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THE IMPACT OF ERP SYSTEMS ON ORGANIZATIONAL STRATEGIC VARIABLES IN BRAZILIAN COMPANIES

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Abstract

The article presents results from a survey in a sample of 70 out of the “500 Biggest and Best” companies in Brazil (Exame Magazine 2000). The research tried to evaluate the impact of ERP (Enterprise Resource Planning) systems on organizational strategic variables of those companies. The survey instrument adapts Mahmood and Soon's (1991) original model, which is aimed at evaluating the impact of Information Technology on such variables. Our study measured 7 strategically important organizational variables: Buyers and Consumers; Competitive Rivalry; Suppliers; Market; Economics of Production; Internal Organizational Efficiency/Effectiveness and Inter-organizational Efficiency. The results reveal only a few contributions of ERP systems regarding the following organizational strategic variables: Buyers and Consumers, Competitive Rivalry, and Market. The ERP contributes to the Suppliers variable (relationship, monitoring, etc.) and to the Production variable (productivity gains, economies of scale in software usage, etc.). The ERP also contributes to the Internal Organizational Efficiency, and specially to the Inter-organizational Efficiency, improving the integration and communication between organizational units and with other institutions.

Keywords: Enterprise resource planning, IT impact, organizational strategic variables

Introduction

This article shows results from a survey applied to a sample of 70 out of the “500 Biggest and Best” companies in Brazil (a well-known Brazilian index maintained by Exame Magazine 2000) regarding the impact of ERP (Enterprise Resource Planning) systems on organizational strategic variables of those companies.

Davenport (2000) says that it is important to analyze the implications of ERP usage in organizational variables and also their impacts on the structure and the organizational culture. Our research intends to contribute to that matter. We report on the effects from using ERP systems in some of the “Biggest and Best” companies in Brazil. For the empirical investigation, Mahmood and Soon's (1991) tool for measuring the impact of the Information Technology (IT) on organizational strategic variables was adapted and deployed.

The following section presents the main theoretical references considered here. Next, the research method is illustrated, and results from the study are presented and discussed. That is followed by final remarks and suggestions for future research.

Impact of the Information Technology on Organizational Strategy

The appropriate use of IT can bring important benefits to an organization, but the choice of one technology depends on a deep understanding of the strategies adopted by the company, as well as an understanding of the consequences from the IT choices on its strategic variables (Parsons 1983). Any decision in the IT area will have some consequences on a company's strategic variables, but if alignment between IT and strategy is not observed, a strong negative impact can be perceived, as well as wastes in the financial and human resources. Lewis, Luffman and Oldach (1983) stated that IT alone does not represent competitive advantage in the long run, because it is easily imitable. The adoption of an innovative IT may lead to a competitive advantage only in the short term. However, if a company does not adopt the IT already employed by its competitors, that company might lose market share and could go bankrupt because it is not as competent as the market demands. This seems to be the case concerning the adoption of ERP systems; therefore it is relevant to investigate organizational strategic variables that they impact.

Every company must be competitive and have strategies to survive in the market and protect its shares. Those strategies are related to factors such as: efforts to reduce cost and increase efficiency and productivity, expansion of the business and organization frontiers, and dealing with the business organization as a living and inter-connected system. Thus, IT is directly applied to reduce costs, to provide product improvements and services with better quality, to supply new services and convenience to customers, and to allow the integration of suppliers' and customers' operations. It could also be used to create new marketing opportunities, according to Venkatraman and Henderson (1983).

In this context, the adoption of an ERP system can raise a series of organizational changes and adaptations, influencing, in one way or another, the company's relationships with buyers, customers and suppliers, and also its products and services. To study this subject, our research compared some theoretical models that try to evaluate the impact of IT on organizational strategy.

Porter and Milar (1985) say that the information revolution affects the competition in three levels: changing the industry structure and, therefore, changing the rules of competition; creating competitive advantage through cost reduction in any part of the value chain, or through differentiation in products and services; and, finally, by creating new businesses.

Taking into account Porter's model (1980), Bakos and Treacy (1986) distinguished three levels in which IT cooperates with corporate strategy: the internal, the competitive, and the business portfolio levels. The first level (internal) focuses on the development of the efficiency and the effectiveness of the organizational structures and operations to achieve goals. The traditional IT domain is to improve the organizational efficiency. On the other hand, the competitive strategy level focuses on competitive movements in the industry. And the business portfolio level concerns the choices that a company needs to make to reach a certain status in its industry. The firm may be able to improve its portfolio by taking advantage of structural changes catalyzed by new technology (Bakos and Treacy 1986, p.107). This overall view of the IT impact in corporate strategy (internal, competitive and business portfolio levels) is considered in the present study.

In a similar way, Parsons (1983) suggests a multi-level model to evaluate the competitive impact of IT on a firm. He presents three levels in which IT can affect a company: the industry level (IT can change products, services, markets, and economics of production in an industry), the firm level (IT affects competitive forces: buyers, suppliers, substitutes, new entrants and rivalry), and the strategy level (IT affects strategies such as low cost leadership, product differentiation, or concentration on market or product niche).

Clemons (1987) also considers Porter's model to study the impact of IT on the sustainable competitive advantage of companies (strategic level), differentiating the use of IT regarding the internal focus (organizational efficiency) and the external focus (creation of added value to customers).

The model chosen for evaluating the impact of IT on organizational strategic variables – Mahmood and Soon (1991) present a comprehensive model for measuring the potential impact of IT on organizational strategic variables. The model is derived from theoretical frameworks suggested by McFarlan (1984), Parsons (1983), Bakos and Treacy (1986) and Cash and Konsynski (1985), and its variables and constructs were properly tested and validated. Mahmood and Soon's model suggests 10 strategic variables impacted by IT: Buyers and Consumers; Competitive Rivalry, Suppliers, Search Costs and Switching Costs, Market, Products and Services, Economics of Production (cost structure and capacity), Internal Organizational Efficiency, Inter-organizational Efficiency, and Pricing. Their model was chosen to be the one for our research, due to its flexibility, comprehensiveness, and the thorough test and validation procedures they performed on it.

ERP Systems

It is important to define which concept of ERP is considered here. Davenport (2000, p.02) defines ERP systems as packages of computer applications that support many, even most, aspects of a company’s information needs. The ERP is a modification of the MRP (Manufacturing Resource Planning) systems. The ERP is different from other systems in that it integrates a company’s information in a single database for the entire organization, and it serves different operational areas and processes of it.

However, it is important to remember that (as it will be seen in the data analysis section of this document) some of the researched companies have developed their integrated systems internally, or have had some modules developed internally and used together with commercial ERP packages. Some of them have three different ERP packages (from different suppliers) running at the same time. Thus, it is common to identify the use of more than one package to fulfill all the information needs within an organization (Lozinsky 1996). Some organizations try to take advantage of the best solutions offered by several ERP suppliers and/or, at the same time, develop some modules internally to better satisfy their particular needs.

There are several academic researches done on ERP systems in the management area in Brazil, specially from 1999 on. We highlight the works of Wood Jr. and Caldas (2000), Cardoso, Silva Neto and Souza (1999), Neves (1999), Bergamaschi and Reinhard (2000), Souza and Zwicker (2001), Hypolito and Pamplona (2000), Saccol, Macadar and Soares (2001), and Mendes and Escrivão Filho (2001). Most researches focus on the ERP implementation process, organizational changes, and outcomes from the use of ERP systems in a general sense.

Research Method

From the main objective of evaluating the impact of ERP systems on organizational strategic variables in Brazilian companies, this research is a descriptive one. The method employed was a survey (Fink 1995) and the target population was the “500 Biggest and Best” companies in Brazil, according to Exame Magazine (2000). The people who answered the survey were CIOs from the companies surveyed (one respondent in each organization).

The survey was developed in two stages. In the first stage, an exploratory survey was performed to generate knowledge about the sample. The goal was to identify from the population the companies that had an ERP system running, and to collect data about the system (period of use, package supplier, etc.). At the same time in which the exploratory survey was done, the research team worked on adapting the survey instrument created by Mahmood and Soon (1991) to the Brazilian Portuguese language. The original questionnaire was composed by 50 questions, all of them using a Likert scale to measure the potential impact of the IT on organizational strategic variables of a company (in a general sense). The tool was adapted for the evaluation of the impact of ERP systems. The adapted instrument was validated by two academic experts from the Information Systems area in Brazil. After that, the instrument was pilot-tested in two classes of executives from two different MBA courses. Some vocabulary was modified in order to be clearer according to the Portuguese language, and the research team found that it was necessary to subtract some questions. A deep examination by the researches to find redundant, duplicate or ambiguous items resulted in reducing the instrument from 50 to 34 questions, and some constructs of the original model were also eliminated (from 10 to 7), according to the goals of this research. The final instrument (see examples of questions in Figure 1) was administered by the Internet to the 70 companies from the “500 Biggest and Best” ranking that were contacted in the first stage of the research and that returned full and valid questionnaires. Thus, the sample is not random nor representative of all the “500 Biggest and Best” companies; so results should be generalized carefully.

A – Buyers and consumers

Q2 – The ERP helps the firm to provide administrative supports (such as billing, collection, inventory management, etc.) to customers.

Strongly Disagree | 1 | 2 | 3 | 4 | 5 | Strongly Agree

B – Competitive Rivalry

Q3 – The ERP helps the firm to make a first strike against their competitors (i.e. offer a product/service that competitors can not match).

Strongly Disagree | 1 | 2 | 3 | 4 | 5 | Strongly Agree

Figure 1. Examples of Questions (Instrument adapted from Mahmood and Soon – 1991)

Results

Sample Profile

As previously mentioned, the final sample consisted of 70 out of the “500 Biggest and Best” Brazilian companies according to Exame Magazine (2000). Most of the companies belonged to the industrial sector (70%), followed by the commercial (20%), and the services one (10%). Despite the fact that the industrial companies were the majority in the sample, there is great variety of sub-sectors to which they belong. Among the main sectors are those of wholesales and foreign trades, steel companies and metallurgy, chemistry and petrochemistry, and food. The sample is formed by big corporations: 42% of the companies had between 1,000 and 3,000 employees (Figure 2), and 20% had between 3,000 and 5,000 employees.

Regarding the suppliers of ERP solutions, 28.4% (23 companies) of the sample adopted SAP’s R/3 system; 24% had modules developed internally; 7.4% (6 companies) contracted Oracle. Some other system providers were JDEdwards, Microsiga, Datasul, Baan, SSA and Peoplesoft. Some companies had industry-tailored ERP systems, which are not identified in this study in order to preserve anonymity of companies. It is important to mention that 9 out of the 70 companies surveyed had agreements with more than one ERP system provider; some of them combined packages from ERP vendors with modules developed internally. Two companies had three different ERP packages in use.

Only 6 companies (8.6%) were using the ERP system for less than one year. The majority of the sample (52.9%) represented companies using the ERP for more than 2 years, and 24.3% of those were using it for more than 5 years. Therefore, the companies surveyed had a noticeable ERP use experience.

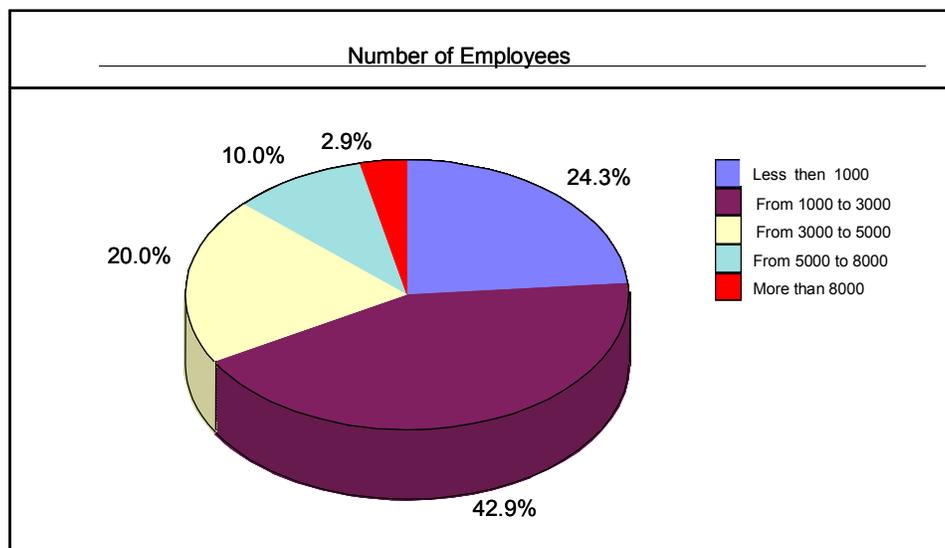


Figure 2. Number of Employees

Evaluating the impact of ERP systems on organizational strategic variables

In order to analyze the data, results are presented according to the 7 constructs studied, which were adapted from Mahmood and Soon’s model (1991): Buyers and Consumers, Competitive Rivalry, Suppliers, Market, Economics of Production (cost structure and capacity), Organizational Efficiency/Effectiveness, and Inter-organizational Efficiency.

Construct 1 – Buyers and Consumers

Related to the contribution of an ERP to the firm’s relationship with its customers, we shall highlight that only 27.2% of the respondents agreed with the fact that the ERP makes the products/services database available for customers, while 42.9% disagreed with that and 28.6% were undecided about it. To avoid false interpretation, it would be necessary to investigate whether

this is about the way the ERP is used within the companies. For example, if it is used as a platform for e-business, it is important to make the products/services database available for customers in real time. However, the majority of the respondents (87.1%) agreed that the ERP helps their companies to provide administrative support to customers, such as billings, collection, and inventory management.

Construct 2 – Competitive Rivalry

This construct investigated whether an ERP helps firms to make a first strike against their competitors (i. e., to offer a product/service that their competitors can not match, or provide substitutes before the competitors do so).

The respondents were divided in reference to the contribution of the ERP for their companies making a first strike against competitors: 37.2% disagreed with that proposition; 31.4% were in line with it, and 30% did not have any stated opinion about. The majority of the respondents were also undecided regarding the use of the ERP to confront competitors by contributing to the development of new products. In the same way, the system is not seen as supporting the competition process by 37.2% of the respondents, that is why no concrete information about the impact of the ERP over the competitive rivalry in companies was indicated.

Construct 3 – Suppliers

In this group of questions, it was possible to identify one of the main contributions of an ERP, that of improving the relationship between a company and its suppliers. Among the respondents, 51.4% agree that the ERP supports their firms to gain leverage over their suppliers.

The ERP also helps to reduce uncertainty in lead-time, according to 67.2% of the respondents, probably due to the real-time information provided by the system. Most respondents (68.6% of them) also perceived the ERP as helping their firms to identify alternative suppliers and substitute products/services. In the same way, the majority of the respondents (67.2%) reported that the ERP enhances the firm's "make versus buy" decisions.

70% of the respondents have also agreed that the ERP helps their firms to monitor the quality of products and services received from suppliers.

In almost all matters related to the organizational strategic variable Suppliers, the ERP was viewed as a tool that contributes to the relationship with, the selection and the monitorship of suppliers by the company.

Construct 4 – Market

With this construct, we tried to identify how an ERP impacts the company's relationship with its market in a general sense. The respondents were again divided. They stated that the ERP does not contribute to identify market trends, but the majority (61.4%) agree that it enhances sales forecast accuracy (Figure 3). However, just a relatively small subgroup of respondents (35.7%) agree that the ERP helps the company to better anticipate customers needs; 40% of the respondents were undecided about this contribution, and 24.2% disagree with that. In the same way, the respondents had different opinions regarding whether the ERP helps to reinforce customer loyalty: 38.6% disagree with that, while only 28.6% of them agree with this contribution. 51.4% of the respondents disagree with the fact that the ERP helps the firm to reduce marketing costs. One more time we see that the ERP is not understood as a tool that contributes to the organizational strategic variable Market.

However, 77.2% of the respondents agree that the system contributes to improve the competitive efficiency of the firm.

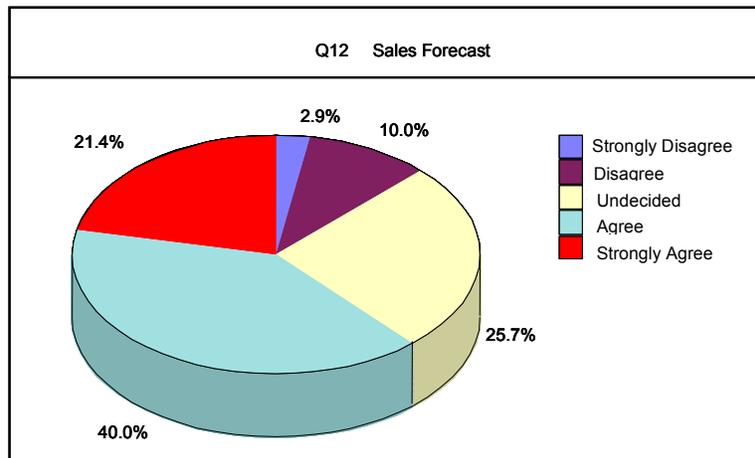


Figure 3. ERP and Sales Forecast

Briefly, the ERP in general does not help firms in the relationship with their markets (knowledge of market and customers needs, improvement of customer loyalty, etc.). It shall be interesting to investigate a little more about the perception of the respondents in terms of competitive efficiency, once in other questions – such as in the Competitive Rivalry construct – the system did not show any significant contribution. Perhaps on answering this question the respondents themselves might be involved with the media discourse about the importance of ERP systems.

Construct 5 –Economics of Production (Cost Structure and Capacity)

The questions in this construct were aimed at measuring the contribution of an ERP to the economics of production, in terms of cost management and productivity, within the firms.

The respondents were divided when asked about the fact that an ERP reduces the cost of designing new products/services. 41.4% of them were undecided about the impact of the ERP in that way. They were also divided when asked about the ERP contribution to reduce the costs of modifying or adding features to existing products/services of their companies (27.1% saw such contribution, 40% were undecided about it, and 32.8% disagreed with that). In that sense, the ERP does not impact the development of products and services.

Concerning the production itself, most respondents (74.2%) agreed with the statement that the ERP helps their firms to improve the productivity.

The majority of the respondents (77.1%) agree that the ERP helps their firms to improve productivity of labor through automation (Figure 4). The ERP is an advance of MRP I and MRP II systems, which were launched to support the production function (Davenport 2000). Therefore, the system contributes to the improvement of the production management, specially in planning and production control. 47.1% of the respondents agree that the ERP helps their firms to improve the utilization of machinery. However, 40% were undecided about this.

In terms of economies of scale in software usage, 61.4% of the respondents agree that the ERP contributes to that. Naturally, this is one of the greatest advantages in adopting an ERP system. And 47.1% of the respondents agree that the ERP contributes to the achievement of economies of scale in hardware usage, although 35% of them were undecided about this proposition. The real gain in that sense, in fact, relies on software usage.

Analyzing this construct (Economics of Production – cost structure and capacity), we concluded that the ERP systems did not represent an important contributor for product development, but they do seem to improve the organizational productivity through automation and economies of scale mainly in software usage.

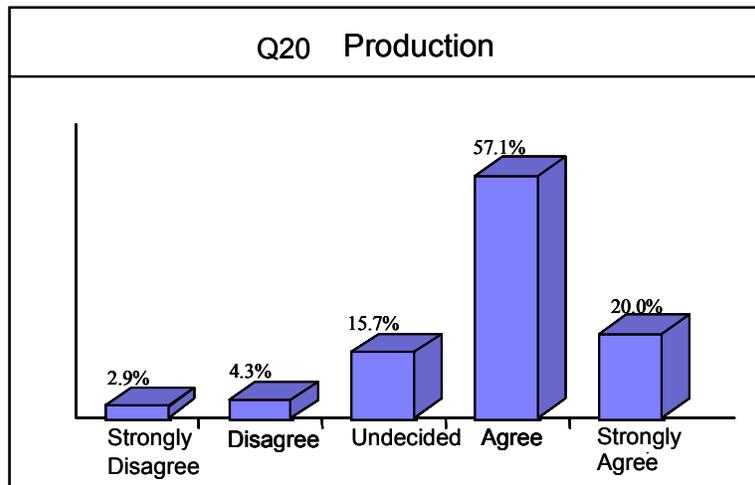


Figure 4. ERP Contributes to the Productivity of Labor through Automation

Construct 6 – Internal Organizational Efficiency/Effectiveness

With this construct, we tried to measure the impact of an ERP on internal organizational efficiency/effectiveness, specially considering its contribution to the firm management.

The first question tried to find out whether the ERP helps firms to improve the process and content of the decision-making. The majority of the respondents (88.6%) say that the ERP contributes in this sense. Only one out of 70 respondents disagrees with this statement. In the same way, 65.8% of the respondents agree that the ERP improves internal meetings and discussions, what is important for the decision-making process.

One of the greatest advantages of an ERP system is the organizational integration. This is confirmed by the majority of the respondents (90%), who agree that the ERP provides better coordination between functional areas in their firms. The respondents also agree in a noteworthy amount (80%) that the ERP contributes to better evaluations of annual budget reports, what improves the financial management of the company (Figure 5). The ERP is also seen as a supportive tool for strategic planning. 65.7% of the respondents agree that it also helps to improve the strategic planning process. Related to the firm's effectiveness, 52.9% of the respondents agree that the ERP helps to increase their firm's profit margins, but 41.4% of them were undecided about the contribution of it to increase their firm's market share. Only 31.4% (22 respondents) agreed that there is some contribution of the system in that sense. Once again, there is a split in the sample when it comes to the contribution of an ERP to variables regarding their firm's market.

We should consider that an ERP seems to be a tool that adds value to many aspects related to management regarding specially the Internal Organizational Efficiency.

Construct 7- Interorganizational Efficiency

Integration is a key concept when we talk about an ERP. This construct played a role in evaluating the impact of an ERP as a supportive tool for the relationships between organizations (i. e., branches/subsidiaries and headquarters, and between companies and external institutions).

First of all, we tried to check whether an ERP enhances the geographical inter-organizational communications pattern. 85.7% of the respondents agreed with this statement, and 88.6% of them agreed that the ERP helps their firms to coordinate activities regionally, nationally and globally. This has always been one of the greatest appeals of the system, in the sense of unifying activities and communications patterns between organizational units in different places.

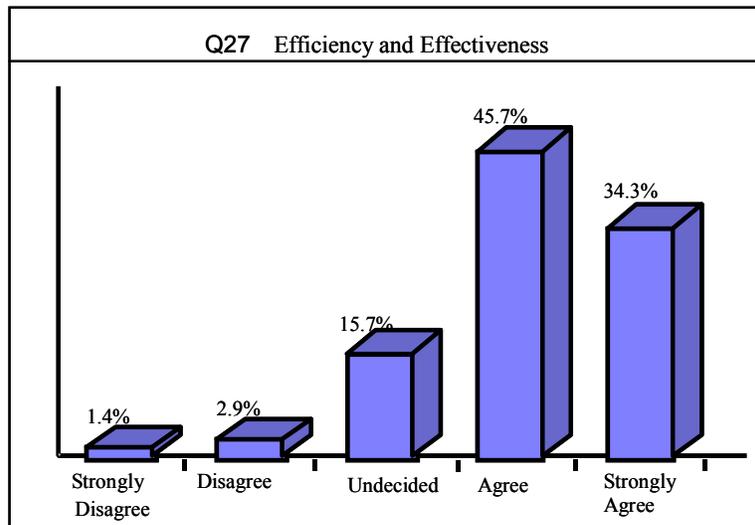


Figure 5. ERP Contributes for Better Evaluations of Annual Budget Reports

The integration with consumers and suppliers is also proved to be a strength of an ERP. 64.3% of the respondents said that it helps their firms to coordinate closely their interaction with customers and suppliers. The respondents have also stated that the ERP allows their firms to aggregate more information to products and services. 65.8% of them agreed with this statement (see Figure 6).

The results point to the contribution of ERP systems to the inter-organizational integration, as suggested by current theoretical references.

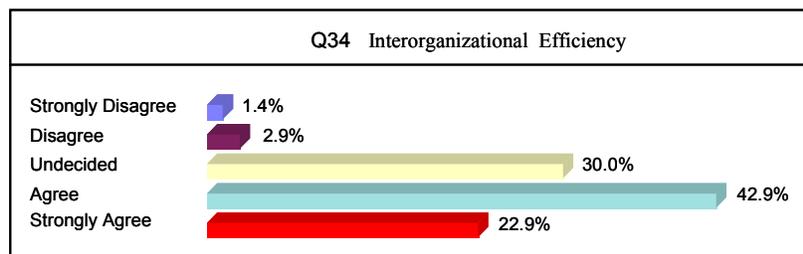


Figure 6. ERP Allows the Company to Aggregate More Information to Products/Services

In a complementary analysis, it was performed a Simple Correspondence Analysis - SCA (Greenacre and Blasius 1994) on the data. The analysis suggested that the research’s results already discussed are coherent. The SCA indicated a dependence between most variables.

Conclusions

Figure 7 shows a summary of the results of this study, emphasizing the main impacts of an ERP system on organizational strategic variables in the sample considered.

In summary, the results reveal few ERP contributions regarding the strategic variables Buyers and Consumers, Competitive Rivalry, and Market. The ERP contributes to the Supplier variable (relationship, monitoring, etc.) and the Economics of Production variable (productivity gains, economies of scale in software usage, etc.). The ERP also offers important contributions for the Internal Organizational Efficiency/Effectiveness, and specially for the Inter-organizational Efficiency, improving the integration and communication between organizational units and with other institutions.

ORGANIZATIONAL STRATEGIC VARIABLES	ERP IMPACT
Buyers and Consumers	<ul style="list-style-type: none"> • ERP does not make the products/services database available to customers • ERP helps companies to provide administrative support to customers
Competitive Rivalry	<ul style="list-style-type: none"> • A direct contribution was not identified regarding the support of ERP for the company making a first strike against its competitors • ERP is not seen as something that supports the competition process
Suppliers	<ul style="list-style-type: none"> • ERP helps firms to gain leverage over their suppliers • Contributions were not found about ERP helping to reduce transaction costs by making it easier for suppliers to handle orders • ERP helps to reduce lead-time uncertainty • ERP helps firms to identify alternative suppliers and locate substitute products/services • ERP enhances a firm's "make versus buy" decisions • ERP helps firms to monitor the quality of products and services received from suppliers
Market	<ul style="list-style-type: none"> • ERP does not contribute to identify market trends • ERP enhances sales forecast accuracy • ERP does not help the company to better anticipate customers needs • A meaningful contribution was not identified regarding ERP contribution to reinforce customer's loyalty • ERP does not help the firm to reduce marketing costs • ERP contributes to improve the competitive efficiency of the firm
Economics of Production (cost structure and capacity)	<ul style="list-style-type: none"> • ERP does not show meaningful contributions to reduce the costs of designing new products/services nor to reduce the costs of modifying or adding features to existing products/services of the companies • ERP helps the firms to improve the level of production • ERP helps firms to improve productivity of labor through automation • ERP helps firms to improve the utilization of machinery • ERP allows economies of scale in software usage, but not as much in hardware usage
Internal organizational efficiency/Effectiveness	<ul style="list-style-type: none"> • ERP helps firms to improve the process and content of decision -making • ERP improves internal meetings and discussions • ERP provides better coordination between functional areas within firms • ERP contributes to better evaluations of annual budget reports • ERP helps to improve the strategic planning • ERP helps to increase a firm's profit margins • Meaningful contributions were not found regarding ERP increasing a firm's market share
Inter-organizational Efficiency	<ul style="list-style-type: none"> • ERP enhances the geographical inter-organizational communications pattern • ERP helps firms to coordinate activities regionally, nationally and globally • ERP helps firms to coordinate closely their interactions with customers and suppliers • ERP allows firms to aggregate more information to products/services

Figure 7. ERP Impact on Organizational Strategic Variables

Thus, we conclude that the ERP contributes to some organizational strategic variables of the surveyed organizations, specially regarding the organizational efficiency, the management and the inter-organizational integration. However, in order to support organizational strategic variables related to the external environment (market, competitors, buyers/consumers), it seems to be necessary to complement it with other systems.

Romeo (2001) states that for one to have the ERP as an e-business platform, some other tools are necessary, like Data Warehouse, Customer Relationship Management, Supply Chain Management, Business Intelligence, Knowledge Management and e-procurement. These technologies are usually associated to the so-called ERP II.

According to Bond et al. (2000), they include basic elements related to the business itself, to the applications and to the organizational strategic technologies. A study published by Gartner Group (2000) previews that, in 2004, 80% of the companies that implemented an ERP will continue to invest in system's improvements, specially through implementation of extra functionalities.

These new trends and improvements associated to the ERP can be suggested as interesting subjects for future research. The study of the impact of ERP according to different industries can also reveal new useful information for IT practitioners. In the same way, models for the evaluation of the IT impacts are also relevant. Even a model extensively tested and validated as is the case with Mahmood and Soon's (1991) had to be adapted in order to fulfill the needs of this research. Some differences in the business terminology were verified in the Brazilian context during the pilot tests of the survey instrument. Nevertheless, it is believed that a contribution has been offered for a better understanding of the impact of the ERP systems, as well as in research methodology for the evaluation of IT impacts, once the adapted survey instrument can now be used to evaluate other IT tools in the Brazilian context.

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