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ERP Implementation and change: towards a cross-functional view

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Abstract

ERP (Enterprise Resource Planning) systems are characterised by particular features such as functional coverage, interdependent relationships, single database and standard management and processing rules; all of which are capable of bringing about various degrees of change within the company and, potentially, encourage a more cross-functional overview of it. However, few quantitative studies have been conducted to measure these effects.

This is the background to this paper, which studied 100 French companies to arrive at the following assessment of ERP adoption. It then goes on to test the relationships between the factors influencing the ERP lifecycle ((preparation (organizational vision, process re-engineering), engineering (specific developments), implementation strategy (functional coverage and speed)), the perception of a more cross-functional overview of the company and, more globally, the scope of the change this technology brings about within the company.

All these factors play significant roles, with functional coverage appearing to be a particularly important consideration, which should be addressed in future research.

Keywords: ERP, cross-functionality, change, functional coverage, lifecycle.

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 and enable profound change to be brought about by "breaking down" functional silos?

It is important to address this question, because the few quantitative studies available to us which have attempted to answer the ultimate question of how ERP systems contribute to business performance have reached negative conclusions (Poston and Grabski, 2001). Our observations of the French² context demonstrate that most companies who say that they have adopted an ERP system have actually adopted only a few modules. It is therefore perfectly possible that the business effects are dependent on the functional coverage delivered by the system and that these business effects come about from a modification of the organizational vision.

This paper has two aims:

- 1- To examine if the implementation (organizational vision, functional coverage, process reengineering, implementation strategy and specific development) of these systems explains the emergence of a more cross-functional overview;
- 2- To evaluate the impact of such implementation in respect of the critical change factors that emerges throughout the lifecycle of these projects.

No quantitative study has yet addressed these issues in the French context and we know that the French context is sufficiently specific (Besson, Rowe, 2001).

In the first part of our paper, we examine the theoretical bases of change and cross-functionality, as well as the ERP literature on which we have formulated our hypotheses. We then proceed to present our methodology. Lastly, the fourth part of the paper presents the test results for our hypotheses.

¹ Special edition of *Systèmes d'Information et Management (SIM)*: ERP/PGI and change, vol.4, no. 4: (1999).

² Observations made as part of a contractual research programme conducted for the French Ministry of Employment's DARES addressing the relative contribution of ERP systems of varying levels of (operational and strategic) flexibility and the effects of introducing ERP systems on the organisation of work and company functions in SMEs and major companies.

1. Change theory, cross-functionality and hypotheses

1.1 Change theory

Within organisational theory, theories of change tend to involve four or so standard ideas concerning the development and change in organisation (Van de Ven, Scott Poole, 1992), a process being defined here as a progression of events over time. These standard ideas differ in terms of their logic and their motors of change. Seen in terms of a lifecycle, the term “change” describes a sequence of events which unfolds in a logical and pre-designed fashion. Conversely, change can also be seen as the result of forces external to the organisation bringing about a kind of natural selection. Moving closer to the social sciences, change may even be seen as a teleological process of enaction, made possible by the involving participants in presenting the action to be taken and redefining the objectives sought or as a conflict-based dialectic process. In the French context, the difficulties encountered with ERP projects – and therefore the problems of change linked to them – have been addressed theoretically on the basis of ideas derived from enaction and conflict typology (Besson and Rowe, 2001). In the American context, the work of Robey et al. (2001) is based on a dialectic reading that takes account of the learning processes related to ERP configuration and the assimilation of new processes. Taking a complementary approach, we intend to return in this article to a closer reading of traditional management literature by identifying the factors that contribute effectively to change. By presenting these factors in a logical fashion and testing them on the basis of a quantitative survey conducted amongst single participants, this reading is similar to viewing change as a lifecycle and may seem simplistic. However, given the current level of knowledge, it seems to us that there is a relatively good understanding of ERP in terms of case studies and that what we lack are truly comparative tests that enable us to explain change.

Many of the threads running through the existing literature on change can be adopted and applied to ERP projects (Boudreau, 1999). We have therefore retained several major contributions.

The work done on innovation in organisations by Leonard-Barton (1988) shows that innovation implementation characteristics are based on implementation strategies which, in turn, determine whether the innovation concerned is accepted or rejected. This outline is probably simplistic, but it effectively highlights the essential characteristics of innovation which are both constraints and choices for managing change in the organisation. The modular and configurable nature of ERP systems makes them inherently divisible innovations and therefore capable of responding to complex implementation strategies. What we mean by implementation strategy is the ability to set limits on those parts of the organisation to be affected by the innovation and the way in which those can be covered. If the level of functional coverage is high, the company will have the option of implementing a divisible technology in progressive stages.

A second major contribution to our research (Gallivan et al., 1994) clearly addressed the debate on the speed of implementation of radical innovations. They stress that in many cases, two quite different questions are confused: the extent of the change envisaged and the speed of the implementation. The vocabulary does not help us here, because according to Quinn (1980), it is normal to distinguish radical change from

incremental change. These two types of implementation strategies both link scope with speed. Radical change would be far-reaching and rapid, whilst incremental change would be a sequence of small steps made at a pace to suit the participants involved and adjusted by mutual agreement. Gallivan, Hofman and Orlikowski (*op.cit.*) demonstrate clearly that radical innovation can be implemented gradually and more widely than one might think and even justify (depending on the context) cases that combine scope and speed of change in widely differing ways.

But would that really be an interesting debate? Wouldn't radical innovation be simply a sum total of small-scale innovations obtained and added according to the principle of divisibility? Some strategies do not meet these criteria for a number of reasons. In practice, some innovations can only produce a beneficial effect when introduced at a certain scale. Just because it is possible to divide it in order to deploy it, it is not necessarily desirable to remain at a preliminary stage of distribution. On the other hand, implementation, even within a closely defined perimeter, has a fixed cost and requires a certain level of effort from the designers and users involved. This effort may, despite the potential benefits of the innovation, result in resistance to change (Crozier and Friedberg, 1977). Typically, ERP systems are affected by this tension between the search for widespread functional coverage in order to gain the expected benefits and the risk of provoking even stronger resistance. In practice, these systems would contribute to establishing the common language or single frame of reference that companies have always dreamed of, as long as the functional coverage is sufficiently extensive (Rowe, 1999). So, the argument over divisibility and, more especially, modularity of innovation as a way of ensuring its success through enabling potentially gradual implementation, seems to lose its persuasiveness where ERP systems are concerned. Or suggest that success would, in this case, be limited to the implementation stage only without progressing to make the anticipated potential gains.

1.2. The application of these theories to ERP

According to the concept of change as a logical progression of stages in which key activities follow one another in sequence, it falls to us to identify as precisely as possible the questions raised by the existing literature on change in the context of ERP system implementation ((transferability, complexity (functional coverage), speed (implementation strategy) and management support)). Schematically, this can be represented by four stages (Markus and Tanis, 2000), as illustrated in figure 1: Chartering, project, shakedown, onward and Upward.

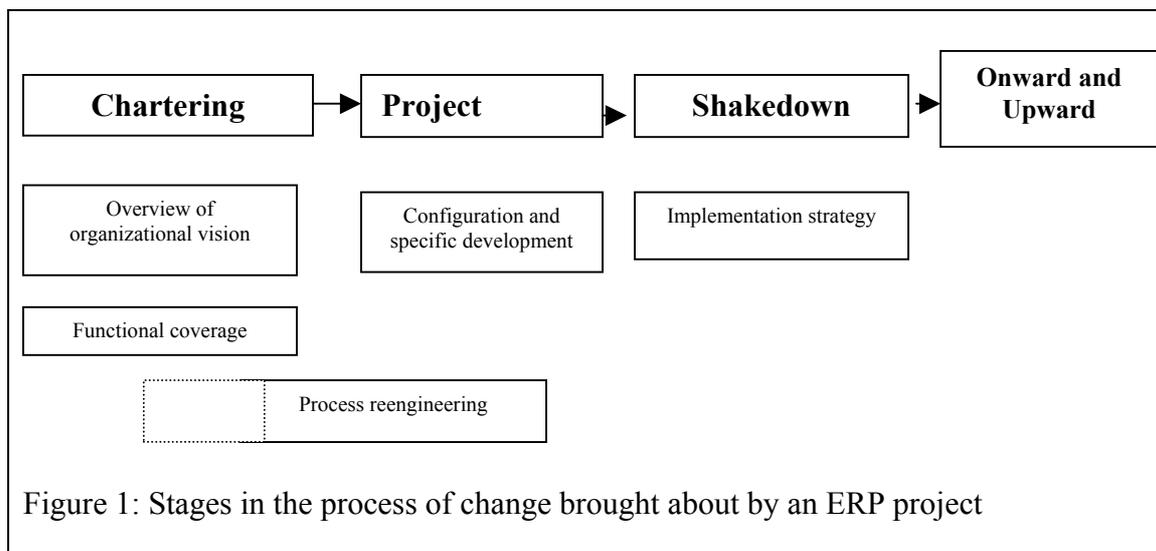


Figure 1: Stages in the process of change brought about by an ERP project

ERP implementation poses the problem of change from two different angles: that of the theory of lifecycles and that of changes in the company's method of operation – the transition from a hierarchico-functional approach to a cross-functional one.

1.3 The cross-functional approach

The topics of horizontal process, inter-functional 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. The literature on cross-functionality puts the emphasis on the precedence of processes over functions and ushers in a new vision of an organisation built around a partition-free horizontal structure and multifunctional/multidisciplinary working teams (Galbraith, 1994).

1.3.1 Cross-functionality: a new vision of the organisation

In the cross-functional organisation, 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 organisational approach, ERP therefore comes very close to delivering the cross-functional coordination so sought after by companies. However, this pre-supposes 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 and Somers, 2001). In practical terms, they must design the organisational model before delegating the task of putting that model into action and handing it over to the technical designers (the project team & external consultants).

1.3.2 Cross-functionality through functional coverage

Selected at an early stage by senior management as part of arriving at an organizational vision, the organisational perimeter of the ERP project provides a fair idea of the scope of the changes to be made. Where functional coverage 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, 2000). At this stage, change becomes inevitable and process re-engineering is often embarked upon in order to maximise the benefits of integration. The multiplicity of people involved and the increasing interdependence between selected modules makes the project extremely risky, both technically and organisationally. 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 organisation which takes the user out of his functional silo in direct proportion to the extent of ERP coverage. The wider the integration perimeter chosen, the greater the perception of cross-functionality becomes.

1.3.2 Cross-functionality: one result of process re-engineering

Over and above the relationship between the choice of a particular technology and the business and organisational objectives targeted, it is therefore essential to carry out preliminary work on the organisation to ensure that it will be capable of “absorbing” the new technical systems. Several studies (Davenport, 1998, Robey et al., 2002) have demonstrated that 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 realised. The literature often recommends starting the process before configuration (Bancroft, 1996). Added to this is the question that 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?

1.3.3 Cross-functionality and implementation strategy

There are two implementation strategies that may be adopted: the Big Bang or the progressive option. 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 all the ERP modules on all sites simultaneously. The financial risks inherent in such a complex project and the interdependence of the modules involved demand rapid implementation in order to maximise the benefits of process integration (Beretta, 2001) and avoid a multiplicity of temporary interfaces and all the other problems connected with introducing organisational change progressively.

Moreover, it will be easier to make users aware of the organisational 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.

1.3.4 Cross-functionality and specific developments

The emergence of the cross-functional organisation has its origins in the development of IT integration (Galbraith, 1994), where the stated objective is to integrate the various functions of the company. The challenge posed by the cross-functional integration is to accomplish what the traditional mechanisms of coordination failed to deliver. However, it should be stressed that the interface type of integration selected by the company can reduce the benefits of cross-functionality by increasing the autonomy for certain functions and runs contrary to the inter-functional collaboration sought through IT integration. Undertaking specific developments is common practice in the context of IT implementation and specifically in ERP implementation (Brehm et al., 2001). They probably deliver operational flexibility by responding to special local needs; nevertheless, they constitute a major restraint on ERP cross-functionality. Is it not true then that, as with integration by means of interfacing applications, specific developments enable interconnections without necessarily providing a cross-functional overview?

1.4. Research model and hypotheses

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

- **H1** Process re-engineering promotes a more cross-functional overview of the company
- **H2** Defining an organizational vision promotes a more cross-functional overview of the company
- **H3** Greater functional coverage promotes a more cross-functional overview of the company
- **H4** Faster implementation promotes a more cross-functional overview of the company
- **H5** Specific developments do not promote a more cross-functional overview of the company.

2. Methodology and results

Our lifecycle approach is based on a fundamentally quantitative method, although it was preceded in 2001 by a qualitative phase which produced eight monographs outlining ERP implementation in the French context (Bidan et al., 2002). The questionnaire listed 62 items and was distributed to a population of 223 SMEs and 116 major companies, all of whom were members of CIGREF (Club Informatique des Grandes Entreprises Françaises). In april 2002, we received 177 responses. 100 questionnaires, 73 of them from SMEs and 27 from major companies, were useable for the purpose of this paper. 77 questionnaires were not used because they had not adopted an ERP system. The responses were gathered from ERP project managers and functional managers at a time when the individuals involved were best informed about the process and consequences of their companies' ERP projects.

2.1 The construction of the Cross-functionality variable to be explained

To build a reliable indicator of cross-functionality, we began by taking five items from the questionnaire and using a five-point attitude scale, ranging from “*Completely agree*” to “*Completely disagree*”. The topic addressed is the change in user opinion as perceived by the respondent.

- Item 49 “*In your opinion, ERP users have a more global overview of their department*”
- Item 50 “*In your opinion, ERP users have a more global overview of their company*”
- Item 51 “*In your opinion, ERP users are more aware of the concept of cross-functionality*”
- Item 52 “*In your opinion, ERP users are more aware of the effect their actions may have on the work of others*”
- Item 53 “*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 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 3, 4 and 5, ranged from 0.40 to 0.80. Given the number of items (3) and scales (5) used, we have retained only items 49, 50 and 51 in constructing the cross-functionality indicator (ITRANSVE).

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

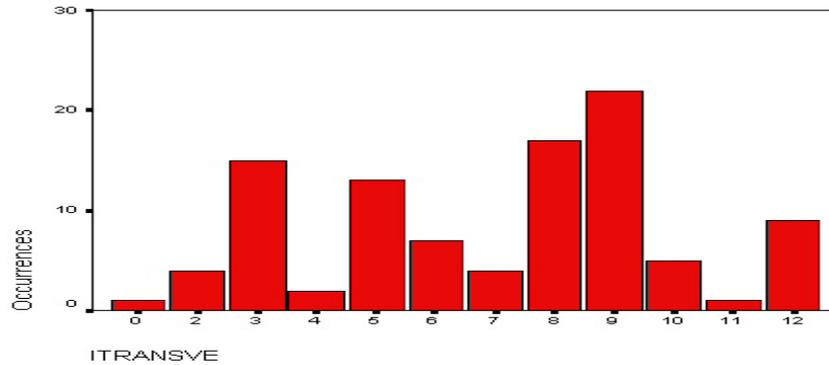


Diagram 1: Frequency diagram for the ITRANSVE indicator

The mean obtained for the cross-functionality indicator amongst the one hundred companies in our sample is 6.99, with a standard deviation of 2.94. We note also a modal value for the indicator of 9 and a median of 8.

2. 2 The construction of the independent variables

At this level, 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 about by the introduction of an ERP system.

2.2.1 Process re-engineering (variable: REDE)

Item 16 “Have you redefined your processes to adapt them to those offered by your ERP system?”

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

Table 1: Frequencies of the REDE variable

Approximately two thirds of respondents said that they had undertaken a widespread redefinition of processes. In most cases, this reconfiguration of processes was undertaken as part of aligning the company’s processes with the organisational 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.

2.3.2 The organizational vision (variable: CIBL)

Item 11 “*Was the implementation of your ERP system preceded by the definition of an organizational vision by senior management?*”

CIBL	Yes	No	Total
Frequency	61	39	100

Table 2: Frequencies of the CIBL variable

Nearly two-thirds of companies had defined an organizational vision in advance. This task was the main preoccupation of senior management and its form differed depending on the context: companies decided to centralise or decentralise their organisational structures as part of harmonising their processes.

2.3.3 Functional coverage (variable: TOTMOD)

Item 2 “*Which are the main modules already installed?*”, from which we have calculated the number of modules installed (TOTMOD).

TOTMOD	1	2	3	4	5	6	7	8	9	Total
Frequency	7	10	17	13	13	11	16	6	2	95

Table 3: Frequencies of the TOTMOD variable

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 5). This variable is distributed relatively evenly, with an average of 4.62 modules installed.

2.3.4. Implementation strategy (variable: DEPL)

Item 8 “*Which method was used to deploy your ERP?*”

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

Table 4: Frequencies of the DEPL variable

The companies in our sample opted in equal measure for one of the two-implementation strategies.

2.3.5 Specific developments (variable: DESP)

Item 37 “*Have you opted for specific developments in order to respond to your company’s management problems?*”

DESP	<i>Not at all</i>	<i>To a limited degree</i>	<i>In several cases</i>	<i>In many cases</i>	<i>No response</i>	<i>Total</i>
Frequency	19	17	36	20	8	100

Table 5: Frequencies of the DESP variable

The companies surveyed had made recourse to specific developments. However, the degree to which this option was taken up varied from company to company.

2.4 Testing our hypotheses

We examined the following in relation to each of our hypotheses:

- the link between each independent variable and the variable to be explained
- the results obtained by multiple and a stepwise regression analysis

The presentation of the statistical tests validating or not the hypotheses will be illustrated by examples pulled from the monographs realized during our research project DARES.

	<i>ITRANSVE</i>
<i>REDE</i>	<i>0.279**</i>
<i>TOTMOD</i>	<i>0.288**</i>
<i>DESP</i>	<i>0.270**</i>

Table 6: (Pearson) correlation between reengineering, functional coverage and specific developments and cross-functionality

Table 6 shows the correlation between the independent variables and the dependent variable (ITRANSVE). The values obtained are significant to 0.01 (bilateral).

	Sum of squares	DF	Mean of squares	F	Significance	
ITRANSVE	Inter-group	69.322	1	69.322	8.625	.004
	Intra-group	787.668	98	8.037		
	Total	856.990	99			
ITRANSVE	Inter-group	58.255	1	58.255	7.245	.008
	Intra-group	739.745	92	8.041		
	Total	798.000	93			

Table 7: Analysis of the variance of the organizational vision and the implementation strategy overview and the cross-functionality indicator

Table 7 shows the results obtained by analysing the variance of the independent variables (CIBL and DEPL) with the cross-functionality indicator.

Hypotheses H1 is validated: the greater the degree of process re-engineering, the more cross-functional the company is seen to be by users (as perceived by respondents).

This statistical result is clearly supported by the case of French company Salins du Midi that has engaged, when adopting SAP package, a large redefinition of its organizational processes. The result of this operation was the adoption of a cross-functional mode of management supported by a new organizational structure conceived around the Autonomous Strategic Units by product division. The adoption of the process vision favored also the decompartmentalization of the organizational structure and the institution of a transverse vision. The SAP users have now a better visibility of the work of other members of the firm. Moreover, even within the competence center, a transverse structure was adopted, including operational managers and members of the IS function, and organized to maintain this logic of cross-functionality and handle the necessary improvements for the future flows.

Hypothesis H2 is validated: where senior management defines an organizational vision, users have a more cross-functional overview of the company. In practice, this means that senior management has set out its vision of the future organisation. This definition is put into practice during the configuration phase undertaken by the project team. It is during this phase of ERP that users begin to perceive greater cross-functionality.

Hypotheses H3 is validated: the greater the number of modules installed, the more cross-functional the overview perceived by users.

The implementation of all SAP modules in Salins du Midi produced an important organizational change and allowed the users to have a better vision of the workflow and of the interdependence created by the ERP (sequential, pool and reverse (Lozzi et al., 2000), favoring a more transverse vision. For example, one user of the logistic module can get easily the products inventory in the SAP system, without calling to production department, to know if it is able to answer or not customer's orders. This operation was long and difficult in the earlier system and took more than two persons. We noted also in others monographs that this transverse vision is translated by an increased attentiveness of the users.

Hypotheses H4 is validated: The big-bang implementation strategy promotes a more cross-functional overview amongst users.

This report is very obvious when we compare changes produced at Renault and Salins du midi. By opting to Big-Bang implementation, les Salins du Midi show clearly their attention to work with a new cross-functional organisation. On the other hand, a progressive implementation of three SAP modules by Renault, a project that started in 1998, did not produce the expected changes and upset the organisation, which until today continues arranging its local processes and structures. This implementation strategy can deform any interest of integration benefits.

Hypothesis H5 is validated: Specific developments do not restrict users gaining a cross-functional overview. The positive correlation the cross-functionality indicator is

unexpected and contrary to our initial hypothesis.

There are two possible explanations for this unexpected result. According to the IS managers and project managers interviewed at the time of writing our monographs, users do not differentiate between specific applications and standard ERP modules. For these users, specific developments are “transparent” and form part of a shared information system. It may also be that respondents have interpreted the term “specific developments” in a wider sense than we anticipated. Such a wide interpretation could include all developments other than ERP modules, thus including truly specific developments alongside interfaces with parts of the information system other than the ERP package. In this latter case, there would be improved IT cross-functionality and therefore a positive correlation between DESP and ITRANSVE.

The main factors contributing to more cross-functional overview (ITRANSVE)

We began with a multiple regression using the TOTMOD (functional coverage), DEPL (implementation strategy), REDE (process re-engineering) and CIBL (organizational vision) variables. We obtained an adjusted R² value of 0.163, with 00 significance. In order to take account of the links between the various independent variables, we then conducted a stepwise regression. The two stages of the model led to the exclusion of two independent variables: process re-engineering correlated with organizational vision, whilst the implementation strategy correlated significantly with functional coverage. Adjusted R² = 0.146, significant to .001. *Thus:*

- *the greater the number of modules installed,*
- *in combination with the definition of a vision organisation by senior management*

the greater the cross-functional overview amongst users.

3. Discussion and general conclusion

All our hypotheses are proven, except that based on specific developments. However, when examined using stepwise regression, only functional coverage and the definition of a vision organisation explain the emergence of a cross-functional overview of the company. Finally, all the tests demonstrate that functional coverage is a factor that should be taken into account in ERP research and, more especially, by those seeking to understand change. This may enable us to go further in analysing the contribution these systems make to financial performance. Another outcome of this research involves exploring the concept of cross-functionality and its measurement.

However, some limitations and reservations relating to this study can be grouped together under two headings.

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 (individualised requests to participate in the survey according to previously defined and validated

criteria). However, given the context of this study, it is fair to consider the size of this sample to be sufficient since this is a difficult area given the sensitivity of the issues addressed and the difficulty to gain access to respondents, who are difficult to identify since their occupation is not a traditional company appointment.

Second, the proximity between the various concepts addressed in the questionnaire may have resulted in respondents giving answers, which are partially interdependent or even self-correlating. To offset this type of distortion, we built the cross-functionality indicator using only those items whose Cronbach alpha coefficient minimise this type of bias (coefficients above 0.9).

These very clear-cut contributions and results require greater explanation in a number of respects:

- 1- Cross-functionality is examined in this research from the point of view of a single participant and merits being examined in greater detail from the user viewpoint.
- 2- The purpose of specific developments should be investigated in order to address any remaining speculation as to their final influence based on the observations of the cases we have studied.
- 3- 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 functional coverage, thus taking account of version upgrades.

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