



ENTERPRISE RESOURCE PLANNING SYSTEMS IN BRAZIL: THE CASE OF THE SAP R/3 AT COELBA

SISTEMAS INTEGRADOS DE GESTÃO (SIGs) NO BRASIL: O CASO DO SAP R/3 NA COELBA

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ABSTRACT

The purpose of this paper is to analyze business benefits of European Enterprise Resource Planning (ERP) systems in Brazil by means of a case study carried out in the Electrical Energy Company of Bahia – COELBA, which has been acquired by the Spanish group IBERDROLA. In order to do so, two frameworks for assessing benefits of ERP systems will be compared and combined, creating a new one, and offering a comprehensive criteria for the evaluation of results achieved by these systems. The proposed model is then applied to the company through interviews and questionnaires with its managers and workers concerning the acquisition and use of the German SAP/R3 information system.

Key words: Information Technology, ERP systems, Evaluation

RESUMO

Este artigo tem por objetivo analisar os benefícios da adoção de sistemas integrados de gestão – SIGs em empresas brasileiras, através de um estudo de caso desenvolvido na Companhia de Eletricidade do Estado da Bahia – COELBA, após sua aquisição pelo grupo espanhol IBERDROLA. Para tal, dois modelos de avaliação de sistemas integrados são comparados e combinados em um terceiro, oferecendo um critério objetivo de avaliação dos resultados alcançados com o uso desses sistemas. O modelo proposto é então aplicado à empresa, através de entrevistas e questionários, com vistas à avaliação dos possíveis benefícios alcançados pela COELBA com a implantação do sistema SAP/R3.

Palavras-chave: Tecnologia da Informação, Sistemas Integrados de Gestão, Avaliação

1 INTRODUCTION

This paper intends to present a case study carried out at the Electrical Energy Company of the State of Bahia – COELBA, in order to assess the consequences of the replacement of its former information systems structure for an European ERP system. Due to the wide functional scope of this type of system and considering the potential impact it caused, this analysis was carried out focusing on different points, investigating not only the results on the strategic, managerial, operational and technological dimensions, but also the impact on the financial performance of the organization and on its employees.

The relevance of this research derives from three basic conditions: 1) ERP systems are presenting a growing and wide application in medium and large size companies. 2) Such systems offer crucial support to a large spectrum of managerial functions in productive organizations, greatly influencing their performance. 3) Its acquisition and implementation require considerable investment.

2 ENTERPRISE RESOURCE PLANNING SYSTEMS - ERPS

ERP systems are semi-finished commercial software (SHANG; SEDDON, 2000) that contemplate a large range of functions, thus allowing the integration of business data and managerial processes throughout the organization and even among different organizations. (MARKUS; TANIS, 2000).

The great majority of systems available is provided by large companies that produce application software such as SAP (Germany) and Oracle (USA). Such systems are usually structured in different modules. Typically, the modules refer to accounting, human resources, logistics and manufacturing. Each module is specific to a business process and can be considered as an almost independent application from the viewpoint of the interface with the user and software structure although accessing the same database (POSTON; GRABSKI, 2001). The major characteristics of ERP systems are integration, specific data storage and retrieval processes and information management and analysis. The ERP systems include the same features as the isolated systems already existing within the organizations, albeit allowing the access by the users to a single database in a limited way. (POSTON; GRABSKI, 2001).

Another relevant feature of the ERP is that it is based on generic business processes which are created via practical observations and academic theories. These so-called “best practices” have been used as a means to promote changes in the organizational processes. Therefore, in order to take advantage of the best practices embedded on the ERPs, many organizations would have to go through a reengineering process.

According to Davenport (2000), organizations are implementing ERP's primarily because they want to reduce data redundancy and inconsistency through the creation and maintenance of a central database. Also, they are trying to optimize and automate their business processes in order to promote operational effectiveness and cost reductions. Other benefits expected from ERP systems are the improvement of resources management and decision-making processes; strategic advantages such as business growth support, alliances, differentiation, innovation and external links; and advantages in technological infrastructure such as integrated and standardized architecture; besides the reduction of costs in the IT area; greater agility and cost-cutting measures in the implantation of new functions and finally, organizational benefits which allow a more horizontal structure and

improvement in the learning process (SHANG; SEDDON, 2000). Thus, organizations implementing ERP systems usually have great expectations about the results. On the other hand, ERPs absorb high sums of resources, are difficult to be implemented and in many cases don't live up to these expectations.

2.1 Information technology investments evaluation

To assess investment returns in Information Technology means to quantify costs of hardware and software acquisition and expenditures on personal development and organizational changes, besides the quantification of the benefits generated from such costs (WILLCOCKS, 1994). Therefore, the evaluation of investments using a cost-benefit analysis can be summarized as the evaluation in quantitative terms of the gains generated by a project and the expenses associated with its realization (WILLCOCKS, 1994).

According to Bacon and Willcocks (1994), such techniques based on the investigation of input and output resources are limited because they consider that the cash flow is known and normally exclude risk factors.

In the technological arena, many projects generate benefits that are difficult, if not impossible, to be quantified (COLEMAN; JAMIESON; WILLCOCKS, 1994) – and are called *intangible benefits*. They include better access to information, improved integration among various organizational departments and enhancement of client's satisfaction. Some of them are basic gains from ERP systems.

In fact, there are several IT projects intangible benefits. Some of them are critical to organizational competitiveness and orientation, although they are frequently omitted from evaluation studies. As they can not be financially assessed, there is no guarantee that they will occur and, furthermore, their results are not feasible in the short term.

Therefore, Willcocks (1994) estimates that the intangible benefits derived from IT projects cannot be measured through conventional evaluation methods which are based mostly on financial parameters.

The identification of intangible benefits from information systems has been the main purpose of many academic studies (BRYNJOLFSSON; HITT, 2000). Murphy and Simon (2002) allude to some of the studies that show that economic and financial indicators fail to assess IT projects feasibility and suggest that the way to determine the value of intangibles is through the managers' perception.

Parker and Benson (1988 apud MURPHY; SIMON, 2002) assert that, in order to achieve competitive advantage, companies should change the justification for acquiring IT, as many projects do not provide immediate financial returns. Conventional quantitative techniques are not adequate for the evaluation of projects, except when the goal is to reduce operational costs. According to Katz (1993 apud MURPHY; SIMON, 2002), such methodologies should be improved and additional measures should be considered, such as client's satisfaction enhancement and IT support to decision-makers.

Some studies have identified several criteria to measure IT benefits such as: improvement in productivity and user applications, impact on the value chain, business alignment, information quality and user satisfaction. Many criteria cited in the literature are intangible and therefore, the traditional methods of evaluation are inadequate (MURPHY; SIMON, 2002).

Financial criteria try to express costs and benefits in a way that all decision-makers can understand; the representation of these two aspects by means of a cash flow is very easily understood (COLEMAN; JAMIESON; WILLCOCKS, 1994). Willcocks (1994) argues that this practice is not adequate and suggests that

organizations could be losing opportunities for IT projects, as well as taking unnecessary risks as they are using limited evaluation techniques that disregard less tangible benefits and do not offer a formal risk evaluation.

2.2 Information technology evaluation models

Many researchers are attempting to identify criteria to evaluate information systems (IS) results (GROVER et al, 1996). The model proposed by Delone and McLean (1992) is one of the most referred in pertinent literature and it proposes the assessment of the IS success which reflects the systematization of measures established in previous works. Actually, it is an attempt to represent the interdependence of six dimensions referring to IS success: (a) system quality, (b) information quality, (c) use (d), user satisfaction (e), individual impact and (6) organizational impact. Delone and McLean also suggest that criteria to assess the success of the IS based on only one dimension, tend to create inaccurate results. They recommend the assessment based on the combination of dimensions, therefore allowing the creation of a consistent model of evaluation.

According to Grover et al (1996), the assessments based on the use of the information system and user satisfaction are those more deeply studied and used because they are easier to evaluate and associate to IS; however, those more closely related to the impact on the business are, in contrast, more difficult to be quantified and associated to the innovation of a specific IS. Like Delone and McLean (1992), Grover et al (1996) also alert that evaluations limited to a few dimensions could produce distorted results.

Seddon and Shang (2000), after analyzing ERP characteristics and the literature referring to the benefits created by IT and compiling data originated from 233 cases of ERP implementation published on the Internet, created a model to help companies evaluate the benefits of ERP. This model classified the benefits into five dimensions: operational, managerial, strategic, technological and infrastructure. According to the authors, the purpose of the model is to evaluate ERP benefits from the viewpoint of an organization's high and medium management.

Gable et al (2003) used as the starting point for their model, the dimensions and measurements of Delone and McLean (1992), as they considered that such elements provided a far-reaching vision of the organization from the perspective of the high-level management as well as the more operational workers. The model created by Gable et al (2003) includes a set of measures destined to evaluate the multidimensional phenomenon of ERP success using four different dimensions: System quality, information quality, individual impact and organizational impact.

On the other hand, Grover et al (1996) argue that a complete evaluation of IT results should be conducted within two perceptions: firstly, the so-called micro perception involving the individual level should be considered important, since IS supports individual decisions and their efficiency should be associated to the satisfaction of the members of the organization; and secondly, the so-called macro perception involving evaluations in the organizational ambit associated to the business performance (inventory level, delivery time and operational efficiency) which indicate if the IS is contributing to the organization's competitiveness.

The present study tries to summarize the Gable et al (2003) models, whose focal point is placed at the micro dimension, here designated as individual perspective; and the Shang and Seddon (2000) model, which

focuses the macro dimension, here designated as organizational perspective; besides the financial performance dimension, as shown in the table below. Table 1

Table 1 – Multidimensional Evaluation Model of Investments in ERP Systems

Dimensions	Sub-dimensions
Organizational Perspective (Dimensions are based on Shang and Seddon model (2000))	
1. Strategic	1.1 Support to business growth 1.2 Support to business alliances 1.3 Possibility of innovation via creation of new business and structural maintenance of new process chains 1.4 Possibility of cost leadership 1.5 Structural maintenance / ties with external clients and suppliers 1.6 Possibility of generating or facilitating product differentiation
2. Operational	2.1 Cost reduction 2.2 Reduction of business negotiations life cycle 2.3 Quality improvement 2.4 Client service improvement
3. Managerial	3.1 Better management of resources 3.2 Planning and decision-making processes improvement 3.3 General improvement of the efficiency and success of business processes
4. Organizational	4.1 Support business organizational changes 4.2 Facility to Business learning 4.3 Support to organizational empowerment 4.4 Build common visions of business
5. Technological Infra-structure	5.1 Infrastructure supporting flexibility and changes in the business 5.2 Cost reductions associated with IT 5.3 Technological infrastructure capacity increase
Dimension was included by the authors.	
6. Financial performance	6.1 Profitability evolution analysis 6.2 Operational cost evolution 6.3 Net profit evolution analysis
Individual Perspective (Dimensions based on Gable et al Model (2003))	
7. System quality	7.1 Ease of use 7.2 Ease of learning 7.3 Agreement with user requirements 7.4 System flexibility 7.5 System integration 7.6 Ease of customization
8. Information quality	8.1 Information availability 8.2 Ease in the application of information 8.3 Ease of understanding of information 8.4 Information relevance 8.5 Information format
9. Individual impact	9.1 Learning focused on the business 9.2 Awareness in relation to the business. 9.3 Decision effectiveness 9.4 Individual productivity

3 METHODOLOGY

Considering these difficulties in assessing the value added to businesses by information technology and that intangible benefits are better studied by means of a qualitative approach, a case study methodology was chosen for analyzing the use of an ERP system by COELBA.

The data used in this research was obtained through semi-structured interviews, questionnaires and analysis of documents concerning the deployment and maintenance of the ERP system. The topics discussed in the questionnaires were based on the Shang and Seddon (2000) model.

In order to investigate the achievement of strategic benefits, the Chief Information Officer and the responsible for the strategic planning were interviewed. Several documents were examined such as the “Business Strategy and Information Technology Planning” which was a driver for the implementation of the ERP. The study of operational and organizational benefits was carried out by interviews with members of the operational management responsible for the ERP system in their respective areas of business. Moreover, one employee (system user) from each business area was interviewed (supply, accounting, human resources, accounts payable, equipment maintenance, works and projects).

Management benefits have been investigated by means of interviews with the system users, as well as with the managers of the supply, financial, structural maintenance and asset management areas. The analysis about technological benefits was carried out through interviews with the hardware infrastructure manager and with the responsible for the ERP system. The Catalog of Information Systems was also analyzed since the moment of acquisition of the ERP until the current days, in order to allow an assessment of the degree of standardization and integration in the technological environment.

The financial performance of the company has also been studied. Historical data covering the last five financial annual reports concerning profitability, operational costs and net profits were analyzed. To evaluate the system quality, its users were interviewed and a questionnaire was applied to two of the operational users in each module of the ERP. Furthermore, two IT professionals who provide support to the system were interviewed.

The information quality was evaluated through interviews with the CIO (Chief Information Officer) and the members of high and middle management. And finally, the individual impact was investigated through the analysis of responses to a questionnaire applied to all interviewees.

4. THE SAP R/3 EXPERIENCE AT COELBA

COELBA is a company that distributes electrical energy within an area of 567,295 km² producing 9,747 gigawatts/hour/year, covering 415 cities and assisting about 3.65 million users over the State of Bahia. Its operational gross revenue was about 1.2 billion US dollars in the year 2004 (Annual Management Report, 2004). In December, 2004, the company had 2772 employees.

On 31 July 1997, COELBA was privatized and the control of the state government was transferred to a consortium formed by the Bank of Brazil, its pension fund PREVI and the Spanish group IBERDOLA, which was the operational controller of the company from the time of privatization up to August 2003. During the last eight years, the company has undergone major changes and started in 1998 a huge project of restructuring that lead to the replacement of all information systems.

Following these strategic guidelines, COELBA implemented the version 4.0-B of SAP R/3 in July 1999, encompassing the following modules: FI (financial/accounting), CO (controlling), MM (supply management), PS (project management), PM (maintenance management), and HR (human resources management).

In August 2003, as the operational agreement with IBERDROLA came to an end, several changes were performed at the company direction and a new strategic cycle began. The creation of conditions that would increase the shareholders capital, prioritizing actions destined to strengthen the internal control of the company was then needed. This process had already been triggered by a project started at the end of 2004 to comply with the rules of the *Sarbanes-Oxley Law*. This law was promulgated in 2002 in the United States, after the occurrence of several accounting scandals in corporations such as ENRON. Its purpose was to improve financial control of the companies that hold capital in the Stock Exchange of New York, including some Brazilian companies. The ERP system played a fundamental role in the accomplishment of such strategy.

4.1 Impact on Strategy

According to this research, it is easy to perceive that the decision to implement ERP systems has had a predominantly strategic bias, since the cost-benefit analysis and the returns of the investments were carried out when the project was already in course. This decision was taken soon after the privatization of the company, when the replacement of the existing information systems by software packages was decided. The SAP R/3 installation required a greater adaptation of the company to its various functions and made the reengineering of organizational processes mandatory. That was highly desirable at that time considering the emphasis of the new management to carry out the changes deemed necessary in the internal processes.

During the study of the cost-benefit analysis (Business Case) carried out by COELBA in the beginning of the SAP R/3 installation, the emphasis on financial justification became clear, especially the reduction of labor costs. That study did not show a major attention to the strategic questions, notwithstanding its obvious strategic impact and the intention to comply with the rules of the *Sarbanes-Oxley Law*. Five years later, labor costs reductions would stay below expectations, what might have meant failure and frustration to those who can't grasp the importance of the intangible aspects of IS projects. According to Davenport (2000), most strategic impacts brought by ERP systems might occur only some years after its deployment.

4.2 Impact on Operations

According to the users, the operational effects of the ERP system have been different in the various areas of the company. In the area of constructions management, it was evident that the "best practices" of the project management (PS) module did not apply, in their standard form, to energy distribution. Several customizations have been required. But, the improvement of accounting, budget control and supply processes efficiency was considered satisfactory since the beginning, despite the later development of supplementary modules such as the e-commerce one.

Davenport (1998) describes the "best practices" as a generic solutions that reflect the proposals of how the organization should operate. According to this case study, the "best practices" of the ERP system are more adequate to support activities such as finance, accounting and supply, because they are usually common to most companies. And therefore more easily applied at any sector. As to primary activities associated to production and

markets, including the management of energy distribution infrastructure, the “best practices” suggested by the system did not apply very well.

4.3 Impact on Management

Most opinions have suggested that the expected results did not occur soon after the ERP system deployment but rather over a longer period of time. The SAP R/3 potential in providing management information was not totally explored, chiefly by the middle management, therefore reinforcing the Davenport (2000) theory that many organizations do not really take advantage of information systems to manage more proficiently their business.

Even after five years, such benefits were not perceived uniformly at the various departments of the company. A more positive vision came from the support areas. But, in the area of constructions management, the system did not allow an immediate and adequate resources management. Therefore the creation of specific reports and the development of additional subsystems have been necessary. Improvements in this area became evident only almost three years later.

4.4 Impact on the Organization

The evolution in the business learning process and the improvement of employees satisfaction at COELBA actually depended more on the kind of activities performed by each professional than on his kind of use of the SAP R/3. Those who performed more analytical activities have been more capable to take advantage of the system. Conversely, those who were responsible for more operational tasks lacked a vision of the whole and couldn't benefit much from the system. In fact, they experienced an increase in their work as they had to enter more data and could not feel any advantage in their everyday tasks. However, almost all the interviewees have acknowledged that the ERP had improved the effectiveness and integration among interdepartmental processes and promoted a shared and more uniform view of the company.

At the operational level the deployment of the SAP R/3 at COELBA allowed a democratization of information and, as a consequence, a decentralization of the decision-making processes. Also, the real-time access to operational data enabled a centralized performance control of the lower management, fostering the prevalence of standard business processes.

Therefore, we can realize that although the use of the SAP R/3 at COELBA promoted business processes standardization, it wasn't enough accurate to assure that several procedures within the company would be performed correctly, thus requiring a high degree of specific knowledge of the system by those who operate it. The system was perceived as excessively “open” as it allowed wrong procedures and did not avoid the dissemination of errors. Many customizations were carried out to add consistent rules for data insertion.

4.5 Impact on Technology

According to the company professionals and managers of information technology, the expectations about the SAP R/3 were fully satisfied. Its impact on hardware acquisition has been positive and provided flexibility at a changing business environment. As to cost reduction, expenditures with hardware suffered a major fall with the replacement of a mainframe by a client-server network structure. Reductions of other systems

programming and maintenance costs could not be identified as there was not sufficient data available. Notwithstanding, the SAP R/3 replaced 25 other information systems in the company, thus simplifying the systems development area and enabling the reduction of the amount of professionals required.

According to previous researches, ERP systems are expected to improve data integration and organization, therefore providing harmony to the information systems area (DAVENPORT; MARKUS, TANNIS; 2000, 2001). Also at COELBA, the SAP R/3 was expected to allow a major reduction in the number of information systems, replacing the several existing systems by only five corporate systems. However, six years after this strategic decision, the information systems structure is very different from the proposed one. There are over 100 information systems, which are not yet fully integrated. The assumption that the company would adapt to the new ERP system did not prevail. In fact, it tried to adapt the system to its specific needs. Moreover, the company still uses a former version of the SAP R/3, not updated and customized to its specific needs by means of integration with several other complementary information systems. Over this period, the SAP Company, a large supplier of corporate management software, has been following markets and technology trends and has brought about several innovations to its product, which have not reached COELBA.

4.6 Impact on Financial Performance

In order to assess a possible influence of the deployment of an ERP system at the company, the Annual Administration Reports have been analyzed. Although the returns on investments and gross profits have increased over the last years, other processes, beyond the influence of information technology, are more likely to have determined these results, as the long-term debt restructuring process and the Energy Saving Program proposed by the Brazilian government in 2002. According to Dedrick et al. (2002), there is no clear evidence at the organizational level of the influence of IT investments on financial performance measures, such as profitability. Dedrick (2002) argues that whereas financial performance is influenced by a wide range of strategic and competitive factors that go beyond operational effectiveness, IT investments can only foster operational effectiveness and its influence usually shows up at operational measures as productivity indexes, inventory turnover ratios and required support time.

At COELBA, operational effectiveness was assessed through the ratio of the number of clients to the personnel, material and out-sourcing expenses. According to the Administration Annuals Reports, great advances in operational effectiveness have been obtained over the last years and the SAP R/3 has been a major driver for these results.

4.7 Impact on System Quality

This dimension evaluates the information system from a more isolated perspective, not concerning its impact on the business. According to Gable et al (2003), the emphasis on quality points to the future of the system. Will it be used in the future? How long is its life cycle? The presence of a large amount of supplementary information systems suggests that the SAP R/3 has not been sufficient to fully satisfy its users at COELBA. Nevertheless, all the managers have asserted that a possible replacement of the SAP R/3 was out of the question for the next 10 years.

Most employees who need to use the SAP R/3 in order to carry out their daily activities and tasks showed a very positive attitude towards the system, mainly regarding the capability to learn and navigate through

the system interfaces and screens. As shown in Figure 1, 85% of the answers are positive about how easy it is to use the system. The use of the system by the operational management is also very intense, thus strengthening the perspective of continuing to use it.

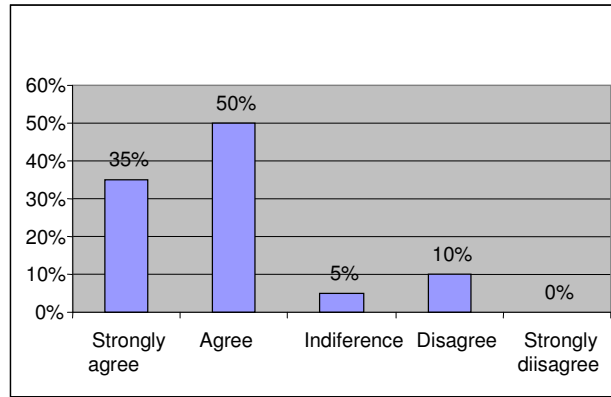


Figure 1: Ease of use of the ERP System

On the other hand the use of the SAP R/3 by the top and middle management is still very scarce. When the usage of the system is optional, it ends up almost not been used.

4.8 Impact on Information Quality

According to this research, the SAP R/3 at COELBA works as a large and reliable high quality data supplier. Its reliability derives from the full integration of all the modules. However, the conversion of such data into information is not so satisfactory due to difficulties to access and understand information through reports provided by the system. In order to overcome such problems, Excel worksheets and Access data bases have been used very often to increase flexibility and to generate information.

O’Brien (2001) describes ERP systems as systems that carry out transaction processes, producing at the same time managerial information. Davenport (2000) observes that the strongest point of an ERP system is its use of a single database, thus increasing information quality, eliminating incompatible or redundant data, and improving decision-making processes.

In this case study, we could observe that the SAP R/3 provides a satisfactory support to business transactions, enabling also excellent integration and data quality. Such data constitute high-quality raw material for the generation of information. Nevertheless, additional procedures are required to make information available for decision makers. Shang and Seddon (2000) remarks that ERP systems are just semi-finished software packages and, therefore, subject to adaptations and customizations. An ERP system is expected to provide a rich and reliable database and the necessary technological resources for its data transference to a friendlier environment, where the required information might be obtained and distributed. The SAP R/3 has certainly played this role at COELBA.

4.9 Impact on Employees

This dimension also assesses the system from a more isolated perspective and not from the business impact viewpoint. According to the answers provided by the employees to the questionnaires, we can easily

infer, that the SAP R/3 is well accepted by them. This positive impact on the employees is likely to be due to the fact that the system is the major working tool for them. The responses, however, show an underlying feeling among users, that the system is not completely understood and training has been insufficient. 50% of the employees believe they are not able to use all the system tools and functions.

5. CONCLUSIONS

According to the framework use in this research, the several answers obtained strongly suggest that the introduction of the system at COELBA successfully followed the strategic purpose of promoting a major restructuring in its organizational processes infrastructure, as well as enabling improvements in the other dimensions of evaluation.

The perceptions of the company's directors, managers and employees clearly indicate that such purposes have been achieved. Moreover, the SAP R/3 also contributed to allow another ongoing strategic initiative of the company: the move to go public, searching to capture financial resources to allow its future growth. These results, therefore, seem to acknowledge the importance of ERP systems for the company strategies and highlight the intangible nature of IT investments benefits.

Although this study has been carried out at one specific utility providing company in Brazil, we hope that its conclusions can as well be valid and useful in other different productive sectors and countries. A better understanding of the strategic possibilities and constraints of ERP systems will certainly help companies to select, purchase and use these systems to support their overall strategy.

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