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ERP PROJECT IN SME: A MATTER OF RISKS, A MATTER OF COMPETENCIES. A QUANTITATIVE ANALYSIS

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Abstract

The paper proposes to assess the salient topics related to ERP systems implementation in the context of small firms: do the risks occurrence and the competencies used during the project influence the success of the ERP project in SMEs? A survey investigated the IT policy of 2000 representative SMEs. The results are analyzed from a final sample of 81 firms which effectively adopted an ERP. Multiple projects patterns are observed, but no “one best way” is found: no specific modality offers a higher rate of success for the project. Among external supports, the integrator appears to play a key role in the resolution of operational difficulties. Although the projects may encounter multiple risks, they are – most of the time - not allowed to fail. This quantitative analysis offers a first confirmation and generalization of the existing case studies on ERP projects in SMEs.

Keywords: ERP, Enterprise Systems, project management, SME.

1 Introduction¹

Firm's computerization led to the adoption of more and more sophisticated software. ERP systems have become a major trend in the firm's computing policy for more than a decade now. They are now credible solutions for SMEs (Small and Medium Enterprises) that aim to rationalize and integrate their information system. But implementing an ERP project is often viewed as a high risk activity (Poban-Nzaou et al., 2008; Iskanius, 2010).

Most of the very large corporations have adopted ERP and the system has often become their backbone software. ERPs potentially provide a cross-functional view of the different functions of the company: sales, production, finance, human resources... (El Amrani et al., 2006). Managing the daily business processes with an ERP allows firms to optimize their multiple workflows (information, physical or financial flows) and aims to avoid various pitfalls such as information redundancy and frequent inconsistencies of information, lack of data control or lack of business anticipation.

In the SMEs context, the issue of ERP presents new features. The IT press and the consultants' studies echo this situation: IT is often seen as a cost and a necessary evil for small businesses. Surveys conducted by consultancy firms stress the idea that *"these companies [SMEs] see IT as strategic to their future success"* (PAC and Knowledge Peers, 2011) but they also underline many barriers: *"60% of respondents said that poor compatibility between packages was an issue for them, while almost as many said that lack of trained personnel was a key issue. A third key issue was the expense of keeping IT up to date, cited by around half the respondents"* (PAC and Knowledge Peers, 2011).

The ERP challenges are now largely located in SMEs: most of large firms are equipped while ERP are rare in small businesses. According to European statistics, ERP are adopted by 65% of large European firms (more than 250 employees) but only present in 16% of the small firms (10 to 49 employees) and 41% in medium firms². SMEs are organizations characterized by low formalization of roles, dominance of mutual adjustment and direct supervision, resources and skills in limited amounts. To manage Information Systems, SMEs lack formalized management, power is often gathered in the hands of one or two persons, resources are limited and the decision makers lack information (Buonnano et al., 2005). Based on this specific context, the objective of this research is to provide a quantitative analysis of how ERPs are implemented in SMEs in order to understand how the risks and skills involved in the project influence its success. In other words, the paper aims to assess the ERP project, its management and its results, considering the specific context of SMEs. The empirical study is conducted as part of a regional survey collecting the IT practices of 2000 small and medium size firms.

The first part of the paper is dedicated to the analysis of the project implementation in SMEs. A series of generic assumptions is then made. The second part presents the quantitative method of research and the selection of the final sample of 81 companies that have adopted ERP. The final section presents and analyzes the results.

2 Research hypotheses

Like many advanced technologies, ERP was initially implemented in large companies. This may explain the initial focus of academic research on issues related these companies (Ngai et al. 2008).

¹ The research was supported by the council of Brittany Region and GIS M@rsouin. The author gratefully acknowledges the help of Patrick Leconte and André Mourrain in collecting data and Jocelyne Trémembert in processing data.

² Data for the 27 countries of European Union, year 2010, all firms without financial sector. Data available on <http://appsso.eurostat.ec.europa.eu/>

Today, as vendors develop the market for small companies, research begins to take into account the specific organizational environment of these organizations. Recently, Haddara and Zach (2011) provided a state of the art on the emergent issue of ERP in SMEs, gathering a total of less than 80 articles internationally published.

There is now a rich literature on the key success factors in ERP projects (Ngai et al. 2008; Umble et al. 2003. Seddon et al. 2010). For example, Ngai et al. (2008) reviewed the literature and identified 18 critical success factors for ERP project. We want to differentiate ourselves from a strict success factors approach by adopting a complementary approach in terms of competencies and risks. This perspective is particularly suited to study the case of SMEs due to their specific features; including their limited resources.

Analyzing adoption of ERPs can be done by following the main steps of the process. The ERP implementation models (eg, Markus et al. 2000, Nah and Lau 2001) identify two major phases in the adoption of an ERP. The first phase is the pre-implantation phase where companies take several decisions leading to the effective adoption of an ERP system and the choice of the software. This preliminary phase is then followed by a second phase of implementation where the implementation of the system in the business is conducted. Although related, the issues raised by these two phases are slightly different (Haddara and Zach, 2011). We choose to discuss the implementation phase.

2.1 Risks related to ERP projects in SMEs

ERP implementation projects are large projects that can really be different one from another. Methods and implementation models are proposed and implemented with the support of external advisers, to fit their frame (Harwood, 2003; Bradford, 2010). However, beyond these methods, each project is different in its scope and general progress. These overall characteristics of the project can be described in a general view: the scope (duration, budget, number of modules implemented) and the approach adopted (specifications definition, simultaneous or phased implementation, terms of external support) are the two categories of characteristics we aim to investigate.

These general characteristics largely refer to managerial choices made within the SMEs and are not without consequences for the occurrence of project risks. But these risks are manifold. The occurrence of these risks affects itself the project's shape. For example, poor cost management will impact the final budget for the project; a long-term project may be a reflection of multiple difficulties. The relationship between project characteristics and risk factors is bidirectional.

The literature now identifies a number of risks associated with ERP projects in general, and sometimes specifically in the context of SMEs. Aloini et al. (2007) conducted a major review of the literature and listed 19 risk factors from 75 academic publications dedicated to ERP (since 1999). According to their results, the most often highlighted risks in the literature are the inadequate selection of the ERP and the deficiencies in strategic planning. Poor technical project management, managerial inefficiency and inadequate change management are also of the concern. Only 1 out of the 75 articles studied is dedicated to the context of SMEs. In the context of SMEs, only qualitative studies seem to be available. Poba-Nzaou et al. (2008) study the risks of implementation for SME through one single case. Snider et al. (2009) conducted five comparative case studies to identify common factors of success of the ERP project in Canadian SMEs. Recently, Iskanius (2010) presented three case studies where nine elements of project management are studied as a risk factor for ERP failure in SMEs.

Consistent with the existing literature, our research uses a set of **seven generic risks for the project**: (1) deficiencies in the management and project management, (2) poor change management, (3) poor objectives management, (4) mistakes in the software choice, (5) unavailability of resources, (6) difficulties of deployment, (7) difficulties with external partners. As mentioned above, a conceptual link can be established between these risks and the general characteristics of the ERP project. This leads to the first hypothesis:

Hyp.1a: Risks occurrence and characteristics of the ERP project are mutually related.

The occurrence of risks affects project performance. This level of performance can be assessed both in terms of project progress and in terms of final result. Risks can potentially lead to failure and cancellation of the project. The existing case studies dedicated to SMEs (Snider et al. 2009; ...) highlight the strong link between the problems' accumulation related to poor risk management and the final result. We formalize this relationship of cause and effect by the following hypothesis:

Hyp 1b: Risks occurrence negatively influences the outcome of the project

2.2 Use of project competencies during the ERP project

Complementarily to the risks analysis, competencies analysis provides a rich conceptual guidance to understand the project's course. Based on the RBV perspective of the firm, the competencies approach supports the idea of "IS capability" as a source of competitive advantage for the firm (Wade and Hulland 2004, Peppard and Ward, 2004). Applied to the context of the ERP projects, the concept makes it possible to link IS resources with the ERP characteristics. Karimi, Somers, and Bhattacharjee (2007) study this link and analyze its influence on the project's outcome. Their quantitative methodology validates that the characteristics of the implemented ERP are influenced by a set of resources concerning knowledge related to the project, project management, users' involvement and top management involvement as well as the IT infrastructure. This association also validates a positive effect on business processes outcomes.

In the context of our research, we use a set of **eight generic skills** (in line with the approaches of Karimi et al. 2007 and Snider et al., 2009). These skills concern (1) the definition of needs (specifications ...) (2) purchases, (3) financial aspects, (4) legal issues, (5) project management; (6) deployment (7) Human Resources (change management, training ...) (8) IT aspects.

Considering SMEs, the question of competencies emerges in the light of two facts: first, except in specific situations (SME in the IT sector), in-house expertise in the IS management is often reduced or absent, and secondly the limited financial resources for IT expenses lead to parsimoniously hire temporary external expertise. Companies can therefore choose to use the internal competencies if they exist, or to pay for external expertise, or to consider that these skills are not required for the ERP project. This choice may be linked to the characteristics of the project. For example, if an SME wants the ERP project to be conducted according to a given budget, it may limit the use of numerous expertise or competencies. In contrast, the more skills are used, the bigger the project is, in terms of scale. A bidirectional causal relationship can be assumed.

Hyp.2a: Use of competencies and characteristics of the ERP project are mutually related.

In line with the results of the KBV perspective (Karimi et al. 2007), we assume a positive effect of the multiple skills used during the project:

Hyp 2b: Use of competencies during the project positively influences the project outcome.

2.3 Project characteristics and project outcomes

The last hypothesis aims to directly link the characteristics the project with its outcomes. To do so, the distinction between the characteristics of project's scope (duration, budget, number of modules implemented) and those related to the approach adopted (specifications or not, simultaneous or gradual deployment, terms of external support) is required. On one hand, theoretical justification is difficult for a causal relationship between the scope of a project and its success: for example, a small ERP project doesn't imply a success. On the other hand, the consequences of managerial decisions can be questioned. Snider et al. (2009) show, based on five cases, the influence of qualified consultants on

projects' outcomes. Following their approach that stresses on the resources of the SMEs, we can consider that gradual deployment (module by module) will be more favorable to the success than a simultaneous implementation.

Hyp.3: Characteristics of the ERP implementation policy influence its success.

To conclude the conceptual part of the research, we provide a general research model (Figure 1). Then this model is assessed for each hypothesis independently.

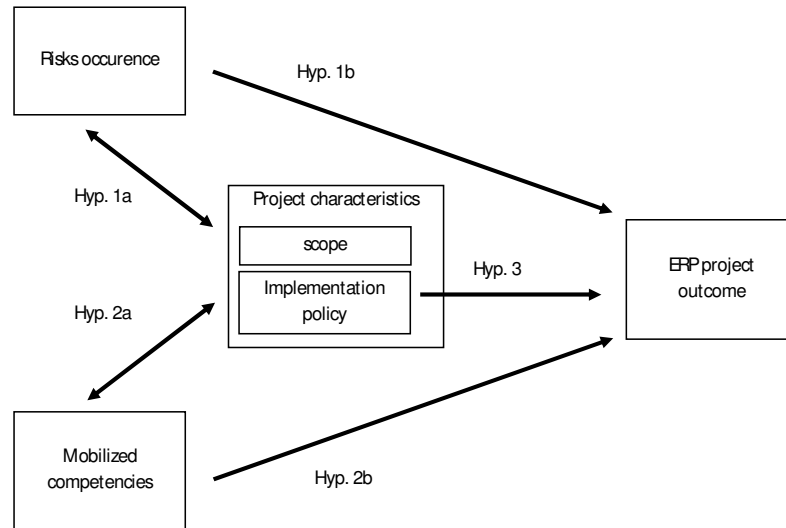


Figure 1. Research model

3 Research method and descriptive results

3.1 A quantitative study with 2000 respondents

The hypotheses formulated in the conceptual part are empirically tested with firms that have implemented an ERP. In 2008, a survey was conducted among firms in the regional district of Brittany. The questionnaire was sent to all SMEs, from 10 to 250 employees, in the sectors of industry, construction, trade and services (excluding public utilities). The survey could be completed and returned in paper copy by mail, or filled online. To achieve the aim of 2000 respondents, a complementary administration of the survey was conducted by telephone. The firms were chosen to obtain a good representativeness in terms of location, size and sector of activity, compared to the statistics of the regional economy.

The survey is based on a general questionnaire, which first queries the company's economic situation, and then lists a large number of IT devices and their possible use within the firm, or with business partners or clients. A specific section of the questionnaire is dedicated to the project of ERP implementation. The first question is "Has your company implemented an ERP?"³. If the answer is positive, a list of questions concerning the conduct of the project is asked. The items selected for the variables can be found in the appendix. The items are selected from the questionnaire. In some cases, a restatement of responses was then performed prior to statistical tests (see section 2.4).

³ Questions are translated here from French to English.

3.2 ERP, a fuzzy concept for respondents

254 companies (13% of respondents) responded positively to the question on the adoption of an ERP. This response is then filtered through two types of additional questions: a series of questions on which ERP modules are implemented, a question to know the ERP software's name and vendor's name. Based on these filters, the number of companies actually using an ERP turns down to 84, that is an adoption rate of 4.2%. This drastic reduction is mainly due to the confusion by respondents between the ERP and other business software such as MRP or financial software. The concept of ERP thus appears as a fuzzy concept in practice⁴.

After excluding respondents with too many missing answers, the final number of firms included for this research is 81. We are confident in the quality of data used to test the hypotheses.

3.3 Descriptive results for 81 firms with ERP

The 81 companies have different profiles. The dominant sector is the industry with 9% of respondents in the food industry, 10% in construction and 36% in other industries. Then the trade sector is for 29% and other services for 15%. 22% of respondents have from 10 to 19 employees, 42% concern the firm with 20 to 49 people and 36% of respondents are from 50 to 250 employees. Two-thirds of the firms are single sites (68% of respondents). 10% of firms belong to a network (franchise, concession ...) and 61% belong to a group.

The ERP systems implemented in the 81 firms are provided by the major vendors: Sage, Oracle, SAP, Cegid or Microsoft. ERP systems support the company's activities, primarily in dealing with financial functions (accounting, management control) as well as sales and purchases: more than 80% of these functions are managed with the ERP. Production aspects (planning and production management, logistics, distribution) are ERP supported for nearly 70% of respondents. For activities dealing with quality, maintenance, human resources or decision-making, the use of an ERP package is effective only in one out of two firms (Figure 2).



Figure 2. *Percentage of the enterprise's activities supported by the ERP system*⁵

⁴ The final adoption rate obtained is very much lower than the official French statistics where 11% of companies from 10 to 50 employees use an ERP, and 36% of medium enterprises do. But the official statistics are not checked with complementary questions, as performed in our study. The official statistics can be compared to the "gross" 13% available before verification.

⁵ The rate is calculated on the 65 respondents that answered this specific issue

The main approach adopted to implement of various modules of the ERP is a phased approach, module by module (55% of responding companies) rather than "big bang" approach, all at once (45%).

Nearly half of companies (48%) conducted their ERP project in less than one year, from its official launch to the start of the first module. The project can, however, go beyond, with the launch of other modules. More than a third of the firms (37%) had a budget of over € 100 000.

Written specifications are highly used but not fully spread: 80% of respondents formalized specifications. External support is primarily provided by the distributor of software packages (31% of companies), but also by a consultant (25%), an integrator (22%) or the ERP vendor (21%). Only 6% of companies declare not soliciting outside assistance from a service provider.

With the exception of computer skills (programming, maintenance) that are totally or partially outsourced (52% of companies), other skills associated with the ERP project are primarily carried by internal resources, in a proportion of two thirds. Among the various skills listed, the legal skills appear to be the least directly required for the ERP project. 11% indicate they have not been used during the project.

3.4 Preliminary data processing

The low number of firms with ERP systems involves several prior adjustments concerning items. It mainly consists of clustering the initial responses in a smaller number of groups. The following adjustments are processed:

- The number of implemented modules are gathered into three groups: less than 5 modules (17% of the respondents), 5 to 9 modules (43%) and 10 to 12 modules (40%);
- The project durations are gathered into three groups: shorter than 1 year (48% of firms), more than 1 year (38%) and non-respondents (14%).
- The budget levels of the project are gathered into four groups: less than 50k€ (25% of the firms), 50k€ to 200k€ (30%), more than 200k€ (17%) and non-respondents (28%).

The dependant variable of the model, success, is also gathered: no firm declared that its project process is a complete failure and only one firm declared that it is a moderate failure. So, three groups are created for the outcome variable: complete success (53% of the firms), moderate success (43%) and non-respondents (4%).

4 Results

4.1 Results regarding the risks occurrence during ERP projects

Hypothesis 1a states the existence of a relationship between the characteristics of the ERP project and risks encountered. Hypothesis 1b assumes an influence on the project outcome. To fully apprehend the risks the firms have to face, we processed a multivariate analysis (multiple correspondence factor analysis) based on the seven risk factors⁶. The first dimension of the factorial mapping refers to the cumulative nature of risk and distinguishes firms that have encountered difficulties from those which have not. In contrast, the second dimension distinguishes:

⁶ Due to non-respondents, this analysis is processed with 74 firms.

- Firms with difficulties related to poor definition of objectives, an irrelevant choice of the system or difficulties with external partners. These difficulties can be described as strategic because they refer to weak reversible decisions;
- Firms having difficulties related to steering deficiencies, poor change management, unavailability of resources and difficulties of implementation (configuration, interface, data transfer). These difficulties can be described as operational as they relate to the operational implementation of the project.

Based on this factor analysis, the ERP project characteristics are located relatively to these dimensions. The following table presents the results for hypotheses 1a and 1b:

		Dimension 1		Dimension 2	
		No difficulties	Difficulties	Strategic difficulties	Operational difficulties
Hyp.1a	Duration	Short duration			
	Budget		Average budget		
	Number of modules				Positive
	Implementation approach		Phased implementation	big bang implementation	
	Integrators /Implementers			Positive	Negative
	Consultants		Positive		
Hyp.1b	Success of the du project	Positive			

Table 1. Significant relationships between ERP project characteristics, risks and project outcomes

Among the SMEs facing difficulties, the medium-budget projects (50 to 200 k €) are over-represented, as well as companies that have deployed their ERP module by module. Projects that solicited a consultant are also significantly over-represented. But this link is assumed to be bidirectional. In details, we see that the presence of a consultant is specifically associated with steering difficulties, poor change management, low availability of resources and difficulties with external partners. A last result is the over-representation of short-term (less than a year) projects among SMEs with no difficulties.

SMEs that have experienced operational difficulties are the ones with the largest number of ERP modules. They also significantly didn't solicit integrators to help them. The importance of implementers services for the operational implementation of ERP in SMEs is stressed. Integrators also reversely influence the firms with strategic difficulties: SMEs having strategic difficulties were more often help by integrators than the other firms. Specifically, the companies that made "mistakes in the system selection" significantly resorted to an integrator. In addition, firms having strategic difficulties in the ERP project were more favorable to implement all the modules simultaneously, than other firms.

Concerning the hypothesis 2b, belonging to the group of firms with strategic or operational difficulties did not affect the perceived level of success. Nevertheless, the lack of difficulty is a factor for positive assessment of the success of the project.

4.2 Results regarding the project competencies during ERP projects

Hypotheses 2a and 2b raise the question of the use of internal skills during the project. The test of these hypotheses is also in two steps, by processing a typology through Multiple Correspondence Factor Analysis⁷. The empirical analysis leads then to be distinguished:

- Companies that worked solely on the basis of internal skills
- Companies that have worked with in-house expertise, external or mixed.

Among the skills deployed, two groups are formed:

- Skills for specifications, project management, implementation (process re-engineering, configuration...) and technological aspects: these are "project skills".
- Skills for procurement, financial and legal aspects, and human resources. These skills can be described as "support skills".

The following table presents the results for the validation of hypotheses 2a and 2b:

		Dimension 1		Dimension 2	
		Only internal skills	External or mixed skills	Project skills	Support skills
Hyp.2a	Duration				
	Budget				
	Number of modules	Positive			
	Implementation approach				
	Integrators /Implementers		Positive		
	Consultants			Negative	
Hyp.2b	Success of the du project				

Table 2. *Significant relationships between ERP project characteristics, skills and project outcomes*

The massive use of internal skills is linked to a higher number of ERP modules deployed. This can be explained by a size effect, since the number of employees positively influences the number of implemented modules. But the size is directly correlated with the presence some specific skills that are skills for implementation (process analysis, configuration) and skills in IT (data processing, maintenance). The presence of skills also hardly influences the project's scope in a positive way, as there is no significant influence from the budget level or the project duration.

Results for external support indicate that the lack of in-house expertise is associated with higher solicitation of integrators. The specific role of integrators is confirmed.

⁷ Due to non-respondents, this analysis is processed with 66 firms.

4.3 Results regarding the effects of implementation policy

Hypothesis 3 is tested through the significance of bivariate relationships (chi-square test at 10% risk and Fisher's exact test)⁸ (Table 4).

Among the characteristics of the project, the only one with significant influence on the overall result is the implementation, where a "big bang" approach is significantly associated to the complete success of the ERP project. Other variables included in the study don't show direct link. These variables (specifications, external support) don't even show indirect influence on success through risks involved or skills used.

		Khi-square value	Link ⁹
Hyp.3	Specifications	4,6948	Not significant
	Implementation approach	5,2799	(*) « big bang » approach: positive
	Integrators /Implementers	0,6948	Not significant
	Consultants	0,0008	Not significant

Table 3. Influence of implementation policy on the success of the project.

5 Discussion: lessons on ERP in SMEs

ERPs are intended to facilitate the coordination of information flow in organizations through a structured approach that maximizes firms' internal value chain. This ambition requires large IS projects with strong organizational implications that give them an unconventional status, often strategic in nature. This statement is reinforced for small businesses.

At the end of this quantitative research, several lessons emerge. They stress a low validation of the generic hypotheses that were assumed: considering the specific context studied and the specific measurement methods, few conceptual relations are empirically validated. The results show that a proper management of various risks and a simultaneous deployment of modules positively influence the outcome of the project.

Based on empirical results, the ways of conducting the ERP project are shown to be diverse. The majority of projects are quite short term ones (less than 1 year) that are implemented with the support of external service providers. The degree of success is not statistically related to methods used to complete the project, reinforcing the idea of no "one best way" to successfully implement an ERP.

Among potential support, the integrator appears to play a key role in the resolution of operational difficulties of implementation. For their part, consultants are solicited when the internal skills are lacking. This reinforces the importance in supporting and managing change in such projects. Although the projects may encounter some difficulties (including deployment), they are - in general - not allowed to fail. Hence the success of projects, as expressed by almost all respondents that have adopted an ERP.

⁸ Due to non-respondents, this analysis is processed with 77 firms.

⁹ * p<0.10

An ERP project requires IT skills, but not only. Expertises in the area of procurement, finance, legal aspects, human resources or project management are also essential. These skills can be owned either internally in a long-term perspective or externally and temporarily acquired. However, statistically, none of these skills and no arrangements for implementation appear to affect directly the results obtained. The analysis focusing on risks is more successful when addressing the issue of impacts. This can lead to a link between risks and skills, because it is not possible to overcome risks related to project management without using multiple skills. This is one of the limits of our current research model, where no direct association between skills and risks are stated. Other limits may be introduced.

6 Conclusion

The research carried out brings useful conclusions. It is based on a sample of 81 SMEs that have been strictly selected. However, the use of a declarative questionnaire implies some limitations. An important limit concerns the measurement of success of the ERP project. Indeed, the success rate found here is particularly high. Even if Iskanius (2010) reported that only 30% of ERP projects in SMEs are a complete success in terms of deadlines, budgets and goals, our sample of respondents show higher rates (53% of companies indicate a "complete success"). This bias probably comes from the design of the survey: the 81 responding firms actually have an ERP, implying they did not fail in their project and gave up implementation.

The statistical tests imply another limit: selected and isolated relationships were tested (only between two categories of variables) and not the simultaneous selection of all the variables of the model. The design of the questionnaire and the low number of respondents do not allow more comprehensive statistical treatment (such as structural equation modeling), which would enrich the analysis.

A future research perspective is to study the effects of the adoption of the ERP on the performance of the entire company. This analysis is difficult to achieve: since Venkatraman (1994), it is recognized that the impact of enterprise systems are diffuse and global, although their potential contributions are the highest.

Finally, from a conceptual point of view, this research has chosen to address the factors influencing implementation of ERP, while considering many internal variables. This analytical framework could be enhanced by a complementary focus on the influence of external factors such as "IT fads" supported by institutionalist approaches (Swanson and Ramiller, 1997).

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Appendix: sample items from the questionnaire

- Did your firm adopt an ERP? Yes / No / In progress / In project
- Name of the Vendor & Name of the software
- Duration: What was the approximate duration of the project (from its launch until the first module of the ERP is operational)? Less than 6 months / 6 months to 1 years / 1 to 2 years / more than 2 years
- Budget: What is the budget for this project? Less than 20k€ / 20k€ to 50k€ / 50k€ to 100k€ / 100k€ to 200k€ / more than 200k€
- Specifications: Were the specifications written before the launch of the ERP? Yes / No
- External supports: Who accompanied your firm for the ERP implementation? (multiple answers allowed) Vendor / Business consultant / Integrator / Retailer / No one / other.
- Implementation approach: The implementation was: phased? Simultaneous?
- Outcomes: The ERP project can be considered as: complete success / moderate success / moderate failure / complete failure
- Risks: When implementing the ERP in your firm, did you face the following difficulties? [list of difficulties]. If yes, what was the level of the consequences? Low / high / very high
- Competencies: Who managed the following aspects of the project? (Multiple answers allowed) [List of skills] internal skills / external skills / unnecessary for this project