companies, the manufacturer can adjust according to the variations in the demand by producing and storing appropriately. When the demand is lower, they can store within warehouses and when the demand is higher, they can produce more (Ashworth, 2004). But that practice can't implement in construction industry. With most of a construction company's work occurring at the individual project's location, the construction company cannot store unused production during slow times for use on future projects. To deal with this, the construction company must constantly bid new work to keep the company's employees' workforce fully utilized or build continuous projects. Speculative type of project set up is risky procedure as they can't be moved or must be altered before handover to another customer.

Construction industry is a very unique industry than other industries. It is basically built up with number of projects. Finance handling of the construction industry is also much differed from other industries. They have to keep accurate costing for each and every project, and also have to keep cost for each group of components on a project. Keeping such accurate detailing on cost would help to control the cost of current projects as well as future projects. Every construction project consists with different mix of labor, material and

equipment. The costing of project depends on the rate of each component where the rates are changing frequently. Construction equipment are selected randomly after checking the availability to occupy. But materials and labors are selected according to a systematic procedure. Most of the time quotations are being called and suppliers are selected with the lowest quotation. Employees are also categorized with several criteria. They are company labors, subcontractor labors and etc. Main parties involved in construction project are client – the owner of the requirement, consultant- who is appointed by the client to supervise the works and contractor-the party which performs the task. With this mix up, finance division has to track each cost transaction and ensure whether the cost is allocated appropriately.

For many construction companies, contracts are long term and the activities are scheduled along the period. Within the period, progress payments are being paid by the client to the contractor and project is moving forward. When the progress payments are made, client retain some amount of money to ensure the project is completed with in the given time. This retention allocation is handled separately, and it requires special financial accounting procedure. Another key aspect of construction finance is subcontractor payments. Subcontractor is a major part in construction industry and it is heavily effect to the contract amount. Therefore, subcontractor payment is considered as a major concern in accounting practice (Burtonshaw-Gunn, 2009).

When it comes to **construction process** also, the design stage of the construction project is very much different to a manufacturing project. In construction projects every design is developed and constructed according to the customer's will and it takes longer time period to finish. In manufacturing, the products are similar to each other as it engaged with a routine process. In construction industry both the design and construction of a building facility must satisfy the conditions of particular site. As all projects are site specific its execution is affected by natural, social and other locational conditions such as weather, labour supply, local building codes and etc. Since the service life of a facility is long, the expected future requirements also difficult to predict. Because of that master plan and the schedule of the building design is subjected to frequent variations. These alterations lead to delay the project for several months. Therefore, organizations have to bear unexpected future circumstance and manage the programs to escape from risks associated with future activities (Fernández-Solís, 2008).

Human Resource Management of the construction industry is different from other industries as it is facing unique set of challenges. In general, labour scarcity is a common problem for all construction companies around the world. Most of the time companies fail

to complete a project with in the scheduled time period because of the unavailability of skilled human resource. Therefore, construction people need to plan for the maximum utilization of existing labours.

Basically, human resource practises are associated with employee recruiting rules, firing rules, finding new job opportunities, HR plans, training opportunities, job description and performance appraisal. Most of the time, these practises are controlled by separate department called HR department and it is observed that the practises of construction organizations are different from practises of other industries (Malkani & Kambeka, 2013). Within a construction organization, management has to handle employees from top to bottom. In top of the hierarchy, top management is managing the works and in bottom of the hierarchy, skilled labours & unskilled labours are performing the work. As lots of unskilled labours are engaged in the process, it is difficult to manage the employees than other industries. Due to that, the job satisfaction which is gain by those employees are very minimum and they tend transfer from one company to other company. This process is much easier in construction industry as employees are working on project basic. There are several categories of employees in construction industry. Some of them are permeant employees those who are paid a fixed salary by the organization, daily basic workers who are paid hourly basic rate, subcontractors who are paid as per the way of work carried out. Therefore, the unskilled labours in the organizations who are paid hourly basis can shift one project to other project with out any other concern and this lead to create much trouble in human resource operation (Yung & Siew, 2014). Further, due to these temporary employees it is very difficult to maintain an employee database. Moreover, attendance of the workers is recorded daily with day work sheets to do the payments.

Subcontractor management is another concern in construction industry. There are several kinds of subcontractors. (a) Subcontractors who work with their own material, labour and equipment (b) Subcontractors who work with company labour, material and equipment.

It is difficult to manage these employee segment who are working based on separate criterions. However, in other industries there is not much variation in the employee segment.

The other feature which specific to construction industry is high turning over of the labours (Othman & Napiah, 2016). Employees in the construction industry is shifting form one company to another company very easily as there is no bond between the organization and the employees. But in other industries, this situation is very much different and when the

appointment is given, they agree to sign a bond with the organization, and they have to follow specific procedures to resign from the work and etc.

Due to these unique functionalities, it can be clearly seen that construction industry has to work on a different working background in order to success with their projects.

2.4 PMBOK & ICTAD Specifications

Project Management Body of Knowledge (PMBOK) gives guidelines to manage individual projects and define project management basis. It also describes the project management life cycle and its related processes. This contains globally recognized and well-established standards to give proper guidance for the project management professions. Further, it mentions broader themes related to budgeting, Financing, Planning, Staffing, Organizational behaviors. Therefore, this can be named as a standard document that describes the establishment of norms, methods and processes and practices of construction industry. The knowledge contained in the book will lead to recognize good practises of project management practitioners.

ICTAD Specifications are intended to ensure that the users' essential requirement of performance quality etc. It spells out recommended standards of material and methods, procedures, workmanship, tests and good practices. Therefore, this can be named as another handbook which should be used by construction organizations to carry out operations.

The proper way of handling four main operations in construction industry namely estimating and tendering, human resource management, construction processes and finance management are described in both of these guidelines. PMBOK consists with knowledge areas such as Project Integration management, Project scope management, Project time management, Project cost management, Project quality management, Project human resource management, Project communication management, Project risk management, Project procurement management and Project stakeholder management.

- Project Integration Management: This refers to the process of seamlessly combining or bringing together the various moving parts of any project in order to work towards a common goal.
- Project Scope Management: This refers to ensuring that each project includes all and only the work identified at the beginning on the project, rather than letting the scope of the project expand as time goes on.

- Project Schedule Management: This refers to keeping an accurate and updated schedule of events for each project, including enforcing accountability and adjusting deadlines as necessary.
- Project Cost Management: This refers to planning, budgeting and controlling the financial aspects of every project in order to keep labour, materials, and equipment costs under the initially approved budget.
- Project Quality Management: This refers to the establishment of quality policies and objects at the beginning of each project so that recurring checks can be made to ensure the project will satisfy the needs of everyone.
- Project Resource Management: This refers to delegating specific tasks to members of the project team in a way that utilizes knowledge, expertise, and skills in the most methodical way.
- Project Communications Management: This refers to determining the most efficient way to distribute, monitor, control, and store information surrounding the project with everyone involved.
- Project Risk Management: This refers to conducting a risk management plan for each project by identifying, analysing, and controlling risk and establishing a response plan to address issues that may arise.
- Project Procurement Management: This refers to obtaining the products or services needed to complete the project. Subsets in this knowledge area include procurement planning, solicitation planning, source selection, contract administration, and contract closeout.
- Project Stakeholder Management: This refers to identifying all of the people or teams involved in the project, what role they will be playing, what their expectations are, and what management strategies will be employed.

ICTAD specification consists with the knowledge areas such as Estimating and Tendering processes, Subcontractor management, Site operation handling, Asset management, Petty cash handling, Finance handling, Inventory management. In the current situation, construction companies are carrying out processes according to ad-hock behaviours which are practised for a long period of time. Even though they have these guidelines they do not

properly adhere to these specifications. Because of that, there is a considerable variation in the practises carrying out by the construction organizations and practises mentioned in the guidelines. Therefore, it is appropriate to use specification and guidelines in PMBOK and ICTAD to analyse the gap in construction organizations with respect to current construction practises. Because of that in my research, above mentioned construction functionalities are summarized in to following criterion as described in ICTAD and PMBOK guidelines for the development of questionnaire.

Table 3 : Criteria development

Module	Description
Inventory Management	This module represents the transactions in the inventory such as reorder level, purchases, delivery of goods etc. of the organization.
Finance Management	This module consists with general accounting and financial procedures used in the business unit.
Site Operation	This module handles all the operations with regarding to the sites such as Report generation, Scheduling of sites, Progress handling etc.
Estimating and Tendering	This handles the BOQ before it submits to the tender process. Once it is accepted this is converted in to the live project.
Sub-Contractor Management	This module handles how subcontractor selection is done, how the payments are done and how the working progresses of subcontractors are managed.
Petty Cash Management	This module includes all transactions related to petty cash handling of the construction sites.
Human Resource Management	This module includes all aspects related to human resource management of an entity. It combines with personal details, payroll system, recruiting procedures, training, benefits and allowances, motivational theories etc.
Purchases Management	This module includes the handling of purchases and suppliers.
Project Management	This module handles every field of construction organization.

2.5 Challenges in construction organizations

Construction industry can consider as the major component in the economy of a country as it directly effects to the development index of it. The construction industry has dynamic and complex environments, where tracking resources and entering data and related information are challenging. But failure to trace them leads to schedule delays and additional cost. Hence, problems of getting and keeping projects on time, with in the budget and safe with the quality offered by the owner and architect/engineer are quite challengeable compared to other industries (Rashid, Hossain, & Patrick, 2002).

Although construction is one of the largest contributions to the economy, it is consideredasone of the most fragmented industries, inefficient and geographically dispersed around the world. Most of the issues like delays and cost overruns happened due to above mentioned features of construction industry. Following are the solutions introduced to overcome this problem.

The main problems of the construction companies are not limited to the following items.

- As there is no electronic tracking system project manager must produce daily production reports.
- Preparation of budget using excel sheets takes considerable time and money out of the company.
- The unique and independent method of encoding confined to each company.
- Site organization is not properly structured.
- Usage of material is difficult to track. Because of that documentation is very poor.
- Unnecessary report generation and lack of necessary details such as
    - Inventory
    - Budget
- Due to scattered nature, there is less time to follow up following processes.
    - Payment receivables
    - Raising invoices
    - Weekly reports
    - Requests of petty cash and reporting
    - Evaluation of the performace of project manger
- No proper method to manage fixed assets in the company.

- Unavailability of structured and accurate tracking system to manage resources in multiple sites.
- Not having sequential preparation of invoices so that it leads to have improper cash flows.

The problems are mainly due to the complex set of interdependent activities. The nature of the construction presents problems not usually found in other industries. For example, construction differs widely from other industries due to following features.

- Each project conssists with uniques characteristics
- Acess problems due to remote sites
- Unpredictable nature of the project processes
- Challenging to apply automation
- Variation in the cost items according to the constrcution environment
- Impropoer handling of resources and utilities
- New innovations in technical side are low
- Qualty of the product is heavily based on the work force
- Heavily based on the customer satisfaction

All these issues make construction projects very complex, difficult to monitor and control. (Seo, 2013). With the development of the infrastructure facilities this situation got worse. Manual involvement was not enough to handle the operations and lot of corruptions were happened. In order to eliminate these corruptions, construction organizations moved towards integrated computer software. One such system is Enterprise Resource Planning (ERP) system. It is an integrated software which can streamline business operations in an organization using a single database.

2.6 Enterprise Resource Planning system (ERP)

Due to dramatically changing construction business environment, construction enterprises face lots of challenges with increasing competition, expanding the market and rising of customer expectations. So that competitors are moving towards the integrating approach to improve their own business. And also, firms should increase their shares with suppliers, distributors, to accomplish those tasks. So that they think ERP is the best way to enhance these targets. It can benefit a construction company in the following way.

Table 4: Benefits of ERP system
Source: (Gardiner, Hanna, & LaTour, 2002)

Operational Benefits **Key Performance Indicator**	**Impact**
Time needed for planning, budgeting & management approval per year	–350 staff days
Expected project payback period	9 to 12 months
Billing (for supplies)	+70% faster (10 to 3 days)
On-time deliveries (from factory site to customer)	+90% to+100%
Tracking of materials issued to subcontractors	+50% more efficient
Requisition to purchase order processing	+30% faster
Year-end financial closings	+50% faster
Appraisal processing time	-50%
Monthly payroll processing time	From 4 hr to 30 min
HR report generation time	-95%
Inventory on hand	-15%
Unnecessary procurement	Eliminated
Need for available cash	-80%
Time required to create final global customer invoices	–50%
Time required for month-end closing	–60%
Transactional data entry efficiency	+10%
Product gross profit	+2%
Data entry labour hours	-4,500 in 1st year
Time to close books	-86% (from 35 to 5 days)
Cycle time in purchasing	-50%
Time for project management	-17%
Accounts receivables management	+66.7% faster

Time to generate HR-related reports	Faster delivery with lower turnaround time

2.7 ERP System and functional analysis of an organizations

Main purposes of an ERP are standardization of system and integration of organizational functions combining with task uncertainty and task inter-dependency. Task uncertainty is" difference between information need to complete a task and amount of information already presents". Low task uncertainty leads to have a good fit between the systems. "Task interdependence is a degree that activities are connected to each other" and task interdependency can be enhanced by ERP systems. According to previous research carried out by (Hustad, Haddara, & Kalvenes, 2016), following criteria help to identify whether the company will fit with the ERP before its implementation. Structures with a high level of formalization, low level of decentralization and low level of structural differentiation are the best to implement ERP. On the other hand, structures with very little formalization, high structural differentiation, and high decentralization are struggling with ERP implementation. Construction organizations are entities which have very lttle formalization, high level of structural diffentiation and high level of decentralization features. Therefore , it is concluded that according to the research carried out by (Hustad, Haddara, & Kalvenes, 2016), constrcution organizations need to be reengineered for a better ERP implementation or other wise ERP has to be customized significantly.

2.7.1 ERP and Organizational misfits

The misfit of construction organization and ERP can be eliminated by two approaches. One approach is customization of ERP so that it won't affect the procedures of the construction industry (Jyh-Bin Yang & Tsai, 2007). The other approach is to customize the construction procedures according to the ERP functionalities so that it won't affect to the ERP functionalities. Out of these two approaches, customizing the ERP software would be expensive than other approach. On the other hand, full customization of construction industry also impossible. Therefore, in-between solution should be carried out.

An enterprise system is developed in four steps. In the first step company's IT team collects and identify the requirements to an ERP system. Then the company sends out a request for proposal (RFP) to IT companies who develop enterprise resource planning systems.

Afterward, thecompany will receive proposals from IT companies, and they evaluate the suitability of the proposed system using the RFP guidelines. Finally, they select the system. Although 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 (Wikipedia, 2016).

This gap creates the misfit between the ERP and Organizational structure. Misfits can consider as the external manifestations of the differences between organizational needs and system capabilities. To analyze that misfit, carrying out an "FIT-GAP" is a closer look at on the reality. Most of the ERP packages are purchased or leased (Cloud based) from ERP vendors. As it is done in such a way, ERP system is developed already without identifying the system functionalities and own organizational procedures. ERP system bundled with predefined, already built-in assumptions and the predictions (How it could be work) (Wikipedia, 2016). But it may not match with the real situation of the construction companies. Therefore, construction firms try to re arrange their business operations to match with the ERP systems. Most of the organizations keep a strong relationship between the vendors even after the implementations as ERP reqires several adaptation procedures (Jyh-Bin Yang & Tsai, 2007).

Reasons for the gap need to be identified to reduce the gap existing between two procedures. There are several approaches which can be used to reduce this gap. Eliminating the gap can't be done. But minimizing them as possible is the key to success an ERP implementation. One approach of declining the potential risk is "Tailoring" or "Customizing" the system according to the organization. Some of the companies like to customize so that they don't want to change their working environment much. It is costly and risky. As it is challengeable, it is better to identify the correlation between organization misfits and tailoring procedures. There are four main categories which influence on tailoring. Those categories are Strategy, Project, System, and Institution. Apart from that culture and resistance also effect to the customization indirectly (Khouadjia, Mezghiche, & Drissi, 2015).

Before doing the customization usually, gap analysis is carried out to choose the adequate ERP system. Gap analysis is a kind of attempt to identify the gap at the design stage. The result of this analysis leads to configure the adjustments needed. Customization is needed because there can be imposed norms, laws and regulations which confined, and there can be unique processes of an organization. Ways of matching ERP and Organization are as follows.

1.Organization can completely adapt to the features embedded in ERP systems

2. Organization can identify the drawbacks of the ERP and eliminate the processes which doesn't match with the ERP processes

3.Temporary solutions are found by the organization for the changes in ERP (Involvement of Manual work).

4. Organization can tailor the ERP according to the organization procedures(Jyh-Bin Yang & Tsai, 2007).

Tailoring is a way of reducing the gap. Too much of tailoring would lead to increase the cost of the ERP. Therefore, it is required to do appropriate level of tailoring in order to comfort the user without having Big-Bang approach. Usually, if the client wants to operate the working environment as same as before, then ERP implementors have to do tailoring appropriately. When there is a misfit regarding the functionality requirement, report output, and presentation formats, integration between internal and external systems are needed. As mentioned above too much of customization creates problems. When doing tailoring, the procedures are arranged so that they fit with the on-going company procedures. But some of those procedures may not suitable to carry out in the way that they are currently doing. Hence, it will make a complex system which is difficult to handle. Too much of tailoring will add lots of external software to the existing system. With the new modifications, the cost of the system may go up indirectly than the invested amount. That may lead to fail the ERP implementation. In the beginning of the implementation, it is not difficult to change the ERP system according to the company structure. But with the time, company structure may need to be changed and ERP has to be changed accordingly. Hence, it is easy to standardize the company processes as per the standards of ERP processes than having complicated tailored system (Yang, Wu, & Tsai, 2007).

There are a lots of advantages of tailoring if we do it properly. To do a proper customization process it is better to identify the gap between organization procedures and ERP procedures. After identifying the proper gap, solutions can be easily applied. Therefore, through this research it is expected to provide guidelines where significant gap exists between construction procedures and ERP procedures.

2.8 Summary of Literature review

"Enterprise Resource Planning (ERP) system is a complex software that integrate business processes and information within and across the functional areas of businesses" (Josep, 2014). It covers areas like business management, planning, manufacturing, sales, marketing, distribution, inventory management, financial and accounting management, human resources management, transportation, project management, service and maintenance, e-business etc (Daniela, Maria, & Lucia, 2016). Therefore, global market for ERP system has registered a significant growth within the last few decades (Madapusia & D'Souzab, 2012).

ERP provides lots of advantages to an organization than that of a company who doesn't have a system. ERP can show one clear picture of whole business using a single database where all business transactions are entered, recorded, processed, monitored and reported. Increasing managerial flexibility, lowering the cost in the entire supply chain, increasing the efficiency, improving the business productivity are some of the major benefits which can be achieved through ERP implementation (Josep, 2014), (Andreas & Somnath, 2005). In spite of ERP's significant benefits to the industry, there are number of challengers that a company may encounter when implementing ERP (Ehie & Madsen, 2005), (Babae, Gholami, & Soudabeh, 2015), (Umble, Haft, & UmbleMichael, 2003). Those barriers can be categorized mainly in to two aspects namely functional barriers and non functional barriers. Functional barriers are arised due to the handling of functions with in the system while non-functional brriers are arised due to the other external factors.

Mainly, the issues related to external factors (Non functional factors) are based on managerial problems, human resource problems and techinical problems. But the issues related to functions are happened due to the oraganizational processes and processes in the ERP system itself. This issue is more related to construction industry. It has long term practised non standard practises than other industries such as manufacturing, hospitality, airline, education etc. Hence, it is vital to carry out a study to identify the functional barriers in the construction organizations to match the ERP with construction procedures.

ERP has attracted many research studies related to barriers and challenges of implementing ERP systems. However, most of the previous researches were based on non-functional issues and there is a lack in researches based on functional issues. Therefore, the objective of my research is to carry out a gap analysis between construction procedures & ERP procedures and to develop a framework to minimize the gap.

Construction is a industry which has geographically disperate locations than other industries. Hence, they have to operate in a dynamic environment where parties are dissolved in various locations and it has its own way of carrying out operations in those separate locations. On the other hand, ERP manufactures are IT related people who have no idea about the operational activites of the construction industry. This mismatch leads to have the gap between the constrcution processes and ERP processes. The Gap indicates the difference between the system needed by the construction company and the system created by the IT company (Hustad, Haddara, & Kalvenes, 2016). However, it is queit challengable to overcome this mismatch completely. One way of avoiding this mismatch is "customizing" or "tailoring" the software (Haddara, 2014). Tailoring is the process of adjusting the ERP software according to the requirement of the constrcution industry. Too much of tailoring leads to increse the cost and implementation time drastically. Therefore, it is better to ajust the constrcution industry according to the ERP systems which developed based on standards like PMBOK and ICTAD Specifications .

Thus, this research aim to identify those non standard methods which exsists with in the constcution industry and replace those with the standards in ERP system by developing a framework.

3 RESEARCH METHODOLOGY

This chapter rationalizes the methodology of the research. Combination of quantitative and qualitative approaches has been carried out to collect data. For Quantitative analysis questionnaire was developed and distributed among construction and manufacturing companies. Along with that semi structured interviews were carried out to support the questionnaire results and validate it with qualitative approach. There are several methods of quantitative data analysis. Out of these methods' questionnaire method was selected as the best method due to following reasons. As my research expected to receive the attitude and opinions of the people who use ERP system with in the manufacturing industry and construction industry, questionnaire will enable to receive responses for a same set of questions. It enables to analyse the data easily and build up the knowledge based on the perceptions of the respondents. However, the researcher has to depend on the respondent's answers heavily with in the involvement of questionnaire in the research. Therefore, researcher has to consider about the reliability of the data significantly in the data collection process. According to the research methods for business student by (Saunders, Lewis, & Thornhill, 2009) it is mentioned that although questionnaire is used as the only data collection method it is better to link them with other methods such as in-depth interviews to explore and understand the attitudes of the respondents properly. Because of that, to improve the reliability of data collection, semi structured interviews were carried out along with the questionnaire survey in my research.

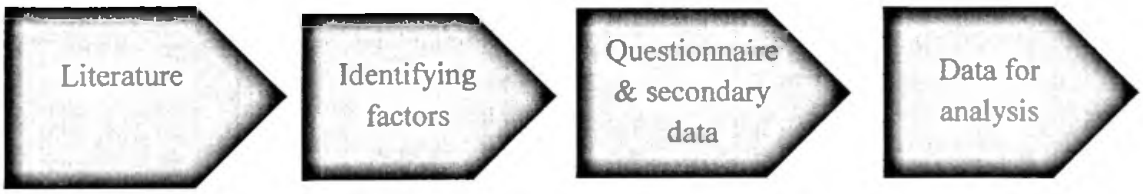

Figure 2: Research method

The companies that were subjected to questionnaire survey are C1-C5 companies naming RH, CML, Sunken Overseas, MAGA, Sierra, Penthouse, ICC, Sri-Palie Constructions, and manufacturing companies MAS, GSK, DSI. The sample selection will be described further in below sections.

The criterions to determine the GAP were selected from PMBOK, ICTAD which considered as the main references by the project management professionals. They are 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 detailed description of criterions is mentioned in the literature review section of the thesis (See Table 5).

- Inventory Management (section 8, (PMI, 2017), (ICTAD, 2005))
- Finance Management (Section 4, (PMI, 2017),(ICTAD, 2005))
- Site Operation (Section 2,5,6 (PMI, 2017))
- Estimating and Tendering (ICTAD, 2005)
- Sub-Contractor Management (section 13, (PMI, 2017))
- Petty Cash Management (ICTAD, 2005)
- Asset Management (Section 9, (PMI, 2017), (ICTAD, 2005)
- Human Resource Management (Topic 9, (ICTAD, 2005), (PMI, 2017))
- Purchases Management (Topic 12, (ICTAD, 2005))
- Project Management (Topic3, (ICTAD, 2005), (PMI, 2017))

Table 5: Description of the modules selected

Module	Description
Inventory Management	This module represents the transactions in the inventory such as reorder level, purchases, delivery of goods etc. of the organization.
Finance Management	This module constitutes the operational aspects of the general accounting and financial information for the business unit.
Site Operation	This module handles all the operations with regarding to the sites such as Report generation, Scheduling of sites, Progress handling etc.
Estimating and Tendering	This handles the BOQ before it submits to the tender process. Once it is accepted this is converted in to the live project.
Sub-Contractor Management	This module handles how subcontractor selection is done, how the payments are done and how the working progresses of subcontractors are managed.
Petty Cash Management	This module includes all transactions related to petty cash handling of the construction sites.

Human Resource Management	This module includes all business processes required to efficiently manage the organization's human resources need such personal, payroll, recruiting, time management, training, benefits, workforce development and analytics.
Purchases Management	This module includes the handling of purchases and suppliers.
Project Management	This module handles all aspects of activities in the construction organization.

3.1 Development of the Questionnaire

The guidelines to develop the questionnaire was extracted from the book "Research methodologies from business students" (Saunders, Lewis, & Thornhill, 2009). The requirement to develop the questionnaire were identified after considering factors such as characteristics of the respondents from whom you wish to collect data, importance of reaching a particular person as respondent, importance of respondents' answers not being contaminated or distorted, size of sample you require for your analysis, taking into account the likely response rate, types of question you need to ask to collect your data, number of questions you need to ask to collect your data.

After identifying these requirements, the structure of the questionnaire was developed. In there, several types of questions were used. Open ended questions used as they allowed respondents to give answers in their own way. Closed questions were used as they provide a number of alternative answers from which the respondent is instructed to choose. List questions were used as they offer the respondent a list of responses, any of which they can choose. Such questions were useful as it is needed to be sure that the respondent has considered all possible responses. Rating questions were often used to collect opinion data and Likert-style rating is used in my research. The utilization of these questions in my research is described below.

At the beginning of the questionnaire, open ended short questions were used to identify the characteristics of the organization. In there, the name of the organization, profit of the organization, employee strength of the organization and the level of using standards within the organization were measured. By those questions, it was easy to identify the type of organizations which tend to use ERP systems and it gave the identity of the organization

with basic parameters such as size, rate of return, adherence to the standards and specifications.

Then the questionnaire was sectioned in to Inventory management, Finance management, Site operations, Estimating and Tendering, Sub contractor management, Petty cash management, Asset management, Human resource management, Purchase management and Project management. These sections were basically selected according to the PMBOK and ICTAD specifications as they represent the whole picture of the processes in a construction organization. The description of each criteria is mentioned in the literature review.

Inventory management section consists with seven questions out of which five of them are closed questions, one list question and one rating question. At first, existing problems in the construction organization related to inventory management ware identified. It is identified that they are facing problems in the areas of item recognition, maintaining Material Requests (MR), Good Receive Notes (GRN), maintaining documentation, stock level. Accordingly, questions were developed to grab the answers indirectly. Question 5 was asked to identify whether the organization is keeping an accurate database. If there is no proper inventory database, it is difficult to use ERP system. Question 6, Question 7, Question 8 and Question 9 give the answers to identify the level of maintaining appropriate records which a vital requirement is to operate an ERP system. If a company is unable to manage proper documentations with transactions, they will also unable to maintain ERP. Because if the data input to the system is wrong, the output from the ERP may also wrong. Then the other basic problem is related to the inventory level, and question 10 and question 11 were asked to clarify how construction organizations react to this problem.

Finance management section consists with three questions out of which two are closed questions and one is rating question. Before the development of question 12, question 13 and Question 14, finance module of the WEB ERP system was operated. After identifying the requirement of WEB ERP, questions were developed to check whether they are applying in the construction industry. Cheques realization, account reconciliation and transparency of the accounting system was measured using question 12 ,13 and 14.

Site operation section consists with three basic questions out of which two are list questions and one is rating questions. Rating question (Question 15) is used to measure the satisfaction level of decision makers. Because without appropriate reports he can map all the operations in the organization and he is unable to prove accurate decision. The other two questions were developed after referring the ICTAD specification guidelines. The reports which need

to be submitted at the working progress level were identified after referring the ICTAD and questions were asked to check whether the organizations are generating those.

Estimating and Tendering section consists with four questions out of which two are closed questions and two are rating questions. All four questions were prepared after operating the Estimating and Tendering module of WEB ERP system. ERP system required rate analysis of BOQ items to prepare the estimation and full estimation was prepared after costing each BOQ item. Development of Question 18,19,20, and 21 was done to identify whether the construction practice allows this procedure.

Subcontractor management section consists with two closed questions. Question 22 was based on the selection criteria of the subcontractors. According to the PMBOK guidelines there is a specific procedure to select subcontractors for a specific task. Thus, question 22 measures whether construction companies follow that procedure or not. On the other hand, construction organizations have to pay attention for the subcontractor's working schedules. It is normally measured though work sheets. So, maintaining proper documentation in order to measure the work carried out is mentioned as a guideline in ICTAD specification. Question 23 check whether the organizations keep proper worksheets for the work performed by the subcontractors.

Petty cash section consists with five questions out of which three are closed questions and two are open ended questions which expect descriptive answer form the respondent. The questions were developed based on the questions faced by the construction organization with regard to petty cash handling. Most of the time petty cash given to site are used to purchase bulk materials and it leads to create shortage of cash within the site. This behavior is checked using question 25 and 26. In question 27, descriptive answer is expected to identify the usage of petty cash. Question 28 and question 29 are targeted to detect the frauds related to petty cash handling.

Asset management section consists with four questions out of which one listed question, two closed questions and one open ended question. Question 30,31,32 were developed referring to the ICTAD specification guidelines. In ICTAD they have developed various kind of reports to have a proper maintenance of machineries. Those reports are listed in the questions 30,31 and 32 to have the response whether construction organizations follow those standards or not. Question 33 developed in order to obtain an explanation how construction industry purchase an asset. That purchasing procedure is well defined in ICTAD and this check whether construction organization follow the guidelines.

Human resource management consists with six questions out of which four questions are rating question and two are closed questions. The level of satisfaction of employees in the fields of communication, leave allocation, salary payment, training, performance handling, rewarding as per the PMBOK guide lines are measured using the Question 34,35,36,37 and 38.

Purchase management consists with three questions including one listed question and other two closed questions. According to the PMBOK guidelines there is an unbiased way of selecting suppliers for the construction project (Suppliers should be selected base on quotations and proper approvals are required to proceed the purchasing). It is tested in question 40 and 41. Question 42 was developed to identify how the organizations handle incomplete purchase orders.

Project management section consists with four rating questions. This section represents the whole organization. Ability of analyzing cost reports, efficiency in controlling and monitoring the working progresses is tested in question 43 and 44. Further, securing the confidentiality of data and the effect of structure for the process handling is measured in question 45 and 46. (The draft questionnaire is attached in the annexes)

After structuring the questionnaire pilot questionnaire survey was done in Sri-Palie construction organization to fine-tune the drafted version to the final questionnaire. Apart from that, expert comments were obtained to upgrade the questionnaire. One of the main comments was to bring the final questioner to one scale as much as possible. This was considered since it would easy to use analytical tool with the single range of values. Another important review comment was to reduce the length of the questionnaire. Also, it had more focus on appropriateness of the content of the questions, sequences of questions, language general appearance of the questionnaire. After finalizing the questionnaire, data collection was done with selected sample.

3.2 Sample Selection and composition

In order to select a sample, it was decided to seek options from construction companies in Sri Lanka who use ERP system and IT experts who are having ERP knowledge and experience. The recipients were selected through convenient sampling technique. Questionnaire was distributed among people along with a semi structured interview. Forty people were subjected to questionnaire and semi structured interview in above mentioned companies. The companies were selected from C1-C5 scale. As Sri-Lanka is a developing

country construction people resist to adapt for the ERP implementation. Most of the small-scale construction organizations don't have enough capacity to implement ERP systems. And also, the competency level of the Engineers and the top management regarding IT is comparatively low in those companies. Thus, it is concluded that conducting questionnaire survey among C1-C5 companies will be most suitable option. For the sample size confidence interval was considered as 95% with Z=1.645, Standard deviation +-0.5, Marginal error 15%. The sample size is considered as adequate for the analysis and is comparable to response rate for ERP systems available in mid-sized organizations in Sri-Lanka. It was calculated from the below equation.

Sample size= $[(\text{Z-Score})^2 * \text{Std Dev} * (1-\text{StdDev})]/\text{Margin of Error}$

Required sample size= $(1.645*1.645) *0.5*0.5/0.15=30$

Sample size (40) > Required size (30)

Following organizations, who are currently use ERP system, has been selected for sample data collection.

Table 6: Sample Selection

Sierra		
MAGA		
Sunken Overseas		
RH		Construction companies
CML		
Penthouse		
ICC		
Sri-Palie Constructions		
MAS		
GSK		Manufacturing companies
DSI		

In the sample, eight construction companies were used to analyze the gap between construction procedures and Enterprise Resource Planning procedures. Further, three manufacturing companies were selected to identify the difference between construction procedures and manufacturing procedures. Same questionnaire was used for the manufacturing companies with slight modifications. Further, semi structured interview was carried out along with the questionnaire. The data collected from manufacturing companies were not subjected to quantitative analysis, but the qualitative analysis was carried out using the feedbacks.

3.3 Theoretical Background for the development of the framework

After selecting the sample for questionnaire survey, questionnaire was distributed among companies. Further, semi structured interview was carried out along with that to enhance the reliability of collected data. Then data was collected and to measure the gap level, each criterion was operationalized with measurable indicators. These measuring indicators were obtained from the forty-six questions in the questionnaire.

Table 7 illustrates the operationalization of main criteria using the variables. In here, Likert scale is used as the measuring tool.

Table 7: Operationalization of variables

Concept	Variable	Measure	Tool
Project Management	Cost variance analysis	Easiness of analysing the cost. Accuracy of the cost analysis	Likert Scale
	Monitoring and controlling the working progress	Accuracy of the working progress.	Likert Scale
	Privacy of Project data	Authorization level	Likert Scale
	Hierarchy level of the company	Hierarchy level	Likert Scale
Finance Management	Payment of Cheque	Quickness of realizing cheques	Likert Scale
	Transaction reconciliation	Effectiveness of reconciliation	Likert Scale
	Accounting procedures	Transparency of handing finance	Likert Scale
Inventory Management	Item Recognition	Usage of appropriate item code	Likert Scale
	Maintaining of GRN, MR	The frequency of updating data The way of recording GRN & MR	Likert Scale
	Re-order level	The time of re-order, Way of identifying re-order level	A Likert scale need to be developed

Concept	Variable	Measure	Tool
			according to the responses
	Procedure handling	Order of the procedures	A Likert scale need to be developed according to the responses
Site Operation	Report Generation	Decision making ability	Likert Scale
	Maintenance of standard formats	The types of formal documents used in the sites /The documents should be used in the site	Scale according to the types of formal documents used in the sites /The documents should be used in the site
	Scheduling of the site work	Idling time/working time	Idling time/Working time
Estimating and tendering	Following up of BOQ	Matching of BOQ items and Estimating items	Likert Scale
	Preparation of BOM	Efficiency in selecting rate	Likert Scale
	Changing of BOQ before tendering process	Level of changing ability	Likert Scale
	Comparison of tender documents at the tendering stage	Easiness of the comparison	Likert Scale
Sub-Contractor management	Subcontractor payments	Payment delays Interim bill evaluation	Payment delays in evaluation of interim bills
	Subcontractor selection	Sequence of Selection procedure	Likert Scale
Petty cash	Petty cash Amount	Amount of re-allocation of petty cash for the previous month	Likert Scale
	The reconciliation process	The level of doing reconciliation	Likert Scale

Concept	Variable	Measure	Tool
	Authorization to petty cash	Authorization level or Deductions in Fraud	Likert Scale
Asset Management	Purchasing an asset	Procedure for purchasing	Likert Scale
	Details of maintenance	Types of records maintaining	Efficiency of the record handling
	Valuation of the assets	Valuation techniques used.	Compatibility of valuation techniques
	Usage of the asset	Idling time/Working time	Idling time/Working time
HRM	Connection between Managers and workers	Level of cooperation	Likert Scale
	Scheduling of works	Efficiency in scheduling	Likert Scale
	Allocating leaves	Efficiency of allocating leaves	Likert Scale
	Training	Frequency of giving training	Frequency of giving training
	Payroll and compensation	Satisfaction of the employee	Likert Scale
Purchases	Selection of material suppliers	Selection criteria	Likert Scale
	Approval process	Time goes for the approval process	Time value comparing
	Purchase requisition	Purchase requisition time	Purchase requisition time comparing
	Handling of incomplete purchases	Efficiency of handling records	Likert Scale

Then the collected data from construction companies were analyzed using Chi-Square test and identified the gap between each factor under above criterions. The collection of data and analyzing techniques are presented in-depth in next chapter. Having identified the gap in each criterion where a significant gap exists, a frame work was developed to empathize the processes which should be aligned with the ERP procedures before the ERP implementation. Framework is a conceptual design which provides functionalities/solutions to a particular problem. In my research, gap areas were identified using the results of the

questionnaire survey (Problem identified) and solutions to reduce the gap were suggested accordingly (Development of the framework).
Further, semi structured interviews were carried out with in three manufacturing companies to compare the construction processes and manufacturing process. The way it conducted is mentioned below.

3.4 Semi structured interview

In my research semi-structured interviews were carried out along with the questionnaire survey to analyse the data qualitatively. The questionnaire which developed for the questionnaire survey was used as the basis for the interview. People who use ERP system such as Top Management (CEO/Director, GM, PM, Engineer, Technical Manager) Technical Officer/IT officer, Quantity Surveyor, Data Entry operator were subjected to the interview for about 15 min to 30 min and it was recorded throughout the period in order to analyze them properly.

3.5 Limitations

Even though research has attempted to reach a wide cross section of ERP types used in different organizations, lack of responses from certain ERP users the sample responses were limited. The other limiting factor was that the responses had been based on the perceptions of the respondents and may not be a realistic measure in certain cases. Interviews conducted by the researchers may have got the most appropriate answers, but difficulties arise due to the inability of conducting interviews with all respondents. Also, some users reluctant to give their feedback as they point out ERP contains sensitive data.

3.6 Chapter summary

This chapter covers the methodology to be adopted in the research. The development of questionnaire, sample selection, operationalization of variable to measure the gap level and development of the framework is described in this chapter.

4 DATA COLLECTION AND ANALYSIS

4.1 General

This chapter discusses the data analysis of the research. A reasonable number of ERP systems were implemented in construction organizations in Sri Lanka within the last decade and majority ERP system implementations are done by large and medium size construction-based companies. A group of construction companies were selected for this research study as mentioned above. Qualitative exploratory methodologies of structured interviews were used to judge the data collected from questionnaire survey. The data were collected over the period of six months. Interviews were carried out to certify the reliability of the data which entered through the questionnaire.

To obtain the reasons for the gap which exists between ERP and Construction procedures, another separate industry was used. So, the manufacturing industry was taken to compare gap which prevails with in these two industries. Separate questionnaire along with structured interviews was carried out and analysis was done.

4.2 Characteristics of responses

The survey and the semi-structured interviews were carried among C1-C5 middle and large eight construction organizations as discussed above. As well as individuals who are using ERP systems commonly are participated to the interviews. The respondents can be categorized as below (See Table 8 to identify the distribution of the sample).

1. Top Management
   - ✓ CEO/Director
   - ✓ GM
   - ✓ PM
   - ✓ Engineer
   - ✓ Technical Manager
2. Technical Officer/IT officer
3. Quantity Surveyor
4. Data Entry operator
5. Stock Keeper

Table 8: Distribution of the sample

Respondents	Number of participants
Top Management	8
CEO/Director	2
GM	1
Engineer	3
Technical Manager	2
Technical officer/IT officer	8
Quantity Surveyor	8
Data Entry Operator	8
Stock Keeper	8
Total	**40**

Above respondents had different perspective towards the ERP implementation within the organization. Perception towards the implementation highly effected to carry out the questionnaire survey in construction companies. Top management of construction organizations were keen on implementing computerized software as they need to identify the whole picture of the construction process at one glance. With the current set up, they had to collect lots of reports and do manual calculations for the decision making. Therefore, top management including CEO, GM, Engineer, Technical manager had a positive feedback towards the ERP implementation. Further, Technical officers and IT officers also supported to implement ERP systems with in their organizations. However, Quantity surveyors of the organizations were reluctant to use ERP systems. Most of the quantity surveyors resisted ERP as they thought, that the data entering of the ERP creates double work. This resistance has created much trouble in the initial stage of ERP implementation. When considering the data entry operator, he satisfied with the job after entering the backlog. Storekeepers were interested in using ERP systems for their activities. According to them, inventory handling using ERP was much easier than the inventory handling manually. This likeness and the resistance of the employees also heavily contribute to the success of ERP implementation.

4.3 Results

Results were obtained after the analysis of data collected from questionnaire and structured interview mapped in to Likert scale numerical values. Those values were put on to a Chi-Square matrix and analysis was done as below.

Assume Likert scale has 4 categories.

COST VARIANCE ANALYSIS

PROCEDURES	1	2	3	4
ERP	6	5	9	7
CCP	8	6	7	12

Figure 3: Application of Chi-Square test

When Chi square value is not significant, Cost Variance and Procedures are independent. Then, cost variance analysis does not vary according to the procedures of ERP and current construction practices (CCP). This was the basic which used to analyse the data.

4.3.1 Identification of gap between practises in construction industry and ERP

Chi-Square test was performed to test the hypothesis whether there is a significant difference in procedures used in ERP system and construction practices. Chi Square test is a non-parametric test of statistical significance for bivariate tabular analysis. A hypothesis tested with Chi-Square is checked whether or not two different samples are different enough in some characteristic or aspects of their behaviour that we can generalize from our samples. If the Chi square value is found to be larger than the critical value at a chosen probability of error threshold – P value (In this research, threshold probability is 0.05), then the data present a statistically significant relationship between variables used in the test (Chi square > Critical Chi square). Table 9 shows the relationship of critical chi-square value and the chi square value relevant to the variable. E.g. In "Cost variance analysis" variable the critical chi square value is 9.48772 and the relevant chi value is 40.927 which is much larger than the critical value. This relationship indicates that "Cost variance analysis" variable shows a significant difference between ERP procedures and ERP procedures. In addition to this, the

significance of the gap in each variable is indicated using a colour scheme (See Table 9). Variables with darker colour show a higher gap than the variable with lighter colour.

Table 9: Gap Identification

Module	Variable	Chi-square	Chi-square (Critical)	P value	Significant /not
project Management	Cost Variance analysis	40.927	9.48772	<0.05	S
	Monitoring and controlling the working progress	13.551	9.48772	<0.05	S
	Privacy of the project data	0.373	9.48772	>0.05	NS
	Hierarchy level of the company	25.473	9.48772	<0.05	S
Finance Management	Payment of Cheque	40.675	9.48772	<0.05	S
	Transaction reconciliation	39.774	9.48772	<0.05	S
	Accounting procedures	48.483	9.48772	<0.05	S
Inventory Management	Item recognition	55.049	9.48772	<0.05	S
	Maintenance of MR and GRN	46.899	9.48772	<0.05	S
	Re-Order Level	48.151	9.48772	<0.05	S
	Procedure Handling	31.994	9.48772	<0.05	S
Site operations	Report generation	25.368	9.48772	<0.05	S
	Maintenance of the standard forms	44.372	9.48772	<0.05	S
	Scheduling of the site works	42.941	9.48772	<0.05	S
Estimating and tendering	Following up of BOQ	58.141	9.48772	<0.05	S
	Preparation of BOM	52.258	9.48772	<0.05	S
	Changing of BOQ before the tendering processes	50.01	9.48772	<0.05	S

Module	Variable	Chi-square	Chi-square (Critical)	P value	Significant /not
	Comparison of tender documents at the tendering stage	53.256	9.48772	<0.05	S
Sub-contractor management	Subcontractor payments	5.606	9.48772	>0.05	NS
	Subcontractor selection	1.36	9.48772	>0.05	NS
Petty cash	Petty Cash amount	1.747	9.48772	>0.05	NS
	Reconciliation process	47.299	9.48772	<0.05	S
	Authorization to petty cash	5.905	9.48772	>0.05	NS
Asset management	Purchasing an asset	1.188	9.48772	>0.05	NS
	Details maintenance	52.285	9.48772	<0.05	S
	Valuation of assets	55.159	9.48772	<0.05	S
	Usage of the assets	52.599	9.48772	<0.05	S
HRM	Connection between managers and workers	52.542	9.48772	<0.05	S
	Scheduling of works	3.742	9.48772	>0.05	NS
	Allocating leaves	24.925	9.48772	<0.05	S
	Training	48.147	9.48772	<0.05	S
	Payroll and compensation	22.858	9.48772	<0.05	S
Purchases	Selection of material suppliers	8.301	9.48772	<0.05	NS
	Approval processes	11.889	9.48772	<0.05	S
	Purchase requisitions	6.073	9.48772	>0.05	NS
	Handling of incomplete purchases	55.076	9.48772	<0.05	S

Table 10 shows the significance of each variable related to main criterions. Table 11 and the bar chart (See Figure 3) show how the integration of those variable lead to create the significant difference between ERP and Construction procedures under main criterions.

Table 10: Identification of areas where gap exists

Module	Chi-Square	Chi-Square (Critical)	P Value	S/NS
Inventory Management	158.766	9.488	<0.05	S
HRM	142.336	9.488	<0.05	S
Asset Management	130.264	9.488	<0.05	S
Finance Management	126.267	9.488	<0.05	S
Site Operations	103.793	9.488	<0.05	S
project Management	53.88	9.488	<0.05	S
Purchases	34.324	9.488	<0.05	S
Petty Cash	28.337	9.488	<0.05	S
Estimating and tendering	22.148	9.488	<0.05	S
Sub- Contractor management	0.492	9.488	>0.05	NS

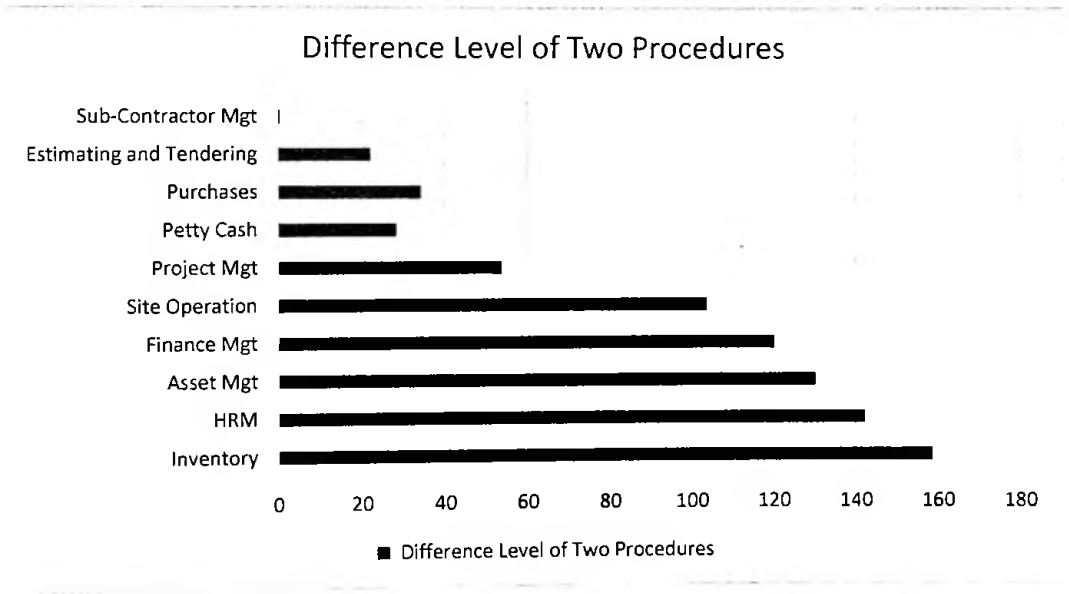

Figure 4: Gap level of ERP and construction procedures

4.3.2 Relationship between ERP type and its implementation

Questionnaire was distributed among construction organizations who use different types of ERP systems. It was expected to find whether there was an effect from ERP type to the implementation. To find out the relationship each module was compared with four types of ERP systems namely Web ERP, SAP, IFS, Microsoft Dynamics. The effect was examined through the questionnaire survey itself. The result of Chi square 2.768 < Chi-Critical 40.113 has shown that handling of modules do not vary with the type of ERP system used in the construction companies.

4.3.3 Development of the framework

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 11 shows the main gap areas and the solutions to reduce those gaps.

Table 11: Framework Development

Criteria	Reasons for Gap	Solutions to reduce the gap
Inventory Management	Existence of several item codes	Standardize a unique item code
	Deficiency in generation of MR, PO and GRN	On-time generation of MR, PO and GRN
	Incorrect sequence of purchasing procedure	Practicing the correct circulation of procedures up to the payment
	Ad-hock behaviours in Payment method	Appropriate Top management involvement
	Absence of Re-Order level	Continuous Stock Updating
Finance	Delays in 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
	Mal Practices in report generation	Restricting the pass in random data to the system

Criteria	Reasons for Gap	Solutions to reduce the gap
	Lack of required data in the reports for the decision making	Appropriate Top management involvement in the report generation
	Inadequacy of capturing necessary data	Proper planning when structuring the repot
	Ad-hock behaviours in scheduling	Proper scheduling with regard to 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 with in the construction projects
	Inability of achieving the profit goal	Activation of realistic approach for estimation and tendering
	Large amount of variations	Hiring proper cost estimators to limit the variation
Sub-contractor management	Bias ways of selecting sub-contractors	Carry out background analysis of subcontractors in the selection process
	Lack of tracking the work done	Manipulating working progress with according to the BOQ items
	Mixing up of subcontractor type	Analysing the variation and initiating the requires method to handle
	Ad-hock practices in Sub contractor payment	Produce systematic way of payment
Petty cash	No proper estimation on petty cash usage	Allocating fixed and adequate petty cash after proper feasible study
	Inappropriate usage of petty cash	Carrying out proper estimation on resource usage
	Ad-hock reimburse practices and poor controlling over petty cash	Carrying out proper estimation on resource usage
	Immoral reconciliation of transactions	Carrying out transparent account practices
	Issues in authorization	Initiation of online authorization system
Asset Management	Malpractices in purchasing asset	Call for Quotations

Criteria	Reasons for Gap	Solutions to reduce the gap
	No periodical maintenance of machineries and plants	Maintain standard records
	No record on valuation methods	Maintaining systematic way of valuating assets
	No proper monitoring on utilization of assets	Implementing a proper schedule on asset usage
	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-hock leave allocations	initiation of systematic approach to leave allocation
	Lack of technical training for employees	Arranging periodical training sessions
	No proper measurement for employee performance	Introducing rewarding system
Purchases	Delays in approval and authorization processes	Initiation of online system
	Bias method of selecting suppliers	Carry out background analysis of supplier in the selection process
	Malpractices in purchasing resources	Call for Quotations
	Misplacement of MR, PO	Proper documentation
Project management	Inability to carry out cost variance analysis	Adherence to generate cost accordance with BOQ items
	Manipulation of calculations	Providing the required level of authorization to access the information
	Malpractices in rate analysis	Standardize the rates used with in 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 tool
	Scattered data among projects	Implementing integrating tool

4.4 Data analysis and Discussion

Before, ERP comes in to play organizations start with spread sheets, quick books, and separate software coupled with hardware for each activity which is operated in the company. But when they mature, they had to keep more records and had to use ERP solutions. Though ERP is a famous aid for data processing in other field, still construction sector is reluctant to identify it as a supporting tool. The main reason beneath this situation is the gap exists between ERP processes and Constriction processes. The research has compared ERP processes and Construction processes according to the PMBOK standards and ICTAD Specifications.

In order to achieve this target at first current practises of construction companies were analysed using manufacturing companies. Following shows how procedures in construction companies vary with the manufacturing company.

I. Manufacturing Companies Vs Construction companies

Construction industry is generally focussed on the production of single and unique product. The construction process consists with six distinct stages such as concepts, contracts and bid documents, bidding, construction, construction payment and completion. In these stages' construction companies have to carry out business operations in the fields of Inventory management, Finance management, Site operations, Humana resource management, Estimating and Tendering, Subcontractor management and etc. However, when the process of construction industry is compared to other industries such as Manufacturing, it is clearly seen that there are significant differences between the processes of those two companies. As manufacturing companies are pioneers of using ERP systems in their operations, it is possible to identify the issues with construction companies to implement ERP systems. Based on that assumption qualitative analysis was carried out using semi structured interviews to compare the features of construction companies and manufacturing companies and following are the findings.

- Construction companies have to handle number of distinct projects with in the same period of time involving number of client parties, consultant parties and contractor parties. This situation leads to have different types of contract agreements such as "Design and Built", "Fixed cost", "Cost Plus" etc. As the way of handling these contract types are different from one another, the way of handling the process under

the contract agreement also different from one another. As an example, preparation of estimating and tender documents in "Design and Built" contract is different from preparation of estimating and tender documents in "Fixed Cost" contact. However, in manufacturing companies there is only one way of handling the operations and it is equal for all products. Thus, implementation of ERP system in such environment is much easier than complex environment like construction companies.

- In manufacturing companies, product cycle is defined as "The sequence of stages from product introduction to growth, maturity and decline". In there, all products have to go through these stages, and it is similar for every product. Therefore, they take similar time period to complete the production process of one product and after some time it turns in to a routine work. But in construction companies, project cycle is defined as "The sequence of stages from project initiation, Planning, Execution and Closure". There are number of simultaneous projects with different project life cycles with in one construction organization. Therefore, ERP should have the capability to handle all types of different projects in the same time.
- In construction companies, each project is unique due to the uncertainties attached with the projects. External influences and constraints towards construction projects would be different, yet subject to change throughout the project timeline. E.g. Technological changes, sources of financing, market forces, climatic changes, politics, changes in client requirements.
- Construction projects are isolated from one another geographically. Most of the sites are in remote areas without enough technical facilities and network connections to implement ERP systems. But in manufacturing companies all departments are in one place and easy to connect with network like LAN.
- In constrcution project the situations are unpredictble. Majorly, weather creates uncertainty for any construction project. Though they have a project schedule in the beginning of the project, it subjects to higher variations when carrying out the works. Therefore, implementation of standard system like ERP is difficult in high uncertainty environments like construction than other industries.
- It is vital to have a satisfactory technological competency to operate the ERP systems. But according to the research it is found that technical competency of the construction companies are very much less compared to other industries. Thus, there is a technical limitation for using the ERP in the construction industries.

- There is a high probability of occurring emergency situations in the construction industry. In that situation, quick approvals are required to carry out the works. But according to the ERP system, authorization is a mandatory to proceed the activities Contradictorily, in manufacturing companies all the operations are streamlined and automated. So, those approval processes go smoothly, and issues are not created.
- Store-keeper is an in-house person in manufacturing companies. Thus, he can handle all inventories form one location. But, in construction sites there are several places of storage and it is very difficult to monitor the inventory transactions.

II. Identification of the gap

To develop the frame work, the areas where significant gap exists need to be identified.
As per the research conducted by Eli Husted, Moutaz Haddara and Baldvin Kavenes it is concluded that there always exists an aperture between organizational practice and the way an ERP system works, regardless of the organization (Haddara, 2014). However, from my results it is clearly identified that this gap is significant with respect to the construction industry as it is difficult to satisfy their requirements. Further my results are verified by the research carried out by Chijoo and Chiheon (Lee & Lee, 2017) mentioning that "Perception gap" which often exists between the proposed system by ERP vendors and construction organizations.
After the research analysis it is concluded that there is a significant gap between construction procedures and ERP procedures in every field related to 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. This gap is created due to some specific features of construction industry than other industries. Using qualitative analysis top most features were identified as listed above. Further, it is identified that whether the type of ERP has an effect on this significant gap. According to the results obtained from my results it is concluded that there is no significant difference between ERP type and the Modules. But this can be happened due to two main reasons.
1. The modules in every type of ERP system are same. Therefore user perspective is same.
2. The modules in each ERP type is different. But, User has experienced one system.

According to the first condition mentioned above, modules in the ERP systems should be same although they are different with ERP system. But it is observed that there are various kinds of ERP systems in the market and they are consisted with several modules with respect to their price ranges. Some of the software consist with one module while other software consist with two three modules for the same price range. So there is a big difference in the quality. According to the above facts user perspective can't be same for each ERP module if they experience each of those modules.

On the other hand, Sri Lankan construction organizations haven't experienced so many ERP systems within the lifetime of the organization. Thus, employee can experience only one type of ERP system with in their working time. Because of that in my research the people who are subjected to survey may have experienced only one ERP system. Thus, they feel that every ERP system is same, and objective of each module is same.

Therefore, it is difficult to conclude that ERP type doesn't affect for the implementation of ERP system.

III. Framework Development

The framework was developed with possible solutions after identifying the gap between procedures of ERP and procedures of construction practices. Below shows the reason for gap in each module and solutions suggested to overcome them. Along with the tables, variables used in questionnaire (See Table 7) and their impact to create the gap were described.

[1]. Analysis of inventory management criteria

Module	Reasons for gap	Solutions suggested
Inventory Management	Existence of several item codes	Standardize a unique item code
	Deficiency in generation of MR, PO and GRN	On-time generation of MR, PO and GRN
	Incorrect sequence of purchasing procedure	Practicing the correct circulation of procedures up to the payment
	Ad-hock behaviours in Payment method	Appropriate Top management involvement

In inventory management gap areas are lied in Item recognition, Maintaining of MR, PO &GRN, Re-order level handling and Procedure handling. In order to reduce this gap, standardize a unique item code, on time generation of MR, PO & GRN, practising the correct circulation of procedures up to the payment, appropriate top management involvement was suggested.

Item Recognition

In item recognition, if the company maintains proper way of item recognition methods it indicates that they have proper stock maintenance. If they carry out the original supplier's code that means, there is a high probability of misplacing materials from the sites especially small items such as nails. In normal construction procedures proper inventory may not maintain because of not having correct way of item coding.

But, when companies use ERP systems, they tend to use standard business processes and move away from traditions practices (Morton & Hu, 2008). Thus, system force to have proper coding for the item for the better identification. So transparency of inventory may secure. Before the implementation of ERP there was no uniform item code. Non-uniform item code was maintained by the organizations. So, the actual amount of inventory in the stock could not be measured properly. However, ERP system force to have a proper item code to maintain the inventory. But, for a long period of time people have used this ad hock behaviour and sudden change of standard procedure may not accepted and this will lead to have the gap.

Maintaining MR, PO and GRN

Most of the construction companies do not use master resource plan developed at the beginning of the construction project for forecasting the resources at later stages. There requirements of the resources are suddenly calculated, and the MR and PO are generated accordingly (Gardiner, Hanna, & LaTour, 2002). This sudden behaviour lead to generate not properly authorized, not recommended and duplicate receipts. Without ERP, construction companies adapt to request resources at the beginning of each month and they were unable to handle resource utilization and wastage.

With the ERP, at the beginning of the project "Master resource plan" is developed. Hence, before the project commencement resource requirement is estimated. Following the master plan, monthly resource requirement plan is established. Then short term as well as long

term resource requirement is known. This behaviour can be identified as reason to have gap between two procedures.

Further, according to the system, to have proper working progress maintaining proper MR, PO, and GRN is a must. In ERP system the sequence of procedure should be fulfilled so as to do a payment for the suppliers. So, automatically proper procedure will be carried out according to the ICTAD specifications. But in construction sites some time the order of the purchasing procedure is different. They practice ad hock behaviours. So, at some point, the system will get stuck. Without ERP, records have to be entered separately and order of generating MR and GRN can't be guaranteed. Thus, this can be identified as a gap creating problem.

Re-order level

Re-order level should be identified through the stock updating. When the system has proper updating on inventory then re-order level will be automatically highlighted. When we manually handle the stock level then the stock keeper has to identify the re-ordering material list by observing all inventories by him. It consumes time and some items can be missed. Construction procedure is looking at physically and order at the moment it needed as there is no proper re-order level. ERP is having constant re- order level for each item, so it forces the management to allocate MR on time (Gardiner, Hanna, & LaTour, 2002). Then there will be no delays on purchasing or over stock with in the storage. The time of re-order is the other concern. When the stock keeper not recognize the re-order level and order the material at the last moment, due to late recognition of stock project will be delayed. But if there is ERP, it automatically ensures the minimum level of the materials. Forcing to maintain a proper re-order level is done by the ERP and construction people reluctant to do so enhances the gap

Procedure handling

"Procedure Handling" has the following sequence when there is a material purchasing according to the ICTAD specifications. (i) Checks the stocks against the master material requirement (ii) Originate purchase requisition (iii) Check and approve if budgetary provisions are available (iv) Calling Tender/Quotations (v) Prepare comparison of offers and obtain approval (vi) Inspect and approve purchase quality (vii) Issue purchase order (viii) Purchase and delivery to site (ix) Raise GRN (x) Raise cheques/Cash. But, this

sequence is not followed by most of the construction companies. With the ERP implementation in order to purchase the material to the site, staffs have to go through this procedure one by one. Then, gap creates as there is a change in its long-term practises of purchasing pattern.

[2]. Analysis of finance management criteria

Module	Reasons for gap	Suggested solutions
Finance management	Delays in 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

The gap areas related to finance operations are payment of cheques, transaction reconciliation, accounting procedures. In order to reduce the gap solutions were suggested appropriately.

Payment of Cheque

Payments of cheques can be easily done through ERP as an online payment. But with the manual system online payments are not allowed and cheques have to be signed by the authorized person by physically present. Due that delay, rate of returned cheques may increase and extra cost for returned cheques will be added. Further, interest payment may affect the profit of the project. But with ERP authorization ability, any authorized person can handle the payments of the cheques after he logged in to the system. So, this shows the gap between manual system and an ERP system.

Transaction reconciliation

Due to human errors, account transactions can be input wrongly. In that case, in normal construction procedure all the transactions should be reversed. As they maintain lot of leger accounts, all the legger accounts have to be corrected with the wrongly input data.

Normally, this is done using separate financial software without showing the reconciliation. But with the ERP system the transactions can be reversed back easily, and the way of reversing can be identified through the system. This creates the gap of normal construction procedures and ERP procedures.

Accounting Procedures

In accounting, transparency of the transaction is the main concern. With the ERP system all transactions are recorded. If someone is doing a wrong accounting practice it is clearly indicated in the system. As an example if we have to do a correction for wrong tractions we have to reverse what we have done. In the ERP system the reverse procedure also recorded. Thus, any management or authorized person can see the working. But in normal construction practice transactions can be manipulated to have positive pictures with wrong data because of the lack of transparency. In ERP system as system is correlated with all the projects handled, the senior management can compare all the transactions and workings in each and every project. In that scenario, they can easily understand the variations in the account practices. According to that, ERP can be considered as a fraud detector of the company.

However, research carried out by Soh, Sia, and Tay-Yap argued that the misfit between ERP and organization is greater in Asia, because the underline structure of most ERP system is influenced by the US and European business processes and applicability of those systems to Asian countries may less (Morton & Hu, 2008). Because of that, there are considerable variations in account practises in Sri-Lankan construction industry and account practises developed in European countries.

[3]. Analysis of site operation criteria

Module	**Reasons for gap**	**Solutions suggested**
Site Operation	Generation of Redundant reports	Identification of reports according to the requirement
	Mal Practices in report generation	Restricting the pass in random data to the system
	Ad-hock behaviours in scheduling	Proper scheduling with regard to expected scenarios concerning the

		environmental situations like weather conditions

In this module, areas where gap exists are report generations, maintenance of standards formats and scheduling of the site work. In order to overcome the gap above solutions were suggested.

Report generation

Reports are considered as the decision making tool of the project. When there is an integrating tool like ERP, required reports of whole company can be obtained at once. But when doing it manually or using other software, reports are generated separately and have to integrate them in order to obtain a proper decision. Further, in normal practise most of the construction companies generate unnecessary reports due to the unawareness of the requirement and don't able to take any decision referring to those reports. But in ERP, reports can be sorted out and management can have a whole picture of the project at one glance. According to (Hustad, Haddara, & Kalvenes, 2016) it is said that most of the report tailoring requests are related to the organization's industry and norms. This practise leads to generate higher amount of unnecessary reports. That is why most of the construction procedures have high gap with standard procedures. Chi-Square of 25.368> 9.48 shows this significant gap clearly.

Maintenance of standard formats

In (Hustad, Haddara, & Kalvenes, 2016), it discusses the necessity to customize the generation of construction reports which were not in the standards of ERP. Similarly, chi-square 44.372 >9.48 shows that there is a significant gap in standards of ERP and construction practise. So, it is true that most of the construction companies have idiosyncratic requirement which company needs to adopt with ERP implementation.
However, it is necessary to maintain proper documentations in a construction company as it handles large no of projects. Because of these large transactions, most of the construction companies handle records very carefully. But the problem is, those reports are not relying on proper standards. Therefore, the construction companies tend to use several kinds of reports to make one decision. But if they maintain proper records specified according to the ICTAD easily they will manage to generate required reports.

On the other hand, most of the ERP's are developed by software companies. So, they follow required standards and specifications to develop the reports as they don't have much knowledge about construction procedures. Because of this reason reports which generate from the ERP can be considered as more formal than the reports generated from construction companies for a long period of time.

Scheduling of site works

Some machines remain idling at a site because they are not required in the process carried out with in that duration. But that machine may be needed in other project at the same time. Normally in these instances, equipment is shared according to the arrangements prepared via telephone conversations. But it takes time to identify the idling equipment in other sites. Using ERP all the machines in all sites which are under the control of the head office can be identified easily. Therefore, without any delay those materials can be requested for the required work and the idling time of the machines get reduced.

Apart from this as per the specifications, material issuing of the site has to be done according to the working orders. But none of the store keepers record the activity wise material issuing in their site operations. Most of them issue materials according to the requirements and calculated the total usage with respect to the deduction of inventory. So, at the interim bill preparations most of the contractors QS confused with sub-contractor payments. Likewise, theses long term practised behaviours enhances the gap of construction practises and ERP practises.

[4]. Analysis of estimating and tendering criteria

Module	**Reasons for gap**	**Solutions suggested**
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 with in the construction projects
	Inability of achieving the profit goal	Activation of realistic approach for estimation and tendering
	Large amount of variations	Hiring proper cost estimators to limit the variation

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	Inability of achieving the profit goal	Activation of realistic approach for estimation and tendering
	Large amount of variations	Hiring proper cost estimators to limit the variation

Following up of BOQ

In the construction practise, most of the companies do not prepare estimations according to their BOQ format. It means in estimation they use lump sum value for one category of information and prepare the whole estimation accordingly. Because of this reason, in most of the time the project planners have to face difficulties with respect to timing and costing. However, ERP forces the companies to follow up the BOQ format throughout the estimation process. According to (Valerie & Pierre, 2005), the "best practises" are embedded in the ERP modules which serve as information coordination mechanisms that facilitate standardization of processes and reduce the uncertainty faced by firms. So, none of the item will be missed and proper estimation will be created as an output. But this accurate estimation requires data appropriately and the data has to be entered to the system separately. As this is a deviation from long term practised procedure, construction estimators resist to the system and the gap increases.

Preparation of BOM

This can be considered as a major issue when preparing the estimations. It was noticeable that some construction companies use different rating system with in the same organization. According to my analysis also most of the construction companies' estimating and tendering section use separate rating system at tendering stage (Guess rates). Then the BOQ at the tendering stage may not match with the BOQ at the construction stage. This adverse situation leads to create variations from the beginning of the construction project with extra time, extra approvals, and extra costs. Further, as a long-term practise companies have general rate breakdown for their own companies (E.g. Pivot tables). This rate breakdown may not specific to the all projects which are controlled by the company. According to the location of the project, type of the project rate of the BOQ item may vary. But in ERP system, estimating and tendering module allows to have one rate for whole construction project as it consists with proper rating library. On the other hand, it doesn't address the practical issue of rating. ERP consists with three types of rating methods. (i) Rates according to the BSR (ii) Rates according to the market value (iii) Rates according to the instant value (As a purchasing item).Using these three type of rating systems companies are able to build up a proper estimation on construction projects.
The other advantage of using ERP for estimation is ,the rates which are used in one projects can be in cooperated with some other projects .This saves time as well as the effort.

Alterations of the Tender Documents before tendering stage

ERP doesn't provide the comparison of tender documents after its modification. According to (Haddara, 2014) the lack of this flexibility in ERP systems creates challenges and one way to solve this is to do more customization or tailoring. Construction companies identify this as a drawback of the ERP system. Once the tender document is modified, construction people supposed to see the variation at each stage. But ERP doesn't keep the previous version after the update. So, in this consideration there is a disadvantage of using ERP and it makes the gap. The other draw back in ERP process is ERP doesn't allow to have item wise percentages of profit margin. However, at the end overall profit margin is shown. But in normal construction practice construction people are looking for item wise percentages. This creates another gap.

[5]. Analysis of sub-contractor management criteria

Module	Reasons for gap	Solutions suggested
Sub-Contractor management	Bias ways of selecting sub-contractors	Carry out background analysis of subcontractors in the selection process
	Lack of tracking the work done	Manipulating working progress with according to the BOQ items
	Mixing up of subcontractor type	Analysing the variation and initiating the requires method to handle
	Ad-hock practices in Sub contractor payment	Produce systematic way of payment

Subcontractor payment

There is a separate module for subcontractor payments in ERP systems. In there, subcontractors are categorized in to three sections. They are labour subcontractors, Equipment subcontractors, Subcontractors with labour and material. And also, subcontractor payments are done through a specific PO which is assigned to a specific subcontractor in ERP. The interim bill authorization and payments are done after issuing the GRN invoices. The payments won't get delayed because of this systematic sequence. But in the usual construction practice, they implement ad hock procedure of payment." Expenditure report" is used at each milestone and payments are done according to that

milestone. The Quantity surveyor must double check the activities which were done and the amount of payment. This takes considerable time and it may delay the payments.
In practical situations, though the sub contracts are doing the work with his own material, there can be situation where he wants to purchase small amount of quantities. At that time, materials are supplied by the site and the amount should be deducted from his payment. Using ERP, handling such kind of practices is difficult in some cases.
On the other hand, in normal practice site managers maintain day worksheet for each subcontractor manually and make interim payments according to that. In that calculation, as ERP force to enter resources, for the working progress BOQ item, there is no need of maintaining day sheets and other supportive documents. This enhances the productivity of the site with the reduction of time and cost.

Subcontractor selection

Most of the construction companies recommend subcontractors based on their past work experience and the rates. So, the subcontractors who gather around a company are same for a long time. As this is the easiest way to select subcontractors for a project, construction companies don't go for quotations of subcontractors. But according to the ICTAD specifications, subcontractor selection also has to be done in a systematic way. ERP encourage construction companies to follow this procedure and reluctant to follow up the correct method of selection makes the gap between these two systems.

[6]. Analysis of petty cash criteria

Module	Reasons for gap	Solutions suggested
Petty cash	No proper estimation on petty cash usage	Allocating fixed and adequate petty cash after proper feasible study
	Inappropriate usage of petty cash	Carrying out proper estimation on resource usage
	Ad-hock reimburse practices and poor controlling over petty cash	Carrying out proper estimation on resource usage
	Immoral reconciliation of transactions	Carrying out transparent account practices
	Issues in authorization	Initiation of online authorization system

Petty cash amount

Petty cash handling is another hectic problem in construction sites. Usually, petty cash is used for small material purchasing, administrative expenses in sites, and refreshment facilities of the site. In construction sites there is a fixed amount of petty cash which is allocated for each project according to the size of the project, location of the project and etc. However, at the current industry level most of the constructions companies tend to use petty cash for bulk purchasing of materials. This is an absurd behaviour which should be prevented for proper controlling of petty cash. With ERP, these mal practises are prevented, and it is easy to decide how much petty cash is required for the site for the given period with the working progress, inventory level (ERP enable proper estimation on every BOQ item). So, there is no need of purchasing bulk material using petty cash. Though this is the standard method to handle petty cash, most of the site operators embrace the easy method of sudden plans of purchasing. Apart from this, the other concern is about petty cash monitoring. There is no proper petty cash controlling mechanism in normal construction practise. This mal practises creates the gap of ERP procedures and Construction procedures.

Reconciliation process

With the petty cash handling also there can be situations where reconciliation is needed to improve the efficiency of transparency. In construction practice there are some ad hock practices in re-correcting those petty cash transactions. If there is a mistake in the transaction, that transaction needs to be revised. Sometimes, the way of revising is hidden and detecting the error is difficult. But with the ERP system re-correction method is clearly appeared in the legger account's transactions and it enhances the transparency of the account. Then, ERP can act as a fraud detector and most of the construction people in the lower management are afraid to use the ERP and this creates the gap.

Authorization to petty cash

Most of the mal practises in any construction organization begin with the approval/Authorization delays by the top management. In normal practise authorized person has to go to a site and physically present to authorize the work. Absence of this person may block up the entire project procedures and third part person can involve in this circumstance. Then privacy of the data gets reduced. This can be done online if there is an ERP system and no need of involving third party people.

[7]. Analysis of asset management criteria

Module	Reasons for gap	Solutions suggested
Asset Management	Malpractices in purchasing asset	Call for Quotations
	No periodical maintenance of machineries and plants	Maintain standard records
	No record on valuation methods	Maintaining systematic way of valuating assets
	No proper monitoring on utilization of assets	Implementing a proper schedule on asset usage
	Absence of systematic ways to transfer assets	Implementing a proper schedule on asset usage

Purchasing an asset

Asset management is a systematic process of developing, operating, maintaining, upgrading, and disposing of assets effectively. At the current industry level, when an asset is purchased, the purchasing process is not well organized as ERP procedures.

ERP procedure consists with call for quotations, asses the prices and raise PO, GRN, and Voucher and Invoice payments. But in the practise, they rarely call for quotations and decide the prices based on the quotations. When ERP comes in to play, they need to adhere to a systematic approach and non-adherence may lead to develop a gap. Most of the time constructions companies are deviating from calling quotations because of the time it consumes and that is why this gap generates. However as per (Gardiner, Hanna, & LaTour, 2002) using ERP system quotation time reduced by 90%.

Maintenance of records

Asset is a company resource that which required to be properly maintained and repaired according to their life-cycle. All most all the construction companies try to avoid these repairs for the cost reduction purpose. Ultimately, these machines and equipment break down due to improper maintenance and company may have to bear higher cost than regular maintenance repairs. But with the asset management module in ERP, company is forced to adhere for the proper records according to the ICTAD specifications. So there will be a significance difference in these procedures.

Valuation of assets

Valuation of assets is slightly practising in normal construction industry and the reports generation regarding the valuation is hardly seen. But, according to the ICTAD specifications, valuations have to be done regularly. In ERP, Asset management module provides the valuation facility with respect to depreciation methods like straight line. However, people who use the ERP software even not interesting in functioning the valuation practises as they don't know the purpose of valuation. This further enhances the gap between these two procedures.

Usage of asset

One of the major problems with respect to asset management is consumption rate. Rates are modified appropriately for the easiness of the usage and the standards of using those rates are not taken in to consideration. Due to this problem several rates can be seen for one item and it leads to create confusions when doing the costing. The other issue in asset usage is transferring of assets from site to site. In the current condition, the transferring process is done via telephone call and there is no proper transferring technique or documentation for the transferring. As there is no proper documentation, it is difficult to track the asset idling sites. Using ERP all the machines under the control of the head office can be managed easily with one integrated data base. The gap comes with the way of utilizing idling resources and way of maintaining rates.

[8]. Analysis of HRM criteria

Module	Reasons for gap	Solution suggested
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-hock leave allocations	initiation of systematic approach to leave allocation

Communication between Managers and Workers

There is a distant hierarchy level in construction companies in normal practice. This is mainly because the geographically fragmented projects controlled by one company. Because of this fragmentation there are considerable numbers of parties who involve in one

project with different authorization levels. This authorization levels develop different hierarchies within a company. When it comes to decision making, it needs to pass number of steps and takes long time (Most frequently used communication method is emails). The bottom line management who really involve with issues may not contribute to the decisions because of this gap. But with the ERP system all projects can be easily handled with one integrating system and there is an opportunity for each and every employer to involve with decision making. This builds a flat hierarchy within the organization. According to (Valerie & Pierre, 2005), it indicates that lateral relationship helps to move the level of decision-making. Further, it is said that ERP system link processes across modules using the mechanisms such as email, groupware, intranets etc.

Scheduling works

Still in Sri-Lanka, construction companies mainly use Ms Project as their main estimation and planning tool. Very few companies use Primavera as the project management tool. There are some constrain conditions of Ms Project, Primavera when it comes to planning. It doesn't provide the facility of handling multiple projects at the same time. So, the management has to schedule the activities according to each and every project aspect separately and they are not able to build up a whole picture of projects. And also, even most of the site people use Ms Project to have a rough idea about weekly plan. Forecasting of future works are not managed by this though it provides the facility to do so. However, most of the companies reluctant to move away from it as it is the traditional practise.
Scheduling of works can be easily handled with the ERP. It prepares the schedule based on the activities carried out by the subcontractors. So that nobody can manipulate the works which were done, according their requirement. In Ms Project any one can change the work done using the "work done percentage" option. So the unauthorized manipulations are prevented in ERP.

Leave allocation

Allocating leave is a major problem in sites with respect to the works scheduled. Most of the labours in sites are uneducated and lack in technical capabilities. So, it is difficult to make them use computational software. The other issue is turnover of the labours are very high in construction field due to lack of skill, salary, health and safety issues etc. And also, as there are several categories of labours in construction field such as subcontractor labours,

company labours, and unskilled labour, skilled labours careful monitoring of payments & leave allocations should be maintained.

In the normal practise labour handling is done according to a "Timesheet". Daily records of labour attendance is maintained manually and at the end of the month salary is calculated using excel sheets. In ERP, this procedure is more systematic. In there, attendance is updated manually, and it has prevented the repetitive feeding of data. However, maintaining of data base of ERP is getting complex due to the unpredictable service period and high turnover in construction companies. So, in this concern there is a high gap of construction practise and developed ERP practises.

Training

Conducting training sessions for an employee is not a major consideration in construction industry. According to them, training is a cost for company and not an investment. Due to lack of this technical training in construction industry the knowledge of the employees are stagnated in one stage. However, when there is an ERP implementation company force to have technical training sessions for their employees. Initial training sessions as well as phase by phase training sessions are mandatory to have a successful ERP implementation. Thus, there is a conflict in construction practise and ERP practise when it comes to the employee training. While construction people try to avoid training sessions, ERP implementation make it mandatory for construction companies.

Payroll and compensation

Customer satisfaction depends on the evaluation criteria and the payment scheme of a company. Though salary is not a motivational factor, most of the labours in construction sites are motivated by the salary. Therefore, with the practical situations it is difficult to measure the employees' performance with right criteria. However, there is an appropriate performance indicator in the HR module of any ERP system. The performance of all employees in the organization can be ranked through this index and the employees can be motivated through that.

According to the construction companies which subjected to the survey proved that HR modules like 7-point tool have not successful in their companies. The failures are happened due to the incompatibility of the performance criteria with the construction industry. The knowledge of the employees /labours is very much less in construction industry than other

industries. Therefore, they won't understand the importance of such measuring tools. Which means they are not keen on implementing such HR module to their organizations. This makes the gap between the usual practice and the ERP practise.

[9]. Analysis of purchase management criteria

Module	Reasons for gap	Solutions suggested
Purchases	Delays in approval and authorization processes	Initiation of online system
	Bias method of selecting suppliers	Carry out background analysis of supplier in the selection process
	Malpractices in purchasing resources	Call for Quotations
	Misplacement of MR, PO	Proper documentation

Selection of material suppliers

According to the current construction industry companies maintain a specific supplier list based on the supplier's experience and reliability. Though it is a practically convenience approach, sometimes suppliers with better quotations may be missed according to this procedure. On the other way, calling quotations for every project consume lots of time and long evaluating procedure according to the view of construction companies. Because of that most of the construction companies are moving with traditional suppliers. But ERP system encourages selecting suitable supplier with respect to quotations. According to (Gardiner, Hanna, & LaTour, 2002) it is proved that quotation time reduced to 90%. However, as this is not practised in the industry, this conflicting situation creates the gap.

Approval process and purchase requisitions

Without an online system the approval process is somewhat long as the approval needs to come from top management and because of this long procedure sometimes project get delayed. However, in ERP practice it is clear that if the person has authorization to login to the system at any time, he can approve the request. Purchasing request can be done through the online system and sudden and unplanned request are prevented through this procedure. For a proper sequence on material requisition it is necessary carry out a future demand for materials. But in normal practice as the progresses are not monitored accurately, they can't obtain a reliable figure for future material requirements. Thus, they do the guess estimation

according to the past practice. This leads to unexpected future contingencies. But in ERP there is a proper plan of material requirement. It auto creates the resource request according to the progress (Daily, Weekly, Monthly). So, there is a gap between the estimation of resources.

Handling of incomplete purchases

Misplacement of incomplete purchases can be considered as one of the major issues faced by the procurement division of construction companies. When the purchase order is placed and all requested items are not delivered to the site, then the purchase order is incomplete and procurement division has to maintain separate records for those incomplete purchases. According to (Jyh-Bin Yang & Tsai, 2007) ERP solution should able to follow up on these repurchases occasions. Thus, in ERP system, incomplete orders as well as incomplete requirements are stored. Therefore, misplacement of purchase orders may not happen with the ERP.

[10]. Analysis of project management criteria

Module	Reasons for gap	Solutions suggested
Project Management	Inability to carry out cost variance analysis	Adherence to generate cost accordance with BOQ items
	Manipulation of calculations	Providing the required level of authorization to access the information
	Malpractices in rate analysis	Standardize the rates used with in 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 tool
	Scattered data among projects	Implementing integrating tool

Cost variance analysis

Cost variance analysis is a vital requirement to identify the direction of the project. Proper evaluation of cost need to be carried out from the estimating stage to end of the project. Most of the project managers continuously keep their eye on this aspect because the successfulness of the project depends on this outcome. In normal construction practice cost variance analysis is done using Excel sheets. It is easy to compare variations in each stage

of the project. In ERP also that facility is provided in the same way. But the problem is, result of excel sheet can be manipulated. But the result in the ERP can't be manipulated. Those values are generated according to the real activities which are done. So, misinterpretations are prevented, and actual picture of the project can be detected through the system. Moreover, the preparation of reports takes long time in manual method than ERP method. In normal construction practise budgeted cost, planning cost and actual cost are not compared with the estimated budget. When there is no proper rate analysis, it is difficult to overlook the progress of the project. Due to this misunderstanding, in the middle of the project there may be huge variation which can affect the profit of the project.

Monitoring and controlling the working progress

Monitoring and Controlling the working progress are mainly done through MS project and Primavera is slightly used in the current constructions industry. Though MS project provides the facility to control and monitor the project with "Tracking Gantt", it can be easily adjusted by any party for their requirements. Further, MS project doesn't compare Planned, Estimated, and Actual values together. ERP working progress is generated according to the resource issues, time consumed or percentage completion. The percentage completion needs to be matched with the time and resource allocation. So it is difficult to conduct mal practices.

According to (Hustad, Haddara, & Kalvenes, 2016) there are special norms in the industry which imposed by the authorities and may not embedded in ERP systems. That is why they implement some tailoring techniques in to the operation. The Chi-Square 13.551>9.48 proves that there is a significant difference in both of these two practises if there is no involvement of tailoring.

E.g. Some of the construction companies pay the interim payments along with the milestones. So, the working progresses of those companies are monitoring accordingly and could not see a proper evaluation for progress handling.

Privacy of project data

The most frequently used communication methods in construction practise are telephone calls and emails. Management decisions are taken using the information transferred through these two media. Usually, construction companies have to handle number of sites which are geographically desperate. Thus, it is difficult to manage them without a proper

integration tool. Mistakes do happen when there are lot of transactions and that may reduce the confidentiality of the information. In ERP system there is no middle party involvement and that secure the data within the system itself. Only the authorized person is allowed to go inside and see the information (Hustad, Haddara, & Kalvenes, 2016) according to the authorization level. Because of that confidentiality of the data is secured in ERP.

Hierarchy level

As there are lots of projects under the top management, it is difficult to pay similar attention for every project. If the top management loose the control of any site, that may result to have loss. Therefore, top management has to keep the overall picture of every site and this result to delegate works. Hierarchy level of the company get widens when this delegation has considerable number of levels and will consume lot of time when it comes to authorization and approvals. So as construction companies have "Adhocracy" behaviour it is required to restructure the organization according to ERP system if we the organization is going to implement it (Morton & Hu, 2008).

However, ERP implementation makes a flat hierarchy level and allows communicating with required person directly. So, the involvement of third party is very minimum. The matching process of ERP with hierarchy levels needs to build standardized decisions-making structure/processes that positively influence operational performance. On the other hand, it is difficult to convert a "Gap level Hierarchy" in to a "Flat" hierarchy suddenly. This makes conflicts at the initial stage of the ERP implementation in any organization.

5 CONCLUSIONS AND RECOMMENDATIONS

The main objective of this chapter is to provide concise conclusion of the findings of the research. The recommendations are based on the results of the research. These conclusions and recommendations provide assistance and guidance to reduce the gap between ERP procedures and construction procedure.

First it discusses the conclusions and recommendation of the research. Afterwards it explains what are the limitations faced when the research is carried out.

5.1 Conclusion

In a construction company, there are number of business processes which are different from one another. Some of them are Site operations, Petty cash management, Inventory management, Sub contractor management etc. But in manufacturing companies they only have to handle limited number of business process which are almost same. On the other hand, one construction company have to handle several projects simultaneously and the life cycle time of those projects are varying according to the requirement of the client. Because of that, though they have an initial master plan in the beginning, that can be subjected to lot of changes when the works are carrying out. Due to this unpredictable situation, forecasting future in construction industry is very difficult. Further, construction companies have to monitor lot of projects which are geographically separated from one another. Most of these sites are located in remote areas which don't have enough technical facilities and network connections to implement ERP systems. As a result of this, most of the employees who are engaged in construction projects are lack in technical knowledge. Therefore, it can be concluded that it is challengeable to implement ERP systems in construction sector than other industries.

These unique features in construction industry effects the implementation of ERP system significantly and has created a mismatch between construction procedures and ERP procedures. Therefore, this study further investigates the areas where there is a significant difference between two processes. The highest significant gap exists in the field of Inventory management. And HRM, Asset Management, Finance Management, Site Operation, Project Management, Purchases, Petty cash, Estimating and Tendering, Sub-Contractor management show variations respectively.

After identifying the areas, solutions were suggested to reduce the gap between two processes using a framework. Those solutions were suggested according to the ad-hock behaviours which were identified through questionnaire survey. With these suggested solutions, recommendations can be provided for the implementation of ERP system in construction organizations.

5.2 Recommendations

Customization is the process of adopting the ERP system according to the requirements of organizational procedures. However, too much of customization leads to expensive ERP packages and it will not effective as a long time practise. Therefore, too much of tailoring should be prevented. This can be done by omitting wrong practises which exists with in the current construction practise. This framework can be used to identify the areas where construction practises should go align with ERP systems. Therefore, it is recommended that if construction companies are moving forward with ERP implementation, before its implementations it is better to identify the areas where their procedures can be altered according to the ERP systems and that can be done by referring to this framework. By that, they can minimize the level of customization and reduce the time and cost for restructuring the business.

6 Limitations

ERP is a new concept for construction industry in Sri-Lanka. One of a major limitation which faced when doing the research was to find out organizations that use different ERP systems. Because of novelty, the availability of existing data is very limited in Sri Lankan context about ERP. Some limitations happened in this research due to the time constraints of the researcher and resource constraint. The research was conducted through convenient sampling method and the number of responses from each company was not exactly proportionate to the number of ERP users in the company. The results and conclusions would have been more accurate if the sample size was randomly and proportionately selected and went for much higher responses. Other than this, the respondents of this research were having experience for less than 5 years. The accuracy of the collected data was subjected to many factors such as the data provider's attitude, perception, awareness,

information knowledge and skill. Other limiting factor was the reluctance of the ERP users to give their feedbacks about the ERP implementation.

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