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ITP4913

ERP Systems Maturity and Competitive Advantage

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ABSTRACT

This study intends to verify, through the perception of professionals in the naval industry, the presence of evidence indicating the generation of competitive advantage through the use of Enterprise Resource Planning - ERP in Brazilian companies. To attain this goal, two factors related to the subject were analyzed: the level of maturity of the system's application in the company and the perception of ERP as a source of competitive advantage. The results obtained point to an association between the level of maturity of the ERP system in the organization and the likelihood that managers will perceive the system as a generator of competitive advantage.

INTRODUCTION

Several studies have been conducted on the competitive advantages of IT (Clemons & Row, 1991; Kettinger et al, 1994; Mata et al., 1995; Porter & Millar, 1985) and the pros and cons of the implementation of ERP systems in organizations (Davenport 1998; Holland & Light, 2001; Krumbholz & Maiden, 2001; Wood & Caldas, 2001). It is estimated that 30 thousand companies around the world have implemented ERP systems and that there are more than 100 integrated management software suppliers (Mabert et al., 2001).

This study seeks a better understanding of the possibility of ERP systems being perceived by the professionals of the companies that implement them as sources of competitive advantage. The question that guided the study was: "Could the level of maturity of the ERP systems implementation influence the perception of these systems as sources of competitive advantage in the companies that implement them?"

ERP SYSTEMS MATURITY

The model proposed by Holland & Light (2001) identifies three stages in the ERP systems maturation cycle. In the first stage, organizations are managing legacy systems and starting implementation of the ERP project; in the second stage, implementation is complete, and the company begins to enjoy the functionality of the ERP system in its activities; in the third stage, the organization has normalized the system and is engaged in the process of obtaining additional value by using additional management systems.

The authors classify the stage of maturity of an ERP implementation process using five theoretical constructs:

a. *Use of Information Technology* - the importance of the technology function within the company;
b. *Organizational Sophistication* - how the organization structure has evolved as a result of the ERP system implementation;
c. *Penetration of the ERP System* - how extensively the system is used, including organizational and technical penetration and employee acceptance;
d. *Vision* - strategic potential for and use of the system itself;
e. *Drivers and Lessons* - the lessons learned during the implementation process and the drivers behind the adoption of the ERP system.

Although Holland & Light (2001) admit that organizations may present characteristics of more than one stage and that the stages are superposed in practice, the authors state that one stage will prove to be dominant as the company implements concurrent projects and gradually moves towards maturity of the ERP system implementation process.

COMPETITIVE ADVANTAGE THROUGH INFORMATION SYSTEMS

According to Kettinger et al. (1994), the contemporary view of the competitive use of Information Technology holds that it must be a component of overall business strategy and that its application depends more on understanding unique business opportunities than on competitive benefits attained through technological features.

Through a vast review of literature, the authors sought to identify factors that contributed to the sustainability of an achieved competitive advantage. Three categories of factors were observed:

a. *Environmental factors* - reflect the environmental and unique situations that affect sustainability;
b. *Foundation factors* - exist by virtue of the company's infrastructure and have evolved over time;
c. *Action factors* - reflect strategic measures to leverage the foundation factors to a level of strategic application capable of creating sustainable competitive advantage.

Classically, a competitive advantage is achieved when the company receives returns on its investment that are above average for the industry, and the sustained advantage, over a long enough period of time, ends up altering the industry structure (Porter, 1985). The impact of implementing a system considered a source of sustainable competitive advantage was evaluated by Kettinger et al. (1994) through a study of events, in which the company's performance in periods preceding and following the system launch were analyzed. As a result of their study, they concluded that, in a sample of 30 businesses reported in the literature as possessing information systems capable of providing them with sustainable competitive advantage, only 15 were consistent in the analysis of the evolution of the relative performance factors in the chosen periods.

METHOD

This paper investigates the possibility that the competitive potential of standardized ERP systems is perceived differently depending on the level of development of the application within the organization. It seeks to relate the stage maturity model proposed by Holland & Light

(2001) to the instrument for assessment of competitive potential generated by information systems, proposed by Kettinger et al. (1995). It supposes that the professionals in the companies at more advanced stages of ERP implementation maturity would be more likely to perceive their companies as having a competitive advantage as a result of the implementation of those systems.

The study considered medium-sized companies that had implemented ERP systems provided by standardized and modularized solution developers. Two companies located in Rio de Janeiro, Brazil, were intentionally selected within the naval industry in order to observe how the characteristics perceived with the implementation of ERP systems varied. It was necessary that the companies be in different stages of ERP system implementation, as we wished to relate the stages of maturity of the ERP implementation process to the perceived benefits of those efforts.

People within the organizations who were effectively in contact with the evaluated system were interviewed, forming two groups of interviewees: *implementation agents*, those who were or are responsible for coordinating the process and participated intensely in the process of implementing the ERP systems; and *key users*, made up of company employees who make use of the information generated by the system.

The first part of the interview utilized a semi-structured script for both groups. This first group of interviews sought confirmatory evidence regarding ERP systems maturity in the organizations, checking the constructs proposed by Holland & Light (2001).

The second part of the interview dealt with aspects reported by Kettinger et al. (1994), relating information systems usage to the obtainment of competitive advantages for the company, following the guidelines proposed by Kettinger et al. (1995). By using affirmative statements, the authors developed a tool to evaluate the sustainability of information systems usage, using a five-point Likert scale. The three constructs were analyzed (environmental factors, foundation factors, and action factors) with a total of 28 affirmative statements to measure the competitive advantage provided by the ERP systems.

RESULTS

The companies we studied realize activities in the naval sector and are based in the Rio de Janeiro region, although possessing operations in several locations throughout Brazil. *Company A* has approximately 900 employees, earned $160 million in 2001, and works mainly in the area of submarine engineering, with specialized services in the areas of oil exploration and naval construction, serving the oil and gas segments as well as the general maritime sector. Recently, this company, which was already part of an international group, segmented its business more explicitly with the creation of a new subsidiary that will concentrate its activities in oil and gas, as a result of a global fusion with another company. This new organizational structure has presented the company with challenges and enriched the proposed analysis, as it also involved strategic decisions in the application of the information systems, especially the ERP system, which had already been implemented in the beginning of 2000.

Company B is an open capital company controlled by an international group, with shares in the London Stock Exchange, earnings on the order of $120 million in 2001, and 2,500 employees. It renders maritime services, such as tugboat rental and freight forwarding, port operation, with its own ports and warehouses, and dockyard and naval construction services. It is a company that has existed for over a century, is a leader in its segments of activity, and was one of the pioneers in ERP system implementation in Brazil, having started using ERP in 1994.

Analysis of the Companies According to the Viewpoint of Holland & Light (2001)

As we mentioned earlier, the research was directed at two groups of professionals within the companies: implementers, usually professionals in the areas of technology or computers, and users, managers who use the system information for decision-making. There were no significant differences in perception among the types of interviewees to warrant a separate analysis for each group. Table 1 presents the main results obtained.

Table 1: Summary of the results of the Holland & Light model (2001)

	Company A	Company B
Use of IT	- A vital tool, but perceived more enthusiastically in crisis moments. - Consultants implemented ERP with minimal customization.	- Seen as a distinguishing feature when compared to the competition. - Internal staff carried out most of the implementation process, customizing, integrating, and developing new systems.
Organizational Sophistication	- Changes perceived only in the process chain, while the organizational structure and its values of autonomy and results orientation remained unaltered. - Implementation of a culture less averse to technology.	- The ERP system was said to be a great propelling force in the organizational change process that culminated in the change of management, the decentralization of the decision-making process, and a change in culture and operational conduct.
Penetration of the ERP System	- Some critical organizational aspects of the company process aren't integrated by ERP yet, such as project management, maintenance management, control of staff on board, and documentation control.	- Because it was totally customized and because the company worked side-by-side with the manufacturer on the development of the application, the ERP system possesses a degree of total comprehensiveness, with integration of all of its areas, branches, and important functions.
Strategic Potential and Vision	- The system implementation in the strategic areas not contemplated is a priority, but, due to characteristics of the business, such as earnings concentrated on few clients, some high-level solutions, such as e-commerce, CRM, and others, will not be prioritized.	- Already makes use of high-level resources, such as Cubo, datawarehouse, and CRM. - Is presently developing Internet solutions to improve the flow of transactional information between the company and its clients.
Drivers and Lessons	- The system implemented cost control and budget in a company that, traditionally, held its values of entrepreneurship and autonomy in high esteem, a heritage of its founders' background as engineers. - After the characteristic adaptation of the learning curve, the ERP system is seen as a strategic need, without which the company would no longer survive.	- Although the motivating factors were inherited from the previous management and were the result of market and consultants pressures, the results were reported as being extremely positive. - The learning process was said to have encompassed several aspects of the organization, such as decision-making autonomy, team spirit, management professionalism, and focus on sales and business.

The comparison of the companies in the light of each of the model's constructs appears to furnish the means to classify them into the different stages of maturity. *Company A* seems to be in the second stage, where it has achieved a satisfactory level of operation, solved the problems that motivated the adoption of the technology, such as lack of budget control, but still requires more sophisticated uses and applications that will improve the company's main business, especially in the areas of project management and maintenance.

Company B appears to be in the third stage and, therefore, more likely to present competitive capabilities and advantages in comparison with the competition. This statement is backed by the pioneering quality and inventiveness of the application, the high level of complexity that a decentralized system requires, the use of sophisticated tools to extract value from routine transactions, the concern with restructuring the configuration of the system, and all of the cultural and organizational transformations that took place along with the implementation of the system.

Analysis of the Companies According to the Questionnaire Based on Kettinger et al (1995)

The model presented by Kettinger et al. was particularly interesting to reveal the interviewees' perception of the possibility that the implemented system would generate a competitive advantage for the company, although, as in all models created to simplify and make feasible the analysis of a reality through the selection of a few variables, the authors point out the didactic and experimental nature of their endeavor.

The mean results presented in Table 2 revealed a higher tendency for the ERP system to be perceived as a generator of competitive advantage in *company B*, when compared to *company A* (paired samples T-test p=0.068). This perception is stronger in the comparison between the foundation factors (paired samples T-test p=0.021), which are more difficult to acquire, imitate, or implement over a short period of time, giving the acquired advantage a quality of sustainability. *Company B*

Table 2: Summary of the Results of the Questionnaire Based on Kettinger et al. (1995)

	Company A	Company B
Foundation Factors	3.73	4.47
Action Factors	3.20	3.67
Environmental Factors	3.00	2.46
Total	**3.41**	**3.83**

presented a significant difference among its factor's means (one way ANOVA: F=12,410; p=0.000)

DISCUSSION

The data analysis in the previous section seems to provide an affirmative answer to the question: "Could the level of maturity of the ERP systems implementation influence the perception of these systems as sources of competitive advantage by the companies that implement them?" We found that the company that is at a more advanced stage of ERP system maturity is more likely to perceive itself as possessing a competitive advantage resulting from the implementation of the system.

Company B, a pioneer in implementation of the system, underwent a profound organizational transformation process, makes use of advanced resources integrated to the system, and possesses a decentralized IT structure. It has the characteristics that allow it to be classified in the most advanced stage of the maturity model, having reported perceptions that reflect more awareness of the potential for generating competitive advantage through the ERP system. *Company A*, on the other hand, has yet to implement functions that are essential to its business, even though the initial goal of gaining control over costs and budgets while maintaining its entrepreneurial characteristics dating back to the foundation of the company was achieved.

The indications that back up the confirmation of the original supposition appear to be in accordance with what authors already affirmed, such as Wood & Caldas' (2001) theory that companies that perceive themselves as possessing a competitive advantage used the implementation of ERP systems as a broader process of organizational transformation. This was made particularly clear by the changes that took place in *company B*. The company's management transition, decentralization of the decision-making process, autonomy, and widespread business- and technology-oriented profile are indications that the transformation process, although acknowledgedly traumatic and risky, generated distinctive competencies that the competition has difficulty achieving. In addition, *company B* higher results for the impact of the ERP system on the foundation and action factors appears to support Clemons & Row's (1991) theory on the importance of a company's structural differences for obtaining competitive advantage over its competitors.

CONCLUSION

The results obtained in this study point to an association between the maturity stage of the ERP system implementation and its generation of competitive advantage for the company. Thus, the higher the level of maturity of ERP system usage in an organization, the more likely its managers are to see the system as a generator of competitive advantage.

The study also allowed us to verify the existence of a few elements highlighted as indicators of competitive advantage resulting from IT applications, such as the technology managers' managerial abilities and the occurrence of considerable structural transformations as a consequence of the implementation of the information systems.

It is important to emphasize that the external validity of this research is limited to the studied companies. Future studies may continue using the models discussed here, seeking to use the instruments in such a way as to validate them, carrying out research in more companies and industries, in Brazil and abroad.

REFERENCES

Clemons, E. & Row, M. (1991). Sustaining IT Advantage: The Role of Structural Differences. *MIS Quarterly*, 15, 275-292.

Davenport, T. (1998). Putting the Enterprise into the Enterprise System. *Harvard Business Review*, 76, 121-131.

Holland, C. & Light, B. (2001). A Stage Maturity Model for Enterprise Resource Planning Systems Use. *The Database for Advances in Information Systems*, 32, 34-45.

Kettinger, W., Grover, V., Guha, S. & Segars, A. (1994). Strategic Information Systems Revisited: A Study in Sustainability and Performance. *MIS Quarterly*, 18, 31-58..

Kettinger, W., Grover, V. & Segars, A. (1995). Do Strategic Systems Really Pay Off? An Analysis of Classic Strategic IT Cases. *Information Systems Management*, 12, 35-43.

Krumbholz, M. & Maiden, N. (2001). The Implementation of Enterprise Resource Planning Packages in Different Organizational and National Cultures. *Information Systems*, 26, 185-204.

Mabert, V., Soni, A. & Venkataramanan, M. (2001). Enterprise Resource Planning: Common Myths versus Evolving Reality. *Business Horizons*, 44, 69-76.

Mata, F., Fuerst, W. & Barney, J. (1995). Information Technology and Sustained Competitive Advantage: A Resource-Based View. *MIS Quarterly*, 19, 487-505.

Porter, M. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: The Free Press.

Porter, M. & Millar, V. (1985). How Information Gives You a Competitive Advantage. *Harvard Business Review*, 4, 149-160.

Wood, T. & Caldas, M. (2001). Reductionism and Complex Thinking During ERP Implementations. *Business Process Management Journal*, 7, 387-393.