

# **An Enterprise Resource Planning (ERP) For A Construction Enterprise Along with Business Intelligence (BI)**

Sudhanva Kadoli<sup>1</sup>, Digvijay Patil<sup>2</sup>, Ajit Mane<sup>3</sup>, Ajinkya Shinde<sup>4</sup>, Shrikant Kokate<sup>5</sup>

U.G. Student, Department of Computer Engineering, PCCOE, Pune, Maharashtra, India<sup>1</sup>

U.G. Student, Department of Computer Engineering, PCCOE, Pune, Maharashtra, India<sup>2</sup>

U.G. Student, Department of Computer Engineering, PCCOE, Pune, Maharashtra, India<sup>3</sup>

U.G. Student, Department of Computer Engineering, PCCOE, Pune, Maharashtra, India<sup>4</sup>

Associate Professor, Department of Computer Engineering, PCCOE, Pune, Maharashtra, India<sup>5</sup>

**Abstract:** India is a developing nation, with globalization widely making impact over its economy. It is observed that large amount of development is mostly concentrated towards the country's urban infrastructure. Due to larger population migrating towards cities it is necessary to accommodate and provide basic infrastructural facilities to their ever increasing demands. So it is necessary for the construction enterprises to efficiently manage their functioning and address the customer requirements by balancing the functioning of individual departments in the construction enterprise. Construction ERP is an ultimate solution to manage entire enterprise under a single roof. This paper presents an efficient ERP system to manage different departments in accordance with for the managerial the company policies and customer requirements. ERP is responsible for integrating business processes within an enterprise. This will only automate the functioning of Construction Company. To enable decision making tier of the company based upon history and future risks BI and DSS are implemented using feedback logic.

**Keywords:** Enterprise Resource Planning, Decision Support System, Business Intelligence, Feedback Mechanisms.

## **I. INTRODUCTION**

The working of construction industry is very different from other industries. It involves people right from lowest level such as the construction labors, plumbers, plaster men, painters etc. These people are hardly believed to have any basic knowledge about computer. While on the other hand there are the directors, the board of directors, CEO's and other highly qualified managerial staff of the industry. Thus, construction industry is said to have wide variations in its working. This wide variation within the construction industry acts as a challenge in the development of the ERP for a construction enterprise. There are other challenges too like need to communicate with other related businesses such as material and equipment suppliers, vendors, subcontractors and clients. ERP systems are being used by construction companies to improve response and relations with the customers, strengthening supply chain partnerships, enhancing organizational flexibility, improving decision making capabilities and reducing project completion time and lower costs. The ERP is designed to integrate and partially automate many of the company's business processes such as human resources, accounts, billing and invoicing, administration, managing site, inventory and sales. The goal of ERP is to automate all the processes running in the construction enterprise and to maintain all the information related to the enterprise. The ERP also aims in avoiding data redundancies. Apart from having a large growth in constructions the construction enterprises rarely use ERP systems. The major reason is that the implementation of any ERP system is expensive in terms of investment in time, money and resources. The benefits of implementing an ERP are not instantly visible to the enterprise but however, when implemented to automate integrate and solve the problems, these ERP systems acts as a powerful tool for business improvement. So far, there is the development of an ERP in every domain but there is very little development in construction industry [5]. There is very few study conducted about the implementation of ERP systems in the construction industry. The unique thing about this paper is to present an efficient and simple way to include Business Intelligence along with the Construction ERP system. Including BI in the

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Construction enterprise helps in organizing the data that can be easily analyzed. This supports decision making for the higher level authorities in construction enterprise.

## II. REQUIREMENTS

A Construction Enterprise is divided into various departments for its sophisticated functioning. Each department functions independently but they are very closely interrelated with each other. Every department is responsible to provide service to other department to achieve a common preset goal. The main role of a construction enterprise is to develop a real estate property that would be commercially beneficial for the enterprise. The Construction sites that are developed by an Enterprise can be categorized into following categories:

- 1) Residential- Flats ,Row Houses, Bungalows, Duplex Apartments, Suits, Townships, Villas
- 2) Commercial- Shops, Malls, Multiplexes, Club Houses, Hotels, Offices, IT parks
- 3) Government Tenders- Roads, Bridges, Dams, Govt. Buildings, Maintenance

The Construction Sites developed by the enterprise are mentioned above. The main complexity of the project is that at a particular time the construction site may have multiple projects in hand from different domains. Thus to efficiently manage and access different modules it is necessary to develop the ERP considering every minute detail and various actions performed by an enterprise. Understanding the working of the construction enterprise plays a major role and it also acts as the initial step to develop a broader perspective of the exact virtual implementation of the project [7].

To properly understand the working and functioning of the enterprise we visited the live sites. This helped to gather the requirements of construction ERP and their analysis.

## III. LITERATURE SURVEY

ERP can be an ideal tool for developing business intelligence applications. The key word, however, is “can”. There is nothing that requires you to use ERP to build Business Intelligence (BI) tools. However the faculties are there if you choose to use them.

Fundamentally BI is about extracting information on your business, your customers, etc. and using it to guide your business operations. In order to make this work you have to have a source of information and that is where ERP comes in.

ERP provides a rich source of highly granular information about all aspects of your business. This is a natural by product of ERP's reach deep into your business and collecting and systematizing you're day to day functioning. BI takes that data one step further to allow you to make strategic and technical decisions about how to run your business.

While it is possible to do business intelligence with only the reporting tools built into the typical ERP system, to get the most out of it usually requires some specialized tools. While there are an enormous range of BI tools available at prices ranging from free to hundreds of thousands of dollars, the most basic tool for business intelligence is some kind of specialized database where you can aggregate information for analysis [8].

Now you can use the database in the ERP system to do this job, which is clumsy and not very effective. The ERP database is designed to support day-to-day transactional operations, not for in-depth analysis.

The answer is usually either a data warehouse or a data mart to store the data for BI analysis. The two concepts are very similar.

A data warehouse is a specialized database which attempts to store and organize all the relevant information, current and historical, on the enterprise and its activities. They are large, often expensive to implement, but they are also comprehensive and usually store data on the level of individual transactions.

A data mart can be described as a “data warehouse light”. It usually does not store data down to the transaction level, but relies on aggregates and averages to give a picture of the company and its operations. This makes a data mart easier

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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to set up, but less accurate. Data marts are often used for special projects because of their relative simplicity.

A major part of using a data warehouse or a data mart is getting the data into the database. In theory it should be easy to import the data from an ERP system since it has been cleaned and put into a standard format. In practice things are seldom that simple and you can expect to do some work to get the data into the database in a usable form.

A related problem is historical data, or lack of it. Ideally you imported all your historical data into your ERP system when you set it up. Practically, most companies import only limited historical data or none at all into their ERP application. This is because of the cost and effort required to import data into ERP.

At this point you have a choice. The more historical data in your business intelligence system the better. But you have to measure the benefits of that historical data against the cost of importing it. Quite likely you will decide to import only a limited amount of historical data – or none at all – and take the hit on the power of the BI solution.

Once you have the data in the data warehouse or data mart, the next step is to analyze it using business intelligence tools. Again, there are an enormous variety of these tools, ranging in price from free to quite expensive and in complexity from simple to use to requiring the services of a trained statistician. A lot of the success of your business intelligence efforts will depend on choosing the right tools for your application.

Like importing historical data this is fundamentally a cost-benefit problem. How complex do you want your BI analysis to be compared with the cost of the tools and the effort to do the analysis. Obviously the more complex (and expensive) the analysis the more benefit you can potentially reap from it.

One approach is to start small, with only basic analytical tools and see what kind of benefits you can add for your company. Then, as you get comfortable with business intelligence, you can add more complex tools and more rigorous analysis.

Fundamentally BI is about extracting information on your business, your customers, etc. and using it to guide your business operations. In order to make this work you have to have a source of information and that is where ERP comes in. ERP provides a rich source of highly granular information about all aspects of your business. This is a natural byproduct of ERP's reach deep into your business and collecting and systematizing your day to day functioning. BI takes that data one step further to allow you to make strategic and technical decisions about how to run your business.

## IV. B.I. IN CONSTRUCTION ERP

A problem that many businesses face these days is an overabundance of data. Some corporations can find themselves drowning in an ocean of numbers and statistics that they simply don't know how to use. What's more, the economic crisis has forced many of these companies to abandon any attempts to organize and analyze their data in order to cut costs. Unfortunately, companies may actually be costing themselves money by abandoning the treasure trove of information this data can provide.

So how can businesses harness this information? The answer is that business intelligence – especially coupled with an ERP system – can make this data accessible and useful.

“BI tools have reached a level of maturity which can elevate executives from the depth of the details, bringing them to a higher operating level where they can add strategic value to the organization,” Cindy Jutras and David Hatch wrote in a report entitled “The ERP/BI Connection.”

“The ability to provide better decision support with integrated enterprise data is an important factor in turning data into actionable intelligence,” the report continues. “The synergistic relationship between ERP and BI can indeed be the perfect storm, igniting improved performance and visibility.”

Some companies can be hesitant to implement BI systems. Recent research has shown that some CEOs still want to go with their gut instincts rather than BI suggestions, especially when they worry that their companies are being “oversoftwared.” However, combining ERP and BI can help make a BI system a little more human. “Gut instincts” and business intelligence don't have to be mutually exclusive – in fact, when BI is done right, the two complement rather than contradict each other.

Surveys by Aberdeen have ranked business intelligence as the technology that will have the greatest impact on the business world in the next two to five years.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 2, February 2014

What business intelligence does that's so helpful is transform the data that is collected and organized by an ERP system into useful, easy-to-understand information that can utilized to help a company reach its maximum potential. In this way, BI and ERP inform each other. Rather than treating them as separate projects, successful businesses understand that ERP and BI can work together to provide the best and most complete access to the data a company amasses throughout the manufacturing and distribution process.

Business intelligence (BI) is a set of theories, methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information for business purposes. BI can handle large amounts of information to help identify and develop new opportunities. Making use of new opportunities and implementing an effective strategy can provide a competitive market advantage and long-term stability.

BI technologies provide historical, current and predictive views of business operations.

Common functions of business intelligence technologies are reporting, online analytical processing, analytics, data mining, process mining, complex event processing, business performance management, benchmarking, text mining, predictive analytics and prescriptive analytics.

The term Business Intelligence (BI) represents the tools and systems that play a key role in the strategic planning process of the corporation. These systems allow a company to gather, store, access and analyze corporate data to aid in decision-making. Generally these systems will illustrate business intelligence in the areas of customer profiling, customer support, market research, market segmentation, product profitability, statistical analysis, and inventory and distribution analysis to name a few.

Most companies collect a large amount of data from their business operations. To keep track of that information, a business and would need to use a wide range of software programs, such as Excel, Access and different database applications for various departments throughout their organization. Using multiple software programs makes it difficult to retrieve information in a timely manner and to perform analysis of the data.

## V. ALGORITHM

### LOGISTIC MODEL TREES

Logistic Model Tree[9] is a classification model with an associated supervised training algorithm that combines logistic regression and decision tree learning.

Linear regression performs a least-squares fit of a parameter vector  $\beta$  to a numeric target variable to form a model

$$f(x) = \beta^T \cdot x$$

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 2, February 2014

1. Start with weights  $w_{ij} = 1/n, i = 1, \dots, n, j = 1, \dots, J, F_j(x) = 0$  and  $p_j(x) = 1/J$
2. Repeat for  $m = 1, \dots, M$ :
  - (a) Repeat for  $j = 1, \dots, J$ :
    - i. Compute working responses and weights in the  $j$ th class
 
$$z_{ij} = y_{ij} - p_j(x_i)$$

$$w_{ij} = p_j(x_i)(1 - p_j(x_i))$$
    - ii. Fit the function  $f_{mj}(x)$  by a weighted least-squares regression of  $z_{ij}$  to  $x_i$  with weights  $w_{ij}$
  - (b) Set  $f_j(x) = \sum_{m=1}^{j-1} (f_{mj}(x) - f_{m,j-1}(x)), F_j(x) = F_{j-1}(x) + f_j(x)$
  - (c) Update  $p_j(x) = \frac{e^{F_j(x)}}{\sum_{k=1}^J e^{F_k(x)}}$
3. Output the classifier  $\text{argmax}_j F_j(x)$

Fig. 1. LogitBoost algorithm for J classes.

A better method for classification is linear logistic regression, which models the posterior class probabilities  $\Pr(G = j|X = x)$  for the J classes via linear functions in  $x$  while at the same time ensuring they sum to one and remain in  $[0,1]$ . The model has the form:

$$\Pr(G = j|X = x) = \frac{e^{F_j(x)}}{\sum_{k=1}^J e^{F_k(x)}}, \quad F_k(x) = 0,$$

where  $F_j(x) = \beta_j^T \cdot x$  are linear regression functions, and it is usually fit by finding maximum likelihood estimates for the parameters  $\beta_j$ .

Fig 1: LMT Algorithm

## VI. APPLYING BI IN CONSTRUCTION ERP PROJECT

In Construction ERP we are using Business Intelligence in CRM. The customer of the Construction Company who is making a purchase of any kind of construction asset from the construction enterprise. The customer is able to give various feedbacks to the company. The company takes feedback from the customer after specific intervals or as per the completion of construction activities for the customer site. The customer can give feedback for the following activities of Construction Company:

- a. Is sufficient information about site given to customer?
- b. Are all the enquired doubts have been cleared?
- c. Is the staff cooperative?
- d. Was the construction completed in time
  - i. Slabs
  - ii. Floors
  - iii. Walls
  - iv. Plastering
  - v. Plumbing
  - vi. Painting
  - vii. Tiling
  - viii. Elevators
  - ix. Backup generators
  - x. Other Specified Amenities
- e. Was the Possession of the asset given on time?

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 2, February 2014

- f. Maintenance was done properly in allocated time.
- g. Quality of the delivered asset.

After taking the various above mentioned feedbacks from the customer, the system will analyze all the given feedbacks and would give efficient suggestions to the higher authorities to take proper decisions. We are going to the BI in the form of BI.

Using BI in Construction ERP takes the ERP system a step further by allowing managerial staff to make strategic and technical decisions about the enterprise. The stakeholders are able to give various feedbacks to the company. For Example- Customer, Supplier, Accountant, Staff, Contractor are the stakeholders who give feedback (in terms of star rating). Let us consider the following customer feedback mechanism.

## Example- Customer Feedback Mechanism

Customer gives feedback for the following activities based on star ratings.

1. Sales team response to customer enquiry.
2. Service provided regarding loan facility and documentation.
3. Overall Costing as compared to surrounding market.
4. Time taken for construction.
5. Amenities Provided.
6. Flat Possession.
7. Flat Condition.

Now we will try to understand how the feedback algorithm is designed.

## SIMPLE AND EFFICIENT ALGORITHM FOR BI

1. Stakeholder gives feedback and feedback goes to database.
2. Average star rating is computed for each feature in feedback.
3. Average feedback is displayed in form of stars.
4. Based on average star rating, most probable suggestions are mapped and displayed to respective department managers.
5. The manager can select the optimal suggestion for the respective entity.
6. The optimal decision which is implemented by manager goes to the decision directory.
7. The implementation of decision is traced and its weekly reports are generated.
8. The weekly reports help the managers to decide the success or failure of the decision.

## Features of Construction ERP

1. Provide an integrating working environment.
2. Enable automation
3. Availability of information from field level until the management level
4. Integration in applications in any departments
5. Flexibility and facility to standardizing process or to accommodate changes and globalization.
6. Achieve balanced development in processes and functioning of enterprise across all areas.
7. Apply planning and program management practices throughout the program life cycle of a project.
8. Alignment of an organization around a consistent set of performance indicators and metrics.
9. Quicker Fact based decision making.
10. Simplified graphical presentation of KPI's and metrics.
11. Reliable presentation of information.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 2, February 2014

12. Combination of multiple data sources (ERP, CRM, and Spreadsheets etc).
13. Faster Collection and dissemination of information.

## Disadvantages of Construction ERP

1. High implementation cost. It can range from some hundred thousand dollars in small companies to a billion dollar for large multinational companies.
2. Delay in return on investments-The benefits of ERP may not be shown until after companies have had it running for some time.
3. When we use BI in Construction ERP then the complexity increases exponentially.
4. Piling of historical data.
5. Cost.
6. Complexity.
7. Limited Use.

## VII. CONCLUSION

Hence we conclude that developing an ERP for Construction Enterprise is the current need of construction market. Since the functioning of the construction enterprise is different from other domain industries. There is a need to develop a specific construction enterprise oriented ERP. The application under development will provide complete solution to manage the entire functioning of construction firm. Implementing Business Intelligence in the Construction ERP will help managerial staff in decision making. Thus this construction ERP will contribute in overall functioning, growth and development of the construction organization.

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