

The effects of enterprise resource planning implementation strategy on cross-functionality

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Abstract. *Enterprise resource planning (ERP) systems are characterized by specific features such as the scope of the ERP modules, interdependent relationships, single database and standard management and processing rules, all of which are capable of causing various degrees of change within the company and, potentially, encourage a more cross-functional overview of it. This paper develops a theoretical distinction between cross-functional integration and cross-functionality as it raises people's awareness of the transverse and coupled nature of work process across different organizational units. It aims to test and discuss the impact of ERP implementation strategy (organizational vision, process re-engineering, the scope of the ERP modules implemented and speed) on cross-functionality. The methodology is basically based on a survey of 100 French companies, of which the results are further discussed in five case studies. The results show that all previously mentioned factors play significant roles. These roles should be addressed in future research.*

Keywords: cross-functionality, ERP implementation strategy, scope of the ERP modules, organizational vision, speed, BPR

The decade of 1990, as far as business information systems (IS) are concerned, was characterized by the implementation of enterprise resource planning (ERP) systems as the *de facto* standard for replacement of legacy systems (Parr & Shanks, 2000). ERP systems are commercial software packages that provide cross-organization integration through embedded business processes and are generally composed of several modules, including operation and logistic, procurement, sales and marketing, human resource and finance (Davenport, 1998). This technology promises to replace discrete, home-grown systems with an integrated, enter-

prise-wide infrastructure that will streamline organizational activities and eliminate duplication of effort and data (Markus & Tanis, 2000).

There are several characteristics of ERP systems, which distinguish them from conventional IS (Markus & Tanis, 2000). ERP systems are much more integrated and flexible than conventional IS because of their integrated component-based software and their evolving architecture and expanding functionality, promising cross-functional integration of all information flowing through a company. These systems, unlike normal IS, are not developed by the organization itself, like normal IS, but are developed and sold by specialized software vendors. These software vendors try to sell their ERP systems with 'industry best practices' which are generic business processes that may differ substantially from the way any particular organization operates.

These shared IS, which integrate all departments and functions across a company onto a single computer system, can serve each different departments' particular needs (Davenport, 1998) and therefore have multiple users and stakeholders who have different cultures and approaches to work (Pawlowski *et al.*, 1999). ERP systems are nothing more than generic representations of the way a typical company does business. In this way, an ERP system affects the whole of the organization simultaneously rather than a single department as was the case with functional IS in the past whose implementation was mostly limited to departmental boundaries. Organizations have to customize the software packages and to change their existing suboptimal business processes and organizational arrangements. This way of operating may change the way an organization works. Therefore, ERP system implementation implies a much wider organizational change (Robey *et al.*, 2002).

ERP systems have been the subject of a large number of French¹ publications, as well as being covered extensively in English (Esteves & Pastor, 2001). However, most of these publications fail to address one of the most important questions posed to companies by these systems: can they offer a more cross-functional overview of the company's problems by 'breaking down' functional silos? It is important to address this question because for many companies the principle of cross-functional integration via a single database is new. Because of the complexity of ERP software and the intangible nature of most costs and benefits, ERP presents an important phenomenon to be studied. The evaluation and the investigation have to be both through quantitative and through qualitative methods.

This paper aims to examine if the ERP implementation strategy (organizational vision, scope of the ERP modules, process re-engineering, speed) fosters a more cross-functional overview. In the first part of our paper, we examine the theoretical basis of cross-functionality, as well as the ERP literature on which we have formulated our hypotheses. We then proceed to present our methodology. This leads us to the third part of our paper, in which we present the test results of our quantitative study. The fourth part of the paper presents the discussion of our results. Lastly, we conclude by mentioning future direction of the research on this topic.

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CROSS-FUNCTIONALITY LITERATURE AND HYPOTHESES

From cross-functional integration to cross-functionality?

Over the past several years, the rapid change and diffusion of technology as well as global competition have intensified the need for a new organizational design (Daft & Lewin, 1993; Volberda, 1996). Firms have become increasingly interested in stimulating, facilitating and maintaining co-operation between the various functional areas. This *horizontal shift* in organizing (Kanter, 1989) has put a great deal of pressure upon organizations for a greater level of cross-functional integration (Hammer & Champy, 1991; Galbraith, 1994).

The notion of cross-functionality refers basically to the awareness of the interdependencies and information sharing between the various organizational units. Generally, in a strict functional approach, work is done by various departments independently with very little cross-functional co-ordination. With functional organization, departments normally do not share their own data. Cross-functional integration requires the convergence of these disparate IS in order to accelerate processes and facilitate information sharing across different parts of the organization (Goodhue *et al.*, 1992). This calls for a considerable degree of cross-functional co-operation and puts the emphasis on the precedence of processes over functions and users in a new vision of an organization built around a partition-free horizontal structure and multi-functional working teams (Galbraith, 1994). According to this view, cross-functionality represents the extent to which different business processes and functions are interconnected, standardized and tightly coupled (Orton & Weick, 1990). Processes are integrated when they are linked organizationally and co-ordinated with information flows. A process is 'a lateral or horizontal organisational form that encapsulates the interdependence of tasks, roles, people, departments and functions required to provide a customer with a product or service' (Earl, 1994, p. 13). The more processes are integrated, the more operations are conducted in a cross-functional way. However, it does not mean that users are aware of that. In this paper, we define cross-functionality as people awareness of the coupled and transverse nature of processes across different units. Cross-functionality stems from cross-functional integration; but these two notions are not equivalent.

The true value of cross-functional integration is its potential to enhance the firm's performance in the marketplace (Valle & Avella, 2003). The topics of horizontal process, interfunctional collaboration and integration methods lie at the heart of the changes introduced by companies with the objective of providing greater control over their corporate performance. With better communication quality and by providing better information to managers, cross-functionality can reduce the overhead cost and improve overall decision-making (Pinsonneault & Kraemer, 2002). This convergence of business functions assists in cost reduction, efficiency improvements and increased productivity and could reduce language barriers between functions. Past research indicates that horizontal integration can offer performance advantages over vertical integration and is a critical determinant for facilitating the co-operation between different functions (Davenport, 2000). A primary advantage of cross-functional integration is the improvement of horizontal communication linkages (Galbraith, 1994; Hammer, 1999). Interfunctional dependencies can be handled through direct information transfers between functions

(Tarondeau & Wright, 1995), thus increasing efficiency and potentially increasing the likelihood of generating valuable new knowledge. Cross-functional integration is also seen as a major contributor to the reduction in product development cycle time. Empirical evidence indicates that better integration of business processes in the value chain such as research and development, manufacturing and sales can lead to products and services that are more attuned to the market (Clark & Fujimoto, 1991). Results show that a firm using cross-functional teams obtains a more effective new product development process and a higher percentage of new products that are successful in the market. Effective cross-functional integration facilitates iterative learning and could potentially improve customer-orientated focus (Valle & Avella, 2003). Most of the time, achieving some degree of cross-functional integration and cross-functionality is a desirable state. However, it is worth noting that change towards cross-functional integration and cross-functionality can be seen as very disruptive. A too tightly coupled organization would have great difficulty in adapting to its environment (Lawrence & Lorsch, 1969).

Achieving cross-functional integration and cross-functionality appears to be far from being simple and easy. Integrating a multitude of organizational processes and technologies requires significant organizational efforts and resources (Markus & Tanis, 2000). Several barriers to cross-functional integration exist in the firm (Hitt *et al.*, 1993). Cross-functional integration violates, in its logic, the classic management principles: functional specialization. Moreover, achieving some degree of cross-functional integration does not mean that cross-functionality is really perceived. Differences between functions and personal cultural differences (Lawrence & Lorsch, 1969) play a role in the way work processes are interpreted even though there is some degree of cross-functional integration. The presence of distinct frames of reference among people who work in different functions, as manifested by their individual cognitive biases, can lead to conflicting expectations and decrease productivity. Power and political considerations are also likely to interfere with cross-functional integration (Markus, 1983). Some managers might feel that cross-functionality could be a potential threat to their functional territoriality and could be seen as a way of reducing their organizational power (Crozier & Friedberg, 1977). However, cross-functionality may help understand better the perspective taken by other functions (Boland & Tenkasi, 1995), develop a more collective sense of belongingness and facilitate the reduction of cross-functional conflicts by ensuring political correctness (Hutt *et al.*, 1995; Huang & Newell, 2003).

Cross-functional integration is a foundation of ERP systems. The implementation of ERP systems typically requires that cross-functional languages and terminology of an organization be standardized so that a common, organization-wide database can be built. Conversely, standardization through ERP leads theoretically to the establishment of one common language and the management of different types of interdependencies between organizational actors (Klaus *et al.*, 2000). By allowing efficient and effective communication across functions, ERP systems enable managers to better understand the business processes that run through the different functions of an organization and, in so doing, facilitate organizational integration. ERP systems facilitate a reflective conformity (Volkoff *et al.*, 2004) and the cognitive integration (Beretta, 2002) of other functions. However, we contend that the development of cross-functionality, as a perceived phenomenon, depends on how the system is implemented by those companies.

Towards a theory of the effects of ERP implementation strategy

Cross-functionality: a new vision of the organization

In the cross-functional organization, information flows between services and functions without passing through hierarchical channels. It no longer structures activities according to the task or skill-based logic on which functions or job functions are based, but follows a logic of customer-orientated final objectives. By their very nature, ERP systems match this approach. As an organizational approach, ERP therefore comes very close to delivering the cross-functional co-ordination so sought after by companies. However, this presupposes that the decision-makers involved have defined an organizational vision prior to implementing the ERP solution. In this very complex type of project, the support and involvement of senior executives from the earliest phases are seen as key factors for success (Nelson & Somers, 2001).

Specifically, the role of the top management team is no longer restricted to deciding whether to go ahead with an ERP project, but it is also to participate in the design and conception of the future organizational model (Besson & Rowe, 2001). These new roles, at the heart of the decision-making process, are not fully assumed and are often delegated to the people responsible for the management of the project. The 'organisational drama' seen at the company Met-alica (Avital & Vandenbosch, 2000) after the implementation of an SAP package was down to a lack of implication on the part of the top management team both at the needs definition stage and during the conception of the future organization, and this despite very firm support for the project. How can the implementation of an ERP package be successful if the company does not know what it is trying to achieve? (SAP is the name of the well-known software company and the software itself. This multi-module application software helps manage the important parts of firm business.)

Therefore, within the framework of an ERP project, the definition of the desired organizational vision consists of clearly outlining the future organization and the direction that the people involved in the project should take to achieve their aims (Collins & Porras, 1996; Lipton, 1996). This strategy of targeting a future organizational model conditions the progress of the project and becomes final during the parameter setting and configuration of the ERP (Bidan *et al.*, 2002). The definition of this vision answers several questions: What will the future organization of the company be with ERP? What organizational bounds are concerned? Which processes need to be re-configured? How can the coherence as a whole be guaranteed? Two key points need to be taken into consideration:

- 1 The principles of ERP information integration (Rowe, 1999) and its organizational logic are based principally on management by process. This cross-functional logic, much sought after by companies, manifests itself by surpassing the hierarchical functionality of the organization with a modelization based on the value flow rather than authorities flow and an organizational formalization of the underlying levels of interdependence in the ERP.
- 2 The management concepts put forward by the ERP must be compatible with those that the company wants to put in place to fit its strategy (Bancroft *et al.*, 1998; Hong & Kim, 2002). The

specific requirements and demands of certain activities render the adaptation to local norms of ERP programmes difficult.

The replies to these questions establish the bases on which the implementation process will be built; they identify the principal stages through which the ERP will go. As a consequence, they define the resources and the technical and organizational competences (identification of key users, choice of consultants, actions to be put in place during the changeover, people to be trained, etc.) necessary for the capitalization of the potential ERP integration and to achieve a greater level of cross-functionality (Markus & Tanis, 2000). These actions and decisions prepare and condition the second phase, which consists of outlining the processes on which the company will work.

Cross-functionality: one result of process re-engineering

In an ERP project, the term integration means two things: it refers both to technical integration (Bidan, 2004) and to the integration of this system in the very operations of companies. The second meaning assumes a fit between the organization of the firm and the operational logic of ERP programmes. In organizational terms, it is therefore important to carry out preliminary work on the organization and understand the existing process to ensure that it will be capable of 'absorbing' the new technical systems (Orlikowski, 1992). The business process re-engineering (BPR) approach, popularized extensively in recent years, is one of the techniques that allows the review of business processes and operations in order to achieve improvement. The BPR approach (Hammer & Champy, 1991; Al-Mashari & Zairi, 2000) proposes to eliminate the greatest number of intermediaries at different levels of the company in order to speed up access and information exchange time. It also aims to change work methods.

Several studies have demonstrated that the implementation of ERP systems requires examination of many business processes (Bingi *et al.*, 1999; Robey *et al.*, 2002), and it is vital for the company's processes to be accurately aligned with those of the ERP system if the full benefits are to be realized. The frontiers of which comes first, BPR and then ERP, or ERP and then BPR, are not well defined in most cases (Esteves *et al.*, 2002). However, the literature often suggests a firm should start an organizational process re-engineering before ERP configuration (Bancroft *et al.*, 1998; Nah *et al.*, 2001).

A BPR intervention is not merely the adaptation of an ERP system or the business processes of an organization; it implies changes in the way of doing business as well as in the structure and culture of an organization; it is changing the way of working of an organization and process-orientated vision that organization needs to integrate. In order to achieve this objective of a cross-functional vision of the operations of the company, companies have to manage double stakes:

- The breaking-up of their hierarchical structure, organizing themselves by process and/or adapting the processes to those of the ERP and, above all, dealing with interdependences (Rockart & Short, 1995).

- Having common base processes for the group of units (a single operations procedure for the level of the targeted area) and to set them up as standard processes. This process reconfiguration phase can be very conflictual in the sense that there is a dual process of confrontation of internal operating methods (between units) and external methods (with the best practices of the sector).

Furthermore, if companies want their ERP system to support a more cross-functional vision of the company, should they not then conduct a process re-engineering project beforehand?

Cross-functionality through the scope of the ERP modules

From the literature concerning computing integration (Alsène, 1994) as a vector for cross-functionality, three key points can be retained:

- A process-based approach for management flows based on a sequential interdependence of units working towards the creation of goods or a service: the output (physical or information) of upstream units becoming the input of downstream units.
- An approach based on pool interdependence: the functions share a common database. This information sharing is a necessary but not unique condition for the improvement of client service.
- A new approach of 'global' management. This implies that each person acquires a wider vision of the company. People learn to work together and not in a sequential and separated manner. This assumes that they take into account the reciprocal relationships of interdependence in their way of working (Lozzi *et al.*, 2000).

However, this cross-functional vision of the company based on these three forms of interdependence (Thompson, 1967) cannot emerge if the organization remains stuck in a functional configuration supported by a patchwork of additional systems. The implementation of the ERP through the entirety of its modules will therefore provide the opportunity to get the users out of their functional silos and to give them a cross-functional view of the organization.

Selected at an early stage by the top management team as part of arriving at an organizational vision, the organizational perimeter of the ERP project provides a fair idea of the scope of the changes to be made. Where the scope of the ERP modules implemented is wide and takes in almost all the company's functions and departments, the ERP project assumes a strategic importance and leads to profound change (Parr & Shanks, 2000). At this stage, change becomes inevitable and process re-engineering is often embarked upon in order to maximize the benefits of integration. The multiplicity of people involved and the increasing interdependence between selected modules makes the project extremely risky, both technically and organizationally. On the other hand, where ERP is chosen to cover a number of support functions connected with standard processes, the strategic considerations become secondary and the scope of future change is narrower.

Through the various forms of interdependence that it introduces, ERP encourages a cross-functional approach to organization which takes the user out of his functional silo in direct

proportion to the extent of ERP coverage. The wider the integration perimeter is chosen, the greater the perception of cross-functionality becomes.

Cross-functionality and speed of deployment

There are two basic implementation strategies that may be adopted: the 'big-bang' or the progressive option (Boudreau, 1999). Progressive implementation proceeds module by module and/or site by site. Conversely, when a company decides to go for Big Bang implementation, it elects to implement simultaneously all the ERP modules on all sites. The financial risks inherent in such a complex project and the interdependence of the modules involved demand rapid implementation in order to maximize the benefits of process integration (Beretta, 2002) and avoid a multiplicity of temporary interfaces and all the other problems connected with introducing organizational change progressively.

Moreover, it will be easier to make users aware of the organizational effects of ERP in terms of greater cross-functionality if the implementation strategy is introduced rapidly (Adam & O'Doherty, 2000). They will be obliged to take a cross-functional overview quickly and at an earlier stage in order to use ERP without causing major problems.

Within the perspective of progressive implementation, the organization of the company is by definition unstable: the sequential setting up of selected modules destabilizes company processes in the short and medium terms, the operating procedure of each person and the learning processes undergo change continually. Notably, these detrimental effects on the ERP operations and the company organization oblige ERP users to go to greater lengths: to assimilate correctly the functionalities of the first modules installed, to prepare for the arrival of new processes (with the widening of the implementation perimeter) and new functionalities (with increases in future versions), and to understand the interactions that link them to the applications of the other functions of the company. Presented this way, such situations very quickly become complex and difficult to manage because 'it is impossible to anticipate the interactions inside a technical system (tools, data, procedures), inside a social system (individuals, group trade, entity), and between the two systems' (Bouillot, 1999, p. 102). Above all, they make the cognitive and managerial integration process that cross-functionality is based upon even harder.

Hypotheses

We have assembled a set of hypotheses for testing, based on our review of existing literature on cross-functionality and ERP (Figure 1):

- **H1:** Defining an organizational vision promotes a more cross-functional overview of the company.
- **H2:** The process of re-engineering promotes a more cross-functional overview of the company.
- **H3:** The larger the scope of the set of ERP modules implemented, the more cross-functionality is likely to be achieved in the firm.
- **H4:** Faster implementation promotes a more cross-functional overview of the company.

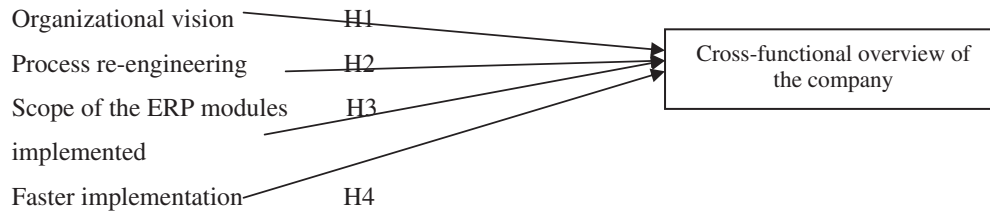


Figure 1. Research model.

METHODOLOGY: A QUALITATIVE AND QUANTITATIVE APPROACH

The research described in this paper adopts both a survey based on quantitative methods and case studies that were used to complement each other (Kaplan & Duchon, 1988; Gable, 1994) to investigate the effect of ERP strategy implementation on cross-functionality. This *complementarity* in IS research was suggested by different researchers who argued that much could be gained from collecting both quantitative and qualitative data in the same research effort (Jick, 1979; Mingers, 2001). Van de Ven (1992) mentioned that different dimensions of changes occurred and measured by the survey could be complemented by interviews to understand more deeply how these changes occurred.

In this research, we first began with qualitative method by conducting a series of interviews. We then developed the survey questionnaire for the quantitative approach. The design of our questionnaire greatly benefited from the case studies, which provide the basic understanding for setting the questionnaire. In turn, results collected are discussed through prominent cases. This research can thus be considered as primarily a quantitative exploratory approach in which case study analysis was done for survey determination. The cases were then subsequently re-analysed with a few subsequent interviews to understand better the implications of the quantitative results.

Qualitative approach

Case study approach is particularly well suited to IS research especially when the phenomenon is broad and complex (Yin, 1994). We believe that it is important to use the case method across a number of organizations to capture such process dynamic of ERP effects. The effects of ERP systems depend on a complex network of factors and therefore require a sufficient understanding of the context of each firm.

Selection of cases

We identified a number of companies with more than a single ERP module in the post-implementation phase so that users could tell us about their perception of what has been accomplished and changed. Hence, we choose the cases of Air France, Renault, Salins du Midi, Gruau and RBL (Table 1).

Table 1. Case studies characteristics

Firm	Sector	Size	ERP vendor	Modules implemented
Air France	Air transport	72 000	SAP	FI, CO, MM, HR
Renault	Automotive	140 000	SAP	FI, MM, HR, PP (Baan)
Salins du Midi	Salt	2 700	SAP	FI, CO, MM, SD, PP, BW
Gruau	Customized vehicles	800	Baan	MM, PP, SCM, SD, FI, CO
RBL	Plastics industry	140	MFG Pro	MM, FI, CO, PP, SD, QM

ERP, enterprise resource planning.

Data collection and analysis

Most of the empirical data from cases studies were collected from May 2001 to December 2001. But some interviews occurred in 2003 in all companies rechecked some of our findings. Data were collected at different levels in order to have different points of view: end users (accounting, logistics, sales and human resources, control operating) and key users who participated to the ERP projects and senior/mid-level managers. Those people have sufficient information about organization background, implementation process and organizational changes that occurred.

The data were collected using a number of techniques including semi-structured and unstructured interviews, reviews of company and project documentation. All interviews were conducted at a company site.

An interview guide was used. It was divided into three sections: top management [chief information officers (CIOs)s and managers], team project and end users. It consisted approximately of 110 semi-structured, open-ended questions designed to get answers about the ERP project, critical factors in each phase and the impact of ERP on the different dimensions of organization. Interviews were approximately 2 hours in length. Reading a brief statement about the research and the purpose of the interviews opened each interview session. During the interviews, care was taken to avoid asking additional questions that might bias the responses. Additional unscripted questions were asked, primarily to ensure that the interviewer understood a person's input or to help get the discussion started again after period of silence.

The number of interviews held varied as is indicated in Table 2. Thirty-four participants were interviewed from Air France, 10 from Renault, 6 from Salins du Midi, 11 from Gruau and 10 from RBL.

All the data from interviews were analysed and cases were written. From those cases many examples were taken to illustrate and explain the results of the statistical tests.

Quantitative approach

No quantitative study has yet addressed these issues in the French context, and we know that the French context is specific (Besson & Rowe, 2001) and is characterized by a very high uncertainty avoidance (Hofstede, 1991). Managers both fear uncertainty, especially the managerial risk associated to ERP systems, and welcome this new tool for controlling.

Table 2. Summary of data collection, techniques and sources from case studies

Level of data collection	Actors		
	End users	Project team	Senior/mid-level managers
Data collection	Semi-structured interviews, electronic documentation review	Semi-structured interviews, unstructured interviews, electronic documentation review	Semi-structured interviews
Interview topics	<ul style="list-style-type: none"> • Work organization before and after ERP implementation (the way work was organized, task and process integration); • Use of ERP (functionality, access to data, main benefits and problem faced with ERP, etc.); • Interactions and work; interdependences, cross-functionality. 	<ul style="list-style-type: none"> • Review of project history; • Explanation of different phases of Markus & Tanis (2000) model and factors identified; • Organizational and technical background of the project; • Impact of some factors on cross-functionality. 	<ul style="list-style-type: none"> • Review of project history; • Managers' perception of ERP; • Cross-functionality overview.
Number of respondents			
Air France	20	8	6
Renault	4	3	3
Salins du Midi	3	2	1
Gruau	4	4	3
RBL	6	2	2

Sample and data collection

The population of our study was the group of Club Informatique des Grandes Entreprises Françaises in France for large companies and a sample of small and medium-sized enterprises (SMEs) for which the university has key contacts. The survey questionnaire was pre-tested by several types of respondents (three project managers, two consultants and three key users) to check its validity. It was posted and sent by email, in January 2002, to a population of 223 SMEs and 116 major companies. We asked the project managers, the CIOs or the chief financial officers to answer the questionnaire. In April 2002, we received 177 responses. The responses were gathered from ERP project managers, the CIOs, chief executive officers (CEOs) and functional managers at a time when the individuals involved were best informed about the process and consequences of their companies' ERP projects (Table 3).

Answers were then coded and extensively checked for validity. All answers whose validity seemed dubious were discarded. Only 100 questionnaires, 55 of them from SMEs and 45 from major companies, were considered for the purpose of this paper, as 77 questionnaires had not adopted an ERP system.

The questionnaire used for the survey listed 62 questions and was designed to capture the impact of ERP implementation on organization and cross-functionality. It was divided into four parts:

Table 3. Quantitative respondents' profiles

Respondents profiles	Number of respondents
CIO	39
CFO	11
CEO	22
Project manager	19
Others	9
Total	100

- The first part took the form of a general introduction describing the characteristics of respondents and their companies, the type of ERP package installed and the deployment methods used.
- The second part included a series of questions on the organizational functions addressed by the ERP system, the methods used for the re-organization and formalization of processes and the organizational changes observed in the functions concerned subsequent to the introduction of an ERP module.
- The third part aimed to evaluate the relative contribution made by ERP systems to the flexibility of the company, as well as the flexibility shown by the software package itself.
- The fourth and final part set out to analyse the effects of ERP introduction on the way work was organized, i.e. changes to task content, the distribution of tasks within and between departments and changes in user opinions.

Some questions contained in the first, second and fourth parts were designed to test our hypotheses. The resulting data were analysed using SPSS statistics processing software. The analysis of data was limited to the use of well-known standardized methods of statistical analysis such as correlation analysis and analysis of variance (ANOVA). The presentation of the statistical tests, some of them support the hypotheses and others not, will be illustrated in the following section with examples derived from the case studies realized during our research in the French context.

The construction of the cross-functionality variable to be explained

To build a reliable indicator of cross-functionality, we began with general discussions about the topic with 67 participants of the eight case studies. From this elicitation about cross-functionality, we were able to formulate five questions in the survey closely linked to the concept. During the pretest of the questionnaire, we paid particular attention to these five points. The three pre-test respondents did not have particular problems with questions, although we admit there might be some bias because our respondents are both users and designers. Although they were asked to give the point of view of users in general, their role could bias the answers towards a higher degree of cross-functionality. Therefore, the answers were certainly influ-

enced by the kind of users, e.g. project managers had to deal with their own views on cross-functionality, etc. We do believe these questions and questionnaire were seriously taken by them, as can be seen from the extensive hand-written comments we received on top of the answers. No returned questionnaire mentioned a particular difficulty with these questions. We then took the five questions from the questionnaire and used a five-point attitude scale, ranging from *Completely agree* to *Completely disagree*, to address the change in user opinion as perceived by the respondent'.

- Question 50: *In your opinion, ERP users have a broader perspective of their department.*
- Question 51: *In your opinion, ERP users have a broader perspective of their company.*
- Question 52: *In your opinion, ERP users are more aware of the transverse character of cross-functional processes.*
- Question 53: *In your opinion, ERP users are more aware of the effect their actions may have on the work of others.*
- Question 54: *In your opinion, ERP users believe that they have a single system of reference.*

A reliability analysis of the first three items was then made by using Cronbach's alpha coefficient. The result obtained was 0.92. The alpha coefficient values obtained from the other combinations of these items, i.e. groups of three, four and five, ranged from 0.40 to 0.80. Given the number of items (three) and scales (five) used, we have retained only items 50, 51 and 52 in constructing the cross-functionality indicator (cross-functionality).

The cross-functionality indicator therefore groups the values (0–4) for each item and may assume values of between '0' (low level of cross-functionality) to '12' (high level of cross-functionality) (Figure 2).

The mean obtained for the cross-functionality indicator among the 100 companies in our sample is 6.99, with a standard deviation of 2.94. We note also a modal value for the indicator of nine and a median of eight.

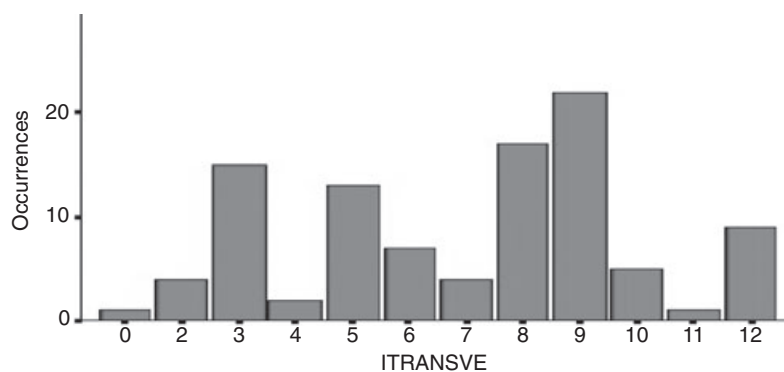


Figure 2. Frequency diagram for the cross-functionality indicator.

The construction of the independent variables

We present the independent variables obtained from the results of single criterion breakdown, which enable us to test the scope of change within company functions and the degree of cross-functionality brought up with the introduction of an ERP system.

The organizational vision Question 11: *Was the implementation of your ERP system guided by the definition of a targeted organizational vision by the top management team?*

Results presented in Table 4 show that nearly two-thirds of the companies had defined an organizational vision in advance. This task was the main preoccupation of top management and its form differed depending on the context: companies decided to centralize or decentralize their organizational structures as part of harmonizing their processes.

Process re-engineering Question 16: *Have you redefined your processes to adapt them to those offered by your ERP system?*

Approximately two-thirds of the respondents said that they had undertaken a widespread redefinition of processes (Table 5). In most cases, this reconfiguration of processes was undertaken as part of aligning the company's processes with the organizational model offered by the ERP system. Other companies were obliged to redefine their processes given the nature of the way ERP works and the interdependence of the modules installed. We also noticed that companies had to have an organizational vision to guide their process re-engineering (cf. Appendix 1).

The scope of the ERP modules implemented Question 2: *Which are the main modules already installed?*

From this question we have calculated the number of modules installed (the scope of the ERP modules implemented). In fact, a list of modules was proposed: *accounting, finance, production, procurement, logistics, sales, human resources, project management, maintenance, others*. For each item, the respondent could indicate whether it was implemented and, if not, whether it was planned or even envisioned. Hence, Table 6 presents the number of modules installed.

At the time of the survey, five companies had yet to complete their ERP implementation, which explains the size of the sample (95) tested in respect of this variable (cf. Table 6). This variable is distributed relatively evenly, with an average of 4.62 modules installed.

Table 4. Frequencies of the organizational vision variable

Organizational vision	Yes	No	Total
Frequency	61	39	100

Table 5. Frequencies of the business process re-engineering variable

BPR	Completely	Widely	Moderately	Slightly	Not at all	No response	Total
Frequency	1	62	28	8	0	1	100

Table 6. Frequencies of the scope of the enterprise resource planning (ERP) modules implemented variable

Scope of the ERP modules implemented	1	2	3	4	5	6	7	8	9	Total
Frequency	7	10	17	13	13	11	16	6	2	95

Table 7. Frequencies of the speed variable

Speed	Big-bang	Progressive	No response	Total
Frequency	47	47	6	100

Table 8. Correlation cross-functionality with business process re-engineering (BPR) and the scope of the enterprise resource planning (ERP) modules implemented

	Pearson's correlation (<i>r</i>)	Significance (<i>P</i>)	Sample size (<i>N</i>)
BPR	0.279*	0.005	100
Scope of the ERP modules implemented	0.288*	0.004	100

*Correlation is significant at the 0.01 level.

Speed Question 8: Which method was used to deploy your ERP?

The results of the survey are presented in Table 7. The companies in our sample opted, in equal measure, for one of the two implementation strategies.

RESULTS AND DISCUSSION

Results of the quantitative study: correlation and ANOVA

For each of our hypotheses, we examined the link between each independent variable and the variable to be explained. The data were analysed using statistical analysis. The Pearson's correlation coefficient² and the ANOVA testing were used. Results of these tests are presented in Tables 8 and 9. Table 8 shows the positive correlation between BPR, the scope of the ERP modules implemented and cross-functionality.

The results of the one-way ANOVA are presented in Table 9. The values obtained are significant and show that organizational vision and speed exert significant influence on cross-functionality.

For ANOVA test, two groups were tested (big-bang and progressive for speed; yes or no for organizational vision). The mean value results (cf. Table 10) indicate that the organizational vision (7.66) and the speed of implementation (7.79) have a significant impact on cross-functionality. In addition, these two variables are independent (cf. Appendix 1).

²Correlation is a statistical technique which can show whether and how strongly pairs of variables are related. There are several different correlation techniques; the most common type is called the 'Pearson'. The Pearson's correlation coefficient is a measure of a linear association between variables and reflects the degree to which the variables are related. Pearson's correlation technique works best with linear relationships; it does not work well with curvilinear relationships.

Table 9. Analysis of the variance of the organizational vision and the speed and the cross-functionality indicator

	SS	d.f.	Mean of squares	F	Significance
Cross-functionality between groups	69.322	1	69.322	8.625	0.004
Organizational vision within groups	787.668	98	8.037		
Total	856.990	99			
Cross-functionality between groups	58.255	1	58.255	7.245	0.008
Speed within groups	739.745	92	8.041		
Total	798.000	93			

SS, sum of squares.

Table 10. Descriptive statistics of the organizational vision and the speed

	N	Mean	Standard deviation	Standard error	95% Confidence interval for mean	
					Lower bound	Upper bound
Yes	61	7.66	2.5	0.32	7.01	8.3
No	39	5.95	3.29	0.53	4.88	7.02
Total	100	6.99	2.94	0.29	6.41	7.57
Big-bang	47	7.79	2.48	0.36	7.06	8.51
Progressive	47	6.21	3.15	0.46	5.29	7.14
Total	94	7.00	2.93	0.30	6.4	7.60

Table 11. Cross-functionality mean and correlation with scope according to speed and organizational vision

Organizational vision	Speed	
	Big-bang	Progressive
Yes		
Sample size (N)	33	25
Mean	8.27	7
Pearson's correlation (r)	0.456*	-0.021
No		
Sample size (N)	14	22
Mean	6.64	5.32
Pearson's correlation (r)	0.502	0.112

* $P < 0.05$.

In order to check for spurious significance of some correlations, we calculated the means for each subpopulation (cf. Table 11). It appears clearly that, when the top management team has defined an organizational vision prior to ERP implementation in a big-bang approach, cross-functionality is greater (8.27) than when it has not been defined (6.64) or when it has been defined but in a more progressive approach (7). In the two latter cases, cross-functionality is nevertheless much greater than when implementation has been progressive with no organizational vision (5.32). Also, cross-functionality constantly increases with the scope of the project. This result is also statistically significant with the second case.

These statistical tests will be further discussed in the following section through examples derived from case studies.

Case studies illustration

Effect of organizational vision on cross-functionality

H1 is supported [cf. Table 9 ($F: 8.625; P < 0.01$)]: where the top management team defines an organizational vision, users have a more cross-functional overview of the company.

This result confirms a certain number of previous results concerning the implication of senior management and the success of an information technology (IT) project (Nelson & Somers, 2001). On a symbolic level, it is a reminder of how important these projects are such that they are borne by the top management team. Here we come across the classic issues of sponsors and communication concerning the project. On a more pragmatic level, it underlines the role of the top management team that goes beyond the simple role of sponsor to become an actor in its own right in the process of change that it plans to bring about. In this way, by defining future organizational objectives, the top management team assumes its role of entrepreneur as Schumpeter (1934) conceived and is the guarantor of overall coherence of the project. This strategic attribute of senior management in an ERP project has a dual dimension: by defining the strategic and organizational choices, it commits the medium- and long-term future of the company and plays the role of integrator.

In the case of the company Renault, we noticed an absence and a lack of implication on the part of senior management in the conception and design of the future organization during the implementation of the SAP package (FI, HR and MM). This situation contributed to the deviation of the project and the absence of a cross-functional vision on the part of the ERP users. This absence of senior management, notably in its role of entrepreneur, brought about management by programme rather than a global management of projects. This signifies that the project leaders from functional management progressively ignored the organizational issues (definition and boundary drawing of the processes, the degree of cross-functionality, formalization of hierarchical power) that required energy and effort and concentrated on reducing financial, technical and time-related constraints. This 'local' approach, limited to the problems of each functional entity concerned by the perimeter of the project, diluted the project and reduced it to the simple task of technical automation. First, this situation made Renault miss out on the integration potential of the SAP package and, second, it contributed to the fencing in of the organization, taking root in an outdated method of working, and extending old practices defined by a vision limited to local interests and preoccupations while the line taken by the senior management calls out for cross-functional project management. Following this, the increased financial costs, as well as the rise to the surface of certain technical and managerial problems (low user productivity and low SAP performance), lead the top management team to intervene directly and push the functional managers to rectify their positions, notably by insisting on the cross-functional aspects of the process that they had not wanted to resolve previously. This involvement of the top management team manifested itself by consultants being brought in to

determine and evaluate the levers and opportunities of development of SAP. The needs expressed highlighted the necessity of improving cross-functionality in the domain of operation methods of SAP projects and the need to bring together the departments that use SAP.

This example underlines that the lever for integration lies at the top management team level and is thus a necessary, but not a sole, condition in achieving cross-functionality in the case of implementing an ERP system.

Effect of process re-engineering on cross-functionality

H2 is supported [cf. Table 8 ($r: 0.28; P < 0.01$)]: the greater the degree of process re-engineering, the more cross-functional the company is seen to be by users (as perceived by respondents).

If the involvement of the top management team in the first phase of the project is indispensable, the second phase, concerning the outlining of processes, also helps the development of a cross-functional view. Nevertheless, our case studies have shown that the objective is not so much to carry out BPR as the underlying process of this re-engineering phase. In other words, the most important part in this phase of the project are the questions 'How was this BPR carried out?' and 'By whom?'

For the firm Gruau, the stakes of the BPR, in the context of their project to set up the Baan system, were threefold: (1) restructure their process; (2) bring in better operational practices (simplify and optimize); and (3) converge towards more cross-functional operations in terms of interdependence of actions and data flow. To meet these objectives, notably those of users appropriating cross-functionality, two factors were key:

1 The investment of users in the process-outlining phase. This implication took the following form: in order to determine which ERP would be the best suited for this company in terms of processes, a study was carried out beforehand in order to gather from users the different, existing applications, their operating methods and their needs. In the rest of the project, the choice of processes that seemed to suit the functionalities of the ERP system the best was always made after consultation and approval of the key users.

2 The composition of the project team. The CIO took great care in selecting the members of its project team and continues today to rely on them to guarantee correct operations of the Baan system and to make it evolve. The choice made by the project leader concerning the make-up of his team underlines the stakes for social capital in ERP projects (Newell *et al.*, 2002). The make-up of the project team was based on the following selection criteria:

- Their knowledge of the business and their expertise in their field; guaranteeing awareness of the implication of the relationships of interdependence between functions.
- Their length of service which guarantees both knowledge of company operations and the existence of interpersonal relationships at the heart of the company that people can lean on.
- Their ability to speak with other departments and to share information.

Organizational rank and firm position was not therefore one of the selection criteria. At the design office level, no member corresponded to all the criteria other than length of service and

business knowledge; their ability to speak with other departments, especially support departments, was limited. By default the manager was nevertheless selected to represent this department. However, the appropriation of the ERP system and its cross-functional logic was to pose big problems that were eventually overcome by the recruitment of an engineer competent in ERP and therefore aware of the issues of integration. In other words, the emerging process of cross-functionality is in play throughout the life cycle of the project: at the beginning during the setting up of certain regulatory systems like the two presented above, and later on during the 'use' phase.

It is therefore important to underline with this example that the BPR participates in the development of cross-functionality on condition that the process adopted by companies to model activity chains firstly involves the users and secondly that the process is carried out by a project team built from the social fabric of the company.

The Air France case study clearly shows that the implementation of SAP is conservative and limits the breadth of organizational changes, even if, in the short term, the institutionalization of purchasing constitutes a significant change. Previously, purchases were made by those directly concerned in each entity, leading to widely differing practices in each entity. Purchasing management had a limited *ex-post* role, but got the ERP underway in order to restructure the main stages of the purchasing/procurement process and retook control of the act of purchasing. In so doing, the new functional process forces the purchaser to receive purchase requests by electronic message, to approve them and to return them to writer so that he can set the order in motion. The rest of the process consists of receiving the good, the drawing up and paying of the invoice. In other terms, the integration of the IS consisted of redefining the interdependent relationships between departments and purchasing management by transforming interdependences that were sequential and reciprocal in limiting formalized action, and introducing a pool interdependence (a sole purchasing database) that allowed this functional entity to exist as a centre of responsibilities. Presented thus, this form of integration does not question traditional divisions of trades and organization, but on the contrary, tends to reinforce them.

Effect of the scope of the ERP modules implemented on cross-functionality

H3 is supported [cf. Table 8 ($r: 0.29; P < 0.01$)]: the greater the number of modules installed, the more cross-functional the overview perceived by users.

One of the reasons often put forward by decision-makers in order to justify the choice of an ERP system is the desire to simplify the complexity of their IS that has been created from the multiplication of local applications independently developed by each entity (functional, services, sites) in response to their needs. By adopting an ERP system, companies try to both select the best practices, whether they be internal or external, and make them a standard process in order to improve visibility of who does what and how. It is this desired visibility that can, under certain conditions, and notably in a wide perimeter of integration, improve the cross-functional vision of users of the operations of the whole company.

In the case of the Salins du Midi, the implementation of nearly all of the modules allowed users to have a better view of interdependence flows driven by the ERP system [sequential,

pooled and reciprocal (Geffroy-Maronnat, 2002)], favouring a more cross-functional view of the organization. Seven SAP modules were implemented (SD, MM, PP, PM, FI, CO) and the firm has just finished integrating the CRM module from the same publisher. (Customer Relationship Management, CRM, is a software that helps an enterprise manage customer relationships in an organised way.) The firm's objective is to reinforce its level of information integration and to allow cross-functional management of its activity flows. During our interviews, a user of the logistics' module, whose work consisted of hiring boats for the transportation of salt and who was very reliant on other services (accounts, production, sales, legal), explained to us that he now has a more global vision and disposes of the necessary information to carry out his work. For example, he now looks at stock levels in the SAP system, without calling the production department, in order to know whether he can respond favourably to orders sent by customers. This cross-functional operation was impossible under the old system and took more than two people to achieve it. The integration of all these processes around a single database brought, according to him, a sole reference point that encourages the use of a common language and the sharing of a common, coherent vision of the process of dealing with information. We also noted during different case studies that this cross-functional vision leads to increased vigilance on the part of users, reinforced by a traceability driven by the ERP system.

In this context, the organization is no longer split into major functions but into the macro-processes that cross over it and that call upon several departments. The same situation was noted in the firm RBL, following the implementation of five ERP-MFG Pro modules. The strategy used by this firm clearly consisted in improving response time to clients (for quotes, production lead times, etc.). Until now this direction of competition was held back by stretched flux management and weaknesses in the existing computerization corresponding to the non-integration of IS hindering the flow and treatment of information. Quotes were given by the industrialization office whereas orders were taken by the sales department. Tooling and subcontracting were dealt with by production and invoicing, and statistics were the responsibility of the accounts department. The objectives of the ERP implementation were to have a global and coherent IS built around a unique database accessible to all of the departments and to improve its reactivity. Thanks to this form of pool interdependence, the company reduced the number of operations necessary to find information, the number of phone calls and the amount of paper being circulated.

But this global approach of IS integration via the scope of the ERP modules implemented is conditioned by the capacity of the company to bring out the cognitive and managerial dimensions of cross-functionality (Beretta, 2002). The example of the company Gruau shows that ERP is a base for cooperation and cross-functionality and allows players to have an improved mutual awareness of constraints, managerial objectives and means of action. A technician explained that Baan was, above all, in his position, '*a tool for managing costs and resources for his workshop planning*'. If manufacturing orders, sent by the planning department via the ERP system, surpass the work plan of the workshop that is on the ERP database, the technician 'negotiates with his colleagues in charge of planning in order to find a solution satisfactory to both parties'. The interactions between these two departments are made easier as they use the same language based on that of the ERP system. As this example shows, the

relationships between departments are not structured by constraints formalized by the ERP system but by integration modalities based on negotiation and shared agreements.

This cognitive and managerial integration, indispensable to the emergence of cross-functionality, only makes sense if the users grasp it. It is therefore important to mention that the existing relationship between the scope of the ERP modules implemented and the emergence of cross-functionality does not result from technology dictating but from a social background that develops during the project via different systems such as the selection of the project team and the training process.

Effect of deployment strategy on cross-functionality

H4 is supported [cf. Table 9 ($F: 7.2; P < 0.01$)]: The big-bang deployment strategy promotes a more cross-functional overview among users.

This is very clear when we compare the changes at Air France, Renault and Salins du Midi. In opting for a big-bang implementation, the Salins du Midi noticed, after 18 months, the passage from a functional organization to a new matrix-based organization. On the other hand, we noticed a lack of cross-functional vision on the part of the users at the two large companies, Air France and Renault, where the project was marked by a sequentialization and compartmentalization.

In both cases, the choice of SAP was made following requests from the accounting management to replace old tools. Following this the purchasing management expressed their desire to procure a program to back up its processes, the computing management became involved in order to make sure that the SAP module R/3 was adopted. The installation perimeter became progressively wider in both companies with the installation of CO and HR SAP modules at Air France and Renault, respectively. The implementation was carried out progressively; the different projects started separately with independent completion dates. Three significant points characterize these two SAP projects:

- 1 The choice to modernize the IS of accounts and purchasing was the result of individual action and shows the lack of communication and coordination between the two entities. We are confronted with a compartmentalized type of layout.
- 2 Each entity undertook process re-engineering on its own.
- 3 A structure to back up the coherence of project management with a low integration factor. This structure relies on an SAP programme management responsible for the functional coordination of the three subprojects and an SAP centre of competence whose task is to ensure technical coordination. Each subproject leant on an organizational structure led by a project leader with a background in the trade (accounts, management control, HR and purchasing) and leading a team whose members they had chosen.

The details of co-ordination were put in place in each project: meetings were organized to answer 'cross-functional' questions and steering committees gathered every month to approve the options chosen. But in the absence of organizational systems to look after the mobilization and coordination of the different players on the SAP project, the subprojects evolved auto-

mously and the people involved took positions on their functional domain and invested themselves little in the other processes. The cross-functional dimension was absent from conception; the potential integration of SAP remained limited.

CONCLUSION

Very little research in IS has been carried out on cross-functionality. The ERP experiences of the past decade have made it increasingly clear that cross-functionality through ERP is not the subject of enough IS research (Markus, 2000). The cross-functionality research framework presented here can provide a first step in the development of a solid theoretical foundation for ERP research. The results of this research can enhance the understanding of the cross-functionality patterns and the factors impacting it. The basic contribution of this research is:

- to explore the concept of cross-functionality and its measurement;
- to show that ERP projects tend to develop that perception with users from the point of view of designers³ (CEOs, CIOs and project managers) as demonstrated by the results of the survey demonstrate and from the point of view of users themselves as illustrated in the cases;
- but this perception with users depends on various ERP strategy implementation factors, including ERP deployment, BPR, organization vision and scope.

Some limitations relating to this study can be grouped together under two parameters. First, the size of our sample (100 companies) is of average size when compared with the quantitative work published internationally on the subject of ERP. Its structure favoured those responses coming from medium-sized companies. The non-random selection of the individuals concerned causes a bias in the analysis of responses (individualized requests to participate in the survey according to previously defined and supported criteria). However, it is fair to consider the size of this sample sufficient because this is a difficult area, given the sensitivity of the issues addressed and the difficulty of gaining access to respondents, especially because an ERP post is still not a well-established company appointment. Second, the proximity between the various concepts addressed in the questionnaire may have resulted in respondents giving answers that are partially interdependent.

Our findings have several implications for management, e.g. the empirical evidence of this research indicates the importance of the cross-functionality as an effect of ERP implementation. By allowing efficient and effective communication across functions, ERP can lead to a better overall understanding of the multitude of underlying business processes and functions. Providing better and more complete information about the operations of the firm can also allow managers to more efficiently integrate business processes and functions. But a cross-functional vision of the company may be due to a very tight integration of functions which can prove risky with respect to disruptive changes in the environment.

³These different actors are considered as designers by Besson & Rowe (2001); this underlines the change of some roles with respect to traditional IS projects.

We hope that the study will stimulate additional work to better understand the effect of enterprise systems on cross-functionality from the point of view of different actors in the firm. These contributions and results require greater explanation in a number of respects:

- 1 Cross-functionality is examined in the quantitative approach of this research from the point of view of a single participant who is also a user, but merits being examined in greater detail from other users' viewpoint, although this was done in those cases. Future research on cross-functionality requires that the researchers elicit perception from all relevant functions.
- 2 The model could be developed to include additional determinant factors impacting cross-functionality and their respective contributions.
- 3 For instance, the goals pursued by the firms and, notably, that of a more flexible/lateral organization which has been associated with cross-functionality (Galbraith, 1994) and ERP (Wood & Caldas, 2001).
- 4 The life cycle approach taken here is restricted purely to the overall description of ERP issue and should be developed and carried forward as a basis for future research into the progressive effects of increasing the scope of the ERP modules implemented, thus taking account of version upgrades.
- 5 Finally, in this paper we have emphasized the effects of the ERP process on cross-functionality. Conversely, other aspects of organizational context and especially the size of the firm (Mabert *et al.*, 2003) seem important to be taken into account. Therefore, future research on ERP effects should try to take both ERP strategy and organizational context into consideration.

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Biographies

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APPENDIX 1

Table of inter-relations between independent variables

Independent variables	Dependent variables			
	Organizational vision	Speed	BPR	Scope of the ERP modules implemented
Speed	Khi-2 2.881 Sig 0.090	–	–	–
BPR	F: 6.515 Sig 0.000	F: 1.425 Sig 0.162	–	–
Scope of the ERP modules implemented	F: 2.186 Sig 0.030	F: 1.425 Sig 0.190	r: 0.337* Sig 0.001	–

BPR, business process re-engineering; ERP, enterprise resource planning.

* $P < 0.05$.

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