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ERPs IN SMEs: EX-POST EVALUATION OF SUCCESS FACTORS

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Abstract

In the latest years, the offering of Enterprise Resource Planning systems (ERPs) started to target in part the Public Administrations (PA's) and, above all, the Small / Medium Enterprises (SMEs), both by software multinational corporations and by local software houses.

The introduction of ERPs into SMEs cannot be based on a sheer reproduction of the experiences with larger companies and represents a new challenge with significant peculiarities to be considered. Therefore, it's of particular interest to analyze the operating implementations, in order to identify the success cases, the nature and measure of the benefits obtained and the context- and project-related factors which can influence the chances of a positive outcome.

The research presented here was specifically targeted to the SMEs which already completed the process of adopting an ERP system, with the aim of evaluating these experiences ex-post, by examining some improvement indicators associated with some context and project characteristics.

The results suggest that the ERP introduction is (in an unexpected measure) evaluated as a success and that the benefits obtained are mostly related to the simplification of internal procedures, a much easier information retrieval, an improved performance management and some increase in production efficiency. These results seem mostly related with a wide and deep organizational innovation, and with the type of the chosen ERP producer.

Keywords: ERP, SME, ex-post evaluation, context- and project-related factors.

1 INTRODUCTION

The diffusion of the ERP (Enterprise Resource Planning) systems in large and medium-large companies has been, by large, the most relevant phenomenon in the Information Technology (IT) sector since the nineties (Markus *et al.* 2000a), with a history spangled with success cases, but also disseminated of a large number of failures (Kim *et al.* 2005, Davenport 1998).

In the latest years – also as a consequence of the primary market saturation and the limited substitution rate of these systems, due to their characteristics – the ERP producers targeted in part the Public Administrations (PA's) and, above all, the Small to Medium Enterprises (SMEs) (Costa & Gianecchini 2006, Tagliavini *et al.* 2002, Holland *et al.* 1999). Beside the software multinationals traditionally active in the ERP segment, the opening to the SMEs has seen the appearance of some local software houses (Costa & Gianecchini 2006), which sell products of minor complexity and lower cost – that someone suggested to call "light ERP" (Schubert & Leimstoll 2004, Inghirami 2004) – with offering approaches rather different from those of the larger operators.

The introduction of ERPs into SMEs cannot, however, be based on a sheer reproduction of the experiences managed in the larger companies and brings in significant peculiarities that must be explored. On the one hand, also the smallest companies, in order to maintain their competitiveness, must attempt to reduce costs along the whole value chain, to shorten the procurement cycle, to minimize the inventory levels and to increase the product quality. On the other hand, they are seldom ready to adopt systems that promise solutions to all these issues, but appear complex and often designed and proposed in order to comply with the characteristics and needs of a large company.

Therefore, it's of particular interest to analyze the implementations of integrated systems already fully operating, in order to identify the success cases and the context- and project-related factors which could influence them, assuming that the diffusion in the SME segment represents a new challenge for ERPs.

The research presented here was then specifically targeted to the SMEs which already completed the process of adopting an ERP system, with the aim of evaluating such experiences ex-post. Fifty SMEs were involved in the research and their managers were asked to globally evaluate the ERP introduction and to specify the nature and measure of the benefits obtained. The evaluations were then related to some distinctive context and project elements, which were supposed to potentially influence the outcome of the ERP introduction.

In short, the results of the research seem to provide some interesting indications on the characteristics of the ERP introduction projects and on the benefits more often obtained, which are mostly related to the simplification of internal procedures, a much easier information retrieval, an improved performance management and some increase in production efficiency. These results are related with the managing of projects which included a wide and deep organizational innovation, and with the type of the chosen ERP producer, whose know-how, dimension and behaviour seem to influence the quality of outcomes (Al Mashari *et al.* 2003).

After a brief review of the main literature on the ERP field and of the implications for SMEs, the theoretical framework assumed in the research will be discussed, together with the research questions and the methodology adopted. Then, the results of the analysis of the collected data will be presented and, finally, the conclusions, together with some limitations and the possible extensions of the research, will be exposed.

2 THEORETICAL FRAMEWORK

ERP systems have been the subject of a huge amount of studies (ample and categorized bibliographies are in: Esteves & Pastor (2001), and Møller *et al.* (2004)) that, under various theoretical perspectives,

dealt with aspects like: characteristics, adoption and implementation processes (Nandhakumar 2004, Butler & Pyke 2003), favourable elements in the context (Sammon Adam 2004), project design and/or execution (Laframboise 2002), organizational impacts (Holland *et al.* 1999, Westrup & Knight 2000), forecasting of the probability of success (Magnusson *et al.* 2004), future outlook (Markus *et al.* 2000a), extension towards e-commerce (Schubert & Leimstoll 2004, Kempainen 2004, Schubert 2003). Recently, accordingly with the new targeting of the offer in the direction of SMEs, a certain number of researches in various countries dealt with the access of the ERP systems in this segment, with the aim of pointing out specificities and differences in comparison to largest companies, in terms of pre-conditions, project behaviours, results achieved (Costa & Gianecchini 2006, Buonanno *et al.* 2005, Compagno *et al.* 2004, Caruso & Marchiori 2003, Tagliavini *et al.* 2002, Ravarini *et al.* 2000, Equey & Rey 2004, El Amrani *et al.* 2003, Beck *et al.* 2002).

The ERP systems challenge to integrate structures, processes and individuals by means of technology (Costa & Gianecchini 2006, Martinez 2004, Light & Papazafeiropoulou 2004) takes a partially different character in the case of SMEs. The dualism of the ERP between flexibility (in the planning phase) and rigidity (in the running condition) (Ravagnani 2000, De Marco 2000, Melin 2003) can turn into a constraint highly remarked by SMEs, once in operation. Moreover, the transfer of the knowledge and the language embedded in the best practices on which an ERP is based (Van Stijn & Wensley 2005, Light & Papazafeiropoulou 2004) can be more difficult than in larger companies, given the ample diversity among the ways of working of different SMEs.

There are also obstacles which can assume a different relevance or have different thresholds vs. larger companies, like: initial costs (Schubert & Leimstoll 2004, Schubert 2003), redesign of the typical internal processes (Westrup & Knight 2000), length of software introduction cycle and "cultural" resistances (Kempainen 2004) of the people involved in the project, also because the technical integration of an ERP requires a social integration (Elbanna 2003). To overcome these problems once and for all, some authors (Olsen & Saette 2006) even suggest the construction of a proprietary integrated system by each SME, through software direct development ("make"), possibly incorporating market-acquired modules for the most standardized functions.

The research discussed here aims at evaluating some experiences on the implementation of an ERP system in a SME, by linking the outcome obtained with some distinctive elements on the context and on the project which can influence the results (Costa & Gianecchini 2006), in order to find out possible indications. The theoretical model of the research is based on a tentative of mixing up some hints by Markus *et al.* (2000b) in order to guide the observation of the success in the ERP adoption, together with those suggested by Buonanno *et al.* (2005), to identify the context factors.

In more detail, while adapting for smaller companies their assumptions in the observation of larger ones, the research refers to Markus *et al.* (2000b) by adopting some dimensions which they identified for success evaluation – success from the organization manager point of view, in terms of: economic results, management control, operating efficiency – and, according to their suggestions, by choosing the full operating condition as the stage to be observed (thereby selecting in the sample only companies that implemented an ERP since one year or longer).

At the same time, the research is based (with some simplification) on the study of Buonanno *et al.* (2005), that revises the model already discussed in Ravarini *et al.* (2000) and Tagliavini *et al.* (2002), for the identification of the factors that can influence the implementation of an ERP, like: the size of the company – distinguishing between micro- to small-sized and medium-sized companies, considering number of employees and turnover as size parameters – and the extent of the organizational change. For the last factor, accordingly with the mentioned papers, this study considered the first three degrees of the scale proposed by Venkatraman (1994) to classify the extent of the organizational change (degree of company transformation) associated with the technological innovation: local modifications, processes integration and processes reengineering (BPR).

Some other factors, potentially interesting in the SME segment, were added: one context-related element, the economic sector of the company (among: Industry, Commerce and other Services), and

two project characteristics, the number of updated processes during the introduction of the ERP and the type of the software producer (divided in three categories: large multinational software house, former supplier of accounting and/or MRP packages to the same client company, small Italian software house that offers its product to a client company for the first time).

3 RESEARCH PRESENTATION

3.1 Research questions

The research questions were:

1. Which are the characteristics of the introduction of ERP systems in SMEs, in terms of supply and project complexity?
2. From the point of view of a SME management, how is the ERP adoption ex-post evaluated and to which context and project factors is this evaluation associated?
3. How the outcome of the adoption is evaluated in economic and managerial terms and to which context and project factors is this evaluation associated?
4. How the outcome of the adoption is evaluated in terms of simplification and efficiency and to which context and project factors is this evaluation associated?

3.2 Methodology and data collection

The research involved 50 SMEs provided with an ERP system since one year or longer. Defining the panel was not an easy task, since the 50 small/medium-enterprises to be found had to comply with two characteristics: be equipped with a fully implemented ERP; be willing to spend time to participate in a review. Therefore, instead of setting up a random sample, the SMEs had to be selected through information gathered from various sources (presentations in conferences and seminars, websites, ...). The survey was performed through direct interviews on the basis of a questionnaire previously sent to the identified persons, together with an illustration on the research motivations.

The questionnaire was structured in three sections: company registration data, project characteristics (among which: type of ERP producer, number of updated processes, level of the organizational change), evaluation of the outcomes (success / failure, relevance for the company, obtained improvements). The questionnaire used included 34 closed-answer questions, of which 21 required a single choice among multiple responses and 12 were dichotomous. The standardization of the answers (detrimental in itself) was adopted in order to make them homogeneous and comparable, particularly considering the probability of confronting highly diverse interviewees, in terms of culture and experience.

In order to obtain answers coherent with the pursued objects, the most proper interviewee was identified as the person who had the top responsibility in the company, or had anyway performed a leader role in the project (sometimes, an interviewee played different roles, due to the limited size of the companies considered). Anyway, preliminary talks always verified that the person to be interviewed had full awareness of the subject to be discussed.

The data collected through the interviews were then analyzed with descriptive statistics tools and by building contingency tables, since all the variables were of nominal type. In order to identify the presence of an association between pair of variables, it was used the Cramer's V index (that is considered the most suitable for $m \times n$ tables), estimating its significance on the basis of its corresponding *Chi-square* (adopting however precautionary criteria, because of the limited sample size). The suggestion of an association between variables is then taken into account only when the V is pretty high (at least about 0,350) and at the same time is low the probability (p value) related to the corresponding *Chi-square*.

4 RESULTS

The distribution of the companies in the sample in terms of size (being always jointly satisfied the thresholds of turnover and number of employees) is the following (see Figure 1.A): about a third (30%, 15 in absolute terms) are micro- or small-sized companies (up to 50 employees), more than two thirds (70%, 35) are medium-sized companies (from 51 to 250 employees). In terms of age, only one is less than 5 year old, while the greatest part of them (38) is between 10 and 50 year old and 8 are over 50 years (up to a maximum of 97).

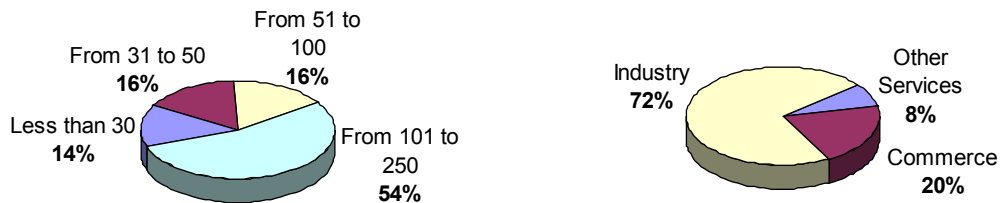


Figure 1. Composition of the panel of interviewed companies by: Number of employees (A) and Economic sector (B).

With regards of the economic sector of activity (see Figure 1.B), the sample shows a marked prevalence of industrial companies (36 out of 50), while commerce and services sum up to a little more than a quarter of the total (for this reason, they will be treated as a single category in the following analysis).

4.1 Characteristics of the interventions to introduce the ERP

At the time of the interview, all the companies selected had already completed the process of an ERP adoption since one year or longer. This software was produced (see Figure 2) primarily by an Italian software house (68%, 34 in absolute terms) and, in smaller quantity (18%, 9), by the former producer of the accounting and/or MRP packages (different from the previous), or by a large multinational software house (14%, 7).

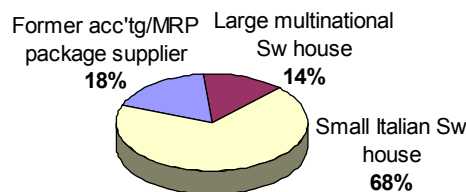


Figure 2. Distribution of types of ERP producers in the sample.

The distribution of the two last factors is shown through a contingency table (see Table 1): in the larger majority of the cases (31), the initiative of introducing the ERP in these companies requested the updating of more than 10 processes, while the distribution among the three levels of the organizational change is more homogeneous. Between the two factors a relevant positive association exists anyway ($V=0,604$), confirmed by the significance of the *Chi-square* (36,425, $p=0,00$), as an indication that in a project which involves a higher number of processes the trend to perform a deeper redesign is more probable.

It was also pointed out that the factor "Number of updated processes" seems to have an association (even if less strong: $V=0,349$, but with $p=0,01$) with the "Economic sector": the updating of a higher number of processes is more frequent in commercial and services companies, than in the industrial ones.

Extent of organizational change		Number of updated processes			Total
		Less than 5	From 6 to 10	More than 10	
Local modifications	Frequencies	11	6	2	19
	row %	57,89	31,58	10,53	100,00
	column %	100,00	75,00	6,45	38,00
Process integration	Frequencies	0	2	16	18
	row %	0,00	11,11	88,89	100,00
	column %	0,00	25,00	51,61	36,00
Process reengineering	Frequencies	0	0	13	13
	row %	0,00	0,00	100,00	100,00
	column %	0,00	0,00	41,94	26,00
Total		11	8	31	50
row %		22,00	16,00	62,00	100,00
column %		100,00	100,00	100,00	100,00
χ^2					
36,425					
DoF		4			
p value			0,000		
Cramer's V				0,604	
N					50

Table 1. Number of updated processes vs. Extent of organizational change.

For the "Extent of organizational change" as well, the possible presence of a statistically significant association with the project factor "Type of ERP producer" was noticed ($V=0,362$, $p=0,01$). As it will be seen later, the type of producer – which identifies a type of product and at the same time an offering service – seems to be one of the most recurring factors in the associations. In this case, the distribution of the frequencies suggests that the projects with a broader organizational innovation are promoted when the ERP system introduction marks a discontinuation with regards to the supplier of the accounting and/or MRP packages already operating in the company.

4.2 Evaluation of the success in introducing an ERP system into the company

The SMEs managers interviewed were asked to express their overall evaluation on the adoption of the ERP and on its relevance on the good performance of their company. In both cases (see Figure 3) the answers are gathered in an unexpected measure on, respectively, the declaration of a success and the decisive role of the ERP system.

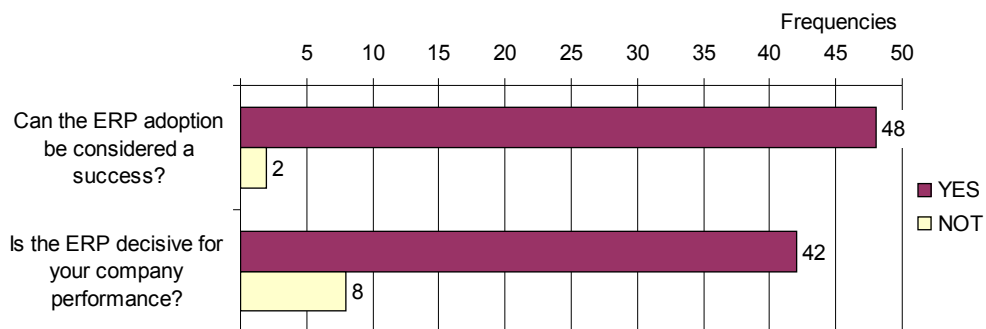


Figure 3. Evaluations of the ERP adoption and its relevance to the company performance.

This concentration is so high that the negative judgements appear marginal, and the same variables are not suitable for statistical comparisons (also taking into account the not so large size of the sample). For this reason, the creation of the contingency tables between these variables and each context or project factor would have been not significant.

As regards to the negative answers, it can only be said that they don't seem to be marked for the correspondence with any particular modality of the considered factors.

4.3 Evaluation of the introduction of the ERP in economic and managerial terms

To evaluate the outcomes of the introduction of the ERP in economic and managerial terms, interviewed managers were asked to indicate the size of the improvement – in percent within a four interval scale: from 0 to 10%, from 10% to 20%, from 20% to 30%, over 30% – obtained as a consequence of the introduction of an ERP into the company, with regards to: administrative costs reduction, performance management capacity, easiness of information retrieval.

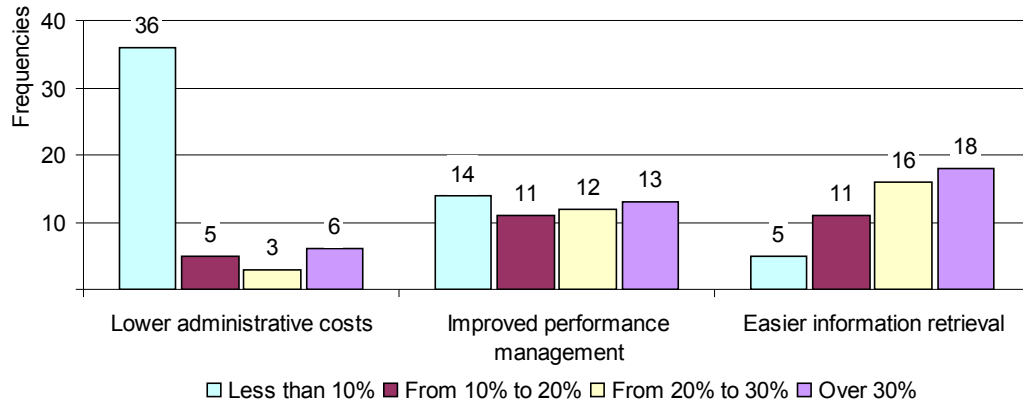


Figure 4. Outcomes evaluation in economic and managerial terms.

The answers distribution is shown in Figure 4. It can be noted that the administrative costs reduction is highly concentrated on the first interval, while the improvement in the performance management capacity – a possible benefit of ERP introduction (Light & Papazafeiropoulou 2004) – shows a statistically homogeneous allocation on the four scale intervals and the increase in the easiness of information retrieval is the only dependent variable that presents a positive asymmetry, with a concentration on the highest values, as a confirmation that this seems to be the most frequently perceived benefit (Davenport 1998), although its effectiveness is disputed in some study (Sammon & Adam 2004).

In order to find out the presence of possible associations, for each of the three indicators the frequencies distribution was analyzed in contingency tables with, respectively, every considered factor about context ("Size of the company", "Economic sector") and project ("Extent of organizational change", "Number of updated processes", "Type of ERP producer"). Because of space constraint, in this case only the values of the coefficients calculated for each examined pair, composed by a variable and a factor, will be reported.

Examined variable	Lower administrative costs				
	χ^2	DoF	p value	Cramer's V	N
Size of the company	0,952	3	0,813	0,138	50
Economic sector	1,527	3	0,676	0,175	50
Extent of organizational change	14,279	6	0,027	0,378	50
Number of updated processes	2,692	6	0,846	0,164	50
Type of ERP producer	4,337	6	0,631	0,208	50

Table 2. Test between "Lower administrative costs" and context / project factors.

As it can be seen in Table 2, only an association with the "Extent of the organizational change" factor appears ($V=0,378$, $p=0,027$). From the observation of the contingency table, this association has positive nature: the more the innovation, the greater the costs reduction (it must be anyway recalled

the strong concentration of the costs reduction on the first modality). They don't appear associations with the other four factors that could characterize the variable in question.

<i>Examined variable</i>	Improved performance management				
	χ^2	<i>DoF</i>	<i>p value</i>	<i>Cramer's V</i>	<i>N</i>
<i>Factors</i>					
Size of the company	2,357	3	0,502	0,217	50
Economic sector	3,254	3	0,354	0,255	50
Extent of organizational change	7,615	6	0,268	0,276	50
Number of updated processes	4,053	6	0,670	0,201	50
Type of ERP producer	14,057	6	0,029	0,375	50

Table 3. Test between "Improved performance management" and context / project factors.

In Table 3, it can be observed that the variable "Improved performance management" shows a significant association with the type of the ERP producer (from the inspection of the contingency table, the largest improvements correspond to the adoption of an ERP produced by an Italian software house and, partially, by a multinational one). Some caution it must be anyway paid for the strong prevalence (34 out of 50, see Figure 2) of the modality "Italian software house". None of the other factors appears to be associated with the variable in question.

<i>Examined variable</i>	Easier information retrieval				
	χ^2	<i>DoF</i>	<i>p value</i>	<i>Cramer's V</i>	<i>N</i>
<i>Factors</i>					
Size of the company	2,453	3	0,484	0,221	50
Economic sector	4,575	3	0,206	0,302	50
Extent of organizational change	5,850	6	0,440	0,242	50
Number of updated processes	4,759	6	0,575	0,218	50
Type of ERP producer	9,154	6	0,165	0,303	50

Table 4. Test between "Easier information retrieval" and context / project factors.

The increase in easiness of information retrieval doesn't show (see Table 4) any statistically significant association with the five considered factors, regarding which its frequencies distribution seems to be always independent. The *V* values corresponding to the Economic sector and the Type of ERP producer, although higher than 0,3 (usually significant in larger samples), in this case are not reinforced by a high enough *Chi-square*.

4.4 Evaluation of the introduction of the ERP in terms of simplification and efficiency

The managers interviewed provided also their indications on the perceived improvements in terms of simplification and efficiency (using the same scale of intervals seen above) obtained as outcome of the ERP system introduction.

By examining the Figure 5, it can be pointed out that in the case of the question about the reached procedural simplification the answers are split in a substantially homogeneous way among the four measurement intervals. On the contrary, the efficiency increase shows a strong concentration, with over 50% of the answers assigned to the lowest interval (less than 10%). However, it must be noticed in this case that the 30% of the sample declares to have reached an efficiency increase larger than 20% (a considerable improvement), and the 48% larger than 10%, which is yet an important result.

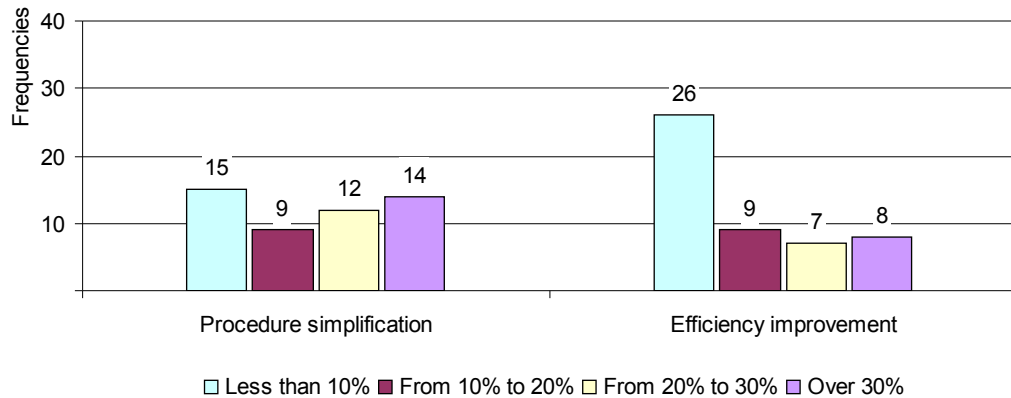


Figure 5. Outcomes evaluation in terms of simplification and efficiency.

As for the former ones, also for these two variables the frequencies distribution was analyzed in contingency tables with each considered context and project factor, in order to find out the presence of possible associations.

Examined variable	Procedure simplification				
	χ^2	DoF	p value	Cramer's V	N
Size of the company	4,021	3	0,259	0,284	50
Economic sector	2,460	3	0,483	0,222	50
Extent of organizational change	11,940	6	0,063	0,346	50
Number of updated processes	10,543	6	0,104	0,325	50
Type of ERP producer	13,231	6	0,040	0,364	50

Table 5. Test between "Procedure simplification" and context / project factors.

Table 5 shows a significant association of procedure simplification, once more with the selected type of ERP producer (but also here some caution is required). From the examination of the contingency table, it can be said that a greater simplification corresponds to the adoption of an ERP system produced by an Italian software house or by a multinational one. It can also be observed, even if at a less evident degree, an association with the Extent of the organizational change (that anyway is of a positive nature: the higher the extent, the greater the simplification).

Examined variable	Efficiency improvement				
	χ^2	DoF	p value	Cramer's V	N
Size of the company	5,902	3	0,117	0,344	50
Economic sector	4,064	3	0,255	0,285	50
Extent of organizational change	9,273	6	0,159	0,305	50
Number of updated processes	11,476	6	0,075	0,339	50
Type of ERP producer	12,273	6	0,056	0,350	50

Table 6. Test between "Efficiency improvement" and context / project factors.

Finally, also the efficiency increase appears (see Table 6) to be associated (although in a less certain measure) with the "Type of ERP producer" (once more, the greater increases are related to ERP systems produced by Italian software houses or by multinational ones). A possible association appears with the Number of updated processes, but the contingency table doesn't clearly show the direction in this case.

4.5 Summary of research findings

The main suggestions that can be summarized from the analysis of its results are:

1. The projects to introduce ERP systems involve more than 10 internal processes in most cases, and there exists a strong correspondence between the number of updated processes and the extent of the organizational change performed;
2. In the absolute majority of the cases, the managers of the companies that introduced an ERP evaluate such initiative as a success, and nearly in the same proportion consider the ERP system as decisive for the success of their company;
3. Under economic and managerial terms, the remark that the ERP introduction into the company eases the information retrieval is confirmed, but this phenomenon doesn't appear to be significantly associated with any considered factor. Significant improvements can also be obtained in performance management capacity, in association with the type of the selected producer. Nearly always, administrative costs are slightly lowered and the reduction increases with the extent of the organizational change;
4. The adoption of an ERP often brings a substantial procedural simplification, especially in association with the project characteristics ("Type of ERP producer" and "Extent of organizational change"). In about half of the sample, a significant increase was found in efficiency, once more in association with the type of the ERP system producer.

More generally speaking, the analysis of the results points out (although with the many times recalled cautions) that the selected context factors don't show any association with the examined variables. This suggests that the overall success of an ERP introduction initiative and the improvements in diverse managerial aspects don't depend on the size and the economic sector of the company. At the same time, the factor of the number of updated processes doesn't show a frequent association with the dependent variables, thence its information contribution is poor.

On the contrary, the considered success indicators are more often related to the other factors describing the project characteristic: the extent of the organizational change and the type of the ERP system producer (which seems to define the product category and the style of intervention at the same time).

5 CONCLUSIONS

The more interesting aspects of the research presented here are its being solely devoted to the SME segment and its focusing on the ex-post evaluation of the outcomes of an ERP system adoption in such companies.

Three indications from the research results are of particular interest:

- the surprisingly high percentage of SMEs which consider the implementation of an ERP a success and its role decisive for company performance;
- the irrelevance of the context factors – sometime overrated – to gain benefits from an ERP: it seems to be worthwhile for companies of all dimensions and of each sector;
- the confirmation of the weight of some preliminary decisions also in the SMEs segment, like the choice of the ERP producer and the project design in term of deepness and broadness of change.

Beyond the presented results, the research shows some limitations that can be turned into hints for further investigations:

- the size of the sample should be extended, in order to reach at least 100 companies, a threshold that influences the level of significance in the measurement of independence or association;
- the possibility of improving the random composition of the sample should be evaluated;
- in order to obtain more detailed analysis, the categories of the factor "Type of ERP system producer" should be usefully articulated in more detail (since it was proved to be highly characterizing), with specific attention to the modality "Italian software house";

- finally, the variables concerning the overall adoption success and the relevance of the ERP system for the company performance should be transformed from dichotomous to intervals scale, in order to obtain more graduated judgments.

Beside these limitations, it must also be underlined that the results could be highly influenced by a national background, as the research involved only Italian enterprises.

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