

# An empirical study of Enterprise Resource Planning systems in construction industry

Joseph Anto S

*M.E. final year in Construction Engineering and Management*

*Meenakshi Sundararajan Engineering College, Kodambakkam, Anna University, Chennai - India*

\*\*\*

**Abstract** - An enterprise resource planning system is an information system and it is the recent solution of information technology. Now a day's enterprise resource planning system offers many benefits to the manufacturing and construction industries. These enterprise resource planning system are integrate various business functions. ERP is a general working platform for an enterprise with single common database and the information sharing and efficient communications can be achieved by the ERP systems between all management functions. This paper briefs the ERP technology, its origin, factors for ERP implementation, and analyzing the critical success factors of ERP systems. However enterprise resource planning systems present a set of unique challenges in construction industry. The successful model of ERP system is to help senior managers to make better decisions when considering their organization..

**Key Words:** Enterprise Resource Planning, Information Systems, Construction Management, Information Technology, Project Life Cycle.

## 1. INTRODUCTION

Enterprise Resource Planning systems are business management system used to provide information for strategy, operations, management analysis and decision making functions in construction management. In the modern world, construction industry is one of the largest contributors to the economy and it is considered to highly fragmental, inefficient and geographically dispersed industries. Generally the construction industry has been faced with the problem of meeting project schedule, budget, and specifications set by the owner and architect/engineer. This is the pressure on companies to lower the total cost in the entire supply chain, as the business world moves to accomplish their objectives, companies are increasingly turning to enterprise resource planning systems. These systems provide advantages that do not exist in non-integrated departmental system. The C-ERP system integrates the business management functions including planning, design, engineering, procurement, logistics, construction, operations and maintenance. The review of critical success factors for ERP implementation will be different from other industries. Therefore this paper

presents the ERP technology, origin, and critical success factors for construction industries based on interview and literature review.

### 1.1 ENTERPRISE RESOURCE PLANNING

An enterprise resource planning system is a fully integrated business management system covering functional areas of an enterprise like planning, design, logistics, production, finance, accounting and human resources. It organizes and integrates operation process and information flows to make optimum uses of resources such as men, material, machine, and money. ERP provides an integrated view of core business process often in real time, using common databases maintained by database management system. ERP systems track business resource cash, raw materials, production capacity and the status of commitments like orders, purchase orders, and payroll. This system shares the data across the various departments that provide the data.

### 1.2 EVOLUTION OF ERP

In the construction business environment have been introduced some applications and planning systems for management purpose like cost control, business requirements and decision making. Some of the information systems are following, management information systems, integrated information systems, executive information systems, corporate information systems, enterprise wide systems, material resource planning, manufacturing resource planning, money resource planning. Enterprise resource planning systems has derived from the system of manufacturing resource planning.

### 1.3 BENEFITS OF ERP

If they are considering the enterprise resource planning systems in their construction the following are some of the benefits achieved by ERP systems,

- Account payable and receivable and thereby boosting their productivity and eliminating their reliance.
- To reduce paper documents for entering and retrieving information.

- It improves timeliness of information sharing.
- The greater accuracy of information shared with detailed content, better presentation, satisfactory for the auditors.
- Improved cost control.
- Faster response on entire business functions of construction management.
- Better monitoring of project and quicker resolution of queries.
- The real time information sharing to change in business operations and market conditions.
- It helps to achieve competitive advantage by improving its business process.
- Improves supply demand linkage with remote locations and branches in different countries.
- It provides a unified customer database usable by all applications.

ERP improves information access and management throughout the enterprise.

## 2. LITERATURE REVIEW

A literature search was performed to identify and choose to study and review critical factors of ERP implementations. There are various streams of research that have been taken by researchers while exploring ERP systems implementation. Some of these streams include implementation of ERP, ERP optimization, ERP software, ERP for supply chain management, case studies, ERP success models, factors research which involves identifying the factors or variables that are critical for implementing the ERP systems, process research on critical success factors of ERP systems.

According to Lee et al (2004) the construction industry has been criticized for its underperformance due to the lack of performance measurements, project monitoring productivity, cost effectiveness, safety, and sustainability. According to Chung et al (2007) even though the use of ERP systems is growing and becoming more popular, these systems are still somewhat unfamiliar in the construction industry. So this study contributes to the state of knowledge of ERP systems selection for construction industry and will greatly help the managers from these companies to make better decisions when selecting ERP systems.

### 2.1 ERP ADOPTION IN CONSTRUCTION INDUSTRY

There are lot of potential of using ERP in each and every phases of the construction life cycle project from based on literature reviews. It has the effective communications

between all management functions in a single common database. It is very helpful to project managers to make better decisions in project management.

According to bingi et al (2000) analyzed the concept of ERP is a complex multimodal software application which tries to integrates all the process of the company, having as a purpose it's perfection and growth in efficiency. From a functional point of view, an ERP integrates all enterprise and management functions. According to Xu and Ahamed et al (2006) information availability, accuracy, and timelines are crucial factors in the decision making process, which will result in better decision making, increase managerial benefits, minimize errors and increase productivity.

## 3. METHODOLOGY AND DISCUSSION

Now a day, the modern construction industry involves some recent trends to be adopted in the building of their facility. Working of each project is unique depending on size, nature and complexity of the project. A information sharing cannot be same among the project participants in the construction projects in the world. So that the information can be shared in a real time updates between the management functions using ERP systems.

### 3.1 ERP SYSTEM FEATURES

After examination of ERP from Indian AEC firms, the development of major features of ERP and ERP can do for the management system are, ERP acts strategic and business planning activities, operational planning and execution activities, creation of materials and resources. It provides complete integration of systems not only across departments but also across companies under the same management. It covers all functional areas like manufacturing, payables, receivables, inventory, accounts, human resource, and purchase. ERP system is project oriented and should be able to manage ongoing projects with the ability of reporting and providing progress status, cost status, profitability, and potential problems such as falling, behind schedule and overrunning cost. An integrated ERP system performs front and back office functions. Those functions interact with each other in making decisions for ongoing projects and it is parallel and distributed technology in order to support multiple management applications or requests.

Scalability is a common requirement for all ERP systems; it must be able to facilitate the strategic development of a company for many years to come. An open and expandable architecture allows a company to tailor its needed applications to fit its business needs. Remote accessibility enables project managers and other personnel to remotely access central information, which may be hundreds or thousands of miles away from the head office. It is reliable and robust and this is a common feature required for all decision - supporting systems. ERP eliminates most business

problems like material shortage, productivity enhancement, customer service, cash management, inventory problems, quality problems, prompt delivery etc. ERP provides intelligent business tools like decision support system, executive information systems, data mining, and easy working systems to enable better decisions.

### 3.2 INFLUENCE OF ERP IN CONSTRUCTION PROJECT LIFE CYCLE

The enterprise resource planning systems are involved in the each phases of construction project life cycle.

#### Project Planning

- Cost estimation
- Schedule plan
- Project budgeting
- Activity and resource planning
- Risk management
- Detail scheduling
- Quantity take-off

#### Engineering

- Document and drawing management
- Specifications, manuals and document development
- Constructability review
- Collaboration

#### Execution

- Capture daily progress
- Review and approve
- Update inventory and resources
- Compute total work completed
- Compute payments

#### Procurement

- Resource management
- Request for quotation and awarding
- Sub contracting and purchase orders
- Equipment management
- Equipment maintenance
- Materials management

#### Project Control

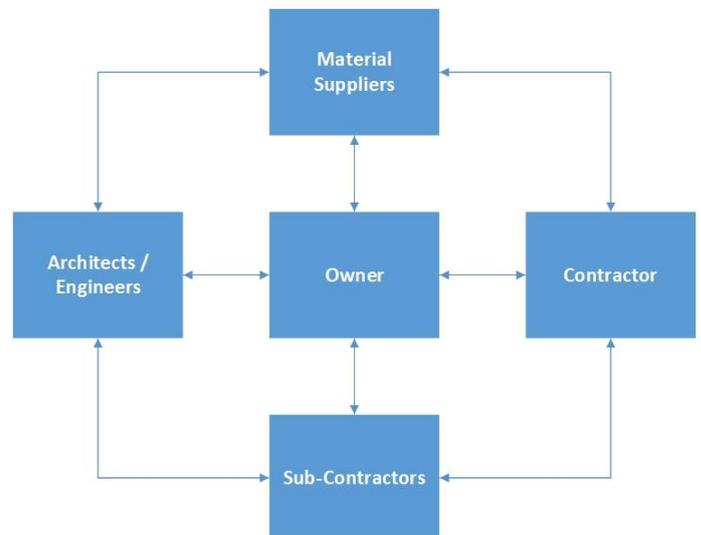
- Site management
- Quality management

- Project billing and costing
- Change order management
- Human Resource Management
  - Pay roll
  - Personnel planning
  - Manpower allocation
  - HR time accounting
  - Travel expenses
- Financial Accounting
  - Accounts receivables and payables
  - General ledger
  - Asset accounting
  - Cash management
  - Standard and period related costing
  - Profitability analysis
- Closing
  - Commissioning
  - Hand over

### 3.3 PROJECT COMMUNICATIONS

In a construction industry information systems are essential. The following figures, figure 3.1 and 3.2 show the information exchange between the project participants throughout the project life cycle.

#### 3.3.1 BLOCK DIAGRAM OF STREAM LINE PROCESS



**Fig -1:** Streamline process

### 3.3.2 BLOCK DIAGRAM OF ERP SYSTEM PROCESS

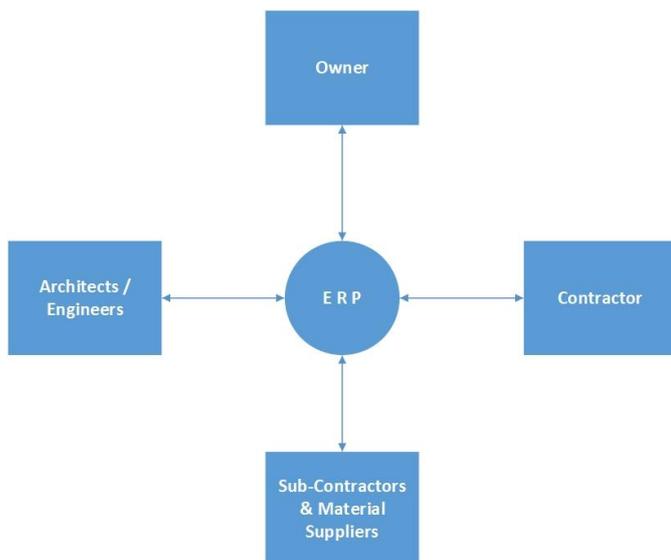


Fig -2: ERP process

### 3.3 CRITICAL FACTORS FOR ERP SYSTEM IMPLEMENTATION

1. Clear understanding of strategic management  
ERP implementation requires the organization vision of how the company operates in order to satisfy customers, empower employees, and facilitate suppliers. There must be clear definition of goals expectations and deliverables.
2. Organizational change management  
ERP implementing involves reengineering the existing business processes to the best business process standard. The company's culture, structure and process are the factors considered in the organizational management. Management should answer every employee question and held company-wide meetings to make the strategy.
3. Top management support  
The top management support as a necessary ingredient in successful ERP implementation because successful implementation require strong leadership, commitment, and participation by top management. An executive management planning committee is committed to enterprise integration, analyzing and rethinking existing business process and costs.
4. Data accuracy  
Data accuracy is absolutely required for an ERP system to function properly. Because of the integrated nature of ERP, if someone enters the wrong data the mistake can have the negative domino effect throughout the entire enterprise information system.
5. Training

ERP implementation requires a critical mass of knowledge to enable people to solve problems within the framework of the system. If the employees do not understand how a system works, they will invent their own processes using those parts of the system they are able to manipulate.

#### 6. Multi-sites consideration

Multi-sites implementations present special concerns. That implementation may be undertaken in order to provide the remote sites with capabilities that allow them to fine tune their processes to their unique situations.

#### 7. Performance measures

The performance measures should indicate how the system is performing and the measures must also be designed so as to encourage the desired behaviors by all functions and individuals project evaluation measures must be included from the beginning.

### 3.4 SUCCESS FACTORS OF ERP SYSTEMS

Project success is evaluated in terms of time, quality of work, scope of the project and budget of the project as usual project management. The success factors of ERP systems are following,

#### 1. Project related variables

##### a) Top management support

The top management support, planning, training and team contributions are respondents ERP implementation projects. Those factors are derived that impact the ERP project success.

##### b) Software selection

The importance of software capabilities and needs are mismatched with company business processes, this can lead the implementation to failure.

##### c) Consultant support

The consultant support is one of the success and failure factors in ERP system implementation. The degree of the consultant capability and consultant support during the ERP system implementation projects is a major factor.

##### d) Information system area participation

Information system should be included in the ERP system implementations. This factor should be matched with the company's essential business functions. The information system area participation is to evaluate how well the functions of their ERP system are defined and how well these are matched with their company's necessary business functions.

## 2. User related variables

### a) Output quality

Output quality can be referred to as how well the system performs tasks matching the user's job goal. The output quality of the ERP system is high and no problem with the output quality.

### b) Job relevance

Job relevance is defined as an individual's perception regarding the system is applicable to him or his job. In a project, every individual said the usage of the ERP system is important and relevant.

### c) Image

Image is defined as the degree to which use of an information system is perceived to enhance one's image or status. In a organization who use the ERP system have high profile.

### d) Result demonstrability

Result demonstrability as the tangibility of the results of using the system including their observability and communicability. There is no difficulty telling others about the results of using the ERP systems.

### e) Compatibility

Compatibility is referred to as the capability of an information system to exchange data with other systems. In the ERP system, there is no difficulty in exploring and importing data from the ERP system to other systems.

### f) System reliability

System reliability is defined as the degree to which the system ensures the delivery of data to the users. It is very reliable because don't worry about data loss and system errors when using the ERP systems.

### g) Reporting capability

Reporting capability is derived from the company management and measurement reporting such as critical success factor and key performance indicator. The ERP system management reports are very useful for upcoming further works.

## 3. Intermediate variables

### a) Perceived usefulness

A person believes that using a particular system would enhance their job performance. In overall the using ERP system is very useful; it improves job performance, effectiveness and productivity.

## 4. CONCLUSION

The main purpose of the study was to show the enterprise resource planning systems as an information technology, its

origin, factors for successful ERP implementation and the critical success factors of ERP systems. The interviews of Construction Company implementing the ERP systems are made through summary and discussion of the successful ERP implementation. The ERP success model will be helpful for the construction industry executives and decision makers to have a better understanding in regard to the success of ERP system implementation. Organizations can develop their company by using the success model of ERP system implementation.

## REFERENCES

- Chung, B. Y., Skibniewski, M. J., Lucas, H. C., & Kwak, Y. H. (2008). Analyzing Enterprise Resource Planning System Implementation Success Factors in the Engineering-Construction Industry. *Journal of Computing in Civil Engineering J. Comput. Civ. Eng.*, 22(6), 373-382.
- Skibniewski, M. J., and Ghosh, S. (2009). Determination of Key Performance Indicators with Enterprise Resource Planning Systems in Engineering Construction Firms. *Journal of Construction Engineering and Management J. Constr. Eng. Manage.*, 135(10), 965-978.
- Tserng, H. P., Yin, S. Y. L., Skibniewski, M. J., and Lee, M. H. (2010). Developing an ARIS-House-Based Method from Existing Information Systems to Project-Based Enterprise Resource Planning for General Contractor. *Journal of Construction Engineering and Management J. Constr. Eng. Manage.*, 136(2), 199-209.
- Chung, B., Skibniewski, M. J., and Kwak, Y. H. (2009). Developing ERP Systems Success Model for the Construction Industry. *Journal of Construction Engineering and Management J. Constr. Eng. Manage.*, 135(3), 207-216.
- Tatari, O., and Skibniewski, M. J. (2011). Empirical Analysis of Construction Enterprise Information Systems: Assessing System Integration, Critical Factors, and Benefits. *Journal of Computing in Civil Engineering J. Comput. Civ. Eng.*, 25(5), 347-356.
- Shi, J. J., and Halpin, D. W. (2003). Enterprise Resource Planning for Construction Business Management. *Journal of Construction Engineering and Management J. Constr. Eng. Manage.*, 129(2), 214-221.
- Tatari, O., Castro-Lacouture, D., and Skibniewski, M. J. (2008). Performance Evaluation of Construction Enterprise Resource Planning Systems. *Journal of Management in Engineering J. Manage. Eng.*, 24(4), 198-206.
- Pacheco-Comer, A. A., & González-Castolo, J. C. (2012). An empirical study in selecting Enterprise Resource Planning

Systems: The relation between some of the variables involve on it. *Size and Investment. Procedia Technology*, 3, 292-303.

Matende, S., & Ogao, P. (2013). Enterprise Resource Planning (ERP) System Implementation: A Case for User Participation. *Procedia Technology*, 9, 518-526.

Kelle, P., & Akbulut, A. (2005). The role of ERP tools in supply chain information sharing, cooperation, and cost optimization. *International Journal of Production Economics*, 93-94, 41-52.

Critical Success Factors in Enterprise Resource Planning (ERP) System Implementation Stages: An Exploratory Study in Oman. (2014). *International Conference Image Processing, Computers and Industrial Engineering (ICICIE'2014) Jan. 15-16, 2014 Kuala Lumpur (Malaysia)*.

Umble, E. J., Haft, R. R., & Umble, M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research*, 146(2), 241-257.

Holland, C. P., & Light, B. (n.d.). A Framework for Understanding Success and Failure in Enterprise Resource Planning System Implementation. *Implementing for Effectiveness Second-Wave Enterprise Resource Planning Systems*, 180-195.

Zarei, B., & Naeli, M. (n.d.). Critical Success Factors in Enterprise Resource Planning Implementation. *Concepts, Methodologies, Tools, and Applications Enterprise Resource Planning*, 10-21.

Planning and Preparing for ENTERPRISE RESOURCE PLANNING Success. (2015). *A Best Practice Guide to Avoiding Program Failure Traps While Tuning System Performance Directing the ERP Implementation Resource Management*, 1-2.

Annamalai, C., & Ramayah, T. (n.d.). Reengineering for Enterprise Resource Planning (ERP) Systems Implementation. *Industrial Engineering Concepts, Methodologies, Tools, and Applications*, 791-806.

Hasibuan, Z., & Dantes, G. (2012). Priority of Key Success Factors (KSFS) on Enterprise Resource Planning (ERP) System Implementation Life Cycle. *Journal of Enterprise Resource Planning Studies JERPS*, 1-15.

Dantes, G., & Hasibuan, Z. (2010). Measurements of Key Success Factors on Enterprise Resource Planning (ERP) Implementation. *IBIMABR IBIMA Business Review Journal*, 1-11.

Voordijk, H., Leuven, A. V., & Laan, A. (2003). Enterprise Resource Planning in a large construction firm: Implementation analysis. *Construction Management and Economics*, 21(5), 511-521.

Méxas, M. P., Quelhas, O. L., & Costa, H. G. (2012). Prioritization criteria for enterprise resource planning systems selection for civil construction companies: A multicriteria approach. *Canadian Journal of Civil Engineering Can. J. Civ. Eng.*, 39(8), 855-866.