

Technologies for Cost Efficient Enterprise Resource Planning: A Theoretical Perspective

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Abstract. Enterprise Resource Planning(ERP) systems are used in all types of organizations. Many vendors are providing ERP software. The aim of ERP system is to reduce the costs and increase the benefits in terms of increased revenues and sales. However, all ERP implementations are found to be costly as compared to benefits gained from it. Also the costs in using the ERP creep up from time to time . This paper highlights the relation between main contributors of costs in ERP systems which include architecture, implementation, integration, maintenance, training and vendor consultation and provides ways to reduce these. Cloud computing, SOA, EAI and ASP model for ERP implementation provide a number of ways of reducing costs.

Keywords: Cost, Cloud technology , EAI, ERP architecture, ERP integration, SOA.

1 Introduction

In today's globalized economy and competitive environment, a total business solution implementation is required which is capable of supporting various business processes within the organization as well as maintains value chains with its customers as well as suppliers. Enterprise resource planning (ERP) is a software solution which integrates various functional areas of an organization using best industry and management practices. Modern Enterprise Resource Planning software is used not only in business for increasing the profits, speed up the delivery and maintaining a healthy customer relationship but also for improving operational efficiency and effectiveness of information services .All the business organizations may aim at the similar structure as is currently adopted by ERP software. ERP software has been used by capital intensive industries, such as manufacturing, construction, aerospace, defense, finance, education, insurance, retail, and telecommunications sectors. ERP has been selected worldwide for its integration capability, reputation, standard software, three-tier client/server architecture, business engineering, and migration tool from the mainframe[3].

The ERP solutions will likely continue to define the IT standards that could enable end users to integrate most of their information systems into one cohesive technology infrastructure. The main benefits of ERP applications are improved organizational efficiency, implementation of best practices, better alignment of organizational processes, and improved data accessibility. The business objectives of ERP solutions are customer services and lower cost for the organization. All benefits though can be achieved with high cost. The aim of this paper is to identify various costs in ERP to be considered and which processes or technologies can help in cost reduction. First the issues in ERP cost estimation process are discussed, then various costs in ERP software are identified. Various ways of reducing different costs are identified. The service oriented architecture, enterprise application integration, application service provider model and cloud computing are the best technologies identified for reducing the ERP costs in a number of ways.

2 ERP Costs and Estimation

ERP planning is the first phase in the overall ERP implementation life cycle. Cost estimation is an important activity of the planning phase. Cost overrun is the one of the most critical risk in ERP implementation. Though properly planned, ERP projects end up incurring more costs than estimated. This is due to the fact that there are many hidden costs associated with ERP implementation which are ignored during formal cost estimation. ERP costs include:

1. Establishment costs (cost of platforms, cost of hardware, software, cost of interfaces and data migration requirements, deployment of cost), Hardware costs (leased, networking services costs) and Software cost (Application license costs, database license cost, OS license cost, Monitoring and management tool cost, costs of the software, external services).
2. Recurrent costs (schedule requirements and constraints, training and associated training material and consultation services) i.e. operating costs.
3. Avoided costs (costs for platforms no longer in use or required to be decommissioned)
4. Post establishment costs (maintenance, licensing updates, version upgradation)

Though cost estimation is difficult task but it is very important in order to meet with the budget requirements. All organization are in pressure to be accurate at this. So in order to calculate the cost of an ERP system, proper plan, a process or a model should be designed to calculate the various types of costs in an organization. The process or cost model should also aim at reducing the time and effort for doing cost estimates at regular intervals. The cost estimates made should always improve as the process becomes mature. The process should also allow to compare various cost estimates. A framework developed using system dynamics simulation modelling of a case study organization can help the organizations to better predict the long-term cost of ERP systems, identify key cost drivers, and determine what dynamic relationships customizations have on total cost of ownership [6].

In order to estimate the costs there are generally three basic methods[15]: analog estimation method, top-down estimation method and parameter model estimation method.

- (i) Analog estimation method : in this method, the actual costs of previous projects are used as the basis for the current cost estimate. Using this method we must carefully analyze the current projects and past projects.
- (ii) Top-down estimation method (bottom-up estimating): This method works on work breakdown structure in a project .It includes estimates of individual work items and the summary of individual work items into the overall project. In order to estimate correctly, individual work items and estimated the size of the staff experience are required .
- (iii) Parameter model estimation method: It is a mathematical model to estimate the project cost. It uses the project characteristics as parameters to estimate the project cost. This model if provided with accurate historical information and easy to quantify project parameters, can model the size of the project is capable of estimating the cost reliably.

In the ERP project cost estimation, emphasis should be placed on the software development cost estimates because other costs can be easily obtained in the market reference price. Along with this, the other costs for which the estimates should be included are infrastructure cost, cost of consultation by ERP vendor , cost of training the employees within the enterprise, the cost of integration, implementation and maintenance, estimated cost of licensing for first time and renewing the same, various subscription fees for shared resources and for version upgradation.

3 Ways to Reduce Costs in ERP

Various ways are suggested here for reducing the costs associated with ERP. Main costs considered are consultation cost, architecture cost, implementation cost, integration cost and maintenance cost.

3.1 Consultation Cost by ERP Expert

The professional charges payable to the outsider also depends on the extent of the services availed by the company. This has also been verified by Ziaee et al. that the costs of the consultation before the procurement are a big portion of ERP system [13]. Instead of conducting refresher programs and correcting the error during implementation, training should be done before implementation which will prove to be less costly.

3.2 ERP Architecture Cost

Most ERP systems have three distinct features in their architecture. These integrated features could facilitate compatibility between task and technology in the ERP system.

1. *Data dictionary* : which specifies thousands of domains that are associated with supporting fields and arranged in numerous tables. This data dictionary could be used across all functional areas within an organization. Once data are entered into the ERP system, it could be shared across an entire value chain in the firm.
2. *A middleware* : which could make distributed systems possible by allowing users to set up application modules and databases at different locations. Data could be moved from a central system to a remote system, permitting applications to exchange information between them. The middleware not only routes data, but also knows what data are needed in a given situation.
3. *A Data warehouse or a repository* : This is the foundation of the business framework, because the repository captures all semantics in the business processes, business objects, and organization model. It contains a comprehensive description of the ERP applications, including all meta information about models, technical programming objects, and business objects. The ERP repository is able to exchange information via application programming interfaces (API).

These three technology features are used to coordinate marketing, manufacturing, distribution, and human resources tasks in the organization. When an integrated ERP is in place, an organization can build whole enterprise applications on top of it. These enterprise applications could provide a timely feedback to enable optimal responses to changing conditions of customer demand and manufacturing capacity. All the ERP systems cannot fit as per the complete requirement of any organization in spite of the fact that they have business practice processes in their repository. So the organization needs to select those applications available from software vendors for its specific requirements, and integrate both the applications and ERP system into the organization's IT backbones. This has also been verified by that a big portion of ERP system acquisition costs are the costs of ERP architecture. Most of these costs are related to the analysis of the organizational processes and a careful determination of the required modules by ERP vendors and consultants.

A large amount of the consulting costs are saved if the modules are studied by the customer organization in the ERP software selection process. A two phase method can be used to select ERP vendor and software where the preliminary actions are forming a project team and doing business process re-engineering (BPR), collecting information about ERP software packages and vendors and filtering unqualified vendors out[13]. While in the second phase (selection phase), a modular approach for ERP vendor and software selection is presented.

3.3 ERP Integration Cost

Integration of other applications or software with ERP not easy. So the organization needs to modify or adapt the current ERP which is a costly affair[3]. The major cost factor is in integrating ERP with other applications or software. Implementation of Capability Maturity Model Integration can also help in reducing integration costs[5]. This model defines three levels of process maturity in a system: initial development process, managed development process and defined development process. Many of the ERP vendors use service oriented architecture (SOA) which is design paradigm which uses loosely coupled services. The services implemented are independent of any particular technology. This reduces the integration cost for ERP because of using open standards. Also using cloud computing, Software as a Service can help in making making ERP integration with other applications or hardware faster, easier, and less risky[9]. Enterprise Application Integration (EAI) can help in reducing integration costs to a great extent. EAI is used for application integration across multiple enterprises[14]. The sharing of business logic and information across multiple enterprises results in reduced integration costs.

3.4 ERP Implementation Cost

ERP project implementation road map: Project preparation; BPR; System developing and tuning, final testing and system go-live. This term will include all the exercises from business process engineering to gap analysis to actual restructuring, training, modifying and transferring data and systems from the old form to new form as costly affairs. The nonmonetary costs include manpower and time spent. In order to save the costs, the company can go ahead with the process of implementation with the help of In-house IT staff than engaging the services of an ERP consultant.

Using SOA, the applications are composed of common business services which can be reused and shared among many business units. This reduces the implementation cost and increases flexibility.

3.5 Training Cost

This is also a crucial determinant of ERP costs. There are two modes of training offered in companies. Companies hire trainers to update their IT staff on use of ERP. They in turn train the user to get acclimatized to ERP's functioning. This method costs less but has lot of drawbacks but still many companies go for it not only because of doing away with the need to train everyone in the company. In spite of the drawbacks this method has claimed relative success in some companies. The other method is training the users and the IT staff as well .In this method the IT staff will be trained on technical parameters while the users will be trained on usage. This method though is costly but is highly successful. Training both the users and IT staff is essential .So ERP training costs can be reduced if in-house IT staff are competent to handle other areas without training. Another solution is to have trainers in the organization itself to save the cost for training all users from outside consultants.

3.6 Infrastructure Cost

The cost of infrastructure includes the cost of hardware and IT resources required in ERP system. One way to reduce this cost is to use the cloud computing using infrastructure as a service. Using infrastructure as a service, the ERP user can store and process the information on computing resources available at another places. This reduces the infrastructure cost and allows the ERP user to deploy and run arbitrary software and hardware through virtualization. Infrastructure cost can also be reduced using platform as a service (PaaS) Platforms that can be used to deploy applications provided by customers or partners of the PaaS provider. It provide the user the capability to deploy onto the cloud infrastructure customer-created or acquired applications created using programming languages and tools supported by the provider.

Application Service Provider(ASP) model for ERP implementation can also reduce fixed costs and overall hardware cost[14]. This is done by deploying, hosting and managing access to applications to multiple parties from centrally managed data server facilities. The ERP customer need only to pay the subscription fee for network components, server-level computing hardware and software.

3.7 Maintenance Cost

Since maintenance is the longest phase of the ERP lifecycle, there is ample opportunity to improve the system in a variety of ways including business process reengineering (BPR) and extending the use of delivered functionality [12].The companies should have better insights in and control over the processes like maintenance and evolvability to improve business and software development processes in order to increase productivity, reduce costs, improve quality, and thus strengthen their position relative to competitors [1]. In order to reduce long-term maintenance costs, Business Process Reengineering (BPR) is encouraged in order to take full advantage of the ERP software but it is difficult because it requires significant enterprise-wide change management which results in high upfront costs ([7], [10]). To address evolvability during the whole lifecycle of the system and to maintain the enterprise system at reasonable costs, companies have a strong need at the level of software architecture [2] . In order to take full advantage of ERP systems, and to control TCO, ERP implementations require drastic structural and cultural changes within the organization including BPR [8].

Maintenance cost can also be reduced by using public cloud. When a public cloud is used, the ERP solution is owned and remotely hosted by the vendor. The users pay a subscription for the services they offer, (licensing model) called Software as a Service (SaaS) instead of licensing the software itself. There is no need for costs and resources required for ongoing maintenance, support and version control with SaaS which are provided by the vendor itself. Hence the maintenance cost is minimized.

A summary of technologies for reducing costs in ERP is shown in figure 1:

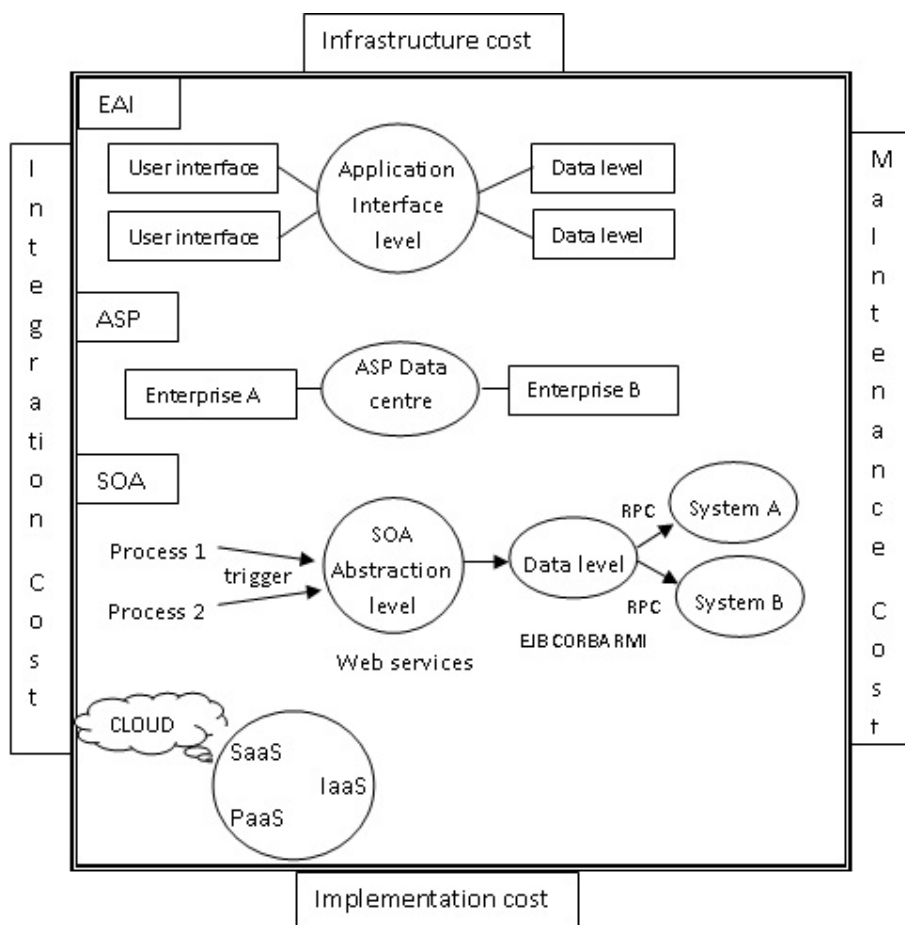


Fig. 1. Technologies for reducing costs in ERP

4 Conclusion

In order to provide lower cost for organization and customer services, continuous business reengineering is supported by ERP [4]. This was not supported by MRP systems and MRP II systems. The adoption of an ERP system brings about new changes to the organization and its information systems. The ERP system with its integrated built-in controls becomes an enabling technology for internal auditors to maintain effective controls over operations and provides assurance of reliable transaction information consistent with the organization's goals and objectives. Traditional controls, such as separation of responsibilities, will not be cost-effective in the ERP system and may not be able to deliver the required level of control.

Almost half of ERP software implementations fail from an investment perspective. A key driver for the success of an ERP implementation begins with choosing the right application with the right pricing model. The ERP system that is selected should be based on total cost of ownership and pricing models as well as for the features and functionality of the technology. Cloud technology would be referred to as an infrastructure tool that can be used to reduce hardware and IT costs while SaaS would be referred to as a deployment and business model that provides customers with a new way to purchase software and reduce cost. Similar technologies are SOA which allows the reuse of various business services using open standards to be integrated easily with less cost among various enterprises. EAI and ASP model for ERP implementation can also be used which reduce the cost of infrastructure by providing access to centrally managed network resources.

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