



Research article

Managing ERP system risk in SMEs: a multiple case study

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Abstract

ERP systems are increasingly accessible to small and medium-sized enterprises (SMEs). If the potential benefits of these systems are significant, the same applies to the risk associated with their implementation. A number of authors emphasize that IS risk management is most effective when it is initiated at the earliest possible moment in the system's lifecycle, that is, at the adoption phase. But how do SMEs actually manage the risk of ERP implementation during the ERP adoption process? The research objectives are (1) to identify and describe the influence of the SMEs' context on their implementation risk exposure, and (2) to understand whether and how, within the adoption process, SMEs actually manage the risk of implementing an ERP system supplied by an ERP vendor, with open source software, or through in-house development. In order to do so, four case studies of SMEs having implemented an ERP system were undertaken. The study shows that to manage risk at the adoption stage, SMEs can proceed in a rather intuitive, informal and unstructured manner, that is explicitly based however upon an architecture of basic principles, policies and practices.

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Introduction

The importance of small and medium-sized enterprises (SMEs) in the world economy is now uncontested (OCDE, 2002). In fact, most large enterprises depend on SMEs for their supply chain (Julien, 1998). Globalization, the internationalization of markets, the knowledge-based economy and the rise of e-business represent challenges that must be met by SMEs as well as large firms (Kalantaridis, 2004). In order to survive, grow and increase their competitiveness in the new business environment, most of these organizations have deployed information technologies (IT) and information systems (IS) (Premkumar, 2003), and many have implemented ERP in particular (Muscatello *et al.*, 2003).

Given the lowering of certain IT costs, a targeting of the SME segment by ERP vendors whose large enterprise market is mostly saturated (Morabito *et al.*, 2005) and the availability of new system alternatives that are better adapted to their specific context, more and more SMEs are adopting ERP systems (Bajwa *et al.*, 2004; Snider *et al.*, 2009). As SMEs generally lack resources and competencies with regard to information systems, the great diversity of system suppliers and the availability of numerous alternatives render their

adoption of an ERP system an even more complex exercise (Bingi *et al.*, 1999). Moreover, whereas most studies of the ERP adoption phenomenon has been made in the context of big business, few attempts have been made to study small business in this regard (van Everdingen *et al.*, 2000; Aloini *et al.*, 2007). However, given the specificities of SMEs as organizations, research results obtained from the study of large enterprise IT/IS cannot necessarily be generalized and transferred to SMEs (Thong, 1999).

Notwithstanding the substantial benefits that can ensue from a successful ERP implementation, certain authors emphasize that this exercise is very risky (Davenport, 1998; Bernard *et al.*, 2004). And while IT implementation projects are reputed to be risky in general, the combination of a technology implementation with a reconfiguration of business processes as well as the scope of their functional coverage make ERP implementation projects even more risky (Austin and Nolan, 1999; Hunton *et al.*, 2004). Also, a SME would have greater difficulty than a large firm in surmounting an ERP implementation failure. As ERP projects are growing in importance and significance for SMEs,

it thus becomes essential that researchers ‘focus on ways to improve ERP implementation’ in these organizations (Robey *et al.*, 2002: 19), while ‘there is also a need to investigate how managers today are managing [software project] risk – what works, what does not and why’ (Schmidt *et al.*, 2001: 30).

In a study of more than 2600 SMEs, van Everdingen *et al.* (2000) found that these firms seek above all an ERP system that can be aligned with their business model and processes. This finding was also confirmed by others such as Chalmers (1999) and Forrester Research (2004). Now, Bancroft *et al.* (1998) as well as Davenport (2000) reported that two of the most important criticisms made by organizations who have implemented ERP systems are their lack of flexibility and their structural – rather than process – orientation. These characteristics of ERP systems ‘as implemented’ would increase the risk exposure of SMEs in their search for alignment, as flexibility is precisely the main advantage of SMEs in comparison to large firms (Levy and Powell, 1998).

In order to reduce the risk of ERP implementation, certain authors recommend a risk management plan that is initiated at the implementation phase of the system’s lifecycle (Markus and Tanis, 2000; Tomas, 2005). However, in a review of the ERP literature, Esteves and Bohorquez (2007) found that only a limited amount of research covered the adoption phase. For their part, Howcroft and Light (2010) found the IS literature on the packaged software selection process to adopt a mostly functionalist perspective centered on the identification of user requirements, the evaluation of the packages’ match with those requirements, and package selection and acquisition. However, none of the studies reviewed by these authors focused on the management of implementation risk from the adoption phase. Kliem (2000) however emphasizes that risk management is most effective when it is initiated at the earliest possible moment in the system’s lifecycle, that is, at the adoption phase. As shown in Figure 1, developed by summarizing and integrating empirical results and recommendations found in the ERP literature, the investment in ERP can be broken down within the various phases of the

system lifecycle (Esteves and Pastor, 1999; Markus and Tanis, 2000; Ross and Vitale, 2000) and associated with varying levels of risk (Scott and Vessey, 2002; Bahli and Rivard, 2003; Hunton *et al.*, 2004). As highlighted in this figure, the greatest proportion of ERP expenses incurred result from decisions made in the adoption phase; hence it is during this phase that the potential for risk reduction is the greatest.

Given the preceding considerations and justification, the present study will attempt to answer the following research question: *How do SMEs manage the risk of ERP implementation during the ERP adoption process?* The research objectives are (1) to identify and describe the influence of SMEs’ context on their implementation risk exposure, and (2) to understand whether and how, within this process, SMEs actually manage the risk of implementing an ERP system. In order to do so, four case studies of SMEs having implemented an ERP system were undertaken. In this study, a SME is defined as an enterprise whose size ranges from 20 to 249 employees, following the European Union’s definition (Kalantaridis, 2004: 249).

Theoretical and empirical background

This research effort aims to explore ERP implementation risk management during the adoption process, in the context of SMEs. The conceptual and empirical background of the research will be exposed, presenting the key concepts retained from the IS knowledge domains upon which this exploration was based. Thus are presented concepts and prior findings related to the risk of ERP implementation, in light of research on IS risk management and on software development projects, and related to the adoption of ERP systems by SMEs in light of these organizations’ specificities, more precisely the environmental, organizational, technological and the ERP-specific context of adoption.

Risk of ERP implementation

ERP systems implementations have a high failure rate, estimated at between 40% and 70% by some (Lewis, 2001; Carlo, 2005). At the same time, successful implementations

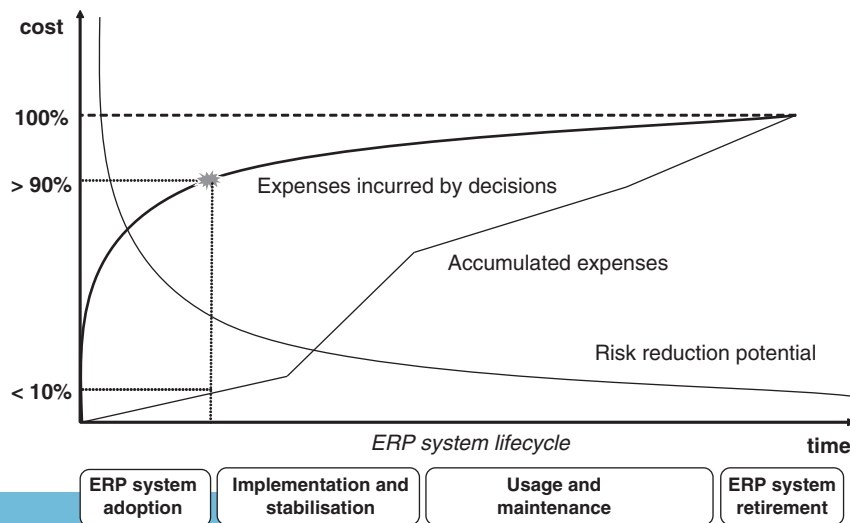


Figure 1 Importance of ERP risk management at the adoption phase.

Table 1 Dimensions of ERP system implementation risk

<i>Risk dimension</i>	<i>Definition</i>	<i>Authors</i>
Technological	Linked to the data processing technologies required to support the ERP system, notably the operating system, the database management system, the client-server system and the network	Austin and Nolan (1999) Bernard <i>et al.</i> (2004) Hunton <i>et al.</i> (2004) O'Leary (2000)
Business	Internal and external coherence of the business model and processes after the implementation of the ERP system	Austin and Nolan (1999) Hunton <i>et al.</i> (2004) O'Leary (2000)
Organizational	Derives from the organizational context in which the ERP system is implemented, including notably the firm's personnel and organizational structure	Austin and Nolan (1999) Bernard <i>et al.</i> (2004) Hunton <i>et al.</i> (2004) O'Leary (2000)
Contractual	Linked to the relationship with the business partners participating in the implementation of the ERP system	Austin and Nolan (1999) Bernard <i>et al.</i> (2004)
Entrepreneurial Managerial	Linked to the owner-manager's and management team's attitude toward IS/IT	Winston and Dologite (2002)
Financial	Derives from problems with cash-flow, software licensing costs or software update costs	Ariss <i>et al.</i> (2000) Alter and Sherer (2004)
Legal risk	Related to open source license restrictions requiring a waiver of intellectual property (IP) rights in a company's own software incorporating open source software or the violation of third-party intellectual property rights	Meyer and Stewart (2004) Walsh and Tibbetts (2010)

provide significant operational and strategic advantages to organizations (Davenport, 1998; Shang and Seddon, 2000). While the notion of risk is deemed to be important for IS researchers and practitioners, there is as of yet no consensus on how to define, measure and manage IS risk; and most risk management models are prescriptive in nature and do not have a theoretical foundation (Alter and Sherer, 2004; Aloini *et al.*, 2007). The present study is based upon Barki *et al.* (2001) model founded on contingency theory. According to this model, project risk management can be understood through the fit between the organization's level of exposure to risk and its risk management profile.

Given the lack of consensus on the nature of IS risk factors and on the principal components of such factors (Alter and Sherer, 2004; O'Callaghan, 2007), a review of prior studies led to the identification of seven categories of risk exposure, namely organizational, business, technological, entrepreneurial or managerial, contractual, financial and legal risk as presented in Table 1. The organizational risk derives from the environment in which the ERP system is adopted and implemented (Austin and Nolan, 1999). The business risk is linked to the internal and external consistency of the business model and processes following an ERP implementation (Hunton *et al.*, 2004). The technological risk emanates from the information processing technologies required by the ERP system (O'Leary, 2000). The entrepreneurial or managerial risk is associated to the attitude of the owner-manager or the management team toward IT/IS in general and ERP in particular (Winston and Dologite, 2002; Caldeira and Ward, 2003). The contractual risk pertains to relations with business partners and with ERP vendors and consultants in particular (Bahli and Rivard, 2003).

The financial risk is present to the extent that cash-flow problems prevent the SME from acquitting software licensing or upgrading fees (Ariss *et al.*, 2000). Packaged software is generally licensed rather than sold, since it is a product that mostly comprises intellectual property. Legal risk is related to 'the risk of losing competitive advantage from open source terms requiring a waiver of intellectual property (IP) rights' on the company's own software incorporating open source software (Walsh and Tibbetts, 2010: 9) or the potential liability for intellectual property infringement, in other words the risk related to the violation of third-party intellectual property rights (Meyer and Stewart, 2004).

Following Barki *et al.* (2001), the organization's risk management profile is broken down into three main components, namely formal planning, internal integration and user participation. Formal planning is an impersonal work organization mode (Zmud, 1980) that refers to plans, schedules and budget estimates to manage a software development project. Internal integration is a vertical coordination mode that aims to improve cohesion and communication among project team members. User participation refers to activities aimed at intensifying communication and exchanges with the eventual users of the software, akin to Nidumolu's (1995) concept of horizontal coordination.

In reviewing the literature on ERP system adoption, nine models of the adoption process were identified, with the number of phases varying from two to thirteen.¹ Most of these models are without any theoretical foundation with the exception of Verville and Halington's (2003) model, founded on the organizational buying behaviour (OBB) models developed in industrial marketing research. The



framework elaborated for the present research is thus based on this last model because of its theoretical and empirical foundation and on Esteves and Pastor's (1999) model because it is somewhat complementary to the first. This last model differentiates the decision to adopt an ERP system from the adoption process itself, but does not provide any detail on the process, whereas the first model does not include a separate adoption decision phase but breaks down the adoption process in more detail. The resulting adoption framework thus consists of seven phases: decision, planning, search for information, selection, evaluation, choice and negotiation.

Prior research on IT/IS adoption suggest that this process is influenced by a number of contextual factors (Pettigrew, 1990; Ming-Ju and Woan-Yuh, 2008). Some researchers emphasize that risk exposure as well as risk management are influenced by such contextual factors (Ropponen and Lyytinen, 2000). More specifically, these factors increase or decrease the exposure to risk (Drummond, 1996; Warkentin *et al.*, 2009). Contextual factors have been regrouped here under two categories, that is, a general context and a specific context of ERP adoption in SMEs.

General context of ERP adoption

A number of IT implementation studies have used Tornatsky and Fleischer's (1990) technology-organization-environment (TOE) framework to characterize the implementation context, emphasizing three groups of contextual factors: (1) characteristics of the environmental context such as external pressures from the firm's business partners, (2) characteristics of the organizational context such as the firm's structure, and resources, including managerial and entrepreneurial (in the case of SMEs) factors, given the key role played by certain individuals in the implementation process, and (3) characteristics of the technological context, including the information technologies already implemented by the firm.

With regard to ERP implementation risk exposure, the SMEs' lesser availability of human, financial and material resources expose these organizations to greater financial risks than large enterprises when it comes to adopting an ERP system. In similar fashion, adopting ERP in a technologically obsolete context in terms of IT infrastructure increases technological risk exposure (Kwon and Zmud, 1987). While the weaker IT competencies that often characterize SMEs increase their exposure to organizational risk. Also, these firms often rely heavily on vendor support and presentations to inform their decision, rather than carrying out detailed requirements analysis (Olsen and Saetre, 2007b). This situation exacerbates the likelihood that the adopted package will fail to meet user requirements (Keil and Tiwana, 2006) and consequently increases the SMEs' business risk exposure.

ERP-specific context of adoption

The review of the ERP implementation literature led to the identification of four components of the ERP-specific context of adoption of an ERP system by a SME. These components have potentially a more direct or immediate influence on the adoption process than the general contextual factors previously identified, in that they pertain specifically to ERP systems. The adoption process can thus

be influenced by (1) the motivations that spur the firm to adopt ERP, be they technological, operational or strategic in nature, (2) the stakeholders in the adoption process in addition to the adopting firm itself, (3) the selection criteria relative to the choice of the system supplier, of the system itself and of the implementation partner (integrator), and (4) the alternative ERP implementation solutions offered to the firm. Each of these components and their potential influence are further defined below.

Oliver and Romm (2000) found three categories of motivations that determine an organization's initial search for an ERP solution: the need to improve the performance of current operations, the need to integrate data and systems, and the need to prevent a competitive disadvantage or a business risk from becoming critical. For Parr and Shanks (2000), motivations are also of three orders: technological (common platform, obsolescence of legacy systems), operational (process improvement, data visibility, operating cost reductions), and strategic (e.g. customer responsiveness, decision-making improvement, need for efficiencies and integration, business restructuring). Given the high cost and high risk of facing complex implementation problems (Figure 1), the organization's initial motivations to implement an ERP system can be a determinant of its behaviour within the adoption process (Ross and Vitale, 2000).

Apart from the adopting organization, the main stakeholders in the implementation of an ERP system are the ERP vendor or supplier and the integrator (Haines and Goodhue, 2003). And these partners are most often implicated at the outset of ERP adoption. In the specific context of the SME, other actors can play an important role during the adoption process, that is, the leader's informal or social network and management team (Riemenschneider and Mykytyn, 2000), an influential business partner (Marsh, 2000), the parent-firm in the case of a subsidiary (Caldas and Wood, 1999), and public or private financial institutions (Ariss *et al.*, 2000). Assistance provided by a prime contractor in the case of subcontracting firms or by the parent firm in the case of subsidiaries can decrease the SMEs' technological or financial risk exposure, or even business risk exposure. However, being more dependent upon external expertise and services for their information system, SMEs have less influence over computer vendors and consultants, which increases their exposure to contractual risk compared to large enterprises (Gable and Stewart, 1999).

To a great extent, IT vendors and consulting firms depend on the power of advertising to persuade potential adopters that their products and services are solutions to organizational problems (Swanson and Ramiller, 2004; Pozzebon *et al.*, 2006). They do so however by minimizing their solutions' complexity, lack of generalizability, and risk involved (Swan *et al.*, 2000). In order to narrow the gap between their perception of the problem and the potential solutions offered while minimizing the risk of implementing one such solution, adopting organizations establish criteria upon which their selection of an ERP system (Rao, 2000), an ERP vendor (Keil and Tiwana, 2006) and an ERP integrator (Kumar *et al.*, 2003) is based. With regard to the choice of the system itself, the two most important criteria in the specific context of SMEs appear to be the level of alignment of the proposed system with the firm's business model and processes, as well as the system's

flexibility (van Everdingen *et al.*, 2000; AMR Research, 2003). Other important criteria include the breadth of the system’s functional coverage (Kumar *et al.*, 2003) and the system’s user-friendliness (Keil and Tiwana, 2006). With regard to the choice of a vendor or software supplier, the licensing costs and the quality of service and support are criteria of choice (Bernroider and Koch, 2001). And the criteria to select an integrator include the latter’s experience with the particular ERP system, expertise in organizational change and knowledge of the specific nature of the adopting firm’s business, environment and industry (Kumar *et al.*, 2003).

The fourth component of the ERP-specific context of adoption consists in the various solution alternatives offered to the firm by the IT industry for purposes of ERP implementation. The availability and accessibility of these alternatives within the SMEs’ business environment should thus influence the firms’ ERP adoption behaviour (Wei *et al.*, 2005). For instance, there are now more than 500 ERP vendors and most offer systems dedicated to the SME market (Bingi *et al.*, 1999; Bachelidor, 2004).² As mentioned previously, choosing an ERP system under these conditions has become a quite difficult and risky task indeed for SMEs. The commercialization of ‘middle market’ ERP solutions by most vendors confirms their growing interest for this market. And there are basically six modes of ERP implementation (or types of ERP solutions) that are now available and potentially accessible to SMEs: packaged software provided by large ERP vendors such as SAP and Oracle, packaged software provided by small and medium-sized ERP vendors (Helo *et al.*, 2008), ‘best of breed’ systems (Light *et al.*, 2001), outsourcing (Trimi *et al.*, 2005), ‘open source’ software (Dreiling *et al.*, 2005), and in-house development of the ERP system (Olsen and Saetre, 2007a). These six modes (or ERP solution alternatives) are further described in Appendix B.

Conceptual framework of ERP risk management in the adoption process

As presented in Figure 2, the ERP adoption process is conceived as being influenced both by a general context and

a specific context. This process can be decomposed into seven phases, that is, the adoption decision, project planning, search for information, selection of ERP solutions, choice of the most adequate solution, and negotiation. The ERP solution to be chosen within the adoption process may be provided to the SME in one of six alternative modes, that is, by one of the ‘big five’ ERP vendor, by a small and medium-sized ERP vendor, or through a ‘best-of breed’, outsourcing, open source ERP or in-house ERP development approach. And given the importance of managing ERP risk early in the system’s lifecycle, it is implicitly assumed, following Barki *et al.* (2001), that risk management requires the alignment of the organization’s risk exposure with its risk management profile.

Research method

Given that ERP adoption, as the phenomenon under study, is hardly separable from its context (Ross and Vitale, 2000), an interpretive case study methodology was employed to explore ERP system adoption and risk management (Walsham, 1995). Here, adoption refers to the first phase in the ERP system’s lifecycle, prior to the system’s implementation (Markus and Tanis, 2000). Given that this is a ‘holistic’ multiple case study (Yin, 1997), the unit of analysis is the SME. Case data was obtained from four SMEs that have adopted an ERP system. The study focused on the adoption process, that is, from the time the firm decided to implement ERP up to the time a contract to acquire or implement a system was signed. Consequently, there was no attempt to describe or understand the ERP implementation process.

The choice of the four cases, Alpha, Beta, Gamma and Delta,³ was based on a theoretical sampling procedure (Eisenhardt, 1989) that is, ‘purposeful’ sampling whose aim is to select cases whose richness illuminates the research question (Robson, 1993; Saunders *et al.*, 2000). Consequently, case selection was based on two principles, namely similarity and variation. Similarity refers to the critical aspects of the research question, hence the firms selected satisfied the following criteria: (1) be a SME (as defined previously), (2) having adopted an ERP system whose

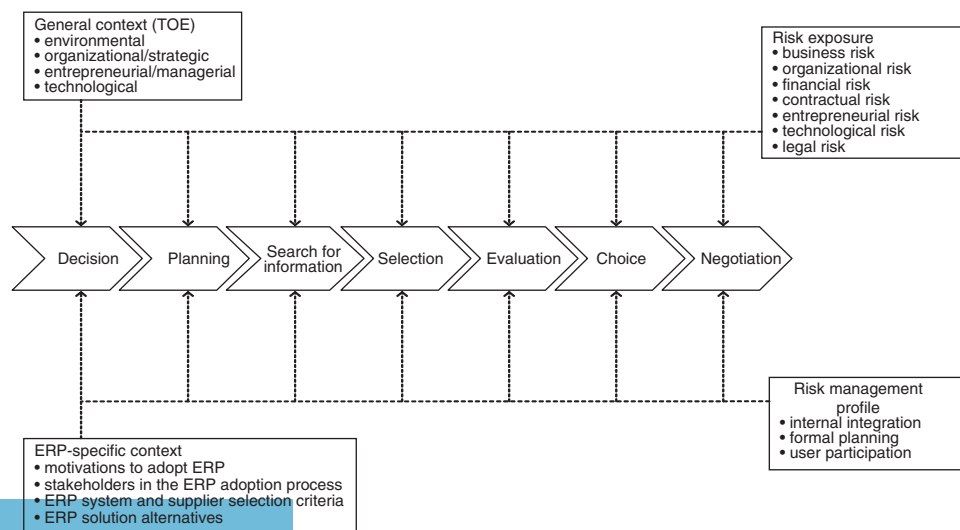


Figure 2 Conceptual framework for ERP risk management in the adoption process.

Table 2 Description of the cases studied

SME case context	Alpha	Beta	Gamma	Delta
Sector	Manufacturing	Service	Manufacturing	Service
Product/Service	Thermal equipment	Bio-agriculture-based product distribution	Technical equipment housing structures	Rubber-based product distribution
Capital structure	<ul style="list-style-type: none"> ● 54% of capital held by a group of investors ● 40% held by management team 	<ul style="list-style-type: none"> ● 96% of capital held by management team ● 4% held by an international group 	Family firm	Subsidiary of an international group
Year of creation	1996	1991	1967	1967
No. of employees	28 incl. 14 managers	30 incl. 6 managers	50 incl. 5 managers	60 incl. 15 managers
Turnover	5 M. euros	12 M. Euros	6 M. euros	27 M. euros
Sales growth	14%	15%	10%	14%
Production volume	46 000 units per year	300 order lines/month	750 units per year	Not available
ERP system alternative adopted	<i>Small vendor</i>	<i>In-house development</i> (prior use for 16 years of a 'best of breed' system)	<i>Open source</i> (2nd implementation as 1st system was abandoned after implementation)	<i>Open source</i>
Functional coverage of the ERP system	<ul style="list-style-type: none"> ● order management ● production management ● sales management ● billing ● accounting 	<ul style="list-style-type: none"> ● CRM ● executive and sales management ● purchasing and supplier management ● inventory mgmt and shipping ● quality management ● accounting ● warehouse management 	<ul style="list-style-type: none"> ● proposals ● order entry ● purchasing management ● production management ● shipping ● billing ● quality management 	<ul style="list-style-type: none"> ● executive management ● accounting ● finance ● sales management ● logistics management
Start of ERP adoption process	August 2002	October 2005	February 2005	July 2003
Start of ERP implementation	January 2003	March 2006	October 2005	November 2003
Main stakeholders in the ERP adoption process	<ul style="list-style-type: none"> ● CEO ● Production manager 	<ul style="list-style-type: none"> ● CEO ● Marketing manager ● 7 employees ● Executive consultant 	<ul style="list-style-type: none"> ● CEO ● Technical director ● Logistics manager 	<ul style="list-style-type: none"> ● Executive and finance manager ● Executive and finance manager of parent firm ● Executive consultant
Date of 'go-live'	June 2004	July 2006	July 2006	April 2004
Number of users	12	30 (all employees)	10	20
No. of informants	4	5	5	4

functional coverage included at least one primary activity and one support activity in the value chain so as to observe comparable organizational integration efforts in the cases (Barki and Pinsonneault, 2005), and (3) the adoption process dated not less than six months and not more than five years. As presented in Table 2, variation concerns the SMEs' size (number of employees and turnover), sector (manufacturing, service), form of ownership, and mode of ERP adoption (small ERP vendor, open source, in-house development). Three firms are based in France and one in Canada.

Data collection procedure

A presentation letter of the study and its objectives, a confidentiality agreement, and an interview guide were first sent to prospective informants. To achieve an appropriate level of internal validity, four sources of evidence were used, that is, semi-structured interviews, written documents, a questionnaire, and field notes. The documents were particularly useful to support, enrich and validate the data collected through the interviews. The interview questionnaire was filled by a member of the management team with the help of the researcher, on the spot or by

telephone. Field notes taken by the researcher during the interviews were used to modulate their transcription.

Four to five interviews were conducted in each of the four organizations, including production, marketing and financial managers as well as employees that had participated in the adoption and implementation of the system selected. In addition, we had the opportunity to conduct informal interviews with consultants that had also participated in the ERP adoption and implementation processes. In each case, saturation was obtained after the third or fourth interview (Guba and Lincoln, 2004). Prior to data collection, a telephone interview was obtained with each firm's CEO to obtain general information on the organization and its ERP adoption process, and to identify the initial key informants in order to plan the interviews, with the possibility of discovering other informants later on. Thus a 'snowball' strategy was used to select these informants (Patton, 1990).

The interviews lasted one hour and fifteen minutes on average, using the same interview guide in all cases in order to allow for inter-case analysis (Miles and Huberman, 2003). The content of the interview guide was based on the initial conceptual framework of the ERP adoption process and risk management. It included initial information gathering on the respondent, the firm, and its business environment, strategy and technology. Motivations to adopt an ERP system, perceptions of ERP risk and selection criteria were then discussed, followed by questioning on the firm's adoption process. Certain questions were clarified with the informants by telephone after the interviews. Approximately 19 h of tape-recorded interviews were thus obtained. The documents consulted included the firms' promotion literature, ERP project documentation, information on their markets and commercial literature from the ERP system vendors and integrators chosen as well as press clippings on the projects. In total, the interview transcriptions and documents amounted to 440 pages.

Triangulation was done by comparing interview data obtained from different respondents within the firm. To increase the reliability of the case data, a case protocol was developed prior to data collection. Following the first (pilot) case, this protocol was slightly modified. By giving sense to the data collected, coding enabled the identification of the main components of the research framework, that is, the general and specific contexts of ERP adoption, the phases of the adoption process itself, the ERP risk exposure factors as well as the implementation risk management profile at the adoption stage.

The coding scheme developed in our study was hierarchical in nature, starting with four broad categories (general context of ERP adoption, ERP-specific context, adoption process, risk and results), each of which were further broken down into sub-categories. For instance, the 'risk and results' category was broken down into 'undesirable results', 'risk factors' and 'risk management profile', and each of these sub-categories were further broken down as illustrated in Appendix C. The principal researcher developed and coded all transcripts. To ascertain the validity of the coding process, a second researcher coded 180 transcript segments from the cases. The kappa intercoder reliability coefficient was equal to 0.62, indicating substantial agreement (Landis and Koch, 1977: 165).

Data analysis procedure

Data analysis was done in two steps, first an intra-case analysis of each firm, and then an inter-case analysis (Eisenhardt, 1989). The intra-case analyses were performed in an iterative manner, as all electronic material was read through several times. At first, we applied data display techniques (Miles and Huberman, 2003), the data being structured to identify the various phases of ERP adoption that the SMEs had passed through; then the data were analysed to identify which contextual factor had influenced the exposure to implementation risk. This also enabled patterns to be identified in the process of moving back and forth between the data and the research framework in a 'hermeneutic circle' (Klein and Myers, 1999).

A narrative approach was then used to describe the case in the form of a 'narrative report' (Langley, 1999). Textual segments were analyzed to highlight initial or new attributes of the research framework such as risk management mechanisms in the firms' ERP adoption process. These segments were placed in matrices so as to generate an evidence chain, as illustrated in Appendix C; it was then possible to apply an 'explanation-building' strategy in analyzing the data (Yin, 2003).

An inter-case analysis was done to increase the generalizability of the results and our understanding of the cases. As proposed by Miles and Huberman (2003), a mixed strategy was used, focussing both on the research concepts and on the cases. Thus the four cases were compared with regard to the categories emanating from the conceptual framework, in order to identify intra-group similarities and inter-group differences. The cases were then compared pair-wise in order to identify similarities and differences between the cases. At the same time, the 'chain of evidence' built during the intra-case analysis facilitated sense-making for each case and helped identify differences between the cases (Lapointe and Rivard, 2005). An example of the chain of evidence for one case is presented in Appendix C.

Intra-case analyses of ERP system risk management in SMEs

This section identifies the general context as well as the specific context of ERP adoption. In each case we identified several phases of the ERP adoption process as well as the identification of the mechanisms employed by the four SMEs at the outset and during this process to manage the ERP implementation risk. This was done in order to provide an in-depth understanding of whether and how, within the adoption process, the SMEs actually managed the risk of implementing an ERP.

The Alpha case

Alpha is manufacturer of thermal equipment whose business environment is characterized by a great sensitivity to the price of raw materials and by exacting customer demands in terms of response time. It produces both on a make-to-stock and make-to-order basis. To increase its flexibility, Alpha calls upon a network of subcontractors for approximately 10% of its annual production. It has a strong innovation capability and protects most of its products with international patents. For its standard products, Alpha is oriented towards a low-cost, product-oriented strategy (Porter, 1982). On the other hand, for its more innovative

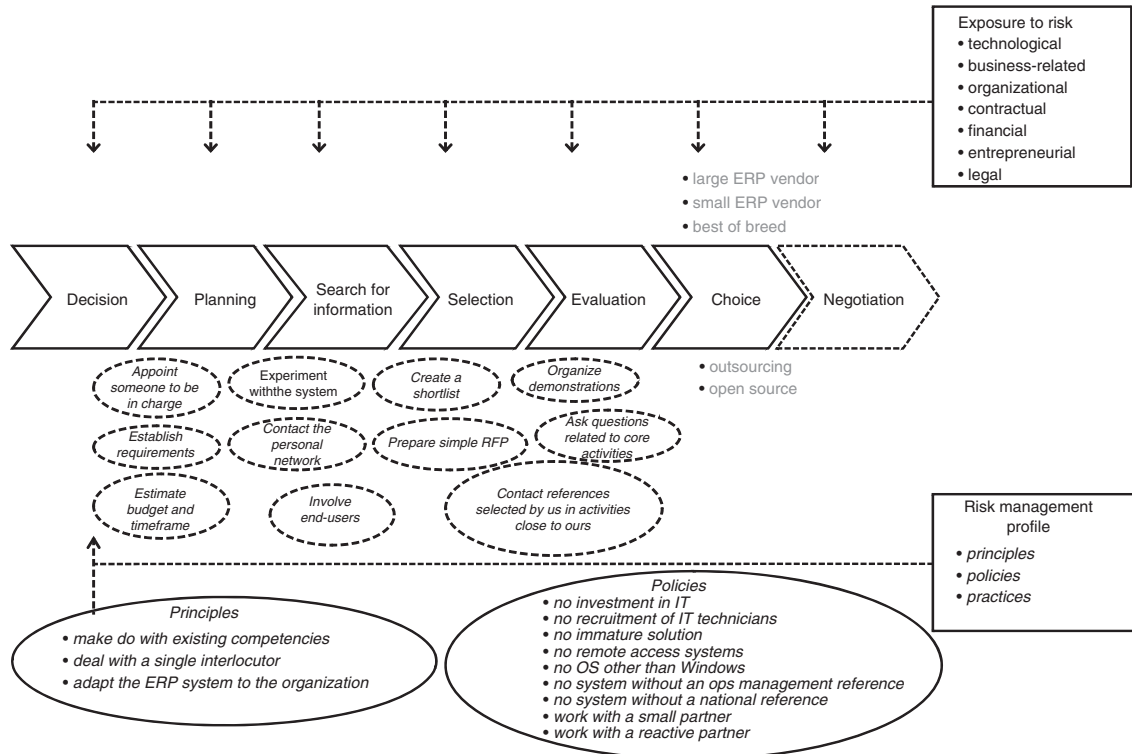


Figure 3 ERP implementation risk management in the adoption process at Alpha.

products that give value to its know-how, it adopts a ‘prospector’ type strategy (Miles and Snow, 1978) accompanied by a high degree of responsiveness.

Alpha’s business processes were characterized by a lack of formalization, a lack of integration and a high error rate. Its business software consisted of an accounting-payroll package whose operation and maintenance were outsourced. It had also developed an Excel-based production scheduling application. There were no dedicated IS personnel and most of the employees had never used a computer. The chief executive and the operations managers are both engineers by training, the latter having had previous experience as an ERP system user in a large enterprise.

ERP implementation risk management in the adoption process at Alpha

As shown in Figure 3, the ERP adoption process at Alpha was decomposed into six of the seven phases in the initial research framework. The project was led by the CEO and the operations manager, and it was their intent that moved the organization from one phase to the next.

A number of risk reduction mechanisms were employed during the adoption process. Alpha’s risk management profile can be described as an intuitive, rather informal and apparently unstructured approach to risk, based on three guiding principles, nine policies and eleven practices, to use the three levels of abstraction proposed by Colbert (2004: 343) as an architecture for such mechanisms.⁴ A statement made by the production manager illuminates this:

‘Maybe we made this risk evaluation without structuring it. We did this rather intuitively. We remove doubts before investing.’

This three-tiered architecture was found at the outset to be more appropriate to describe and explain Alpha’s risk management profile than the three dimensions initially posited in the research framework, that is, internal integration (extent of communication and cohesion among IS project team members), formal planning (extent of reliance upon plans, schedules and budgets) and user participation (extent of coordination between users and project team members) as proposed by Barki *et al.* (2001). It also appeared that for Alpha’s given level of risk exposure, this architecture constituted a whole, an internally-consistent ‘configuration’ (Fiss, 2007).

As presented in Table 3, these principles, policies and practices had an effect on the level of ERP implementation risk exposure. The principle that ‘the system is to be adapted to the organization’ indicates that the firm had opted at the outset of the adoption process for having the ERP systems fit its business model and processes. Observing this principle reduced the level of organizational change required and thus decreased organizational risk exposure. The ‘make do with our own competencies’ principle indicates that in addition to not wanting a service provider to implement its ERP system, Alpha was also looking for a system whose complexity could be mastered, thus minimizing its contractual, technological and business risk. And estimating a global budget and timeframe for both the adoption and implementation processes provided Alpha with points of reference that helped to limit its financial risk exposure.

In similar fashion, practices such as ‘ask questions related to core activities’ and ‘contact references selected by us in activities close to ours’ have contributed to minimize the risk of doing business through the chosen ERP system. Observing the ‘no operating system other than Windows’

Table 3 Impact of principles, policies and practices on ERP risk exposure at Alpha

	Organizational risk	Technological risk	Business risk	Financial risk	Contractual risk	Entrepreneurial risk	Legal risk
<i>Principles</i>							
Make do with our own competencies	●	●	●	●	●		
Deal with a single interlocutor			●		●		
Adapt the system to the organization	●		●				
<i>Policies</i>							
No investment in IT				●			
No recruitment of IT personnel				●			
No immature solution	●	●	●				
No remote access system	●	●	●				
No OS other than Windows	●	●					
No system without a national reference			●				
No system without operation management reference			●				
Work with a small-sized partner					●		
Work with a reactive partner			●		●	●	
<i>Practices</i>							
Involve end-users	●		●				
Appoint someone to be in charge	●		●		●		
Establish requirements			●	●	●		
Estimate budget and timeframe				●			
Contact personal network			●		●		
Prepare a simple RFP		●	●		●		
Create a shortlist					●		
Experiment with the system	●		●				
Organize demonstrations	●		●				
Ask questions related to core activities	●		●				
Contact references selected by us in activities close to ours			●				

● Contributed to reduce risk exposure.

policy implied selecting a system that functioned in Alpha’s existing software environment and that was known by the users, thus reducing exposure to technological and organizational risks. Alpha also reduced its organizational risk by having users participate immediately in the adoption phase.

The Beta case

Beta is specialized in the commercialization and distribution of food products that originate in biological agriculture. It works with more than 300 suppliers, of which there are five main ones, including Beta’s former parent firm, Sigma, that provides Beta with 77% of its supplies. Within its development plan, Beta decided to invest in a new building with the aim of decreasing complaints from customers and reducing to less than 24 h the time between reception of a customer’s order and shipping of the order. To increase the flexibility of its operations, Beta outsources the transportation and delivery of its products. It has a ‘niche’ strategy (Porter, 1996) and is characterized by a quick response to its market’s needs. Beta’s owner-manager and marketing manager both have a university degree. The former practices participative management and has a positive attitude toward IT for management support.

Before implementing the new ERP system, the firm had been using for the last sixteen years a ‘best-of-breed’ system, whose main component was an ERP system provided by a large ERP vendor, completed by modules provided by other vendors or developed specifically for Beta. There are few dedicated IT personnel, but most employees use IT tools intensively. Consequently, Beta’s level of IT use and IT management sophistication is high (Raymond *et al.*, 1995). Until July 2006, business processes were supported by an applications portfolio that lacked integration. Many data were entered more than once, generating multiple errors and requiring multiple verifications.

ERP implementation risk management in the adoption process at Beta

During the adoption process, Beta followed one guiding principle, namely ‘the system is adapted to the organization’, enacted six policies, and applied fifteen practices (Becker and Gerhart, 1996; Colbert, 2004). As shown in Figure 4, the process was broken down into six phases: adoption decision, planning, search for information, evaluation, choice and negotiation. There was no selection phase. This process was triggered by the move to the new building, but the organization was put into motion by the shared vision of its working in this building, whose photos and plans were apposed on the walls of most headquarter offices.

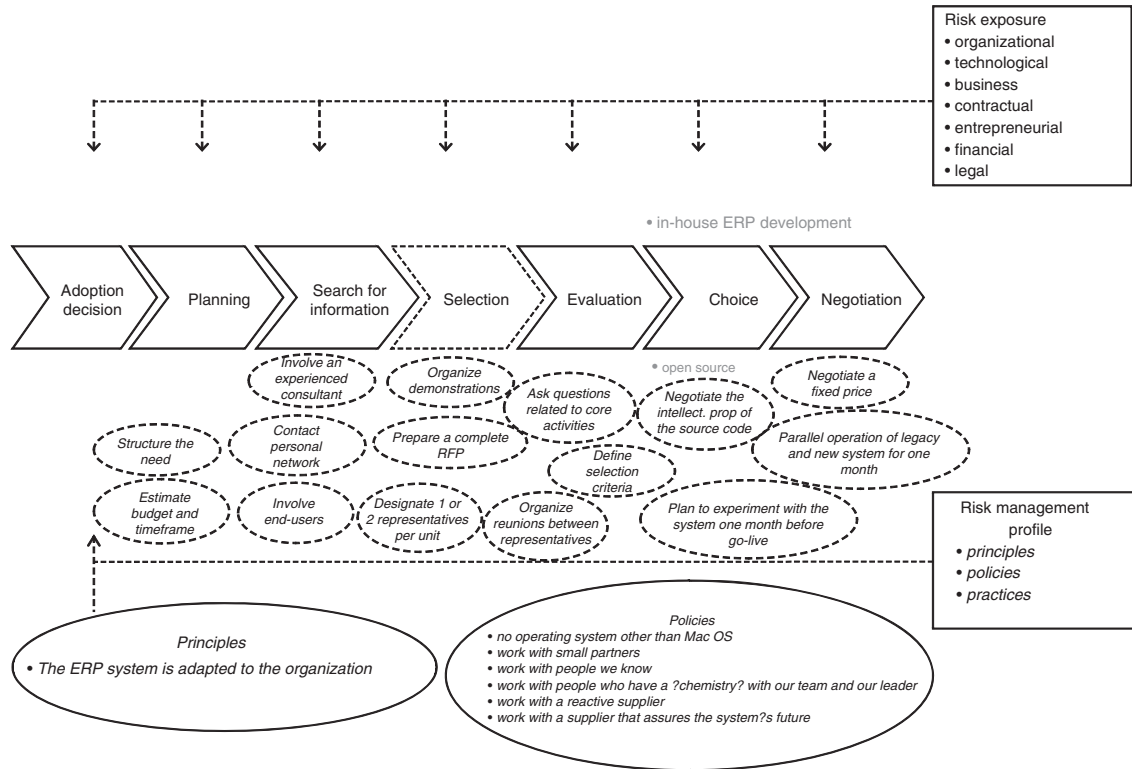


Figure 4 ERP implementation risk management in the adoption process at Beta.

For Beta, taking risk into account immediately at the adoption phase was based on a reactive, informal, intuitive and incremental approach (Blili and Raymond, 1993). As represented in Figure 4, this apparently unstructured risk management approach was nonetheless based on observable principles, policies and practices. The following statement by the owner-manager illustrates this:

‘I was rather guided by events as they happened. I gathered information here and there. I didn’t have much information because 95% of firms use PCs.’

A milestone set by management was that the new ERP system was to be fully up and running by the time Beta moved to its new building. At the conclusion of its search for information, Beta has a shortlist of two ERP system alternatives, one being a system developed ‘in-house’ and another of the ‘open-source’ type. An evaluation of the two alternatives, based on two demonstrations and about twenty criteria, was followed by many discussions which led to the choice of the first alternative. After a formal negotiation, the contract signed between Beta and the software vendor granted the intellectual property of the source code to Beta.

As presented in Table 4, the guiding principle, policies and practices enacted by Beta has an effect on the firm’s exposure to ERP implementation risk.

For instance, by following the policy of ‘working with a supplier whose size is small’, the owner wanted as a business partner an organization whose CEO he could easily have access to, thus limiting the contractual risk. The policy of ‘working with people we know’ and ‘working with

people who have a “chemistry” with our team and our leader’ had a similar effect on the contractual, organizational and entrepreneurial risks. Following the policy of ‘no operating system other than Mac OS’ here again reduced technological and organizational risks by implementing the ERP system within the existing IT infrastructure, already mastered by users. Implementing the practice of ‘involving end-users’ immediately in the adoption phase reduced organizational risk exposure. Similarly, the practice of ‘asking questions related to core activities’ and of ‘operating legacy and new system in parallel for one month’ contributed to reduce the risk of doing business through the chosen ERP system.

The Gamma case

Gamma fabricates structures designed to house technical equipment. Over 40% of its turnover is due to one main customer. It competes in a national market against five large firms. This market is characterized by high levels of professionalization and regulation. To respond to market needs, Gamma produces both on a make-to-stock and on a make-to-order basis. In order to increase its flexibility, it subcontracts approximately 5% of its production to other SMEs. Gamma obtained the ISO 9001 certification in 1990 to satisfy the requirements of its principal customer.

The firm’s strategy is based on differentiation (Porter, 1996) founded upon its reputation, responsiveness and the quality of its products and services. Until June 2006, its applications portfolio consisted of the Microsoft Office suite and two software packages for accounting and payroll whose operation and maintenance were outsourced. There was no dedicated IS personnel but a number of made-to-measure applications had

Table 4 Impact of principles, policies and practices on ERP risk exposure at Beta

	Organizational risk	Technological risk	Business risk	Financial risk	Contractual risk	Entrepreneurial risk	Legal risk
<i>Principles</i>							
The system is adapted to the organization	●		●				
<i>Policies</i>							
Work with a supplier whose size is small	●				●		
Work with a supplier that assures the ERP system's future			●	●	●		
Work with people we know	●		●		●	●	
Work with people who have a 'chemistry' with our team and our leader	●		●		●	●	
Work with a reactive supplier			●		●	●	
No operating system other than MacOS	●	●					
<i>Practices</i>							
Involve end-users	●		●				
Designate one or two representatives per unit	●		●				
Organize workshops between unit representatives	●		●		●		
Structure the need			●	●	●		
Estimate budget and timeframe				●			
Negotiate fixed price				●	●		
Contact personal network			●		●		
Prepare a complete RFP		●	●		●		
Organize demonstrations	●		●				
Ask questions related to core activities	●		●				
Plan to experiment with the system one month before "go-live"	●	●	●				
Parallel operations of legacy and new system for one month	●		●				
Involve an experienced consultant		●	●		●		
Define selection criteria		●	●	●			
Negotiate the intellectual property of the source code							●

● Contributed to reduce risk exposure.

been developed in-house with the Excel spreadsheet software. The management team are university graduates and the CEO had a positive attitude towards IT.

ERP implementation risk management in the adoption process at Gamma. As shown in Figure 5, this process what decomposed into five phases rather than seven as there was no 'search for information' and 'selection' phases. Gamma's approach to risk management can be described again as being rather intuitive, informal, apparently unstructured but based on certain principles, policies and practices that helped in reducing its exposure to the risk of ERP implementation. As presented in Figure 5, Gamma followed one basic principle during the adoption process, namely that 'the system must be adapted to the organization', and it applied nine practices.

The adoption decision was reactivated by the prospecting activity of an open source ERP system integrator. Prior to this visit, Gamma had accepted an offer from an independent software developer to build a custom ERP system and had started both to define specifications and to develop the program. By the time the integrator arrived, the system had become more and more complex. As opposed to the first

solution that required all application software to be custom developed, the second solution consisted in adapting an open source ERP system to Gamma's needs. Attracted by the potential advantages of this second solution as compared to the first, management decided to evaluate it and invited the integrator to demonstrate its ERP software. In particular, this second solution was deemed by the chief executive to be less risky than the first:

'SourceSoft came to see us, saying: 'We suggest starting with this software and adapting it to your need'. Thus, instead of the custom-built solution proposed by the independent software developer being realized from scratch, we said to ourselves: Why not start with an existing solution? We didn't think it could be any riskier.'

As presented in Table 5, the principles, policies and practices followed by Gamma had an effect on its exposure to ERP implementation risk. By following the principle of 'adapting the ERP system to fit the organization' and by observing the practice of 'informing and consulting with

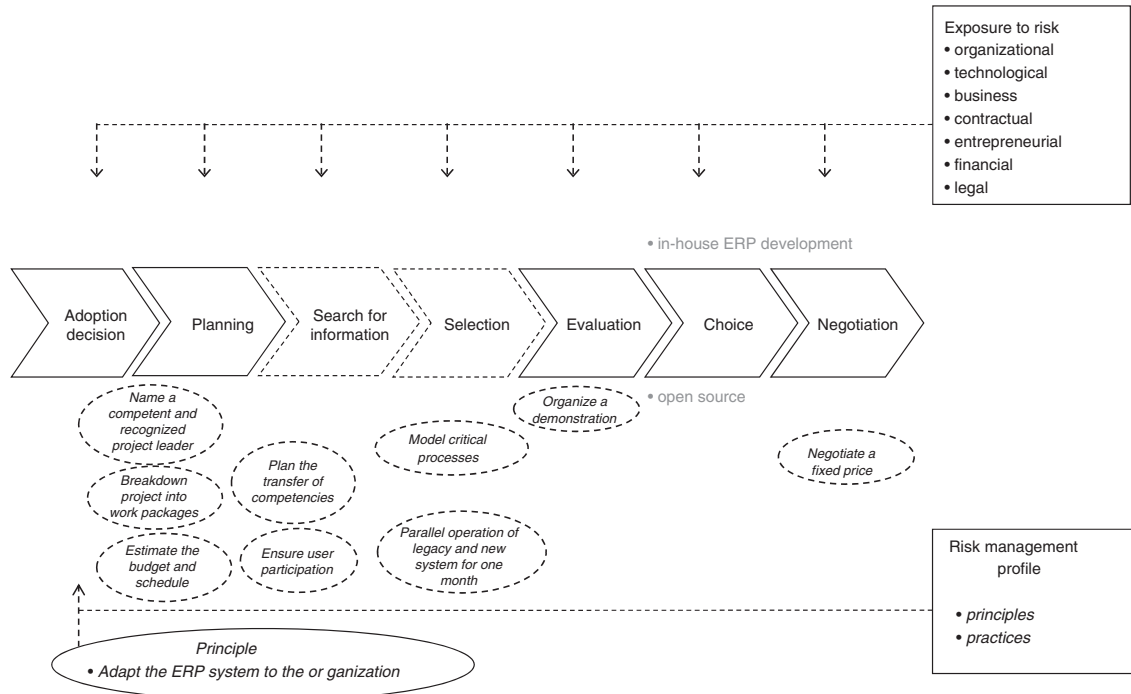


Figure 5 ERP implementation risk management in the adoption process at Gamma.

Table 5 Impact of principles and practices on ERP risk exposure at Gamma

	Organizational risk	Technological risk	Business risk	Financial risk	Contractual risk	Entrepreneurial risk	Legal risk
Principles							
The ERP system is adapted to the organization	●		●				
Practices							
Ensure user participation	●		●				
Name a competent and recognized project leader	●		●		●		
Estimate budget and schedule				●			
Negotiate a fixed price				●	●		
Model critical processes			●				
Organize a demonstration	●		●				
Breakdown project into work packages		●			●		
Plan the transfer of competencies	●		●				
Parallel operation of legacy and new system for one month	●		●				

● Contributed to reduce risk exposure.

future users’ at the outset of ERP adoption, Gamma was able to reduce its exposure to both organizational and business risks. Also, the practice of ‘negotiating a fixed price’ reduced its financial risk while ‘operating the legacy system and the new system in parallel for one month’ allowed Gamma to reduce its organizational and business risks.

The Delta case

Delta commercializes and distributes rubber-based products in a business environment characterized by a great sensitivity to the price of raw materials and by the arrival of new entrants to the market. This environment is also

characterized by strong customer demands in terms of responsiveness. Delta makes 85% of its procurements from its parent firm and 25% of its sales are made to other subsidiaries of this firm. On the other hand, approximately half of its turnover is due to one main customer. Product delivery is outsourced to two transportation firms.

Prior to the implementation of the ERP system, Delta’s applications portfolio was not integrated. It consisted of an accounting application and a sales application developed in the MS-DOS environment, and of the Microsoft Office suite. Payroll was outsourced. Delta has no dedicated IT personnel, this function being accomplished by IT personnel at the parent firm. The finance manager confirms that Delta’s

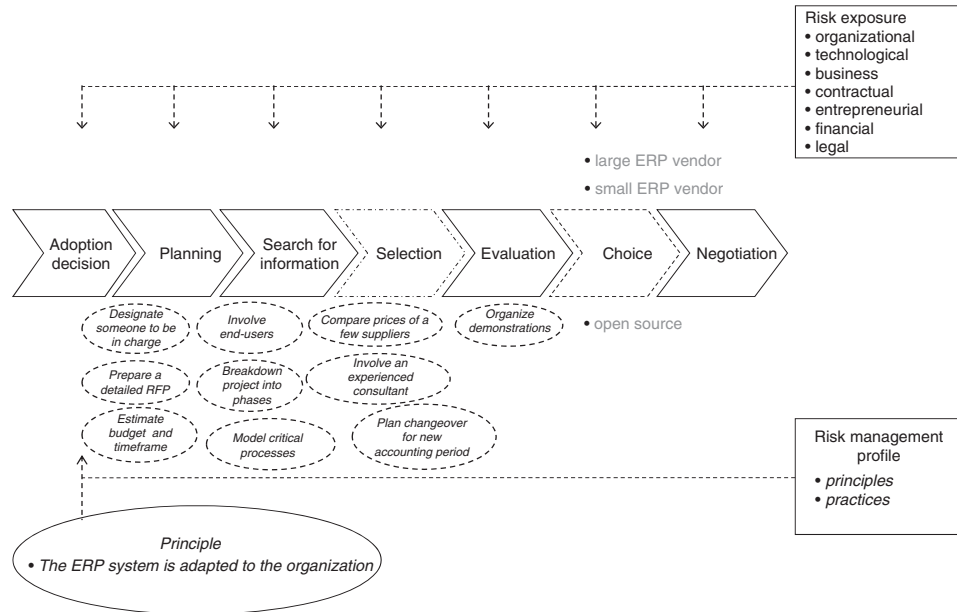


Figure 6 ERP implementation risk management in the adoption process at Delta.

Table 6 Impact of principles and practices on ERP risk profile at Delta

	Organizational risk	Technological risk	Business risk	Financial risk	Contractual risk	Entrepreneurial risk	Legal risk
<i>Principles</i>							
The system is adapted to the organization	●		●				
<i>Practices</i>							
Organize demonstrations	●		●				
Breakdown project into phases	●		●				
Model critical processes			●				
Compare the prices of a few suppliers				●			
Estimate budget and schedule				●	●		
Designate someone to be in charge	●		●		●		
Plan for changeover at the beginning of the accounting period	●		●				
Involve an experienced consultant	●	●	●		●		
Involve end-users	●		●				
Prepare a detailed RFP		●	●		●		

● Contributed to reduce risk exposure.

accounting and financial data are unreliable, as an incorrect financial situation was presented to the parent firm on two occasions previously.

ERP implementation risk management in the adoption process at Delta

At the outset, Delta was guided by the principle that the new ERP system had to be adapted to the organization. As shown in Figure 6, ten practices were adopted during the adoption process that consisted in five out of the seven phases proposed in the research framework. This process was triggered by the parent firm.

As presented in Table 6, the guiding principle and the ten practices adopted were influential throughout the ERP

adoption process and in reducing Delta’s exposure to ERP implementation risk. To evaluate the adequacy of the open source ERP solution to Delta’s needs, a detailed request-for-proposal document was prepared with the help of an experienced outside consultant recruited by the parent firm.

Two practices, namely ‘prepare a detailed RFP’ and ‘involve an experienced consultant’ led to a reduction in the business, technological and contractual risks of ERP implementation at Delta. In similar fashion, the practice of ‘estimating a budget and timeframe for the project’ reduced financial risk exposure, while ‘modeling critical processes’ and ‘planning for changeover at the beginning of an accounting period’ diminished the business risk, and ‘involving end-users’ brought down the firm’s exposure to organizational risk.

Table 7 Influence of general context on the SMEs' ERP risk management

SME General context	Risk exposure			
	Alpha	Beta	Gamma	Delta
<i>Environmental context</i>				
● power of customers	nil	nil	nil	T(-) B(-) F(-) C(-)
● env. turbulence	nil	nil	nil	nil
● networking intensity	nil	nil	nil	nil
<i>Organizational context</i>				
● size, structure	O(-) F(+) C(+)	O(-) F(+) C(+)	O(-) F(+) C(+)	O(-) F(+) C(+)
● professionalization	nil	nil	nil	nil
● innovativeness	nil	nil	nil	nil
● flexibility	B(+)	B(+)	B(+)	B(+)
<i>Strategic context</i>				
● org. timeframe	B(+)	B(+)	nil	nil
● proactiveness	B(+)	B(+)	nil	nil
● different./low-cost strat.	B(+)	B(+)	B(+)	nil
<i>Entrepr./Managerial context</i>				
● management style	O(-)	O(-)	O(-)	nil
● educ. and experience	T(-) B(-) O(-) C(-)	T(-) B(-) O(-) C(-)	T(-) B(-) O(-) C(-)	nil
● attitudes toward IT	nil	nil	nil	nil
<i>Technological context</i>				
● applications portfolio	T(-)	T(-)	T(-)	T(-)
● IT sophistication	O(+)	O(-)	O(+/-)	O(+)
● IT integration	T(+)	T(+)	T(+)	T(-)

Nota: T = technological risk; B = business risk; O = organizational risk; C = contractual risk; F = financial risk; E = entrepreneurial risk; L = legal risk (+: positive influence, -: negative influence).

Inter-case analysis of ERP system risk management in SMEs

It follows from the within-case analyses that the architecture of principles, policies and practices emerging from the case studies seems appropriate to describe and understand the ERP adoption process of SMEs and especially their ERP risk management behaviour, notwithstanding differences in terms of their general context, their ERP-specific context, their adoption process *per se*, and of the type of ERP solution adopted (small vendor for Alpha, in-house development for Beta, and open source for Gamma and Delta). And while the exposure to ERP implementation risk differed in each case, the risk management profiles differed little among the four cases as an intuitive, relatively unstructured and incremental approach based upon principles, policies and practices was used to manage the risk of ERP implementation at the outset.

Influence of the general and specific contexts on ERP risk exposure

In comparatively analyzing the data collected in the four cases, aggregate values (+, - and +/-) were assigned to characterize the influence of the general context on implementation risk exposure, in a fashion similar to Lapointe and Rivard (2007). Results presented in Table 7 indicate that the ERP adoption process in SMEs must be contextualized if their implementation risk exposure is to be fully understood. As befits the specificity of SMEs, the influence of the entrepreneurial and managerial context in particular was strong in all four cases. The firms' basic

management style as well as the individual managers' attitudes and prior experience explain a number of the ERP risk management policies and practices put in place.

For Beta, implementing participative management practices allowed more than a third of all employees to be involved in the ERP adoption process and in certain decisions within this process. A similar recourse by Alpha to an open and collaborative management approach led to the participation and consultation of users. Having previously abandoned an ERP system, Gamma's leaders were also keen to practice open management and thus inform and involve users. Delta used a somewhat more directive management approach to promote user participation through selected information and consultation activities. Moreover, Alpha's production manager initiated certain policies aimed at minimizing risk at the outset, such as the 'no remote access to the system' policy, as illustrated by the latter's statement:

'The servers had been placed in a subsidiary in Switzerland while we were located way back in Normandy. Communication was very slow. For example, it would take us more than one minute to go from one page of the product catalogue to the next. Here, I take care that this doesn't happen.'

In an analogous manner, one of Beta's risk management policies originated in its previous ERP implementation experience. In this case, the policy of 'working with a supplier that assures the system's future' was inspired by

Table 8 Influence of ERP-specific context on the SMEs' ERP risk management

SME ERP-specific context	Alpha	Beta	Gamma	Delta
	Risk Exposure			
Motivations to adopt ERP	nil	nil	nil	nil
Stakeholders in the ERP adoption process	<ul style="list-style-type: none"> ● internal O(-) B(-) ● external T(-) B(-) C(-) 	<ul style="list-style-type: none"> ● internal O(-) B(-) ● external T(-) B(-) C(-) 	<ul style="list-style-type: none"> ● internal O(-) B(-) ● external T(-) B(-) C(-) 	<ul style="list-style-type: none"> ● internal O(-) B(-) ● external T(-) B(-) C(-) F(-)
ERP system and supplier selection criteria	<ul style="list-style-type: none"> ● ERP system T(-) B(-) ● vendor B(-) C(-) ● integrator nil ● consultant nil 	<ul style="list-style-type: none"> ● ERP system T(-) B(-) ● vendor O(-) B(-) C(-) ● integrator O(-) B(-) ● consultant O(-) 	<ul style="list-style-type: none"> ● ERP system T(-) B(-) ● vendor nil ● integrator nil ● consultant nil 	<ul style="list-style-type: none"> ● ERP system T(-) B(-) ● vendor nil ● integrator nil ● consultant nil
ERP solution alternatives	<ul style="list-style-type: none"> ● alternatives envisaged nil 	<ul style="list-style-type: none"> ● alternatives envisaged nil 	<ul style="list-style-type: none"> ● alternatives envisaged nil 	<ul style="list-style-type: none"> ● alternatives envisaged nil

Nota: T = technological risk; B = business risk; O = organizational risk; C = contractual risk; F = financial risk; E = entrepreneurial risk; L = legal risk (+: positive influence, -: negative influence).

the SME's obligation to change its ERP supplier as it had been acquired by another firm.

In Alpha and Beta's case, the organizational, strategic and technological contexts influenced their exposure to the risk of ERP implementation. Risk management policies such as 'work with a small partner' and 'work with a reactive partner' denote a search by both firms for a supplier whose organizational and strategic contexts matched theirs. Also, for Alpha, it was the maturity of the information system that triggered the decision to adopt an ERP system whereas for Beta, it was the difficulty in managing product traceability with its existing best-of-breed system after the move to the new building. The environmental context was truly influential in only one case, Delta, as the ERP adoption process was engaged on the initiative of its parent firm.

Further comparative results with regard to the ERP-specific context of the cases studied are presented in Table 8. In only two out of the four cases were motivations expressed at the outset of the ERP adoption process. Alpha's management wanted to improve decision-making with regard to inventory and production management processes. Beta's management wanted improvements in service quality and a technological platform common to all of its activities.

There were few internal stakeholders in the ERP adoption process in three out of the four cases studied, that is, the firm's CEO and one or two other managers, confirming Premkumar's (2003) observations with regard to SMEs. As for external stakeholders, both Beta and Delta employed an experienced consultant to accompany them during this process, in particular to help them to identify their requirements and produce a RFP document, and in so-doing reduce their exposure to technological, contractual and business risks. Another stakeholder also played an important role, that is, Delta's parent firm in suggesting the adoption of an ERP system, recruiting the consultant and validating the RFP. In both cases, the underlying factor was the firm's IT capability, judged to be inadequate by Beta's management and Delta's parent firm.

Criteria to evaluate ERP systems and suppliers were formally determined in Beta's case only. However, all four SMEs were explicitly looking for an ERP system that was adapted to their business model and processes. Hence the 'flexibility' criterion became very important, in line with previous results reported by van Everdingen *et al.* (2000)

and Forrester Research (2004).⁵ Taking this criterion into account in the adoption phase allowed a diminution in the levels of technological and business risk. Both Alpha and Beta also explicitly mentioned criteria with regard to the system's supplier, previously unmentioned in the literature, including the quality of the interpersonal relationship with the chief executive and other managers, knowledge of the firm's business and processes ('proximity'), and two others emanating from their policy of 'working with a small partner' and 'working with a responsive supplier'. The first two criteria were also applied to the choice of a consultant. Taking these criteria into consideration attenuated contractual and business risk. And even though the four SMEs' growth rate ranges from 10 to 20 %, only Alpha and Beta preoccupied themselves with the capacity of the ERP system to adapt to this growth.⁶

ERP risk management behaviour of SMEs in the adoption process Data analysis revealed the SMEs to be rather similar with regard to their exposure to the risk of ERP implementation, whereas all four were looking for a 'true' ERP system in the ontological sense, that is, one that would be both flexible and integrated. Flexibility would allow the system to be adapted to the firm's business model and processes, whereas integration eliminated the redundancies, incapacities and errors that plagued the legacy system. Table 9 shows all four cases to be similar with regard to their high exposure to organizational and business risks, and their low exposure to financial risk. However, in contrast to the three other cases, Alpha showed a high exposure to entrepreneurial/managerial risks and a low exposure to contractual risk while Beta showed a lower exposure to technological risk.

Discussion and implications

In line with prior research on IS risk management (Bannerman, 2008), the present research has found that the four SMEs studied attempt to decrease risk rather than simply accept it, and they do so at the outset, that is, in the adoption phase. In all four cases studied, managers did not quantify risk but all seem to indicate that they 'felt' it, as reported by March and Shapira (1987) who cite a company vice-president's words. In contrast with the majority of risk management studies that prescribe formalized or even

Table 9 ERP risk exposure and management principles, policies and practices of SMEs

<i>SME risk dimension</i>	<i>Alpha</i>	<i>Beta</i>	<i>Gamma</i>	<i>Delta</i>
<i>Organizational risk</i>	High exposure	High	High	High
• Lack of project management expertise	No. of principles ^a = 2	1	1	1
• Lack of technical expertise	No. of policies = 3	4	0	0
• Project size (functional coverage)	No. of practices = 5	7	5	6
• Growth rate				
<i>Technological risk</i>	High exposure	Moderate	High	High
• Complexity of ERP	No. of principles = 1	0	0	0
• Newness of ERP	No. of policies = 3	1	0	0
• Inadequacy of technological infrastructure	No. of practices = 1	4	1	2
<i>Business risk</i>	High exposure	High	High	High
• Alignment of targeted and ERP processes	No. of principles = 4	1	1	1
• Gap between present and targeted processes	No. of policies = 5	4	0	0
• Lack of operational expertise	No. of practices = 9	13	6	8
<i>Contractual risk</i>	Low exposure	High	High	High
• Characteristics of the vendor	No. of principles = 2	0	0	0
• Characteristics of the integrator	No. of policies = 2	5	0	0
	No. of practices = 5	6	3	4
<i>Entrepreneurial or managerial risk</i>	High exposure	Low	Low	Low
• Management attitude	No. of principles = 0	0	0	0
	No. of policies = 1	3	0	0
	No. of practices = 0	0	0	0
<i>Financial risk</i>	low exposure	Low	Low	Low
• Financial capability	No. of principles = 1	0	0	0
	No. of policies = 2	1	0	0
	No. of practices = 2	4	2	2
<i>Legal risk</i>	Low exposure	Low	High	High
• Intellectual property rights	No. of principles = 0	0	0	0
	No. of policies = 0	0	0	0
	No. of practices = 0	1	0	0

^aApplied by the SME as part of its risk management profile.

highly formalized approaches, the results of the present study suggest that in the context of SMEs, the approach to risk management can be more intuitive, less formal, and yet be effective in reducing risk. Findings of this nature reinforce and extend those previously obtained, most notably by Boehm (1991), Ropponen (1999) and Ciborra (2004).

The risk management profile based upon principles, policies and practices is consistent with the definition of ‘software project risk management’ proposed by Boehm (1991). In the same vein, Ropponen (1999) reported survey results indicating that 75% of projects managers did not follow any detailed risk management approach. In a more recent survey, Bannerman (2008) revealed that formal risk management was implemented within only 29% of the projects studied and that this same proportion represented the projects in which no risk management was practiced at all, while 41% had implemented a selection of semi-formal or formal practices. This last study thus led to the conclusion that ‘formal project management is neither necessary nor sufficient for project success’.

According to Ciborra (2004: 15), ‘risk is socially constructed’ and what is needed in managing risk are actions that are situated, that is, based on contextualized behaviors (Ciborra, 2006). The observation and characterization in the four cases studied of an ‘informal, reactive and intuitive’ risk management approach, at the outset of the ERP adoption process, is thus consistent with this last author’s work, given these three adjectives specify the SME context in contrast to the large enterprise.

This multiple case study has provided initial empirical support to the proposed research framework on the management of ERP implementation risk by SMEs at the adoption stage. It corroborates the specificity of SMEs, when compared to large enterprises, in that the former manage risk by following a reactive, informal or apparently unstructured, intuitive and incremental approach. More precisely, their ERP risk management profile is based on basic principles, one of which is common to all four SMEs, i.e. that the system should be adapted to the organization, and on a number of relatively simple yet effective policies and practices.

This research has contributed to the domain of IS risk management in a number of ways. Given this domain's lack of theoretical foundation (Sherer and Alter, 2004), Barki *et al.*'s (2001) contingency model of IS risk management was used as it is one of the few to benefit from a solid theoretical grounding. However, its empirical grounding covers only large enterprises and software development projects. By validating this model for the ERP adoption process in the context of SMEs, this study has extended our knowledge of the risks involved in complex implementation projects and of the ways to manage them, thus reducing a research gap with regard to information systems in general and to enterprise systems in particular (Aloini *et al.*, 2007). More specifically, the results of this study have further confirmed and strengthened Barki *et al.*'s (2001) theoretical and empirical contribution by conceptualizing and operationalizing, from a contingency theory perspective, ERP risk management as the alignment or 'fit' between the firm's level of risk exposure and its risk management profile. In so doing, further evidence was provided that effective IS risk management in SMEs is better explained by a strategic contingency argument founded upon the influence of institutional and organizational contexts (Charette, 1996), rather than a purely prescriptive or universalistic argument based upon formal IS project management practices (Bannerman, 2008).

The analysis of the four cases suggests that an adaptation of the IS risk management model proposed by Barki *et al.* (2001) is however necessary in order to better describe and understand ERP risk management in the specific context of SMEs. In this regard, the three-tiered risk management principles-policies-practices architecture observed in the four cases seem to provide greater insight into the SMEs' risk management profile than a three-dimensional profile based solely on levels of internal integration, formal planning and user participation. And remembering that this architecture constituted an internally-consistent configuration in each case, the 'fit as gestalt' perspective (Veliyath and Srinivasan, 1995) would be more appropriate than the 'fit as profile deviation' perspective, initially posited by Barki *et al.* (2001), to analyze ERP risk management in a SME context. Thus, rather than there being one 'ideal' risk management profile, different internally-consistent configurations of principles, policies and practices can be equally effective in minimizing implementation risk (Bergeron *et al.*, 2004).

In attempting to better describe and understand the ERP adoption process, fundamental concepts of Roger's (2003) diffusion of innovation theory (DOI), namely 'compatibility', 'complexity', 'observability', 'trialability' and 'relative advantage', can be applied in all four cases studied. In each case, the 'compatibility' of the organizational innovation, that is, of the ERP system, with the internal workings of the organization revealed itself to be most important. Applying the principle that 'the system must adapted to the organization' (and not the other way around) indicates that all four firms were looking for a system that was compatible with their business model and processes. In each case, this compatibility was verified through demonstrations of the system. In addition, both Alpha and Beta ascertained this compatibility through questions principally related to firm's core activities. Alpha was also referred by its ERP vendor to three firms that had similar business activities and had successfully implemented the vendor's system.

DOI theory also appears relevant in describing and explaining the SMEs' risk management profile in adopting ERP. Data analysis reveals that the compatibility sought by Alpha and Beta went beyond the characteristics of the ERP system. Through a policy of 'working with a small supplier', these firms were looking for compatibility in terms of size (and eventually in terms of the simplicity of their structure) between their organization and that of the ERP vendor. In similar fashion, the policy of 'working with a responsive supplier' indicates that both Alpha and Beta were seeking compatibility with the vendor in terms of their 'strategic orientation' (Venkatraman, 1989) and structure. In addition, the observation of the policy of 'working with people who have a "chemistry" with our team and our leader' reveals that Beta were seeking compatibility with the vendor at an 'individual' level. These three added levels of compatibility suggest extensions to DOI theory in the case of the adoption by a SME of a complex, 'mission-critical' innovation such as ERP.

A second fundamental characteristic of adopting an ERP system as an innovation, namely its complexity, came into play in three out of the four cases, that is, for Alpha, Beta and Gamma. Another characteristic, namely the observability of innovation results, appeared in the case of Alpha through two policies put in place during the adoption process to the effect that there was to be 'no system without an operations management reference' and 'no system without a national reference'. The trialability aspect of ERP as an organizational innovation also appeared important for Alpha, Beta and Gamma. And, finally, Alpha's and Beta's management team perceived the relative advantage of the ERP system for their companies, with similar observations made in both cases that 'we were able to imagine our products within this system'.

Two of the cases studied, Gamma and Delta, answer von Krogh and von Hippel's (2006) call to researchers of all disciplines to further study the 'open source' phenomenon from diverse theoretical and methodological backgrounds. Again, this confirms the SME as being more idiosyncratic in its processes and more 'organic' in its structure than the large enterprise (Julien, 1998). Diffusion of innovation theory seems to offer a direct insight as to why Gamma and Delta adopted, without any particular fears, the apparently riskier open source ERP alternative rather than, say, the 'large ERP vendor' or 'small and medium-sized ERP vendor' solution alternatives. In Gamma's case, previous ERP experience followed by the interest in a custom ERP system as well as the high tolerance to risk on the part of managers may provide the background to understand this behaviour. Also, Gamma was more interested in the business value potentially provided by open source ERP software than by the technology itself, and showed a relatively high level of risk-propensity. Its behaviour is thus more in line with Roger's (2003) 'early adopter' profile. While open source ERP systems are being adopted by a growing number of SMEs, particularly in manufacturing, there is still much to learn on the process by which these systems are adopted and on the risks entailed by their implementation.

Moreover, a further contribution lies in the strong empirical evidence in support of Soh and Sia's (2004) call to resolve the question of the strategic alignment of the ERP system at the earliest stage in the system's lifecycle,



that is, at the adoption stage. In all four of the cases studied, the principle that 'the system must be adapted to the organization' was initially formulated and then followed throughout the adoption process. Or, in information systems development terms, an 'IS alignment' rather than 'IS impact' planning methodology was employed by the SMEs to identify ERP implementation as a strategic opportunity (Bergeron *et al.*, 1991). This runs contrary to the 'vanilla' approach to ERP implementation that is proposed by many (Parr and Shanks, 2000).⁷ While adopting and implementing a standard software package 'as is' may be deemed less risky, less time-consuming and less costly (Luo and Strong, 2004), three of four SMEs nevertheless opted for a customized solution (open source software or in-house development). This choice implies that they did not perceive ERP simply as a technological tool but rather as a strategic system that would enable the achievement of business objectives (Davenport, 2000).

For owner-managers of SMEs, this study suggests that while an ERP implementation project entails a high level of risk for their organization, this risk can be mitigated at the outset by following a set of relatively simple principles, policies and practices that do not require a high level of formalization. In this regard, solutions other than those provided by the 'big five' ERP vendors constitute credible alternatives that may be envisaged, including ERP systems supplied by smaller vendors, developed 'in-house' and 'open source' ERP systems deemed to be even riskier initially than other types of solutions. Also, many of the risk management principles, policies and practices identified in the four cases studied could be applied by other SMEs when adopting an ERP system.

For ERP vendors whose interest in the SME market segment is growing due to the saturation of the large enterprise market, this study reveals that the interest of SMEs is not limited to the system itself but also includes the system's supplier. In other words, these firms were not only looking for a system that was compatible with their business model and processes but also for suppliers whose size and strategic orientation was similar to theirs. This might explain why the large ERP vendors occupy as of yet a small portion of the SME market, as smaller vendors and suppliers would have a distinct advantage related to their greater 'proximity' to this market.

Limitations and conclusion

The main limitation of this study is related to the purposeful sampling strategy that was employed to select the cases, in that only SMEs that had successfully implemented an ERP system were studied. While this criterion allowed us to control this factor and thus increase the internal validity of the cases, the explanatory power of the research framework and of the risk management behaviour of SMEs would have been greater had cases of failed or unsuccessful ERP implementations been included. The imperative answered here however is one of increased understanding of a complex phenomenon in its natural context, that is, the ERP adoption process and the risk management behaviour of SMEs, rather than one of generalization in the statistical sense. Having said this, a fairly obvious avenue for further research lies in studying cases

where ERP implementation was unsuccessful and where the three other ERP system alternatives were implemented, namely large vendor, best-of-breed, and outsourcing solutions. Second-generation or 'extended' ERP systems should also be studied to include the 'inter-organizational' dimension of IS risk management as a number of SMEs, in the face of globalization, are now called upon to implement such systems in order to achieve 'world-class' status.

In a business environment characterised by globalisation and based on knowledge, many SMEs are subjected to increased pressures with regard to competitiveness, innovation, flexibility, quality, and information processing capability. In attempting to respond to these challenges, a number of these firms have adopted an ERP system. As a complex evolutionary phenomenon, ERP adoption is deemed by common wisdom to involve substantial risk. In line with March and Shapira's (1987: 1414) findings, this study has demonstrated that the risk management behaviour observed in the four SME case studies 'does not easily fit into classical theoretical conception of risk management'. Having attempted to describe and understand the dynamics of the ERP adoption process within change management and risk management perspectives, it is hoped that this empirical investigation of risk management behaviour has provided a significant conceptual and practical contribution. The theoretical and methodological postures taken in this study cannot, however, fully encompass such complex organizational phenomena. We thus hope that this initial research effort will stimulate further work on IT risk management within the ERP domain, and not only in SMEs but also in other types of organizations such as government and not-for-profit organizations.

Notes

- 1 The reference and number of phases for each of the seven adoption models are presented in Appendix A.
- 2 This change in the ERP vendors' strategy in order to access the SME market confirms the specific nature of these organizations when compared to large enterprises. For example, SAP used to offer the same R/3 software package to both large firms and SMEs. In 2002, SAP bought for 50 million dollars a small vendor specialized in the SME market, Top Manage (Datamonitor, 2005). SAP's new offer destined to the SME market was then built around the software developed by Top Manage.
- 3 Fictitious names to preserve the anonymity of the four SMEs.
- 4 The hierarchical nature of this architecture is illustrated in Appendix D.
- 5 This contrasts with Marbert *et al.* (2003) results indicating that SMEs would have a greater tendency to adopt the 'best practices' embedded in ERP. It must be noted however that 60% of the firms' surveyed by these authors had implemented an ERP system supplied by a large vendor.
- 6 This preoccupation was underlined by Liang and Xue (2004) who, from an ERP vendor's perspective, reported that the requirements of SMEs vary in relation to their stage of growth.
- 7 By adopting a standard ERP software package 'as is', with the 'best practices' that are embedded in it, the firm is seen to equal the leading enterprises in its sector or industry; however the universal applicability of such practices is questioned (Soh *et al.*, 2000; Uwizeyemungu and Raymond, 2009).

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Appendix A

Table A1 ERP adoption process models

Authors	No. of phases in the ERP adoption process model
AMR Research (2003)	7
Deep <i>et al.</i> (2008)	4
Esteves and Pastor (1999)	2
Keil and Tiwana (2006)	4
Oliver and Romm (2000)	4
Stefanou (2000)	3
Umble <i>et al.</i> (2003)	13
Verville and Halington (2003)	6
Wei <i>et al.</i> (2005)	7

Appendix B

ERP solution alternatives

- Large ERP vendor: These are the five industry leaders that, together, occupy more than 50% of the global ERP market (Gartner Dataquest, 2005), namely SAP, Oracle, Sage, Microsoft and SSA.
- Small and medium-sized ERP vendor: All vendors other than the five large ones, such as Epicor, Mapics and many others (Helo *et al.*, 2008).
- Best-of-breed: As opposed to the two preceding alternatives that provide fully integrated ERP systems, the ERP system is assembled from functional modules that are provided from different suppliers (who may be ERP vendors or not), each module being considered the best in its category (Light *et al.*, 2001).
- Outsourcing: The organization delegates to an application service provider (ASP) all or part of the tasks of installing and operating the ERP system. As opposed to the previous alternatives in which the organization must acquire a software licence, the system is leased and is generally hosted by the ASP (Trimi *et al.*, 2005; Olson, 2007).
- Open source: There are no licensing fees for the ERP software and the organization uses the source code which it can freely copy, modify or even commercialize with or without conditions (Dreiling *et al.*, 2005).
- In-house development: As opposed to the previous alternatives in which the ERP system consists of a pre-existing software package or pre-existing modules developed by an ERP vendor or other suppliers, the organization develops the system itself, internally or with outside help, based on its own specifications (Olsen and Saetre, 2007a).

Appendix C

Table C1 Example of the chain of evidence for Alpha

Category 4: Risk and Results

Sub-category 4.3: Risk management profile

4.3.1 Principle	4.3.1.2 Deal with a single interlocutor	Production manager, pp. 26–27: ‘We definitively did not want to have many suppliers. In mechanical engineering, we are very wary of that. We very well know that if there are three suppliers involved in a system and a problem arises, each puts the blame on the other two. For instance, when I buy a machine-tool, I want to deal with a single organization. It’s the same thing for IT. This works very well for us and I have done that ever since I was a young engineer. Even though it may cost you more at first, you’re sure to have fewer problems and things will work a lot better.’
4.3.2 Policy	4.3.2.8 Work with a small partner	Production manager, p. 34: ‘We have the same case today, I applied it to purchasing. I work with small outfits that react quickly, even though they are relatively more expensive at first. But in terms of flexibility and response, these people will bail you out and bend over backwards to satisfy you.’
4.3.3 Practice	4.3.3.5 Contact the personal network	Production manager, pp. 25–26: ‘Given my good relationship with the sales representatives of our previous ERP supplier, I called them, saying: Here I am now in charge of production for a small manufacturer and I am looking for some software. They told me: ‘To be honest with you, given your company’s size, our product is not at all appropriate for you’. They advised me instead to seek an ERP vendor that specializes in manufacturing SMEs.’

Appendix D

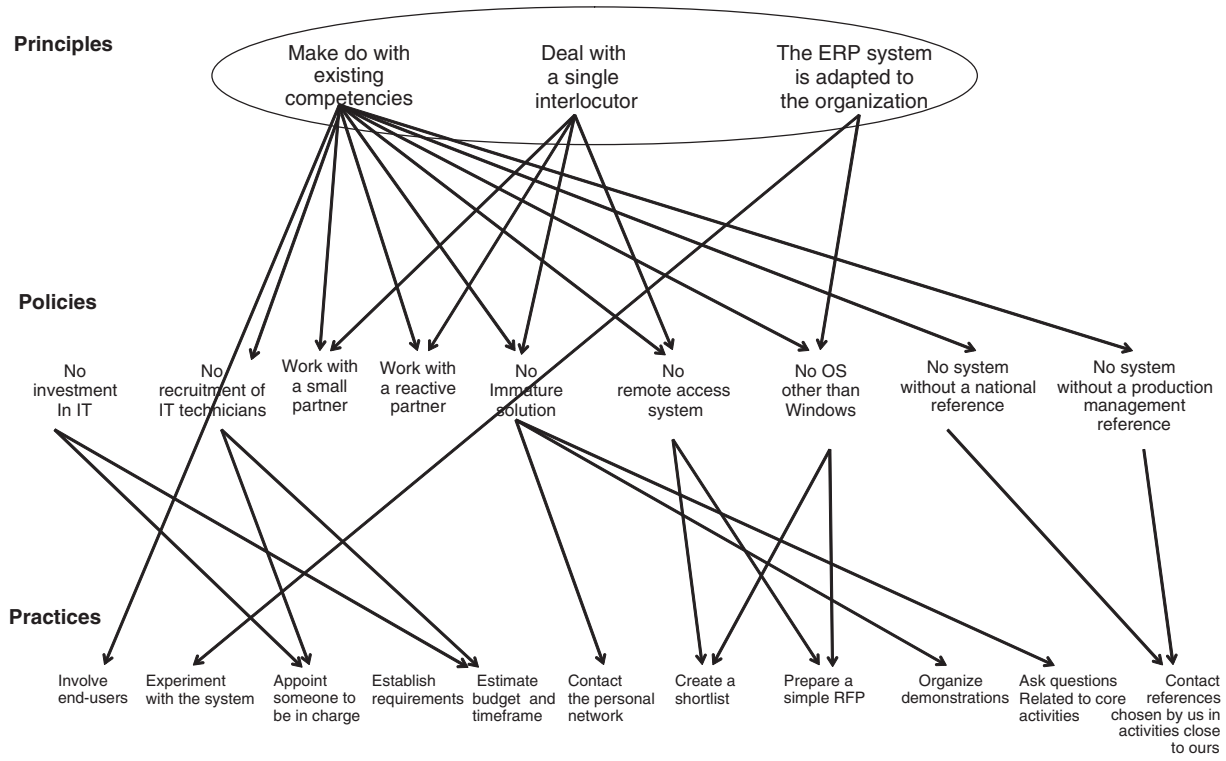


Figure D1 Architecture of the principles, policies and practices put in place by Alpha.

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