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ABSTRACT

ERP systems are now an important component of information technology architecture in most large and medium sized companies. As such, it is inevitable that the activities undertaken to align this component to business requirements, conduct its evolution and ensure its performance and availability become increasingly important to companies' IT areas. Success of these activities relies upon knowledge and participation of various actors inside and outside the IT area, imposing challenges not observed in internally developed systems

Many authors have researched the implementation processes of ERP systems with diverse approaches and stressing the benefits achieved by its application. However, few have analyzed the management of already implemented ERP systems. This work proposes a model for the analysis of ERP systems management, including the activities and actors engaged in this effort. The proposed model is the basis for an exploratory survey conducted with 85 Brazilian companies whose results also comprise this text.

Keywords

ERP Systems; IT Management; ERP Systems Management

INTRODUCTION

ERP systems have become the main and vital component of corporate information systems of many companies. This takes place at a time when IT staffs are under great pressure to ensure the capacity of response and adjustment of their systems to business needs and constant changes (Feeny and Willcocks, 1998; Agarwal and Sambamurthy, 2002). The ERP system is a critical component of the integrated management of diverse company areas and of supply chain management, which demands compliance with extreme availability and performance requirements. In principle this describes the meaning and the importance of managing such systems.

According to Souza and Zwicker (2005) this management encompasses the set of actions undertaken to ensure meeting the business needs, the performance, availability and control of the maintenance and operation costs. The authors present a model for the study of ERP systems management which includes the activities of *development* (implementation and evolution of the system), *operation* (keep the system operation within the specified parameters of performance and availability) and *support* (user services). As actors the model includes the *IT area, the system's supplier; the user areas and outside consultants*. The present text initially carries out a revision of the model proposed by these authors based upon the concept of core capabilities of the IT area as proposed by Feeny and Willcocks (1998). Next, the aspects covered in the revised model are analyzed through a survey conducted at 85 companies using the SAP R/3 system.

CORE CAPABILITIES MODEL

According to Feeny and Willcocks (1998) and Willcocks and Feeny (2006), to reach sustainable competitiveness using IT, companies must pay attention to three issues: 1) focus on utilization of systems that support business opportunities; 2) development and management of effective strategies for the high quality and low cost IT service delivery; and, 3) choice of a technical platform or IT architecture on which services will be made available. The authors regard as premise that the current trend is the outsourcing of an extended range of IT services. In this way, the issue becomes one of outlining the internal capabilities which should be kept and to which maximum of attention should be given. Included are the core capabilities which the IT area must have internally, independent from the type of sourcing it elects to adopt. The rationale is that core capabilities ensure that the current and future capability of the business to benefit from IT is not jeopardized, and that they provide adequate support to the three listed issues.

According to the Feeny and Willcocks model the core capabilities are: 1) *leadership*, or the capability to integrate IT efforts with the business objectives and activities ; 2) *business systems thinking*, or the capability to discern new procedures made

possible by the technology; 3) *relationship building*, or the capability to achieve a constructive engagement of the user areas with IT matters; 4) *architecture planning*, or the capability to create a consistent technology platform to meet current and future requirements; 5) *making technology work*, or the capability to quickly solve unexpected problems and keep up delivery of IT services; 6) *informed buying*, or the capability to set up and manage a fitting sourcing strategy for business; 7) *contract facilitation*, or the capability to manage the day to day of sourcing contracts to avoid interruption problems. 8) *contract monitoring*, or the capability to guarantee that the current and future position of the company is protected in the sourcing contracts; and 9) *vendor development*, or the capability to identify the potential of reaching value by means of IT based upon the current and future services offered. The relationship between these nine core capabilities and the three issues of IT management are illustrated in figure 1.
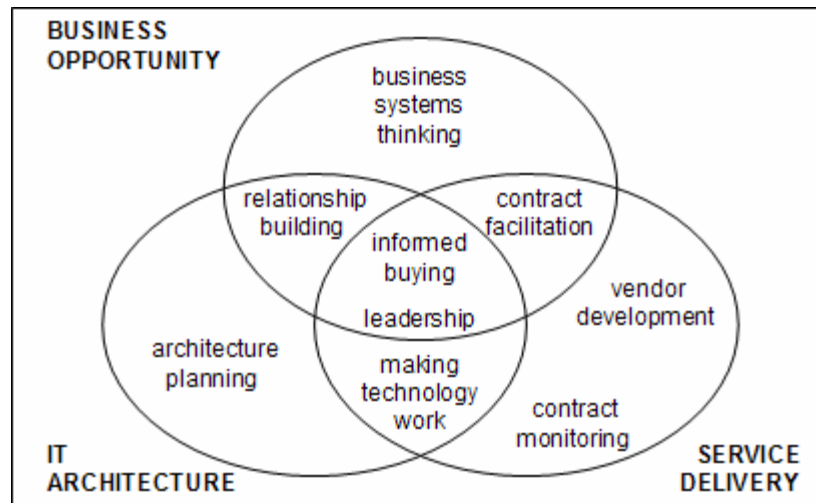

Figure 1 – Core capabilities model (Feeny and Willcocks, 1998)

The relationship between the core capabilities model and the implementation of ERP systems is examined by Willcocks and Sykes (2000). The need of systems thinking and the capability of building relationships to achieve an effective integration of the procedures promised by the ERP systems are enhanced. Furthermore, the implementation effort requires preservation of the internal capability to solve problems to meet the company's specific situations and qualification for the vital activities related to outsourcing including informed buying, contract facilitation and monitoring.

One of the issues not addressed by the authors is the issue of IT governance, that is to say the perspective of sharing decision making responsibility on diverse aspects that involve the IT area, business areas and users themselves. In addition, as the model is strictly built according to the "total" outsourcing of the IT area, no consideration has been given to environments that combine outsourcing with activities conducted internally. Finally, details specifically related to ERP systems management, such as the level of proficiency to manage projects of the user areas and relationship with other companies that use the same ERP system, were not considered by the cited authors.

MANAGEMENT OF ERP SYSTEMS

Most models of IT management emphasize two aspects that pervade this process: (1) *provide for business needs,* in the sense of strategic alignment of IT with company business and (2) *technological response* in the sense of the support architecture and portfolio of applications. With respect to these aspects, IT management involves decisions about *what* must be done, characterized as IT governance, as well as decisions on *how* it should be done, characterized as IT management (Starre and Jong, 1998). Inherent to IT management is the quick evolution of technology and the growing pressure to justify IT investments worth and effective contribution to company productivity and competitiveness. This is the context of the challenge to respond to the company business needs. To equate this response is a wide ranging problem which, among other things, must consider aspects as the company strategy, the knowledge of current and future technology and the suitable relationship between the IT area and the other business areas. From the previous discussion the aspects that may be considered relevant for the study of ERP systems management are shown consolidated at figure 2. This figure states the model of the components of ERP systems management that was used to develop the survey presented next.
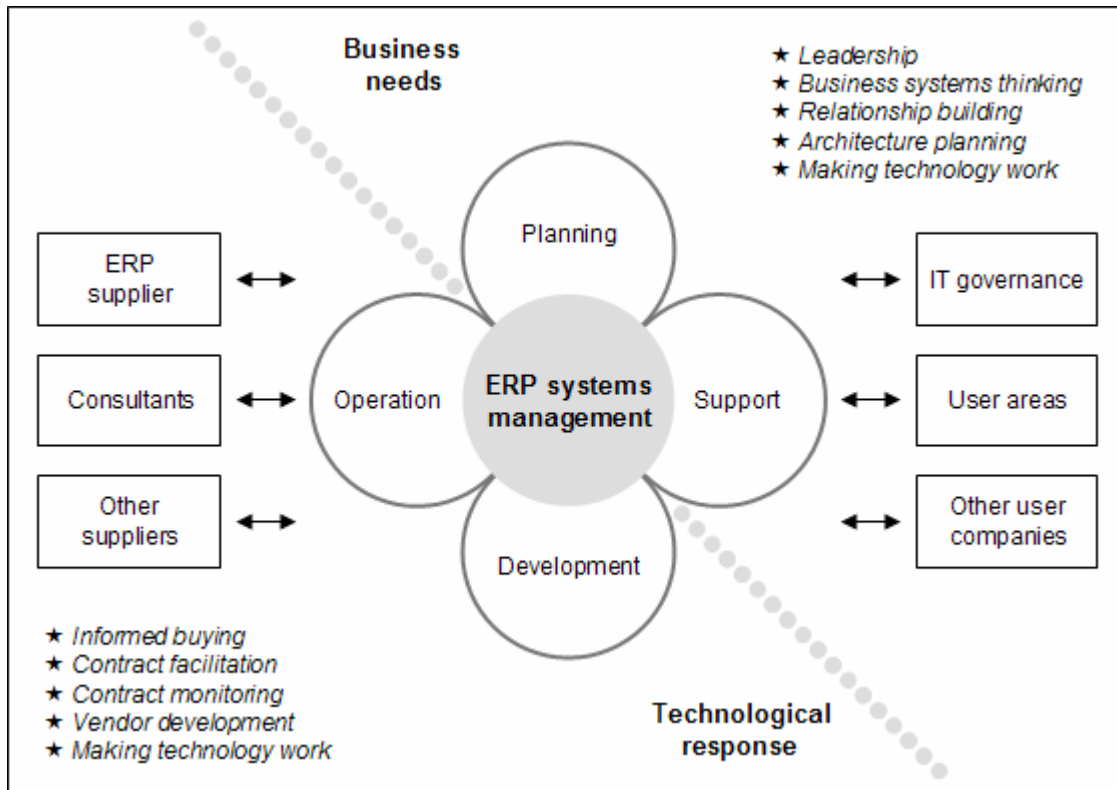
Figure 2– Model of the components of ERP systems management

At figure 2 the diagonal dotted line produced two "spaces": the space of the business needs in the upper right triangle and the space of the technological response in the lower left triangle. These are spaces for the action of different actors and where specific abilities are demanded from the internal actors of the company. In the space of the business needs appear those involved with IT governance, the user areas and owners of the same system that likewise seek to achieve solutions for their needs. In the space of the technological response emerge the vendors of the ERP system, the consultants and the remaining vendors, all of which are involved with the technological architecture defined for the company. Arrows in the figure represent the actors' participation in the managerial process.

The performance of the IT area is expressed by the activities related to ERP systems management found in the center of figure 2. To the managerial activities previously shown was added the planning activity, in order to consider the medium and long term evolution of these systems from the point of view of IT and business. Planning and support activities are preferentially located in the space of business needs, while the development and operational activities are preferentially found in the space of technological response.

In each of the spaces were allocated the core capabilities for the company's positive performance in the domain of management of its ERP system. In the business needs space are the capabilities regarding relationship and strategic alignment of the system and technology architecture, while in the technological response space are the capabilities regarding the achievement of solutions. Note that the capability of making technology work is essential in the two spaces. The model of figure 2 consolidates the core capabilities under the perspective of Souza and Zwicker (2005) of the users' participation on the management of ERP system and under the perspective of Feeny and Willcocks (1998) on the management challenges brought about by outsourcing.

RESULTS OF THE SURVEY

The survey was carried out by sending a questionnaire at July 2004 to the members of ASUG Brasil, the association of Brazilian SAP users. In early 2006 it had 460 members that corresponded to 56% of the companies using SAP R/3 in Brazil. The return comprised 85 questionnaires considered valid (24% of the 350 members at the time, and about 17% of the companies using R/3 in Brazil). The questionnaire was completed by companies participating in the association's yearly congress, by means of their IT managers, business analysts and key users. The questions were elaborated based on the

professional experience of the authors relative to ERP systems management and encompassed more than one hundred operational and managerial aspects of the ERP routine of the companies. The questionnaire may be requested from the authors (in Portuguese).

Charts 1 and 2 show some results that characterize the sample obtained. The sample may be considered representative of the population of companies that are associated to ASUG Brasil. Most companies belong to the industrial sector and are medium and large sized companies with some of them highly representative of Brazilian economy. The median of invoicing of the sample companies for the year of 2003 was R$ 500 million and the median of the number of employees was 1500.
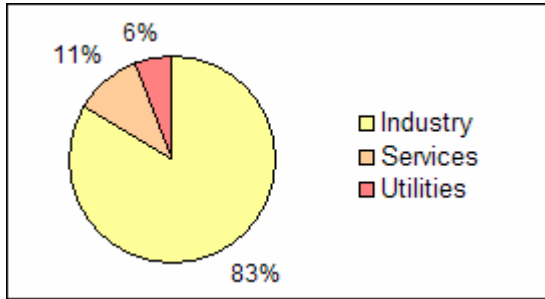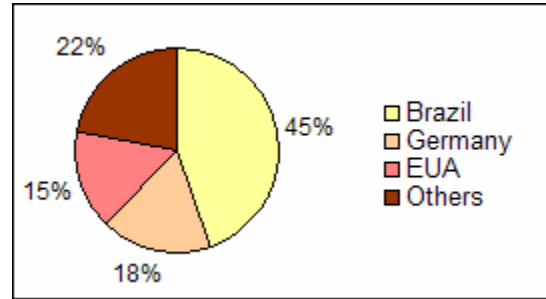

Chart 1 – Sector of activity   **Chart 2 – Nationality of the companies**

Human Resources of IT Areas

Chart 3 shows the mean number of employees (internal and external) of the IT area of the companies in the sample. On the average IT areas have 31 persons, but the median is around 17 people with a larger number occupying the functions of business and system analysts. Also significant is the number of help desk people, although their time dedicated to the ERP is relatively short. The percentage of the professionals' time dedicated to the R/3 discloses that it is rather high for programmers and analysts, which shows that these professionals are almost solely dedicated to project and develop applications tied to the ERP. This suggests that system's architecture and the effort of IT areas are significantly focused on ERP on these companies.
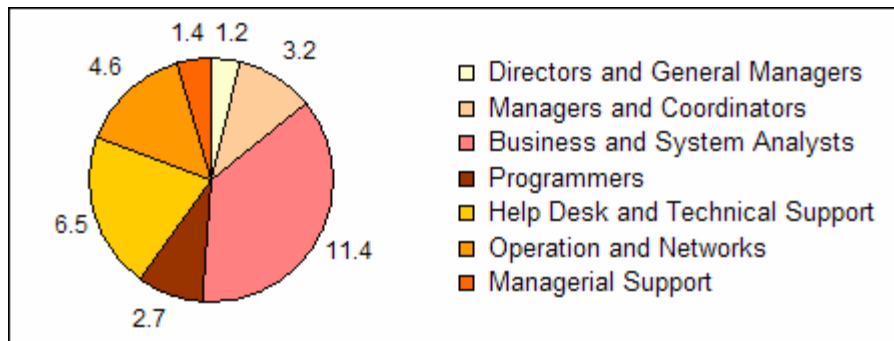

Chart 3 – Mean number of employees in each function

Table 1 shows statistics related to the size of the IT area. SD indicates the standard deviation of the sample and N relates to the number of companies that supply information considered valid. The number of employees of third parties in the IT area is small suggesting that companies indeed keep their own staffs with a size that may also be considered small. On the average the R/3 uses 51% of the IT area's time, which again shows its importance within the company. Companies were also asked if there was a separate area in the IT department exclusively dedicated to the ERP system and 32% of the companies gave a positive reply. This finding discloses that separation is feasible and takes into account the peculiar proficiencies of the development and maintenance personnel.

Another indicative aspect is that 65% of companies reported currently having in their IT staff people coming from user areas, especially key users. In these companies the average of people coming from user areas is about 6 persons, that is to say they comprise some 20% of the IT area. This apparently indicates a change of view of the IT areas that begin to seek knowledge and proficiencies dedicated to processes. It also may point to an IT management strategy to consolidate the relationship with user areas that begun during the implementation projects.

Table 1 - Statistics of IT human resources

Description	Mean	SD	Median	N
Total of employees in the IT area	25.8	27.3	14.0	70
Total of third party people in the IT area	5.3	14.9	0.0	70
Total of people in the IT area	31.0	36.5	17.5	70
Percentage of time dedicated to the R/3 in the IT area	51%	24%	52%	70
Number of IT users per person in the IT area	31.8	20.6	26.7	35
Number of R/3 users per person in the IT area	26.2	75.5	14.1	68
Percentage of persons in the IT area coming from user areas	65%	-	-	85
Number of persons in the IT area coming from user areas	6.2	7.2	3	55
Percentage of separated areas dedicated to the R/3	32%	-	-	85

Perceived ERP Contributions to the Company

Chart 4 displays the evaluation of respondents on the ERP system contribution to the company's business according to a ranking from 1 (very low) to 5 (very high). The main contribution perceived is the integration of information between departments while, contrary to the initial expectation of many projects, decrease of IT expenses and increase of the level of outsourcing of IT were viewed as lesser contributions. Respondents were also queried if expectations related to the original implementation project were met by the ERP system and the results are shown at chart 5.
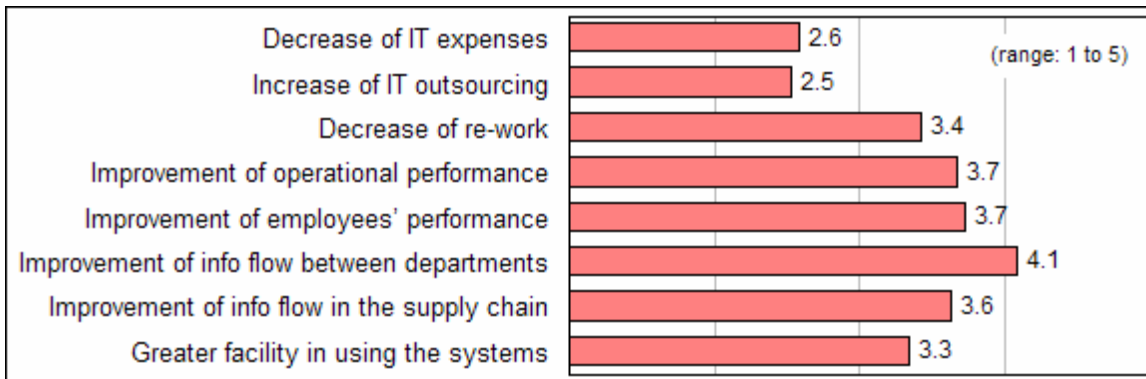

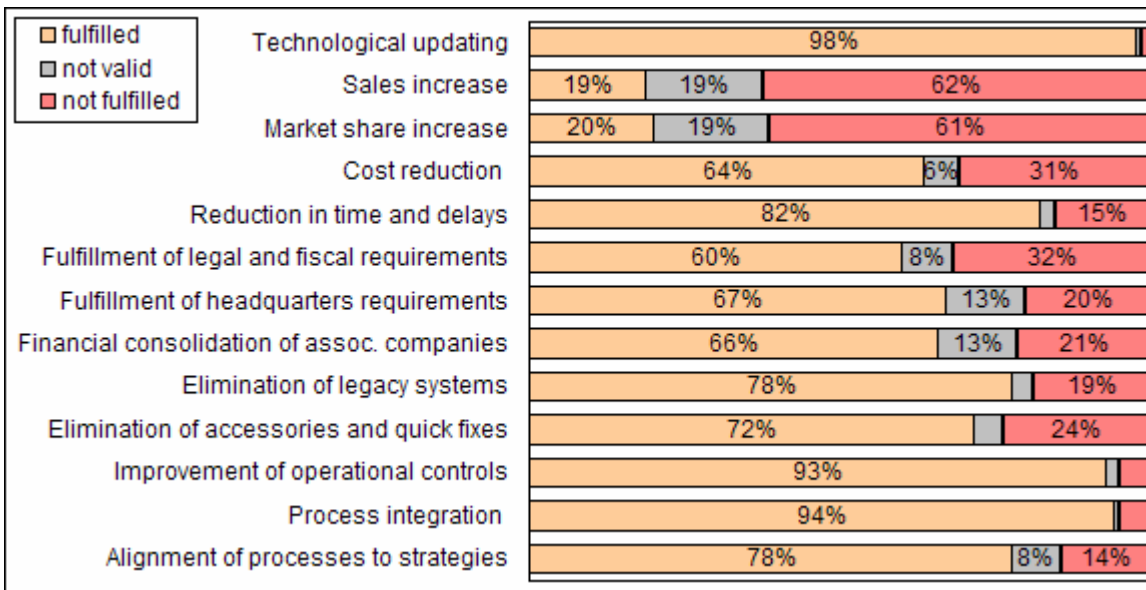
Chart 4 – Contributions of the ERP system to business

Chart 5 – Fulfillment of the original expectations

Aspects of the Components Model

Each company informed by means of its respondent about the effort in activities related to the day to day management of its ERP system according to a ranking ranging from 1 (very low) to 5 (very high). Chart 6 shows the means reported indicating that they concentrated efforts in all activities and mainly in what is directly related to the users. It should be noted that negotiation with vendors and third parties does not seem to be too demanding which is in agreement with the relatively little importance given to this capability by companies' IT areas (according to chart 19). More results of the survey regarding aspects of the model of components of ERP systems management are presented next.
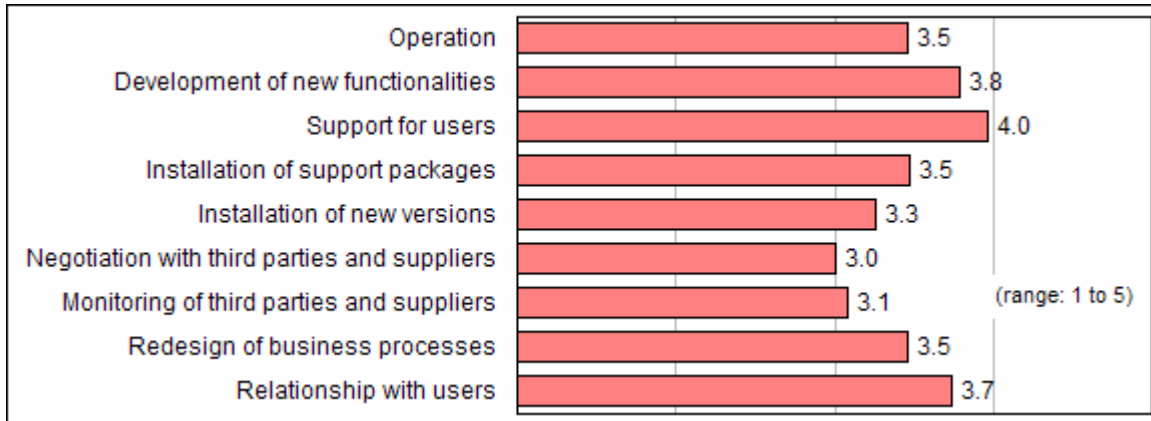

Chart 6 – Effort dedicated to management of the ERP system

IT Governance and Planning

Chart 7 shows the participation of six sets of people responsible for the definition of objectives related to the R/3 in the companies. This responsibility is in general shared between top management and the IT area, however participation of the user areas seem quite remarkable. The Users Committee has a limited participation in the definition of objectives, but it must be taken into account that it appears only in half of the companies in the sample (Chart 9). Apparently, the Committee has the role of strengthening the relationship between the area of IT and the user community that it played during the ERP implementation process. The Committee does not always share the responsibility for management of the ERP system and therefore cannot be viewed as a formal instrument of IT or ERP governance in the companies.
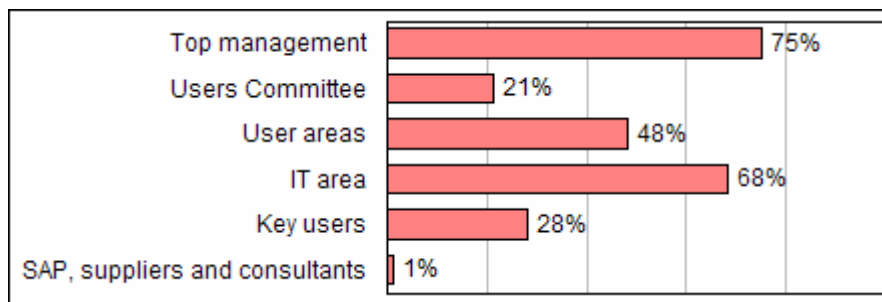

Chart 7 – Who sets the objectives regarding the R/3

The results presented on chart 8 show that the IT area considers that it has the power to carry out changes in user areas, which fulfills the need for integration of processes by technology and is consistent with the perception of the IT areas that their participation is relevant in the redesign of the company processes. The ERP context is definitely a vital operational support for business and, in this sense, participation of the IT area is understood as significant. The results on chart 8 also corroborate the participation of user areas in decisions on R/3.
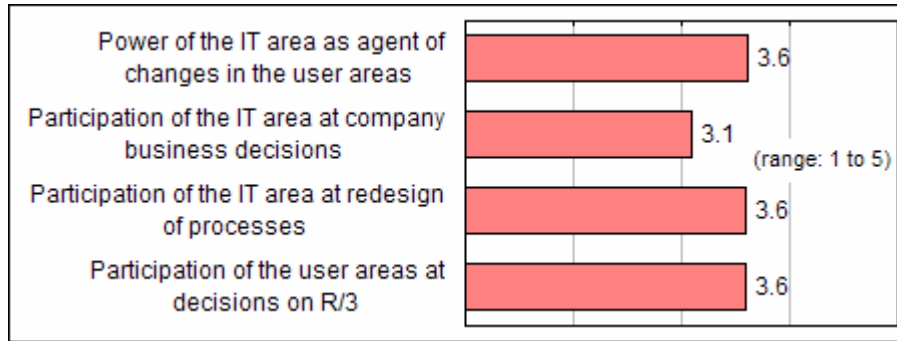
Chart 8 – Participation of the IT area and user areas

These results are consistent with the finding presented on chart 10 that the IT area normally has a participation in the leadership of projects involving R/3. But it is interesting to note that in about 25% of companies, leadership belongs exclusively to the user areas. Possibly, in most companies ERP systems are viewed as technology and not as business solutions. In principle, it would be expected that in more companies the user areas would be the exclusive holders of the new applications projects, under the perspective of the ERP being indeed a business solution. The issue can also be ascribed to the user areas' difficulty to manage projects, fact that not takes place at the IT areas.
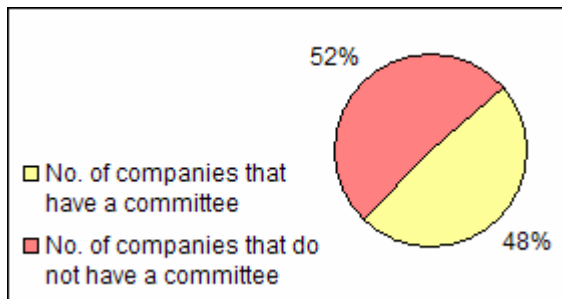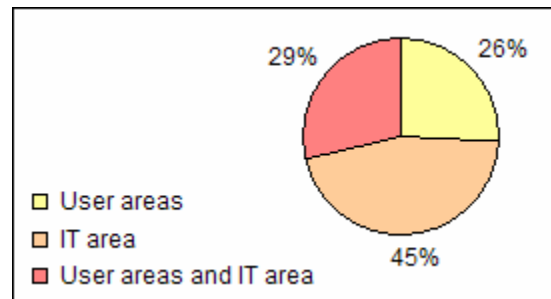

Chart 9 – Users committee (of the ERP)

Chart 10 – Leadership of R/3 projects

User Areas

Key users play an important role in various activities. They are involved in the system's maintenance, testing corrections and new versions, participate in disseminating knowledge on the system when training users and solve doubts and problems of other users and contribute to the system's evolution when collaborating with the specification and implementation of new functionalities. The dimension of such involvement is registered in chart 11 which also shows that centralization of contacts with the IT area through key users is not adopted by companies as a rule. Few companies report that users developed "quick fixes", in general in the form of accessory spreadsheets, to by-pass ERP restrictions. Nevertheless, it becomes evident that development of "quick fixes" is a recognized fact in at least 20% of companies.
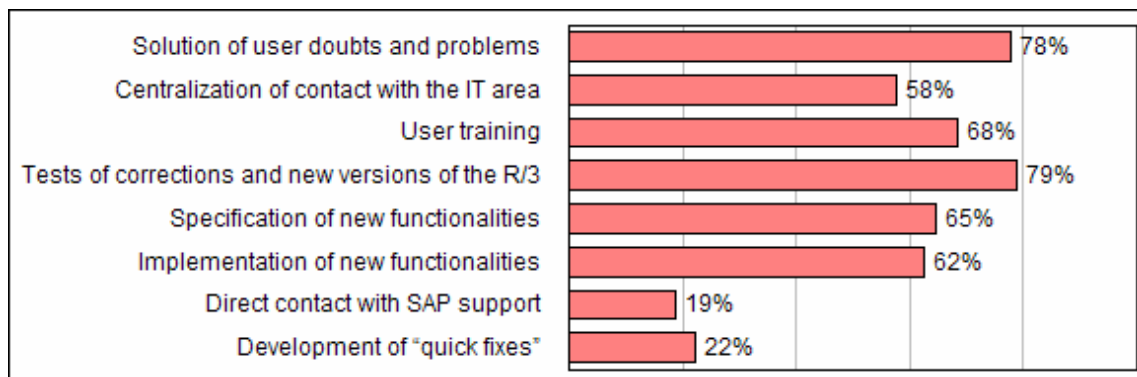

Chart 11 – Participation of key users

Chart 12 portrays the level of satisfaction and cooperation that prevails among the user areas and the IT area. Results mirror the IT area's point of view, since it provided the replies in a ranking from 1 (very low) to 5 (very high). The IT area considers that users are relatively satisfied with the area, while it is rather less satisfied with them. Cooperation with the user areas is to some extent brought into evidence and the role of key users is acknowledged by the IT area. Overall satisfaction with the SAP system is evidenced.
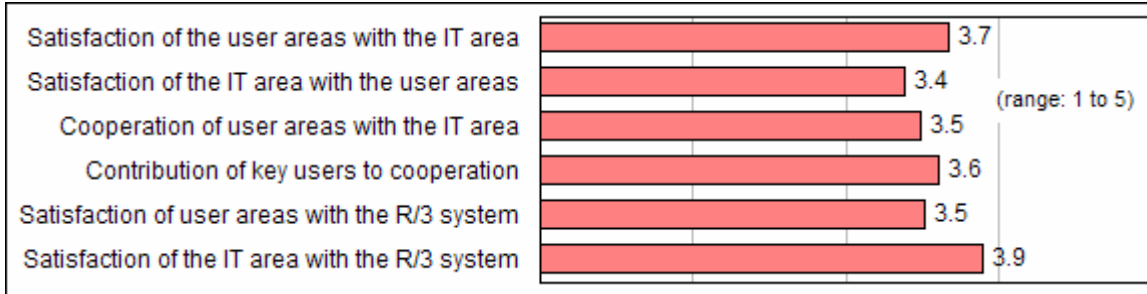

Chart 12 – Satisfaction of user areas and IT area

Other User Companies

Other companies using the R/3 system also seek to achieve solutions for their problems. Sharing of these problems and of eventual solutions may take place through associations or groups of users. Chart 13 presents mean scores of the evaluation of companies related to the issue of the role played by the group of SAP users (ASUG Brasil). Note that the group is considered important for exchange of experiences with other participants, but of little importance regarding protection of the companies' interests when facing the system vendor.
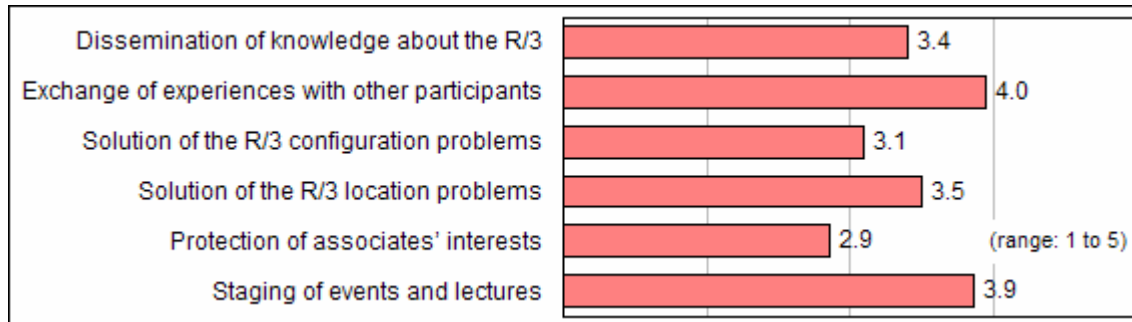

Chart 13 – Role of the group of SAP users

Consultants

The charts 14 to 16 list results of the issues on outsourcing, consultants and service supply. As previously noted, the level of outsourcing of the various activities connected to management of the R/3 system may be considered low. The IT area tends to carry out with the internal personnel, mostly activities not directly related to the R/3 technology. Consultants are in charge of the system's configuration, customization and programming in ABAP, the R/3 language. The main reason for utilizing consultants is that they have a better knowledge, specifically on the R/3 technology, however results they supply are not well assessed. This is probably why few companies adopt an explicit policy on outsourcing. Note that contrary to expectations, consultants are understood as not being of great help for redesign of processes.

Companies surveyed seek to establish long term relationships with the service suppliers and performance assessment of these suppliers is not representative. The companies tend to use large sized suppliers what is coherent with the severe dependence of the company from their ERP system. There is also a certain degree of conflict between user areas and service suppliers. The nature of this conflict must be more closely investigated and is possibly related with the finding that almost a third of the companies stated that consultants and suppliers interfere in the management of the company's technological architecture.
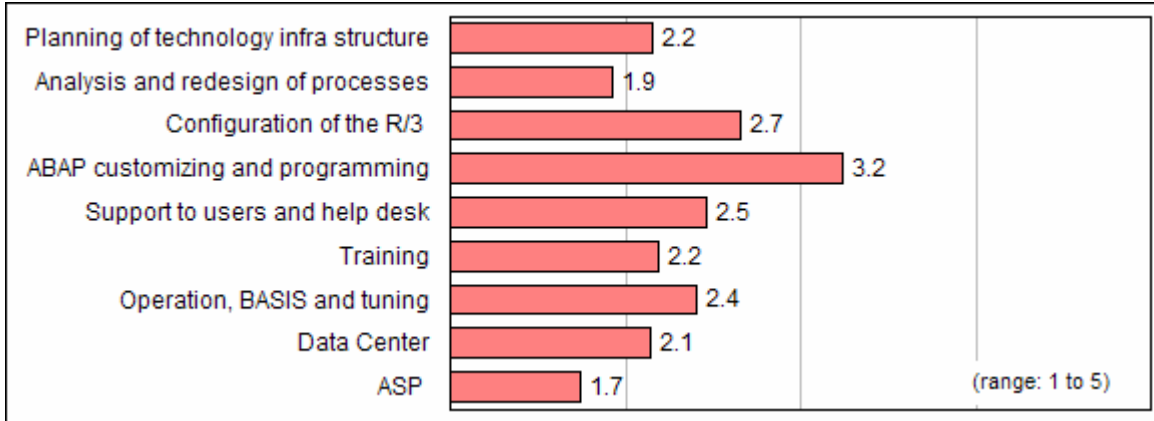
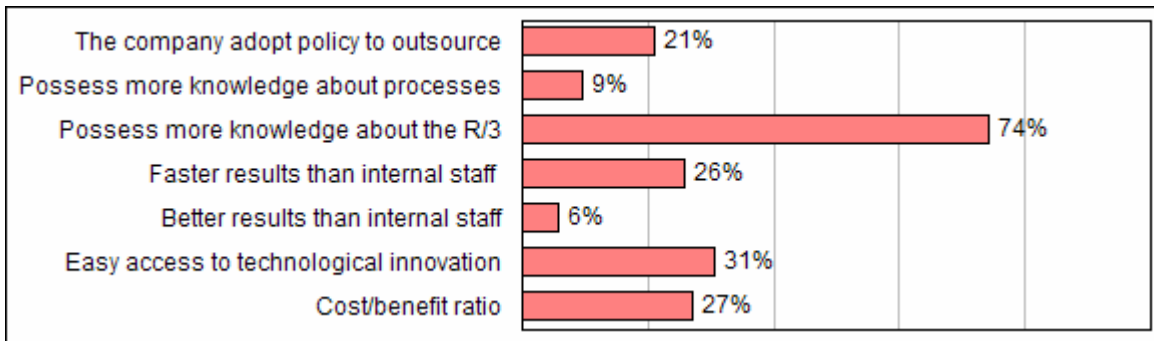**Chart 14 – Level of outsourcing of activities related to the R/3**

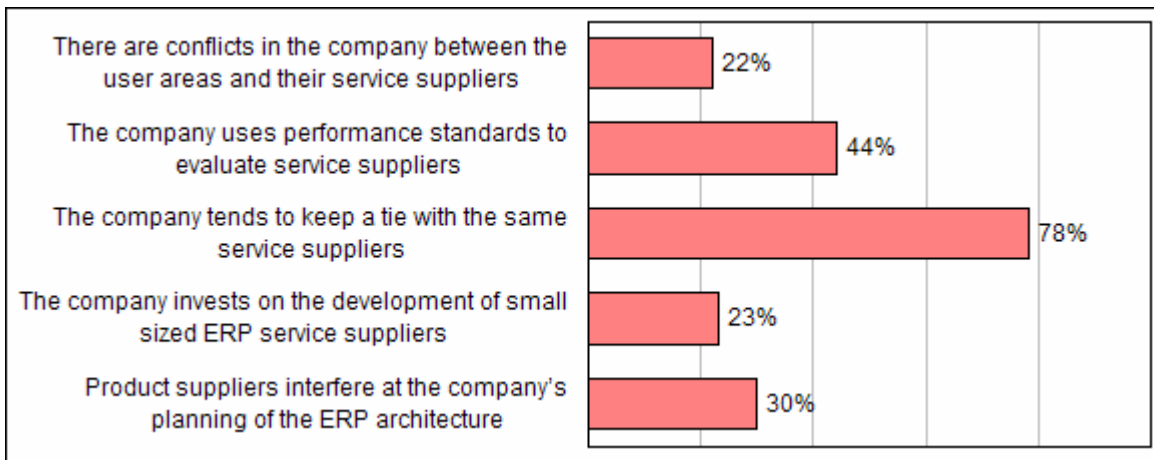**Chart 15 – Motive for consulting and outsourcing**

Chart 16 – Relationship with third parties

Chart 17 shows that the IT area has the exclusive responsibility for monitoring of outsourcing services related to the R/3. Greater participation of the user areas in this monitoring was expected, based upon the argument that more consulting activities were carried out in the ambit of process redesign. This further corroborates the finding that centralization of the contact with consultants and with the ERP vendor, by the IT area, may represent the area's endeavor to retain power and responsibility over evolution and management of the ERP system.
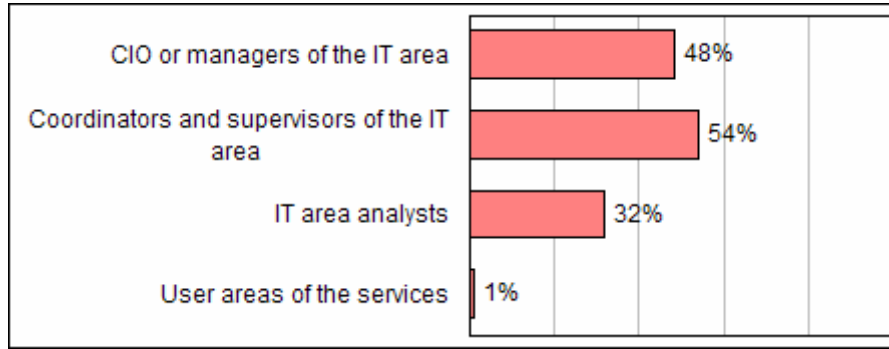
Chart 17 – Responsibility for monitoring of third parties linked to the R/3

Relationship with the ERP Vendor

The company's relationship with the ERP vendor is outlined in chart 18, which describes the company's satisfaction with various tasks that would be within the vendor's scope according to a ranking from 1 (very dissatisfied) to 5 (very satisfied). In general, companies are satisfied with the SAP support and with the quality of new versions of the system. Dissatisfaction is related to the difficulty of keeping up the old versions of the R/3 and also to the pressure from the vendor to force the company to adopt upgraded versions of the system. This is a touchy point in the management of the ERP system, since implementation of new versions may entail significant risks and costs.
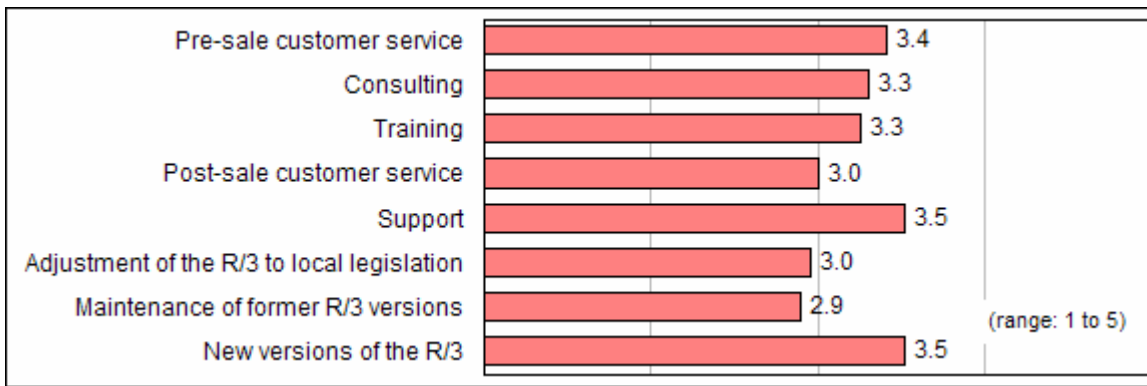

Chart 18 – Company satisfaction with SAP

Core Capabilities

Charts 19 to 21 disclose some results related to Feeny and Willcocks (1998) IS core capabilities model. Companies were requested to classify seven items linked to the capabilities, attributing a classification 1 as the least important and a classification 7 as the most important. The mean of the classifications of each item are presented at chart 19 where the brackets indicate the corresponding linked capability number. Knowledge of the company's processes was considered the most important, followed by knowledge and control of the R/3 system. Monitoring of outsourcing was considered the least important, once again pointing to the high rating of services carried out internally. Likewise, capability of negotiating with third parties was also not considered important.
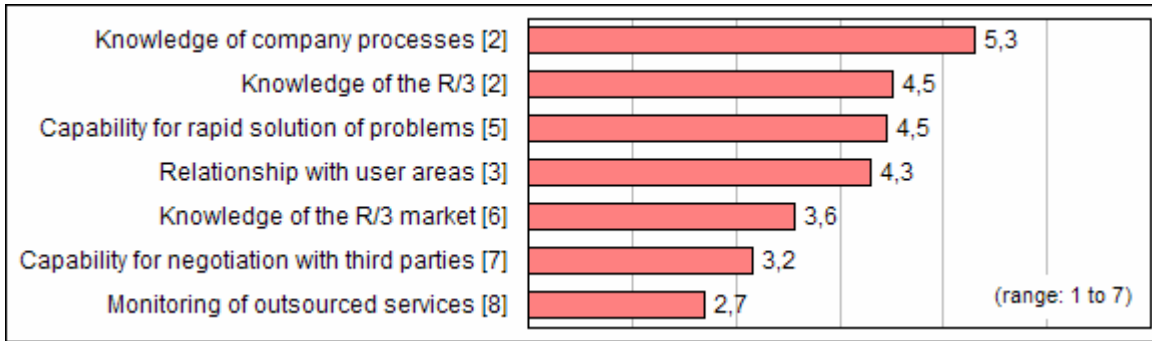
Chart 19 – Importance of some capabilities to ERP systems management

Generally speaking, knowledge of the company's processes is held inside (by key users and IT area) while knowledge of the ERP is held outside (ERP vendor and consultants). But companies also believe that they detain a high level of knowledge of the ERP. The need to adjust the system to the processes or vice-versa and the fact that knowledge on this adjustment is held by different actors, as seen in chart 20, often brings about tensions and difficulties during the implementation and use of the system's functionalities.
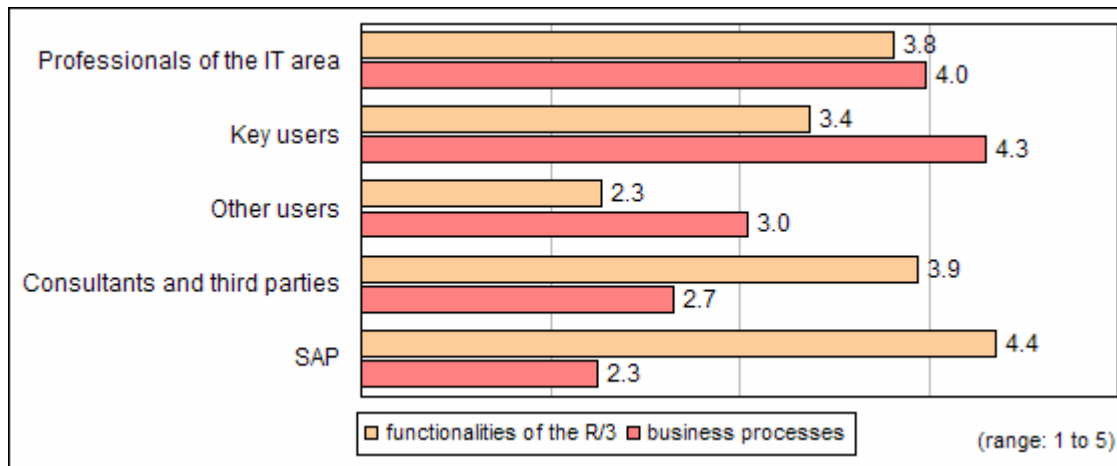

Chart 20 – Knowledge of those involved in management of the ERP system

Finally, the capability to quickly solve problems was also assessed in the survey. Chart 19 shows that it is considered the third in importance and chart 21 records where this capability resides. Most companies keep this capability inside, but some also take simultaneous avail of other resources. It is clear that third parties and the ERP vendor do not manage to successfully handle contingency situations in accordance with the company needs.
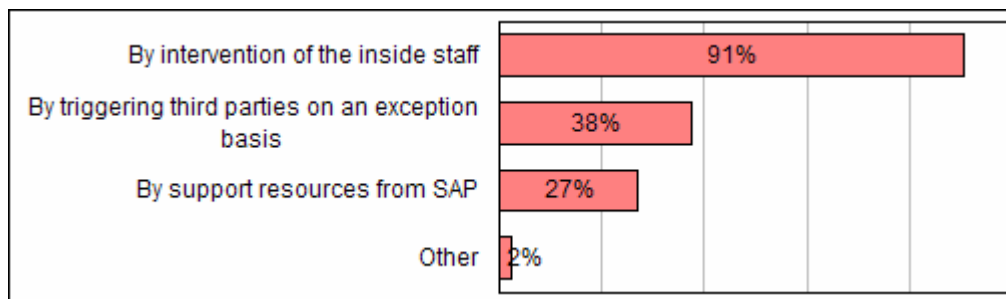

Chart 21 – Handling of contingency situations

CONCLUSIONS

The implementation of an ERP system is viewed as a significant technological step forward with definitive impacts on the integration of processes and improvement of the operational controls. The ERP system becomes a critical tool for the company what requires compliance with extreme requisites of availability and performance, with repercussions on the capabilities required from those with responsibilities regarding the system.

The leadership capability expressed in the form of integration of IT efforts with the objectives and activities of the business was only indirectly perceived through the observed influence of the IT area on the user areas, insofar the participation of these areas at ERP decisions seems still limited. Anyway, it can not be evidenced that the leadership capability is clearly exercised by the IT areas of the companies. On the other hand, the business systems thinking as the capability to discern procedures made possible by technology seems to be intrinsically driven by ERP technology. Users as well as the IT area endeavor to seize all the functionality that technology makes available. Exploitation of the R/3 possibilities and the redesign of processes are ongoing matters and signal that this capability continues to be acquired. Substantiation that knowledge of the company's processes is clearly internalized and that users and the IT area are its main holders, suggests that business systems thinking is part of the everyday of the ERP management of companies.

To achieve constructive engagement of the business areas with IT issues is the maxim of relationship with users. Relationship building pervades the efforts of the ERP area and in this direction certainly contributed the approach advocated by the ERP vendor about formal user involvement during the system implementation. The figure of key users, the Users Committee and the effort stated by the IT area in the relationship with users and in the supply of support, clearly disclose that in the ERP context the capability is understood by the company as being very important. Also architecture planning through conception of a consistent technology platform to meet current and futures needs pervades the efforts of the IT area. Likewise, making technology work or have the capability of quickly solve unexpected problems and sustain delivery of services is essential to the ERP area. Results show that these capabilities continue to be internalized and that pertinent decisions are merely supported by the vendor or by third parties.

Management of supply of information technology that meets the business interests by means of its informed buying, by the nature and size of the surveyed companies and by the nature itself of the ERP context does not seem to be an issue with many alternatives. Companies are essentially tied to a large size and good quality supplier with whom, in principle, they are satisfied. The relationship with consultants is in general longstanding, which is closely related to the knowledge they have already acquired on the technological environment and processes of the company. Eventually, it can be concluded that companies are accommodated; however this does not mean that decisions on technology supply are inevitably out of line with the company's interests. In this ambit it is further noteworthy that the outsourcing issue related to the ERP is not on the list of the important concerns of the company's IT managers, contrary to what was originally expected in the survey.

Contract facilitation in the sense of guaranteeing success of the service contracts ends being treated in a centralized manner by the IT area, when it takes over all the intermediation and contact of third parties with the user areas. Business analysts, supported by the key users, end up as the company's contact facilitators with consultants. Nevertheless, the level of conflict with user areas does not signal irrelevance. This fact, associated to the finding that less importance is given to contract monitoring to protect the contractual position of the business and the virtual ignorance in relation to the possibilities of supplier development, suggests that the company and the IT area may progress in terms of these capabilities. It can be argued that the potential of value that may be added by vendors and service suppliers needs to be more intensively explored.

In the ERP context, sharing of the decision making responsibility between the IT area and the user areas seems natural. It also seems natural that a significant part of the IT efforts are outsourced in the end. Therefore, it is a scene for various actors with defined roles that, to be well played requires abilities and capabilities that may not yet have been acquired. This study brought forth data leading to the conclusion that one of the actors, the IT area of the companies, is maintaining or acquiring these capabilities. Eventually the proposed model may be fine tuned to further encompass the desired capabilities of the other actors in this scenario.

ACKNOWLEDGMENTS

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