



Towards an ERP life-cycle costs model

José Manuel Esteves

Departament de Llenguatges i Sistemes Informàtics
Universitat Politècnica de Catalunya, Campus Nord, Jordi Girona Salgado, 1-3
08034 Barcelona – Catalonia - Spain, (*email*: jesteves@lsi.upc.es)

João Álvaro Carvalho

Departamento de Sistemas de Informação
Universidade do Minho - Portugal, (*e-mail*: jac@dsi.uminho.pt)

Aldemar A. Santos

Departamento de Ciências Contábeis
Universidade Federal de Pernambuco - Brasil, (*e-mail*: aldemar@npd.ufpe.br)

ABSTRACT

Many organizations have adopted ERP systems, but most of them are not aware of the total costs associated with them, and they only consider the costs related with the software acquisition. This article is an exploratory study that sets out to identify other costs related to ERP systems during their life-cycle. Through the different phases of the life-cycle we define and categorize the various costs. The costs were classified as tangible and intangible. We also describe a case study where the costs related to the three initial phases of the life-cycle were analyzed: acquisition, implementation, and usage and maintenance. Finally, some conclusions are drawn and we pose some research questions for further work.

INTRODUCTION

AMR research Inc., a leading enterprise in market analysis, expects that the market for *software enterprise resource planning* (ERP) will grow at a rate of 37% until 2003 (Caruso, 1998). Forecasts show that the ERP market will rise to \$66 billions (Hangendorf, 1999), and that ERP will remain one of the biggest in growth with more influence in the software industry, quotes AMR. Nowadays, the ERP products and services industry is one of the most promising.

Through the usage of ERP systems such as SAP, BAAN, Peoplesoft and Oracle, organizations try to integrate the information-flow of the different business areas and, at the same time, improve efficiency and reduce costs. Theoretically, these integrated systems provide large functionality in terms of problem-solving associated with data-flow when they are integrated with different software systems.

Some critiques of ERP systems focus essentially the high costs of ERP projects, the high failure-rates and their complexity, which makes it difficult for users to perceive the advantages and the opportunities of these systems.

ERP systems demand a large investment at the economic, human-resource and organizational levels. This investment is made not only in the initial phase but throughout their life-cycle. Thus, this study is intended to analyze the necessary investment to integrate an ERP system during its life.

The paper was structured in the following way. First, the ERP life-cycle is defined. Next, the different costs are defined and analyzed for each phase. Then, a case study of a Portuguese company is described, and the costs of the three initial phases were studied. Finally, we present some considerations for future work.

1 ERPSYSTEMS OVERVIEW

Typically, an ERP system is a software package composed of several modules, such as production, sales, finance and human resources, providing for the horizontal integration of data across an

organization and through its business processes. These software packages can be customized to address the specific needs of an organization (Esteves and Pastor, 1999a).

According to Davenport (1998), an ERP system is a generic solution, the design of which reflects a series of conclusions (best practices) about the way organizations work. Thus, and contrary to the proprietary systems developed according to the specific requirements of an organization, the ERP systems are generic in nature. They impose their own logic in respect of strategy, culture and structure of an organization, many times forcing changes in the way of doing business (SAS Institute, 1998).

The idea behind ERP systems is that the software needs to represent the whole of the business process chain. With an ERP system, the financial department can close a paying account as soon as the warehouse clerk confirms the reception of goods. This is done with minimal human intervention and without paper documents flowing through the organization (Slater 1999).

Ross and Vitale (1998), define six common motivations to adopt an ERP system: need for a common platform, process improvement, data visibility, operating cost reductions, increased customer responsiveness and, improved strategic decision-making.

One of the issues in the ERP systems area is that of determining if the investment made will be compensated in the future. A survey of Meta Group Inc (Craig 1999), shows that, typically, in financial terms, ERP projects cost more than the expected benefits. These are close to academic studies on this object. But there are some suggestions that, financial terms and other strategic benefits should be considered. This issue is included in broader discussions about investment in information systems and their performance (Bender, 1986; Brynjolfsson and Hitt, 1994; Harris and Katz, 1988). Some authors found no or little relationship between them (Strassmann, 1990, 1999; Turner, 1985), while others concluded that the investment in information systems has been detrimental to

organizations (Roach, 1988).

ERP systems demand high investment at the economic, human-resource and organizational levels. These investments are made not only in the initial phase but throughout their life-cycle. Thus, this study analyzes the necessary investments for the integration of an ERP system during its existence, along with an analysis of the costs associated with each phase.

2 ERPSYSTEMSLIFE-CYCLE

To define the life-cycle model we use a simplified version of the model proposed by Esteves and Pastor (1999a, 1999b). This model is structured in phases and dimensions. Here, we only make reference to the phases as the different stages of the life-cycle of an ERP system in an organization. Next, we describe each phase, i.e., adoption, acquisition, implementation, usage and maintenance, evolution and retirement.

Adoption decision phase. During this phase managers examine the need for a new ERP system while selecting the general information system approach that will best address the critical business challenges and improve the organizational strategy. This decision phase includes the definition of system requirements, its goals and benefits, and an analysis of the impact of adoption at a business and organizational level.

Acquisition phase. This phase consists on the selection of a ERP product that best fits the requirements of the organization, thus minimizing the need for customization. A consulting company is also selected to help in the next phases of the ERP life-cycle especially in the implementation phase. Factors such as price, training and maintenance services are analyzed and, the contractual agreement is defined. In this phase, it is also important to make an analysis of the return on investment of the selected product.

Implementation phase. This phase include the customization or parameterization and adaptation of the ERP package to the needs of the organization. Usually this task is made with the help of consultants who provide implementation methodologies, know-how and training.

Use and maintenance phase. This phase covers the personal of time where the ERP product is selected in a way that returns benefits and minimizes disruption. During this phase, one must be aware of the aspects related to functionality, usability and adequacy to the organizational and business processes. Once a system is implemented, it must be maintained, because malfunctions have to be corrected, special optimization requests have to be met, and general systems improvements have to be made.

Evolution phase. This phase corresponds to the integration of more capabilities into the ERP system, providing new benefits, such as advanced planning and scheduling, supply-chain management, customer relationship management, workflow, and expanding the frontiers to external collaboration with other partners.

Retirement phase. This phase corresponds to the stage when, with the appearance of new technologies or the inadequacy of the ERP system or approach to the business needs, managers decide if they will substitute the ERP software with other information system approach more adequate to the organizational needs of the moment.

3 COSTS ALONG THE ERPLIFE-CYCLE

A bibliographical analysis of academic publications on ERP systems shows the lack of studies in this field. Based on published case studies and literature review related to the cost analysis of information systems, we developed a structure of costs along the ERP life-cycle.

Table 1 summarizes the cost items, where costs were classi-

fied as tangible or intangible. Thus, tangible costs are the costs that can be measured in a direct way, taking always into account that, sometimes, tangible costs cannot be measured in monetary terms. Intangible costs are those costs that are difficult to be measured in a direct way, since they refer to vague concepts, as illustrated in table 1. Next, we describe in detail each phase and related costs.

Phase	Tangible Costs	Intangible Costs
Adoption		Decision making costs
Acquisition	Consultancy Hardware Software licenses	Decision making costs Opportunity costs
Implementation	Consultancy Training Human resources System specification	Customization, conversion and data analysis Time dedicated by staff Business process re-engineering
Usage and Maintenance	System Reconfiguration System adaptation Cost of system failure	Indirect costs of system failure Loss of competitiveness
Evolution	Cost of new applications	
Retirement		Opportunity costs Decision making costs

Table 1 Costs items along the ERP life-cycle.

3.1 ADOPTION

Intangible Costs

Decision-Making Costs. This phase is perhaps the phase that has the least associated costs, because it represents only the decision to adopt or not an ERP system. The associated cost is essentially the time spent by managers in the decision-making task. In the context of the decision-making process, the concept of avoidable costs is used to define the costs that can be eliminated when we opt for a specific choice or solution. The unavoidable costs refer to the costs that we cannot eliminate.

3.2 ACQUISITION

Tangible Costs

Consultancy Costs. Consultants help with knowledge and experience in the selection of the ERP system most adequate to the organizational needs, and they help in the implementation phase. They also act as mediators between the ERP provider and the organization. Analysts are unanimous in stating that the costs related to consultancy are the highest for an ERP system.

Hardware Costs. Acquisition of an ERP system implies changes in the existing hardware infrastructure. These changes can vary from a change and/or actualization of the actual hardware infrastructure to the complete installation of a new hardware infrastructure. Hardware needs must not be forgotten due to the fact that the new hardware infrastructure must have the maximal performance to provide access in real time to databases and the ERP system modules. Aspects such as network-communication capacity, servers and processing-speed rates are important.

Software Licences. After the selection of ERP software, there is the need to make an agreement contract. The cost of these contract can be calculated in several ways. Some contract consider the number of licenses and the number of users, while others include factors such as organization benefits and number of employees. Usually, providers offer price reductions depending on the number of modules acquired and the acquisition of extended applications

and the purchase of maintenance services and upgrades of software.

Intangible Costs

Decision-Making Costs. In the acquisition phase decision-making costs must be analyzed again. The main decision consists of the selection of the ERP system that best addresses the organization needs.

Opportunity Costs. These costs measure the opportunity that is lost or is sacrificed when an option is abandoned. The analysis of the several ERP systems that exist in the market should take into account these costs.

Analysts recommend that at this point a return on investment (ROI) study should be done. The ROI has two important elements: the “how much” and the “when”. The “how much” element represents the benefits created by the investment, and the “when” represents the period of investment return.

3.3 IMPLEMENTATION

Tangible Costs

Consultancy Costs. Most organization use consultants to implement the ERP system, due to the fact that they don't have the technical knowledge in-house to complete this process. Consultants incorporate knowledge, experience, implementation methodologies, and training programs for users. They also help re-engineering the organization and its business processes.

Training Costs. Here, we include the training of a project team and the end users. These costs are usually high because users need to learn a set of new processes and not just the usage of a new software application. To minimize these training costs, there presently exist internet-based tools or video-conference tools that reduce the number of trainers and have a larger scope of training.

Human-Resources Costs. The costs associated with the project team have a high weight. They are expert professionals and their price per hour is high and must be quantified. Sometimes there is the need to recruit these human resources from outside.

System-Specification Costs. These costs refer not only to the number of human-resource hours spent on this task but also the acquisition of tools and instruments (denominated enterprise modelling tools) that help to make specific the necessary business vision.

Intangible Costs

Customization, conversion and data analysis. The effort made in the software customization and adaptation to organization needs is usually not measured, except in terms of time. The data to be inserted in the new system constitutes a heavy burden to the project costs. The data converted from other systems and the new ones have to be verified due to inconsistencies, because usually they are not adequate to the new formats. Usually, there is the need to insert new data in the new system

Time of dedicated staff. The project team and staff have to keep many times their work and make the tasks related with the project. The costs associated with this effort and the respective loss of efficiency are not usually measured. The option of keeping them totally dedicated to the project could result in the recruitment of personnel, whose costs are measurable.

Business-process re-engineering cost. *Forrester Research Inc* (Koch, 1997) estimated in 1997 that in a typical SAP installation,

more than 50% of the implementation budget is spent in business process re-engineering. The implementation of an ERP system means in many cases a radical change in the organization business processes, forcing changes in organizational flows and in organizational structures.

3.4 USAGE AND MAINTENANCE

Tangible Costs

System reconfiguration. Usually, after ERP-system implementation some inefficiencies appear in its operation, which requires an adjustment to the ERP configuration. Reporting functions are particularly sensitive to reconfiguration needs.

System Adaptations. Organizations change over time, so there is always therefore the need to adapt the systems to whatever changes have been made. The introduction of new information flows and new business processes influence the ERP system usage and performance.

System-failure costs. Failure costs refer to the costs arising from ERP-system break-downs. In big organizations the direct costs are very high, because orders cannot be satisfied, stocks cannot be updated and in certain cases these failures cause a total disruption of the organization's business.

Intangible Costs

Indirect costs of system failure. System failures cause many indirect costs, such as loss of access to vital information, loss of customer loyalty, or the ability to survive in the business (Uram, 1999).

Loss of competitiveness. A common criticism of ERP systems is the standardization of business models through the imposition of ERP models. Most organizations adopt these business models to facilitate the software implementation and they may thereby lose competitive advantages over other organizations. These changes should be measured in economic terms.

3.5 Evolution

Cost of new applications. In this phase the main costs are related to the purchase and implementation of new applications, such as advanced planning and scheduling, customer relationship and management, workflow, e-commerce, etc.

3.6 RETIREMENT

Here, the opportunity and decision-making costs repeat and all the tangible costs related with software. When this phase is reached, it is expected that the original investment was been recovered. In cases of abandonment (in implementation phase, for instance), the associated costs can constitute high losses, as happened to the FoxMeyer company (Scott, 1999). The company imputed its bankruptcy to the investment made in an ERP system.

4 CASE STUDY

In this section, we describe the case of a company that implemented the SAP R/3 system.

It was not possible find a case study with the whole ERP costs life-cycle. Most organizations only analyze the costs relating to the implementation phase, probably due to the fact that the values in this phase are high. Next, we describe the different costs associated with the integration of a SAP R/3 system, the top ERP product worldwide.

“ABC” (a fictitious name) is a Portuguese medium-sized

company engaged in financial services, and is presently in the usage and maintenance phase of the SAP system. The company has experienced high profitability growth over the last few years and intends to improve the services to its customers and optimize its business processes. This motivated the adoption of SAP R/3 system, with the implementation made last year.

The implementation phase is divided in three stages: development, test and exploitation. In this company, part of the costs related to tests are divided between the development and exploitation stages. The initial findings obtained in the case study demonstrate the complexity associated with the implementation phase. Table nº. 2 shows the costs found in the case study analysis.

The costs of licenses, hardware, implementation training and consultancy were spread out over two years. The total cost at the end of the first year was \$1,810,412. The analysis of the values shown in table 2 shows that the implementation phase is the one that incurred the greatest costs, at 72.8%, while 23.6% and 3.6% of the total expenditure may be apportioned to the acquisition and the usage and maintenance phases, respectively.

Training represents 4.2% of the costs associated with the implementation, a value that is low when compared to that of a typical implementation phase. According to Gartner Group and International Data Corp, the training costs constitute at least 15% of the implementation budget (Marion, 1998). This lower value of 4.2% can be explained in part because some of the training was offered by the consultancy company.

Phase	Task / Costs (in dollars)	Total
Acquisition	SAP R/3 licences : 428.077	428.077
Implementation	Technical attendance during the project: 14.000 Consultancy: 59.090 Training: 55.681 Development: software SAP installation : 8.272 Acquisition of development <i>Hardware</i> : 39.950 Implementation of financial, logistic and human resources modules: 872.795 Tests: Internal human resources costs: 94.545 Acquisition of hardware to make tests: 9.022 Exploitation: Aquisição de <i>Hardware</i> de exploração: 184.718	1.318.122
Usage and Maintenance	SAP Licences (annual value): 64.213	64.213
Total		1.810.412

Table 2. Costs of adoption of SAP R/3 system in a portuguese enterprise.

Hardware represents 17.7% of the implementation costs. The company needed to re-structure its computer network and, in addition, needed to purchase some hardware, specifically to facilitate the implementation process. The company opted to charge all the hardware costs to this phase, without discriminate any value in acquisition phase.

Software costs at the end of the first year were 27.2% of the total costs. This value is nearly that defined by Kale, set at 30%, for a typical SAP project (Kale, 2000).

Consultancy costs have the value of \$59,090, but there are some hidden consultancy costs included in the implementation phase, namely in the implementation of the SAP modules, and we note that these costs are globally high.

Relative to the usage and maintenance phase, only the costs of the software licenses were measured. This cost is not fully accurate, because the task of parameterization of reports was performed and the database was upgraded, but these costs were not measured.

Managers of ERP projects point out the need to make a schedule of the investments needed, mainly during the implementation phase, because the lack of economic resources in this phase can make the realization of goals difficult (especially the period of implementation). Thus, they suggest that the financial department of the organization should approve and follow the investment plan of the ERP system.

ABC organization costs structure is the same as defined in our model in relation with tangible costs. The organization did not evaluate the intangible costs. The organization plans to adopt (or develop) an ERP costs model with more accuracy than the actual structure.

CONCLUSIONS

This exploratory study tried to analyze the costs associated with ERP systems. The study presents a list of costs that demonstrate that this type of system has a strong organizational perspective, and therefore the costs associated with this perspective should be taken into account and measured. The list does not intend to be exhaustive but attempts to give a general view of the whole ERP life-cycle.

The case study described shows that most costs are spend in the implementation phase in terms of costs in an ERP system, mainly, the consultancy and hardware costs. Thus, there is the need to analyze these costs because they can increase the initial budget, if the changes in the existing organization hardware were not designed according to the ERP needs.

The next step in this research will be the validation of the cost model proposed in this article through case study approach. Other pertinent issues for further research are:

- What are the benefits after an ERP implementation?
- How do ERP implementation costs affect organizations?
- How should TCO (total cost of ownership) of an ERP system be defined? What are the elements of these costs?
- Have the ERP-system expectations been realized?

In conclusion, we think that there are many things to analyze, evaluate and develop in future studies about costs and ERP systems, including procedures for benchmarking.

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