THE ROLE OF SCANNING, EVALUATION, AND MINDFULNESS IN THE

ASSIMILATION OF INFORMATION TECHNOLOGY: THE CASE OF ENTERPRISE

RESOURCE PLANNING (ERP) SYSTEMS

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The Role of Scanning, Evaluation, and Mindfulness in the Assimilation of Information

Technology: The Case of Enterprise Resource Planning (ERP) Systems

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Enterprise Resource Planning Systems (ERPs) are commercial software packages that enable integration of information and business processes throughout the organization. Realizing the business value of information technology (IT) requires its successful assimilation by the firm. ERP assimilation refers to the effective application of this type of IT in supporting a firm's business strategies and value-chain activities. To succeed at this, the IS function must continuously manage the adaptation between the organization and the ERP system, even after initial deployment. For this purpose, the IS function must continuously scan both the firm's internal and external environment to identify new ERP adaptation opportunities that will allow the effective application of new ERP technologies to support the firm's objectives. Also, it is important for the IS function to engage in evaluation activities to analyze and select those ERP adaptation opportunities with the greatest potential for impact on ERP assimilation. It is posited here that ERP scanning will have a direct positive effect on the firm's level of ERP assimilation, and that this effect will be moderated by the extent of ERP evaluation activities. IS mindfulness, the degree of collective mindfulness present in the IS function, is also posited to moderate the relationship between ERP scanning and ERP assimilation. Collective mindfulness is an elevated state of alertness toward expectations, in the face of new and unprecedented situations or changes, with a nuanced appreciation of the specific context. IS mindfulness makes more likely the identification and realization of unexpected ERP adaptation opportunities leading to a higher

level of ERP assimilation for the firm. A model is proposed to describe the relations among IS mindfulness, ERP scanning, ERP evaluation, and ERP assimilation. This model has been tested by collecting survey data from 113 firms. The results suggest that first, collective mindfulness is a construct with two dimensions: alertness/attention, a state of vigilant alertness, and change/situation, an awareness or knowledge of an unprecedented situation or change in the firm's environment; second, scanning of the internal environment (scanning of needs) has a main effect on ERP assimilation, and this effect is moderated by the presence of IS mindfulness ("alertness" dimension), as predicted by the model; and third, ERP evaluation has rather a direct effect on ERP assimilation and does not moderate the scanning-assimilation relationship as expected.

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PREFACE

This dissertation constitutes the fulfillment of a long cherished dream and as such I feel very fortunate of having accomplished it. I have realized that although the academic training in a doctoral program prepares you to be a competent researcher, only the grueling dissertation process allows you to become one. Still, a dissertation process starts very early on and many people contribute to its successful completion. Although it is not possible to acknowledge every single person, I would like to thank first, Prof. William King, who encouraged me to join the doctoral program and whose acute observations during the proposal phase helped me understand the full extent of the risks involved in my proposed research topic; Prof. James Craft, who became my informal guide in understanding how the academic world operates; Prof. Thomas Saaty, who got me into the fascinating world of decision making and with whom I have spent precious moments of scientific, philosophical, or perhaps aimless speculations. Next, I would like to thank my advisors, Profs. Laurie Kirsch and Brian Butler, who always made sure, sometimes against my wishes, that my work was up to the best research standards in the academic community. Many times, the work of the advisors is taken for granted; however, I am aware of the amount of effort that was required to review my material at every step –and most doctoral research is rather painful to read and understand in the early stages. However, without this effort a doctoral dissertation is at a risk of becoming the end of a career rather than the

foundations to begin one. Similarly, I would like to thank my committee members, Profs. John Prescott, John Hulland, and Richard Moreland. They were all very proactive during the dissertation process and each of them provided a valuable contribution at some critical point. In general my colleagues at the faculty and doctoral level were fully supportive of my efforts and provided help when it was needed.

On a more personal note, I would like to thank my parents who instilled in me the joy of learning and the discipline required to accomplish difficult tasks -and a dissertation is certainly a very difficult one. My family and friends, who were always supportive and enthusiastic about my dissertation and never complained that I had become monothematic in my conversations. Finally, thanks to my beloved wife Mili who had to endure my "mental" absences from home (I did a large part of my work in our home basement), weekend after weekend for several months in a row; in particular, during the last stages of my dissertation.

1.0   INTRODUCTION

The importance of constant investment in information technology has been widely recognized, as organizations have deployed innovative technologies such as client/server architectures, enterprise resource planning (ERP) systems, and web-based systems, with the purpose of increasing their performance (Brynjolfsson and Hitt 1994; Brynjolfsson and Hitt 1996). Yet, information technologies (IT), in particular those of strategic or infrastructure nature, can be high risk investments because they involve large capital outlays, long timeframes for return of investment, and hard-to-define returns (Lucas 1999). This is further aggravated by the difficulties organizations face when attempting to move beyond ERP initial deployment, assimilate the new system, and realize its full benefits (Fichman and Kemerer 1999; Pyun 2002).

Even though it is difficult, IT assimilation is key to successful IT investment. Assimilating complex information technology (IT), that is, using it effectively to support, shape, and enable a firm's business strategies and value-chain activities (Armstrong and Sambamurthy 1999), requires adaptation of both the IT and the organization; technical systems and organizational practices change in this ongoing process. Identifying and taking advantage of these adaptation opportunities may be a difficult learning process. For many organizations, this learning process may constitute a serious knowledge barrier hindering full IT assimilation (Attewell 1992). Consequently, failure to assimilate IT is a common problem within organizations (Glass 1998). For example, some industry experts consider that only 5% of the

organizations that have adopted a web-based architecture have actually assimilated this technology to the point of using it to its full advantage (Patrick 2003). Similarly, James and Wolf (2000) found that only 10 to 15% of surveyed firms had achieved expected performance improvements from their ERP spending. In summary, although IT assimilation is necessary to realize benefits from the IT investment, failure to assimilate IT is rather a common problem in organizations.

Enterprise Resource Planning systems are "commercial software packages that enable integration of transaction-oriented data and business processes throughout the organization -and perhaps eventually throughout the entire inter-organizational supply chain" (Markus and Tanis 2000, p. 176). ERP systems constitute one of the most complex information technologies in the market today and are deployed by many organizations as a way to improve their performance and overall competitiveness (Masini 2003). In reviewing ERP assimilation results, it is clear that organizations vary in their ability to use these systems effectively to realize their business benefits. An American Production and Inventory Control Society (APICS) Conference Board report stated that 40% of participants failed to achieve their business objectives even 12 months after deployment (Salopek 2001). Other researchers have suggested that this failure rate may be even higher than 50% (Escalle, Cotteleer and Austin 1999). In spite of these difficulties, there is evidence that effectively assimilated ERP systems constitute an important source of competitive advantage for the firm (Hitt, Wu and Shou 2002). Therefore, the study of the assimilation of ERP systems is important from both academic and practical perspective.

Why are ERPs so difficult to assimilate? One important reason is that ERPs don't merely automate business processes, they also change the way both people and the organization operate. It has been argued that this type of organizational adaptation may create significant knowledge

barriers to the effective assimilation of information systems (Attewell 1992; Swanson 1994). That is, organizations may differ in their ability to learn and combine new complex information technologies and novel organizational practices. However, it is usually necessary to both implement software and re-engineer organizational business processes to obtain ERP 'best-practice' advantages (Lozinsky 1998; Ross 1999; Markus, Axline, Petrie and Tanis 2000; Ko, Kirsch and King 2005). For some firms, this learning process may constitute an insurmountable knowledge barrier for the effective use of the information system. It has also been found that these knowledge barriers can lead to an assimilation gap, that is, a partial, incomplete assimilation of the information technology (Fichman and Kemerer 1997). In effect, many firms can deploy an information system in production mode but still use the system way below its full potential.

There are other reasons why ERP assimilation may fail after initial production deployment has taken place, during what is called the onward/upward phase of the ERP life cycle (Markus and Tanis 2000). To ensure effective ERP assimilation, it is necessary to continue adapting the ERP system and the organization, based on the firm's objectives. An ERP is the prototypical type IIIc IS innovation defined by Swanson (1994), where the IS innovation will evolve during its use, so either the technology (or the associated work practice) is increasingly tailored (or even transformed) by means of new features. Without an on-going management of the ERP adaptation opportunities, these new features will never came to existence and the ERP system will not be used optimally by the organization; that is, it will not be fully assimilated. To continue managing ERP adaptation opportunities after deployment, the IS function should engage in activities such as post-implementation audits, system upgrades, add-on selection, and additional training to increase user-skills and to allow the deployment of new features in the ERP

system. However, these activities do not always take place because the organization may be unwilling to keep investing in a system that is perceived either as successfully completed or as a failure (Markus and Tanis 2000). Another reason for the assimilation difficulty is the loss of knowledgeable personnel who understand the ERP system and organizational processes. In many cases, ad hoc teams from different areas of the organizations are formed to deploy an ERP system and the key team members are disbanded (so they can return to their original jobs) once the system is in production. Their loss negatively influences a firm's ability to improve the effective application of the ERP system in the organization (McKinley 2000). A final reason for difficulties in ERP assimilation may be a simplistic conception that once the ERP system is working without problems in production, the ERP system has been assimilated. Therefore, little attention is given to managing further opportunities to adapt the system and the organization. As a result, some ERP systems that were considered a 'success' when they went live, are not effectively assimilated and fail to deliver the expected business benefits in the long term (Larsen and Myers 1997). In sum, many firms fail to understand the dynamic nature of ERP assimilation, and do not continue the on-going management of opportunities for further adaptation between the organization and ERP system, after the system has been deployed in production.

In the face of the challenges discussed above, the IS function must engage in practices that support the on-going management of adaptation opportunities that may lead to a more effective assimilation of ERP systems. Based on a review of the literature, this research has identified that *scanning* and *evaluation* of ERP adaptation opportunities are key activities for promoting *ERP assimilation*. Similarly, it is proposed that the level of *IS mindfulness*, or degree of collective alertness within the IS function toward expectations and changes in the organizational context, is an important factor in supporting ERP assimilation. A model based on

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these constructs is proposed (**Figure 1**) and an overview of the model is provided below, with more elaboration on the theoretical foundations of this model provided later in this document.

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                        ┌─────────────┐
                        │  IS Unit    │
                        │ Mindfulness │
                        └──────┬──────┘
                               │
                         H3    │
                               │  +
┌──────────┐                   ▼              H1    ┌──────────────┐
│   ERP    │───────────────────────────────────────▶│     ERP      │
│ Scanning │                                    +    │ Assimilation │
└──────────┘                   ▲                     └──────────────┘
                         H2    │  +
                        ┌──────┴──────┐
                        │     ERP     │
                        │ Evaluation  │
                        └─────────────┘
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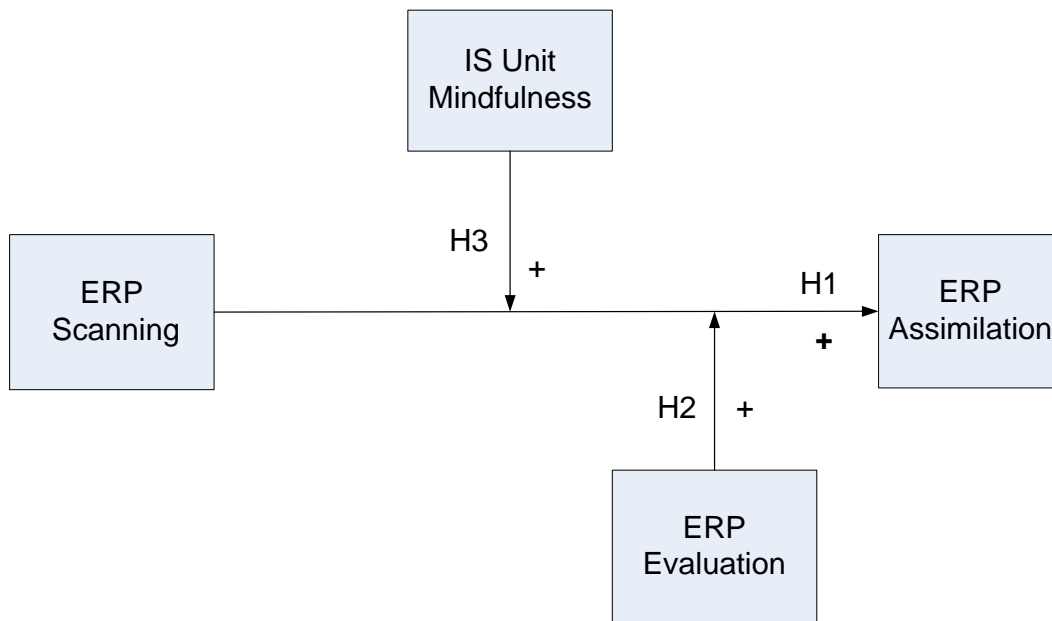
Figure 1: Research Model

1.1   MODEL OVERVIEW.

Scanning has long been considered an important management process leading to effective organizational (Aguilar 1967) and group (Sutcliffe 1994) performance. Since IT assimilation requires on-going management of the opportunities to adapt the system to the changing needs of

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the organization, it is important to monitor the organizational environment to identify these adaptation opportunities when they appear. This process is called IT scanning and is critical for effective IT assimilation. In effect, it is necessary to identify relevant adaptation opportunities before any further action to realize its benefits can be taken. However, the role of scanning in the IS function is rather understudied (Maier, Rainer Jr. and Snyder 1997), and its effect on IT assimilation have not been studied yet. For this reason, this dissertation studies the effect of IT scanning on the assimilation of ERP systems, and proposes, based on existing research literature (Armstrong and Sambamurthy 1999; Weick, Sutclife and Obstfeld 1999; Benamati and Lederer 2001), collective mindfulness and evaluation activities as key moderators in the effect of ERP scanning on ERP assimilation during the post-deployment stage of the ERP life cycle.

ERP scanning refers to efforts by the IS function to acquire information regarding new ERP adaptation opportunities, such as new ERP add-ons, potential business process improvements or emerging organizational needs (Aguilar 1967; Choo 1993; Maier et al. 1997). This study focuses on the scanning activity that takes place after the ERP system has been initially deployed. The model proposed here posits that the IS function is more likely to become aware of ERP adaptation opportunities if they engage in ERP scanning, and that this awareness will lead to more effective ERP assimilation.

ERP evaluation is the set of activities undertaken by the IS function to analyze and select specific ERP adaptation opportunities to be acted upon in the organization. It is proposed here that by engaging in ERP evaluation activities, the IS function can increase the likelihood of selecting ERP adaptation opportunities that have the greatest potential for ERP assimilation. In other words, ERP evaluation will positively moderate the effect of ERP scanning on ERP assimilation.

Finally, it is also proposed that the degree of collective mindfulness in the IS function will play a role on the extent of ERP assimilation. Collective mindfulness is an elevated state of collective alertness toward expectations, in the face of new and unprecedented situations, with a nuanced appreciation of the specific context (Langer 1989; Weick et al. 1999; Fiol and O'Connor 2003; Swanson and Ramiller 2004). Collective mindfulness in the IS function will be referred to as IS mindfulness in this study.

IS functions with high levels of mindfulness are expected to take advantage of ERP scanning in a different, more effective way, than less mindful IS functions. For example, highly mindful IS functions will interpret the collected information about both organizational needs and new ERP technologies in a more thorough and unbiased fashion. Information will be less likely to be disregarded when it doesn't fit familiar patterns; for example, the implications of the collected information will not be ignored simply because it diverges from what would be expected according to the trade literature. Information coming from different sources, both internal and external to the organization, and even contradictory in nature such as from competing ERP vendors, is more likely to be assessed. The process leading from monitoring relevant adaptation opportunities to the selection and deployment of the most suitable ones for greater ERP assimilation will be more likely to be characterized by attention to detail, avoiding oversimplification, and taking into account the specific organizational situation (Fiol and O'Connor 2003). On the other hand, a less mindful IS function is more likely to collect and interpret information in a mechanical fashion (e.g. routinely attending the same 'traditional' conference every year and focusing on the "expected" new technologies), overlook information and its meaning if they don't fit well known situations, concentrate on information only from traditional sources, such as the official ERP vendor, and focus on adaptation opportunities that fit

only familiar patterns or industry trends. Therefore, the extent of IS mindfulness in the IS function will positively influence the extent of the effect of ERP scanning on ERP assimilation will be in the organization. In summary, it is proposed here that ERP scanning will have a positive direct effect on ERP assimilation and that this effect will be moderated positively by the extent of collective mindfulness and ERP evaluation activities in the IS unit, as shown in **Figure 1**.

In order to test the proposed model, a survey has been conducted in 113 midsized and large firms that have ERP systems in production. The survey data have been analyzed using hierarchical regression analysis and the results show that internal ERP scanning of needs has a positive direct effect on ERP assimilation and that this effect is moderated by the level of IS mindfulness ("alertness/attention" dimension) in the IS function. Finally, ERP Evaluation is found to have a positive direct (instead of moderating) effect on ERP assimilation.

This study contributes to the current IS research literature as follows: first, obtaining a better understanding of the effect of scanning and evaluation processes on ERP assimilation; second, studying the role of a new IS function attribute, IS mindfulness, on effective ERP assimilation; and finally, the results of this research are useful to the study of IT assimilation in general. For practitioners, the results of this study suggest changes in IS management practices (e.g. increasing the level of mindful alertness in the IS function) to increase the likelihood of a more effective use of ERP systems and information technology in general.

This chapter has introduced the research topic and provided an overview of the problem, conceptual framework, methodology, and expected contributions of this study. Chapter 2.0 reviews the literature on IT and ERP assimilation. Chapter 3.0 discusses the research model and hypotheses. Chapter 4.0 explains the operationalization of variables and methodology to be used.

Chapter 5.0 discusses the data analysis. Chapter 6.0 discusses the results. Conclusions from this

study and their implications are provided in Chapter 7.0 .

2.0 LITERATURE REVIEW

As mentioned in the previous chapter, this research explores the role of IS function's scanning, evaluation and mindfulness in the assimilation of ERP systems. To characterize the assimilation of ERP systems, we draw on two streams of IS research: IT assimilation and ERP systems.

2.1 INFORMATION TECHNOLOGY (IT) ASSIMILATION.

Information technology is deployed with the expectation of generating business benefits for the firm as a whole (Brynjolfsson and Hitt 1995). However, even when investing significant capital in IT, firms often fail to realize the expected payoffs (Brynjolfsson 1993; Lucas 1999). It is not enough to just deploy IT. It is also necessary to assimilate it into the firm's value-chain activities and business strategies before IT can provide business value (Boynton, Zmud and Jacobs 1994). For this reason, IT assimilation is important in firms (Mahmood and Soon 1991; DeLone and McLean 1992; Sethi and King 1994; DeLone and McLean 2004). IT assimilation refers to how effectively firms apply IT to bolster their business activities (Armstrong and Sambamurthy 1999).

In this study, IT assimilation is used in a narrower sense than elsewhere in the IT innovation literature, where assimilation has sometimes been used to cover the whole life cycle of IT adoption. IT assimilation here is "the effective application of information technology in

supporting, shaping, and enabling a firm's business strategies and value-chain activities" (Armstrong and Sambamurthy 1999). 'Effective' is used here in its everyday dictionary meaning, that is, as "having an intended or expected effect" (Houghton-Mifflin 1992). For example, a firm with a lowest-cost producer strategy will deploy an IT to minimize production costs; however, economic benefits (e.g. higher profits) will be obtained only when the system has been effectively embedded in the organization, to the point of allowing the intended faster production cycle times and cost reductions; that is, once the IT has been assimilated.

This definition emphasizes that IT assimilation not only refers to the extent to which IT has been infused into specific business activities, but also how effectively IT is supporting the conduct of these activities (Armstrong and Sambamurthy 1999). It is the effective conduct of these activities that will provide the firm advantage over its rivals (Armstrong and Sambamurthy 1999). Sabherwal and King (1991) have found that most frameworks for understanding IT assimilation are rooted along two dimensions: generic business strategies and value-chain activities, as proposed by Porter (1980). The strategic dimension of IT assimilation refers to its use in competitive strategies such as being a low-cost producer, having manufacturing/operations flexibility, enhancing supplier or customer linkages, and enhancing or creating new products or services (Porter 1980; Parsons 1984; Porter and Millar 1985; Porter 2001). The operational dimension of IT assimilation refers to its use in the value-chain activities of the firm (Porter 1980; Porter and Millar 1985). These dimensions: strategic and operational have been found extremely effective in the study of IT assimilation and they have been extensively used in the literature and by practitioners (Hax and Majluf 1991; Armstrong and Sambamurthy 1999; Porter 2001).

IT assimilation can be differentiated from IT investment and IT implementation. IT investment refers to a firm's decision to approve an ERP project and fund it. IT implementation refers to the activities required to get the system up and running. In contrast, IT assimilation refers to the effective application of the system to enhance the firm's strategy and the performance of its business processes. It is this effective application of IT that ultimate provides a firm with economic benefits. While it is common for firms to invest in IT, many of them are not able to successfully implement it (Ewusi-Mensah 1997). From those who successfully implement the technology, a large number fail in its assimilation (Fichman and Kemerer 1999; Patrick 2003), and therefore are unable to realize the overall economic benefits expected for the firm (Brynjolfsson 1993; Lucas 1999).

Previous research has studied some organizational and IS unit factors important for IT assimilation. In a mail survey of 51 IS executives, King, Grover, and Hufnagel (1989) identified IS function leadership position, technical support within the firm, and pressure from competition as facilitators in the effective application of information systems for strategic purposes. Johnston and Carrico's (1988) study of 11 companies found that certain internal IS capabilities such as senior management IT leadership, integration of IT and business strategy, and direct contact between IT and line management were important for the strategic application of IT in the firm. Technical and business competence of the IS function have also been highlighted as an important success factor for IT assimilation (Copeland and McKenney 1988). Miller and Doyle (1987) measured the effective application of IT in the financial services sector and found that IS staff quality, measured in terms of technical competence, user-orientation, positive attitude, etc., was one of the factors leading to IT effectiveness. Boyton, Zmud and Jacobs (1994) found that the IT management climate in the IS function, defined as shared enduring perceptions of salient aspects

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of the IT work (e.g. how decision-making occurs in the group, diffusion of ideas), had a positive role on the extent of IT assimilation, through the mediation of IT management process effectiveness.

In conclusion, the reviewed literature shows that first, IT assimilation represents an important outcome in firms (Mahmood and Soon 1991; DeLone and McLean 1992; DeLone and McLean 2004); second, IT must be effectively applied in the firm's value-chain activities and business strategies before IT can provide significant business value (Boynton et al. 1994; Cooper and Zmud 1999; Straub 2003); third, that certain characteristics of the IS function play an important role in IT assimilation; and finally, that most approaches for understanding IT assimilation are rooted in concepts of generic business strategies and value-chain activities (Sethi and King 1994; Porter 2001). For these reasons, this study uses this same approach to study the assimilation of IT. However, this research is made within the context of enterprise resource planning (ERP) systems, a specific type of advanced information technology of great current relevance in the industry. The next section discusses the ERP research literature and the reasons to use this type of system for the present study.

2.2   ENTERPRISE-RESOURCE PLANNING (ERP) SYSTEMS.

An enterprise resource planning (ERP) system consists of a set of integrated business applications or modules designed to carry out most business functions such as inventory control, general ledger accounting, accounts payable, accounts receivable, and others (Martin, Brown, DeHayes, Hoffer and Perkins 1999). Although there is not an agreed upon definition of ERP systems, it is possible to understand them in terms of their key characteristics: integration of

enterprise-wide information, packaged software requiring little in-house developments (in comparison to developing the whole IS from scratch), incorporation of industry best practices, and the evolving nature of the ERP system (Markus and Tanis 2000), as summarized in **Table 1**.

Table 1: Key Characteristics of ERP Systems (Based on Markus and Tanis 2000)

Characteristic	Description	Comments
Integration	ERPs promise "seamless integration of all the information flowing through a company-financial and accounting information, human resource information, supply chain information, and customer information" (Davenport 1998, p. 121)	However, this integration may or may not become a reality depending on the configuration given to the system, for example, when only certain modules such as accounting and finance are installed, or when co-existence with legacy systems is required. In these instances, full integration may not be feasible.
Packaged	ERPs are software packages so, in principle, no in-house software development is necessary.	Two important consequences are: (1) adopters do not develop a system for the organization but rather adapt the organization to the ERP system, (2) it is more important for the ERP adopters to be part of user associations where they have a better opportunity to collectively influence vendors toward the addition of useful new features and modules.
Some Code Development Required	The exception to "no code-development needed" occurs when the user requires to interface ERPs with other existing systems in the firm, not originally available in the ERP.	For example, many ERP early adopters required the development of special interfaces to interconnect with their existing customer relationship management (CRM) software, not available at the time as part of standard ERPs.
Best practices	Vendors design ERPs based on their observation of the best practices in the industry.	This is a powerful reason for companies to implement ERPs as they come since the ERP processes represent the most effective way to redesign the organization. However, this also requires a large degree of business process reengineering commitment by the organization (Connolly 1999).
Evolving	Finally, and more importantly for the present research, ERPs like any other IT are rapidly changing.	They change at the functional level, for example by incorporating additional business functions such as CRM capabilities, and architecturally, for example by moving from mainframe to client-server, and more recently, to web-enabled versions.

These characteristics position ERPs as integrated, all-encompassing, complex mega-packages designed to support key -ideally all- functional areas of an organization (Adam and Sammon 2004). ERP systems are "commercial software packages that enable integration of transaction-oriented data and business processes throughout the organization -and perhaps eventually throughout the entire inter-organizational supply chain-" (Markus and Tanis 2000, p.176).

In reviewing ERP research two distinct research streams emerge. The first focuses on ERPs as a strategic concept, providing the firm with unique capabilities to support business strategies and activities. A second stream of research focuses on the details associated with implementing ERP systems and their relative success and cost (Jacobs and Bendoly 2003).

2.2.1 ERP as a Strategic Concept.

This research approach focuses on the potential impact of ERP on the performance of various business functions, such as the impact on the supply chain management (Akkermans, Bogerd, Yucesan and Van Wassenhove 2003) or on information resource management (Hoven 2001). For example, Akkermans et al (2003) identified some key supply chain management (SCM) issues and found only a modest role of ERP in improving future SCM effectiveness. In the area of information resource management, Hoven (2001) found that the information ERP plan should be integrated and driven from the formal business plan of the enterprise for the system to be effective.

Key to the strategic concept approach is the identification of business benefits such as reduction in production costs and faster cycle times, derived from the use of ERP systems. The

literature discusses these benefits within the broad scope of ERP success, although the meaning of ERP success depends on which organizational stakeholder is considered the point of interest (Tallon, Kraemer and Gurbaxani 2000; Sedera, Gable and Chan 2003). ERP success is also multidimensional, and its assessment depends on the dimension of interest (e.g. user satisfaction, organizational impact) and timing of the measurement (DeLone and McLean 1992; Markus and Tanis 2000). This dissertation focuses on the success of an ERP system considered in terms of its effective application to the firm's business strategies and activities, during the onward/upward phase of the ERP life cycle, that is, after the system has been deployed in production.

One stream of research has either used or adapted generic frameworks of IS success, such as DeLone and McLean (1992)'s, to evaluate the success of ERP systems. For example, an instrument based on DeLone and McLean (1992) has been developed (Gable, Sedera and Chang 2003) and validated (Sedera and Gable 2004). Another stream of research has focused on defining specific successful outcomes within the context of the ERP life cycle (Markus et al. 2000; Markus and Tanis 2000; Bajwa, Garcia and Mooney 2004). Markus, Axline, Petrie, and Tanis (2000) identified a set of problems and outcomes possible to occur in each stage of the ERP system life cycle. Based on their study of 16 companies that had implemented ERP systems, they defined successful outcomes for each stage of the ERP life cycle experience. They found that success in one stage didn't imply success in a later stage and vice versa. For example, consistent with Ross and Vitale (2000), they found that a decrease in performance after going live with an ERP system was common, although companies that were able to deal with problems during this stage were able to realize business benefits later on. In other words, problems at the time of deployment did not hamper success in the onward/upward phase. Conversely, they found that, as Larsen and Myers (1997) observed, some companies that achieved "success" at the

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moment of going live could be classified as failures later on. Larsen and Myers (1997) observed, using case study methodology, that successful ERP deployment led a company to an excessive reduction of skilled personnel, as well as disbandment of their ERP team, who many times left the company to capitalize on their acquired ERP expertise. Thus, when unexpected ERP effects occurred, there were neither capable people nor management processes in place to deal with them. Furthermore, Markus et al (2000) found that several companies that had been using the ERP system for quite a while, could not even say with confidence whether they had achieved any ERP benefits. In sum, the point of time in which the success of an ERP system is measured is important; furthermore, the success of an ERP system in any given stage of the ERP life cycle is not related to the success in the next stage. Firms that deploy ERP systems successfully may still fail to assimilate the system and obtain expected benefits in the long run.

Shang and Seddon (2002) reviewed 233 ERP vendor-reported stories and interviewed managers in 34 organizations to assess long-term ERP benefits from the business manager's perspective. They proposed an ERP benefits framework that included the following dimensions: operational, managerial, strategic, IT infrastructure, and organizational. This benefit framework has been found useful for the evaluation of long-term benefits derived from ERP systems (Staehr, Shanks and Seddon 2002). Fuss et al (2005) has reported some of the major ERP expected benefits listed in the literature as follows: cost reduction, higher quality and more efficient business processes, better information transparency and quality, increase in organizational flexibility, reduced complexity and better harmonization of the IT infrastructure, improved integration, improved security, and better compliance with legal requirements and frameworks (particularly important in certain sectors such as the banking industry). In general, it is clear that ERP benefits are multidimensional, ranging from operational improvements to

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strategic goals and the choice of framework depends on the researcher and organization's objectives (Davenport 2000; Markus and Tanis 2000; Ross and Vitale 2000) and this is the reason that ERP systems continue to be deployed by organizations.

In summary, although ERPs are considered to provide strategic and operational benefits, there have been contradictory results about realizing their expected benefits (Markus and Tanis 2000); however, ERPs are still being widely deployed by organizations to support its business strategies and activities.

2.2.2   ERP Implementation Research.

ERP implementation research, following a long tradition in IS research, focuses on the factors associated with a successful ERP implementation. These studies include both theoretical undertakings (Cliffe 1999; Collins and Kirsch 1999; Prasad, Sharma and Godla 1999; Markus and Tanis 2000) and empirical studies (Holland and Light 1999; Mabert, Soni and Venkataramanan 2003). They tend to investigate the role of factors that are often cited by ERP practitioners as the most critical issues during an ERP project (Masini 2003). Some of the findings underscore the importance of a clear understanding of the objectives and the strategic goals of the project, commitment from top management, the use of highly qualified teams, the role of change management, the importance of data accuracy, the role of education and training, and the importance of adopting focused performance measures (Davis and Wilder 1998; Krupps 1998; Lee and Lee 2004).

Through a comprehensive review of the literature, Nah, Lau, and Kuang (2001) identified 11 critical success factors (CSFs) for the implementation of enterprise systems: ERP teamwork and composition, top management support, business plan and vision, effective communication,

project management, project champion, appropriate business and legacy systems, change management program and culture, business process reengineering and minimum customization, software development and testing, and monitoring and evaluation of performance. Next, the importance of each factor at different stages in the ERP life cycle was discussed. Nah, Zuckweiler, and Lau (2003) built upon this work to survey CIOs from Fortune 1000 companies and asked for a prioritization of CSFs. The five most critical factors identified by the CIOs were top management support, project champion, ERP teamwork and composition, project management, and change management program and culture. Similar CSF models based on literature reviews and case examples have been developed, and most of them are consistent with Nah et al (2001)'s model (Holland and Light 1999; Muscatello 2002; Mabert et al. 2003; Colmenares 2004).

There have also been some studies that seek to understand ERP implementation within the context of the complete software life cycle (Kumar and van Hillegersberg 2000; Light and Holland 2000; Markus and Tanis 2000). Holland and Light (2001) proposed studying ERP systems in terms of its stage of use in the organization. Based on an analysis of qualitative and quantitative case data collected from 24 organizations in Europe and the U.S., the authors present a maturity model for ERP systems consisting of three stages. In stage 1, organizations are managing legacy systems and starting the ERP project. In stage 2, implementation is complete and the system is deployed for its use across the organization. In stage 3, organizations have normalized the ERP system into the organization and are engaged in the process of obtaining strategic value from the system by using additional ERP systems such customer relationship management, knowledge management and supply chain planning.

Markus and Tanis (2000), based on a previous emergent process theory designed by Soh and Markus (1995) to explain how IT creates business value, proposed the Enterprise System Cycle Model, which describes the key process of investing, implementing, and assimilating an ERP system. In this model, the ERP life cycle is described in terms of four phases: *Chartering phase*, corresponding to the decisions defining the business case; *project phase*, which consists of getting the system and end-users "up and running;" *shakedown phase*, in which bugs are eliminated and normal operation is reached; and *onward/upward phase*, which consists of maintaining the system, supporting users, getting results, and upgrading.

The *chartering phase* includes the decisions leading up to the funding of an ERP system. Key activities include building a business case, selecting a software package, identifying a project manager, and approving a budget and schedule. The key outcome of this phase is a decision about whether to proceed or not with the ERP system.

The *project phase* consists of activities intended to get the system up and running. Key activities include software configuration, system integration, testing, data conversion, training, and rollout. The outcome of this stage may be a system ready for initial deployment in one or more organizational units or a project termination due to cost or schedule overruns or intractable technical problems.

The *shakedown phase* is the period of time from "initial deployment" until ERP normal operation is achieved. In this phase, bugs are fixed, user-related problems are addressed, user training is performed, etc. This phase can be said to end when normal operations, that is routine business operation of the ERP, is achieved (or the organization gives up, uninstalling the system).

The next stage, *onward/upward phase,* is where assimilation of the ERP system takes place, and is the focus of this research. In this phase, activities such as continuous process improvement, technology upgrading, additional end-use skill building, contribute to the adaptation of the ERP system and the organizational business processes. Also, at this point, unexpected new adaptation opportunities for the ERP system begin to appear, and the organization may take action to capitalize on them. An unexpected adaptation opportunity may occur when the ERP system is found to be useful, by using it in a novel way or by tweaking a business process, to fulfill certain emerging organizational needs or to provide capabilities that had not been considered in the initial ERP deployment. Similarly, it is possible that the appearance of new ERP add-ons may allow the development of novel organizational capabilities not contemplated initially. It is during the *onward/upward phase* that businesses adapt the system and business processes in order to fully assimilate the ERP system and realize its business benefits (Markus and Tanis 2000). For this reason it is of significant interest to senior management, IS practitioners, and IS academic researchers, to know more about this post-implementation period, and the factors affecting ERP assimilation, without which, realization of the ERP business benefits is significantly curtailed.

Based on the discussion of the two streams of research literature, this research proposes that certain management processes such as scanning and evaluation, as well as certain IS function characteristics such as collective mindfulness, are important for an effective assimilation of ERP systems. Based on Armstrong and Sambamurthy's (1999) definition of information technology assimilation, **ERP assimilation** is defined as the effective application of ERP information technology in supporting, shaping, and enabling firm's business strategies and value-chain activities. An effective application of ERP involves fulfilling the intended firm's

strategic and operational objectives once the system is being normally used by the organization. For example, a company may decide to deploy an ERP system with the main objective to decrease production costs. Once the system goes live, it takes at least six months before any cost improvement can be obtained and may take as much as forty-eight months before the ERP system is assimilated to the point that the firm can realize benefits such as optimal cost reduction (Deloitte 1999). On the other hand, the ERP system may fail to be assimilated by the organization; that is, despite the large investment and effort, the company will not achieve the intended cost reduction objective. Unfortunately, this situation is not uncommon. According to Koch (2002), 40 percent of ERP project managers are unsatisfied with performance improvements from ERP spending. James and Wolf (2000) have found that only 10 to 15 percent of surveyed firms have achieved expected results.

Due to the importance of ERP assimilation to realize the long term benefits of ERP systems, this study focuses on ERP assimilation as the dependent variable. More specifically, this research studies the role of certain key IS function management processes and characteristics, whose presence during the onward/upward phase of the ERP system life cycle, may contribute to obtain a greater extent of ERP assimilation. The next chapter discusses this line of thought in more detail, and proposes a related conceptual model for this purpose.

3.0   RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

It has been previously stated that a completed ERP implementation doesn't guarantee that an organization will be able to effectively apply an ERP system to support its business strategy and operations over time. It is not enough to invest in and deploy new IT, it is also necessary to apply it effectively in the firm's business activities (Sambamurthy and Zmud 1994; Brynjolfsson and Hitt 1996); that is, it is necessary to assimilate the new information system. Some organizations may successfully go live with their ERP systems but fail to assimilate them, missing significant opportunities to realize benefits from the new system (Markus and Tanis 2000; Salopek 2001). One reason for this is that organizations often fail to learn how to deal with the expected (and some unexpected) effects of applying the information technology (Attewell 1992; Fichman and Kemerer 1997). If these effects are not properly managed, the ERP cannot be effectively applied to support the firm's strategies and activities, that is, the ERP can not be effectively assimilated.

ERP assimilation can be understood in terms of managing opportunities to adapt the ERP system and the organization. It is only when this occurs that the ERP system can be effectively applied to support the firm's goals. Where do these opportunities come from? Either changes in the firm (e.g. an acquisition) or ERP utilization (e.g. business units discovering how to use the system in novel ways) may lead to the appearance of new ERP-related organizational needs that the IS function can detect and respond to. In addition to this, vendors may develop new ERP upgrades and add-ons, such as customer relationship management, knowledge management, and

supply chain planning modules, that may fulfill these emerging organizational needs; therefore, the IS function should keep track of these new ERP technologies as they become available. In other words, ERP adaptation opportunities involve matching of emerging organizational needs with new ERP technologies. If these adaptation opportunities are properly managed, then ERP assimilation will follow.

Since ERP assimilation requires on-going management of the opportunities to adapt the ERP system and the organization, it is important for the IS function to pay ongoing attention to new ERP- related adaptation opportunities as they emerge after initial deployment, during the onward/upward phase of the ERP life cycle (Markus and Tanis 2000). Organizational adaptation involves change and this is a process that occurs not as a consequence of a single event but as a result of taking advantage of multiple opportunities over time to further increase the adaptation between the ERP system and the organization. Because of this, one key process for the IS function seeking to achieve a high degree of ERP assimilation is to continuously monitor the appearance of new ERP adaptation opportunities, by recognizing both emerging ERP-related organizational needs and new technologies. This process is called ERP scanning, and is similar to environmental scanning, as discussed by Aguilar (1967), and extended to the information technology area by Maier et al (1997).

Aguilar (1967) defined environmental scanning as the acquisition of information about events, trends, and relationships in an organizations's environment. This knowledge is expected to assist top management in its task of charting the organizations's future course of action. Aguilar (1967) brought to light the importance of managers scanning their business environment. He found that for top managers, marketing and competitor information is more important than technical information; personal sources (e.g. subordinates, customers, etc.) were considered to be

more important than impersonal sources (e.g. publications); and that information from outside sources was mostly unsolicited while information from inside sources was mainly solicited.

Following Aguilar, several studies found that scanning improved organizational performance (Newgren, Rasher and LaRoe 1984; Daft, Sornumen and Parks 1988). Similarly, Maier et al (1997) have shown that the IS function should also actively monitor its environment to identify new technologies that can provide new capabilities to the organization. In this study, IS scanning is expanded to include efforts to identify both emerging organizational needs (scanning of needs) and new technologies (scanning of technologies), which in combination give rise to ERP adaptation opportunities. More specifically, **ERP scanning** is the process of monitoring the appearance of new ERP adaptation opportunities in the IS function's environment and where ERP adaptation opportunities are constituted by both emerging organizational needs and new ERP technologies. Emerging organizational needs appear as a result of either changing organizational circumstances or the discovery of potential new uses of the ERP system, as a result of its utilization. New ERP technologies are constituted by ERP upgrades, new modules, and add-ons developed by vendors and third parties. For example, advanced planning, customer relationship management, and supply chain management systems constitute typical ERP upgrades. It is through ongoing ERP scanning that the IS function becomes aware of new ERP adaptation opportunities that if acted upon can enable a more effective application of the ERP system in support of the firm's business strategies and value-chain activities.

Achieving ERP assimilation is a matter of managing the ongoing adaptation of the ERP system and the organization to more effectively support the firm's strategies, goals and activities. The IS function is more likely to become aware of ERP-related adaptation opportunities if it is engaged in ERP scanning. For example, IS personnel may be assigned to monitoring either the

appearance of new organizational needs or seeking out new ERP technologies. The IS function can encourage individuals to exchange information with colleagues in other areas of the organization in order to gather information about possible trends and emergent needs. Similarly, the IS function may send individuals to trade shows, conferences, and vendor presentations for the purpose of monitoring new ERP technologies. IS functions that engage in these scanning activities are more likely to become aware of ERP adaptation opportunities that can be used to achieve higher levels of assimilation. IS functions that don't engage in ERP scanning activities, or that do so to a lesser extent, will be more likely to miss opportunities to apply their ERP systems to support their business strategies and value-chain activities more effectively. Therefore, it is proposed here that

> H1: The extent of ERP scanning will have a direct positive effect on the level of ERP assimilation.

Not all adaptation opportunities have the same effect on ERP assimilation and not all opportunities can be realized by the organization. Among the adaptation opportunities, some significantly improve the degree to which the ERP system supports the business goals while some have little or no impact on ERP assimilation. Still others may not be aligned with the organizational objectives and strategy. Also, not all possible ERP adaptation opportunities can be realized since organizations have finite personnel and financial resources. Therefore, the firm can only realize some of the possible ERP adaptation opportunities.

Also, organizational adaptation of ERP systems may be affected by many different influences. Some ERP adaptation opportunities are realized as a result of daily user interaction

with the ERP system and improvisation by the organizational actors responding to the specifics of their work and context (Orlikowski and Hofman 1997). In other cases ERP adaptation opportunities are acted on because management is responding to industry bandwagons or fads (Abrahamson 1991; Swanson and Wang 2005). ERP adaptation can also occur as a result of accidental co-occurrence of interests, resources, and salient problems (Cohen, March and Olsen 1972) or internal conflicts and clashes of personal and group agendas (Cyert and March 1963).

In addition to this range of influences, IS management interested in facilitating ERP assimilation also seeks to shape adaptation of ERP systems. To accomplish this the IS function can put in place mechanisms to analyze and select the ERP adaptation opportunities with the greatest potential to contribute to the firm's overall objectives and strategies. These mechanisms, which we will refer to as **ERP evaluation**, include activities performed by the IS function to analyze and select ERP adaptation opportunities upon which to take action. Some ERP adaptation opportunities could be realized without formal evaluation by the IS function taking place. Individuals and groups can proceed to adapt the ERP system according to their specific interests, needs, agendas, or even by accident. However, an ERP adaptation opportunity "selected" this way may not be the most optimal for ERP assimilation and may even be detrimental for the firm's objectives. The interests of specific groups in the organization are not necessarily the interests of the organization as a whole. ERP evaluation activities will act as a filter that will allow the selection of those ERP adaptation opportunities which the IS function believes to be of greater interest for the firm. Therefore, the presence of ERP evaluation activities will increase the likelihood of the IS function selecting ERP adaptation opportunities that lead to the more effective application of the ERP system in support of the firm's objectives, strategies, and activities (i.e. greater ERP assimilation). In summary, some ERP adaptation

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opportunities can be realized by the organization with minimal or no intervention by the IS function; however, these adaptation opportunities may not be the most beneficial for ERP assimilation since the IS function didn't participate in their selection. ERP evaluation activities provide the detailed background that the IS function needs to manage their effective realization in the firm by promoting them, managing them, and hindering competing opportunities.

Benamati and Lederer (2001), in a nationwide survey of 246 IT organizations, identified several IT mechanisms employed by IS functions to cope with emerging technologies. Many of these mechanisms are ERP evaluation activities. One activity consists in training the IS staff, for example, by sending them regularly to courses in ERP technologies or ERP-related improvements the IS function has identified as worthy of careful evaluation. Another evaluation activity consists of experimenting with new ERP technologies and applications (e.g. by requesting a trial system from the vendor) that have been selected as of great interest for the firm. The purpose is to analyze their pros and cons when deployed and to understand the implications of using them in the organization. Experimentation allows asking "what if" questions in a controlled environment. Experimentation encompasses success and failure, both of which are important for learning what works and what doesn't when using the new technologies (Thompke 2003). If these evaluation activities, training and experimentation, don't take place, the IS function risks not understanding the new ERP opportunities well enough to evaluate them effectively. As a result, the IS function may promote a sub-optimal ERP adaptation opportunity, one with marginal or negative ERP assimilation benefits, or may hinder the realization of opportunities with potential impact on ERP assimilation.

The IS function may also have a formal committee, with ERP stakeholder participation, whose task is to evaluate emerging requirements and potential ERP upgrades. Should this formal

committee be absent, ERP adaptation opportunities are more likely to be realized based on individual or group agendas, bandwagon behavior, or even by accident. Realized opportunities may not be the most optimal ones, in terms of ERP assimilation, for the firm as a whole. Also, the IS function may use standardized procedures, that take into account the firm's current objectives, to select a suitable ERP adaptation opportunity. These standards, when consistently applied, increase the likelihood of realizing ERP adaptation opportunities consistent with the firms's objectives in terms of strategies and activities.

The IS function may also establish a formal alliance with ERP vendors to assist in the evaluation of new ERP adaptation opportunities. In effect, vendors will contribute to the evaluation activities by providing demos, assisting in setting up pilots, and advising based on their industry experience. Consultants may be also engaged to assist in the evaluation of additional organizational needs and new ERP add-ons. There may be several reasons for hiring consultants, including a lack of internal expertise (Smith, Mitra and Narisimhan 1998), poor personnel retention (McFarlan and Nolan 1995), or inability to keep pace with the changing technology (Lacity and Willcocks 1998). For these reasons, it may not be possible for the IS function to have personnel knowledgeable about all the potential ERP improvements. This applies to both the new ERP technologies, where vendors can be very skillful, and related emerging needs, where consultants can have experience, in other functional areas of the organization. Vendors and consultants allow the IS function to capitalize on their previous technological and industrial experience, and to bring into the organization skillful personnel to the process of analyzing and prioritizing the ERP adaptation opportunities. This way, the IS function may ensure realizing an evaluation where in addition to the local experts, it is also tapping into industry-wide experts in the ERP adaptation opportunities at hand.

ERP scanning increases the likelihood of identifying ERP adaptation opportunities. However, since not all ERP adaptation opportunities have the same potential to improve ERP assimilation, and since the firm has only finite resources (e.g. money, time, people, etc.), only some of these opportunities can be realized by the firm. ERP evaluation, the set of activities to study and select ERP adaptation opportunities, acts as a filter that allows the IS function to select and manage the opportunities with the greatest impact on the firm's ERP assimilation. On the other hand, underinvestment in ERP evaluation can lead to ERP adaptation opportunities being realized either by chance, bandwagons, or local agendas, resulting in pursuit of opportunities that may not ultimately contribute to greater assimilation of the ERP system. Therefore:

H2: The effect of ERP scanning on the level of ERP assimilation will be positively moderated by the extent of ERP evaluation activities.

Some of the ERP adaptation opportunities may be unexpected since they may occur due to sudden changes in the firm (e.g. an acquisition) or new technical developments (e.g. availability of a new ERP add-on). Sometimes these unexpected events can be more dramatic, such as in the case of a new CEO with a different strategic emphasis; or in the case of newly found problems (e.g. from the vendor) in deployed add-ons or modules. In other cases the opportunities can be more difficult to detect such as slight changes in the market that the firm could capitalize upon. All this underscores the need for the IS function to manage unexpected situations for an effective use of the ERP system in supporting the firm's business activities; in particular, in the face of organizational or technical changes. Weick et al. (1999) have argued that the presence of *collective mindfulness,* an elevated state of collective alertness, leads to an

enhanced ability to deal with unexpected events. The presence of collective mindfulness in the IS function, or **IS Mindfulness,** can be defined as an elevated state of collective alertness toward expectations in the face of new and unprecedented situations, with nuanced appreciation of the specific context (Langer 1989; Weick et al. 1999; Fiol and O'Connor 2003; Swanson and Ramiller 2004). It has been previously argued that detecting and responding appropriately to ERP adaptation opportunities is key for the effective assimilation of the ERP system after its deployment. By their very nature, these opportunities tend to be unexpected events. Since IS mindfulness leads to an enhanced ability to manage the unexpected (Weick and Sutcliffe 2001), the presence of a high level of IS mindfulness is important for the management of ERP adaptation opportunities.

The key characteristics of a mindful IS function that contribute to an enhanced management of the unexpected are: a) openness to novelty, that is, avoiding automatic behaviors that preclude new information; b) alertness to distinction, or paying active, vigilant attention to distinctive characteristics of unfolding events, and c) implicit awareness of multiple perspectives to continuously challenge existing assumptions and expectations (Langer 1997; Weick et al. 1999; Weick and Sutcliffe 2001; Fiol and O'Connor 2003).

A mindful IS function, due to its *openness to novelty*, will be less likely to scan the environment in a routine, automatic way. This fosters a rich action repertoire which is more likely to capture unknown information and to interpret it in novel ways (Langer 1989; Weick et al. 1999). For example, rather than relying on attending presentations from traditional vendors in ERP trade shows, a mindful IS function might encourage its staff to attend also presentations by less known and newer vendors. Similarly, rather than relying exclusively on explanations from internal memoranda, the mindful IS function will actively encourage their staff to independently

interpret organizational events. In summary, a highly mindful IS function, due to its openness to novelty, will act in a way that will make it more likely to identify and manage new ERP adaptation opportunities with great potential for increasing ERP assimilation.

A mindful IS function, due to its *alertness to distinction*, will be less likely to miss an adaptation opportunity just because it is too different from common experience. Less mindful IS functions, on the contrary, will be more likely to overlook opportunities that are too different from what they are accustomed to. An information source or system will tend not to be used or given less attention whenever having the information leads to more "pain and trouble" than not having the information (Mooers 1960). It has been also argued that decision makers tend to avoid anything that threatens their current perception or pattern of behavior (Festinger 1967). On the other hand, rather than considering only ERP adaptation opportunities consistent with previous IS plans -a form of expectation- the mindful IS function will notice new ERP adaptation opportunities, even if they are quite a departure from original plans. In summary, a mindful IS function will be more likely to take advantage of a distinctive, "different" ERP opportunity, relevant for the firm's context, that may have a positive impact in the ERP assimilation.

Finally, a mindful IS function, due to its *awareness of multiple perspectives,* will be more likely to consider new ERP adaptation opportunities in a critical fashion. For example, rather than taking their ERP vendor's assessment for granted, the mindful IS unit will also look for approaches that differs or challenges the existing views. An IS function with low levels of mindfulness, on the contrary, will tend to assess information consistently with the dominant perspectives widely accepted in the industry and organization (Abrahamson 1991). A more mindful IS function will take into consideration ERP adaptation opportunities that go beyond traditional points of view. In general, the mindful IS function will consider new ERP adaptation

opportunities, taking into account different –even contradictory- perspectives, which will make it more likely to detect valuable, realistic ERP adaptation opportunities with potential for greater ERP assimilation.

In summary, scanning activities in a mindful IS function are more likely to uncover and take action on ERP adaptation opportunities leading to greater ERP assimilation, while scanning activities in a less mindful IS function are less likely to uncover and act on the ERP adaptation opportunities that are the basis for high levels of ERP assimilation. That is,

H3: The degree of IS Mindfulness will have a positive moderating effect on the relationship between ERP scanning and ERP assimilation.

Summarizing this chapter, it has been argued that ERP assimilation will not be effective unless ERP adaptation opportunities, resulting from changes (some of them unexpected) in the firm or in the environment, are identified, evaluated and taken action upon by the IS function. It is posited here that a greater extent of ERP scanning activities will increase the likelihood of detecting ERP adaptation opportunities and in turn lead to more effective ERP assimilation. In addition, it is proposed that ERP evaluation activities will allow the IS function to better select those ERP adaptation opportunities with the greatest likelihood of increasing the ERP support to the firms' business strategies and activities. With less investment in ERP evaluation, some scanned ERP adaptation opportunities may still be "selected" for deployment but without the filter which identifies those with the greatest potential to increase ERP assimilation. It is proposed then that ERP evaluation will positively moderate the effect of ERP scanning on ERP assimilation. Unless the IS function is alert, some ERP adaptation opportunities may not be

noticed or taken action upon, either because they constitute weak signals in the environment or because they are too different from daily experience. For this reason, higher levels of IS mindfulness, an elevated state of alertness toward the unexpected, are expected to increase the impact of ERP scanning activities on the assimilation of ERP systems.

3.1   CONTROL VARIABLES IN THE STUDY.

An important control variable to be used in this study is IT turbulence, derived from the literature on environmental turbulence (Pfeffer and Salancik 1978; Scott 1998). Turbulence refers to instability, volatility, or difficult-to-predict discontinuities in a dominant industry (Dess and Beard 1984). It has been found that organizations that operate in turbulent environments need to innovate more frequently to be able to compete effectively (Eisenhardt 1989). For the IS function, taking advantage of an ERP adaptation opportunity, a type of technology-related innovation, will be much more important in IT turbulent environments (Calantone, Garcia and Droge 2003). IT Turbulence is defined here as the rate to which frequent and unpredictable changes in IT within an industry accentuate risk and uncertainty in the selection and assimilation of information technologies. Another control variable to be considered in this study is the number of ERP users since this is a good proxy for the size of the ERP system. It is reasonable to expect that the difficulty to fully assimilate an ERP system could be related to the size of the system. **Figure 2** shows the research model with the control variables.
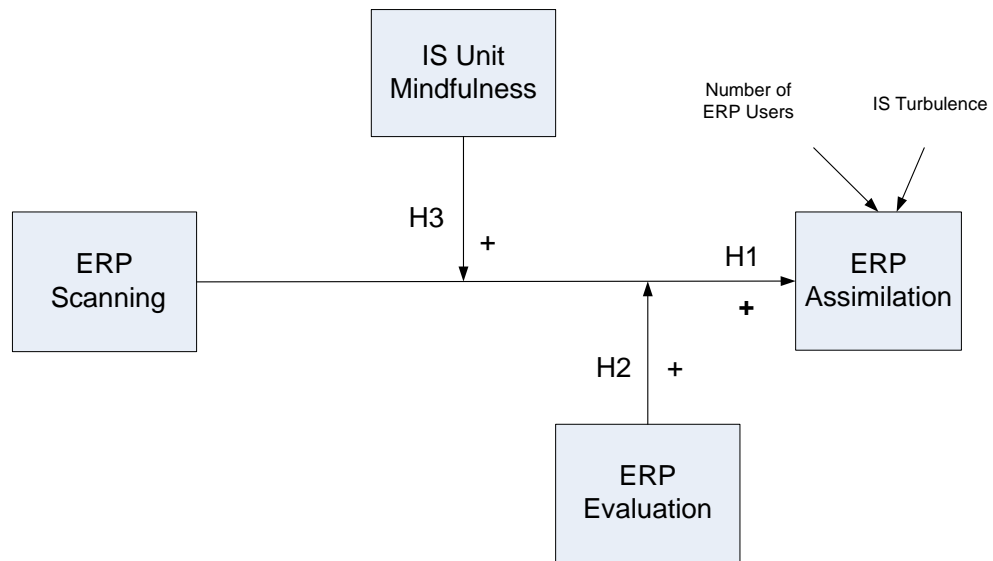
Figure 2: Research Model with Control Variables

4.0   RESEARCH METHODOLOGY

This chapter describes the empirical study that was undertaken to test the proposed model of ERP scanning, ERP Evaluation, IS Mindfulness and ERP Assimilation. A field study of firms with ERP installations already in production[1] was conducted using a survey-based research method. To minimize the problem of common variance and social desirability bias[2], the questions about the IS function characteristics (scanning, evaluation, and mindfulness) were answered by an MIS participant (e.g. CIO), while the questions about the ERP performance were answered by a business participant (e.g. COO). At the same time, based on previous experiences that showed the difficulty of obtaining large sample sizes with a matched-pair design, the IS survey also included the questions about ERP performance. This would ensure that even in the event of not having enough matched pairs, it would still be possible to measure the independent and dependent variables based on the IS survey alone.

Two different survey instruments were developed, one for the IS participant and one for the business function participant. The final surveys are shown in **Appendix A**. A summary of the constructs and items to measure them is shown in **Appendix B**. This study has been conducted in three stages: (1) Instrument Development and Pre-Tests (2) Pilot Study, and (3) Field Study.

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[1] An ERP system in production is one that has been deployed for daily use; that is, tests have been completed and the system is being used for the normal activities of the firm.
[2] In effect, one concern of having the IS respondent assess the ERP performance is that he/she may have a tendency to be more positive in the assessment due to the fact that the IS function has played a key role in the ERP deployment.

Appendix C shows a timeline for these stages as well as for the additional steps in the dissertation process.

4.1   INSTRUMENT DEVELOPMENT AND PRE-TESTS.

The first step in this stage was to gain a better understanding of ERP assimilation and the other constructs by examining the research literature and supplementing it with a practitioner's point of view. The next step was to develop survey questionnaires and to pre-test them to ensure they had face validity for both academics and practitioners.

ERP scanning measures were created based on available items drawn from prior studies of scanning (Sutcliffe 1994; Maier et al. 1997) which were then adapted for the ERP context. Initially, the questions were intended to ask about the scanning of "ERP adaptation opportunities' but this was found to be a strange term for practitioners (who would be filling in the survey) so questions for scanning of emerging organizational needs and for scanning of new ERP technologies were developed separately. *ERP evaluation* measures were created based on Benamati and Lederer (2001), by modifying the scale to include only the activities related to ERP evaluation and adapting the wording to make it more specific for the ERP post-implementation context. It was considered convenient to validate the presence of these ERP evaluation activities in the context of a real ERP site. Fortunately, one of the advisors in this research had worked extensively on several ERP sites and allowed access to the interviews conducted at Dow Corning. Therefore, the *Dow Corning's ERP experience Case* (Ross 1997; Ross 1999) was used to identify which of the activities listed by Benamati and Lederer (2001)

were used in a real ERP context, as shown in **Table 2**. Only the Benamati and Lederer's activities found in the *Dow Corning's ERP Experience Case* were included in the evaluation measures. Based on this analysis, a subset of activities was selected and used to generate the initial set of evaluation items, as shown in **Table 3**. In this case, the questions were repeated to refer to the evaluation of needs and the evaluation of ERP technologies for consistency with the scanning measures.

Table 2: Identification of IT Benamati and Lederer (2001)'s Evaluation Activities in the Dow Corning Corp Case (Ross, 1997; 1999).

IT Evaluation is the set of activities engaged by the IS function to study and select specific ERP adaptation opportunities upon which to take action.

	IT Evaluation Activity from Benamati and Lederer (2001)	Note	Found in Dow C.	Used by Dow C.	Sample Reference in Dow Corning Case (Ross, 1997; 1999)
1	*Engage a consultant to help in addressing problems*	**1**	Yes	Yes	"…Dow Corning had called in consultants…" DCC, p. 7 (Note 2)
2	*Engage a consultant to aid in the implementation of new IT*		Yes	No	"…very stringent use of consultants…" DCC, p. 7
3	*Engage a consultant to provide ongoing support for new IT*		Yes	No	"…the firm had not hired a system integrator.." DCC, p. 7
4	*Engage a consultant to help plan for new IT*	**1**	Yes	No	"…consulting costs was less than 10% of total...cost…" DCC, p. 7
5	*Inform IS professionals of the benefits of new IT*	**1**	Yes	Yes	"Lacefield had been communicating...with area managers … DCB p.19
6	*Educate IS professionals about new IT through classes*	**1**	Yes	No	"…bringing employees up the learning curve …" DCB p. 12
7	*Encourage personnel to learn more about the new IT*	**1**	Yes	Yes	"We are going to let our people do this…" , DCB, p. 12, p.13
8	*Customize education to include the new IT*		Yes	Yes	"…management created the PRIDE academy…" DCCB p. 18
9	*Pressure IS professionals to use the new IT*		Yes	Yes	"The alternative is nowhere… DCB p.20
10	*Have vendors customize new IT*		Yes	No	"For purposes of maintainability... DCB, p. 13
11	*Rely on IT vendors to provide solutions to problems*	**1**	Yes	No	"Dow Corning would have to support SAP in house..." DCB, p. 12
12	*Pressure vendors of new IT to provide support*		Yes	No	ibid
13	*Work with IT vendors to improve future versions of IT*	**1**	Yes	Yes	"Ultimately, they would need some 'bolt-ons' which…" DCB,p. 13
14	*Engage vendor to write required interfaces between IT*				ibid
15	*Coordinate communication about multiple vendors*				
16	*Use a well defined IT evaluation procedure*	**1**	Yes	Yes	"Requests... had to go through the Process & IT Board" DCB, p. 13
	(e.g. a formal committee)				"...'think tanks' [within the company] were assembled…" DCB, p.18
17	*Consider only new IT compatible with existing IT*	**1**	Yes	Yes	"For purposes of maintainability... DCB, p. 13
18	*Use a well defined IT acquisition procedure*				

Table 2 (continued)

	IT Evaluation Activity from Benamati and Lederer (2001)	Note	Found in Dow C.	Used by Dow C.	Sample Reference in Dow Corning Case (Ross, 1997; 1999)
19	*Consider only new IT successfully used by other organizations*	1			
20	*Document the differences between new and previous IT*	1	Yes	No	"...workflows [designed] around the capabilities of the software…DCB
21	*Work around problems without fixing them*				
22	*Ignore Problems*				
23	*Learn new IT informally without classes*	3			"We are going to let our people do this…" , DCB, p. 12, p.13

Note 1.   These items are relevant for Evaluation Activities in the ERP-post implementation period.

Note 2.   DCCA - Dow Corning Case Part A (Ross, 1997); DCB - Dow Corning Case Part B (Ross, 1997); DCC - Dow Corning Case Part C (Ross, 1999)

Note 3.   Item 23 is the reversal of item 6 so it was not included in the preliminary list of items for evaluation activities.

Table 3: Development of Evaluation Activity Measures from the Dow Corning Corp Case.

IT Evaluation is the set of activities engaged by the IS function to study and select specific ERP opportunities upon which to take action.

IT Evaluation Activities based on Benamati and Lederer and identified in Dow Corning Corp Case (Table 2)

Consultant Support

    Engage a consultant to help in addressing problems

    Engage a consultant to help plan for new IT

Education and Training

    Inform IS professionals of the benefits of new IT

    Educate IS professionals about new IT through classes

    Encourage personnel to learn more about the new IT

Vendor Support

    Rely on IT vendors to provide solutions to problems

    Pressure vendors of new IT to provide support

    Work with IT vendors to improve future versions of IT

Internal Procedures
Use a well defined IT evaluation procedure

    (e.g. a formal committee)
Consider only new IT compatible with existing IT

Consider only new IT successfully used by other organizations
Document the differences between new and previous IT

Development of IT Evaluation Measures for current study

Consultant Support

1 *Engage a consultant to help in addressing potential problems related to new ERP-related technological opportunities*

2 *Engage a consultant to help plan for new ERP-related improvements such as in add-ons, process optimizations, etc.*

Education and Training

3 *Inform IS professionalsl about the pros/cons of new ERP-related technological opportunities*

4 *Educate IS professionals about new ERP-related technological opportunities through classes*

5 *Encourage personnel to explore new ERP-related technological opportunities.*

Vendor Support

6 *Rely on IT vendors to help in addressing potential problems related to new ERP-related technological opportunities*

7 *Pressure IT vendors to help plan for new ERP-related improvements such as add-ons, process optimizations, etc.*

Internal Procedures

8 *Use a well defined IT evaluation procedure such as a formal committee to evaluate new ERP-related technological opportunities*

9 *Use a well defined IT evaluation criteria for new ERP-related technological opportunities*

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ERP assimilation, the dependent variable in this study, was originally measured similarly to previous studies of IT assimilation; that is along two dimensions: strategies and value-chain activities (Armstrong and Sambamurthy 1999). The items were modified to make them more specific to ERP systems. Based on the results of the pilot test, a question arose whether measuring assimilation using the same summated scale of strategy and value-chain activities for all firms was correct because some of the strategies and activities could be relevant for some firms and irrelevant for others; therefore, a low scale in the ERP support of an irrelevant activity could not be computed as low assimilation. Another issue raised at this time was the fact that the framework used to measure assimilation was incomplete since the value chain support activities were missing. Based on these suggestions, the following changes were made to the assimilation measures: first, two more dimensions, support activities and overall support, were added; second, the respondent was instructed to identify which activities were critical for the firm and which were not. Only the critical activities were used to compute assimilation.

In summary, there are four sets of measures for ERP assimilation. The first set evaluates the effective use of the ERP system in supporting the firms' business strategies, the second set evaluates ERP support in the value-chain primary activities, the third set evaluates ERP support in the value-chain support activities and the fourth and last set (a single indicator) is an overall scoring of the support of the ERP system to the firm's business strategy. In the first three sets of measures for assimilation only those activities that the survey respondent identified as critical for the firm were aggregated and averaged to measure ERP assimilation.

Finally, an instrument to measure the *IS mindfulness* construct was developed. Since there are few empirical studies that measure mindfulness, extra care was taken when developing the mindfulness scale. Items were generated based on Weick and Sutcliffe (2001) and Knight

(2004). The instrument was pre-tested to ensure participants could understand and respond to the items (Converse and Presser 1986). The main objective here was to check question clarity, respondent's attention and interest, and the general flow of the questionnaire (Converse and Presser 1986). Based on feedback obtained during this stage, changes were made to the formatting and wording of the instrument. The instrument for IS mindfulness was pre-tested as follows. The original set of items for mindfulness went through two rounds of card sorting to check face validity and clarity (Thomas and Watson 2002). A total of eight graduate students (four in each round) were asked to sort the items according to the construct definitions. In each round, some items were dropped, modified, or added as needed. Once a consistent set was obtained, the preliminary IS mindfulness survey was pre-tested by 27 MBA-level students from the European Business School. Reliability analysis indicated a Cronbach's Alpha of 0.867 for the 9-item collective mindfulness scale. See **Table 4** for a summary of the pre-test reliability result.

Table 4: Reliability Summary for Pre-test with EBS Students

Construct	N	# of items	Item Means	Item Variances	Cronbach's Alpha
Collective Mindfulness (7-item Scale)	27	9	5.19	1.96	0.785

The ERP demographic part of the surveys was pre-tested with a senior researcher from the European Business School in Germany who teaches ERP systems, has worked as an ERP consultant, and has conducted research in this area. This feedback allowed the identification of the specific modules and add-ons available in SAP systems, as well as suitable general names that could be used for all systems (**Table 5** and **Table 6**). Based on this pre-test, the ERP questions were modified and some items dropped to ensure the survey clarity for ERP-knowledgeable professionals (See **Table 7** for relevant comments). Also, this feedback showed

the difficulty of using common terminology for the add-ons among the different vendors. Fortunately, the questions about add-ons were important for the ERP demographic part but not for the actual hypothesis testing section. So, the SAP-oriented terminology, although not ideal, was clear enough to be understood by all ERP users. Once the questions for the ERP demographics part were fully developed, they were pre-tested once more with an ERP consultant (See **Table 8** for a sample of his comments).

Table 5: List of Standard SAP Modules

Common Initials	SAP Module
SD	Sales & Distribution
MM	Materials Management
PP	Production Planning
FI	Financials
CO	Controlling
AM	Asset Management
HR	Human Resources
PS	Project Systems
QM	Quality Management

Table 6: List of SAP Product Add-Ons

General Name	SAP Product	Remarks
Strategic Planning	Strategic Enterprise Management (SEM)	
Advanced Planning System	Advanced Planner and Optimizer (APO)	APO is now part of mySAP SCM
Supply Chain Management	mySAP SCM	
Customer Relationship Management	mySAP CRM	
Supplier Relationship Management	mySAP SRM	
Product Lifecycle Management	mySAP PLM	
Portal	SAP EP (Enterprise Portal)	
Data Warehouse	SAP BW (Business Warehouse)	
Mobile Infrastructure	SAP MI (Mobile Infrastructures)	
Enterprise Application Integration or Business Process Management System	SAP XI (Exchange Infrastructure)	
Application Server	SAP Web AS (Application Server)	
	Industry-specific Solutions	
	Industry-specific Add-ons	
	Industry extensions	
	xApps	Better not included

Table 7: Comments to the IS Survey Questions

(Pre-test by SAP expert at the European Business School in Germany)

Original Survey Question	Pre-test Comment	New/Modified Survey Question
What is the current SAP system in use in your organization ? Don't Know_____ SAP R/3___ SAP R/3 Enterprise__ mySAP ERP___	Only a suggestion …Knowing the number of installations might give an impression of the size and complexity of the overall SAP system.	The following question was added: Approximately, how many SAP installations are there in your firm? 1_ 2_ 3_ 4_ 5_ + 5_ Don't know__
Which of the following statements best reflects SAP in your organization: a. It is installed only in a single site_____ b. It is installed in multiple sites in one state_____ c. It is installed in multiple sites in multiple states_____ d. It is installed in multiple sites, internationally_____	I am not really sure what is meant by state: the geographical state or the same state of customization, product (as in 1.), release? If the first one is meant: *Not every country has states*, perhaps you could use the word region. If the latter is meant perhaps some explanation of what is meant by state is needed.	Which of the following statements best reflects SAP in your organization: a. It is installed only in a single site_____ b. It is installed in multiple sites in one region or state_____ c. It is installed in multiple sites in multiple regions or states_____ d. It is installed in multiple sites, internationally_____
Approximately how long ago was the SAP system purchased?	First? System or module?	Approximately how long ago was the first SAP module purchased?
How would you rate the extent of modification done to the SAP system to customize the software? (from 1 – very little to 10 – very much).	Perhaps "to tailor" is better than "to customize", as customization is a specific type of tailoring in SAP parlance excluding interfaces, code modifications etc. See Brehm, Heinzl, Markus (2001). Probably, this question is very hard to answer, especially in the case of many individual systems being installed. However, I cannot think of a suggestion to ask this in a better way.	How would you rate the extent of modification done to the SAP system to tailor the software? (from 1 – very little to 10 – very much).
Which statement best describes the breadth of use of SAP? a. It is used by a small number of people within a department b. It is used by a department c. It is used by more than one department d. It is used in a region _____ e. It is used in more than one region _____	If in 4. you meant state geographically then this is question is redundant.	Which statement best describes the breadth of business process reengineering? a. Changed activities of a small number of people within a department b. Changed activities of a whole department c. Changed activities in more than one department d. Changed activities in a region e. Changed activities in more than one region

Table 7 (continued)

Original Survey Question	Pre-test Comment	New/Modified Survey Question
- Indicate the number of staff in your unit. - How many employees are there in your firm (approximately)?	Perhaps "staff in the IS unit" to make it correspond to question 4. In case you change it into IS unit, I would change the positions of question 2 and 3.	Questions were inverted (to move from firm to unit) and modified as follows: - How many employees are in your firm (approximately) - Indicate the number of employees in your unit (approximately)

Table 8: Pre-test by ERP Consultant (U.S.)

Survey Question	Comment	New/Modified Question
Approximately how many users does the SAP system have?	In your organization?	Approximately, how many users does the SAP system have in your organization?
Approximately how long ago did the first SAP module go "live" (i.e. become a production system)? [A scale from 6 months to 60 months was provided here]	Should you expand your scale beyond 60 months because quite a few companies have had SAP for about 8-10 or more years.	The option "More than 60 months" have been added to the scale.
How would you rate the extent of modification done to the SAP to customize the software? (from 1 – very little to 10 – very much).	You may need a scale in these questions. And provide some more elaboration as well.	This question has been replaced with two questions below and a scale from 1 to 10 has been provided. - How would you rate the extent of configuration done to the SAP system to reflect organizational features? - How would you rate the extent of code modification done to the SAP software to perform unique business processes?

Finally, the items developed for ERP scanning, ERP evaluation, and ERP assimilation were pre-tested with another MIS professional, an IS analyst, to identify for inconsistencies or lack of clarity in the questions and to identify how long a real participant would require to complete the questionnaire.

All the different construct measures were assembled within their respective surveys: IS survey and ERP business survey. These paper-based surveys were pre-tested once more with two different people representative of the expected participants. The IS participant survey was pre-tested by a supply chain manager currently working with SAP systems while the business participant survey was reviewed by an academic with operations experience.

Up to this point, the pre-tests had been done using paper-based questionnaires. Once the contents and wording of the items had been refined as previously explained, the questionnaire was posted on the web. The first survey was built using *FrontPage* but the settings were found to be rigid and difficult to modify. For example, it was not possible to randomize the items corresponding to the mindfulness constructs. This is useful to decrease first-question bias in the survey. Ultimately, a commercial survey site, *SurveyMonkey*, was chosen based on the simplicity of setup, modification, and data exporting. Using this commercial website, two web-based surveys corresponding to the IS function and ERP business participants were created.

A new set of pre-tests was conducted for the web-based questionnaires to determine if: a) errors had been introduced when building the on-line survey, and b) if the web-based survey settings operated as expected and could be easily used by the participants. For this purpose, the assistance of four people (two IS doctoral students and two IS professionals) was requested. They pre-tested the on-line instruments helping to locate errors, identifying functional problems

and also suggesting format changes for some questions. Based on this feedback, the on-line surveys were revised and deemed ready for the pilot phase.

4.2   PILOT STUDY.

The second stage involved conducting a pilot study. For this purpose two web-based surveys were used, one for the IS participant (e.g. CIO) and one for the business participant (e.g. COO). Also, the data collection protocol was developed and the invitation and follow-up letters were written and fine-tuned (**Appendix D**).

The data collection protocol was as follows: An invitation letter via e-mail or postal mail was sent to a potential IS participant. The e-mail included a link to the web-based IS survey while a postal letter had a paper questionnaire attached. One question in the questionnaire requested the IS participant to refer a business officer (i.e. not from the IS unit) who could further answer questions about the effectiveness of the ERP system in supporting the business activities. Next, an invitation letter or e-mail was sent to this potential business participant asking him/her to complete a web-based survey (ERP business participant survey) with questions about the effectiveness of the ERP system in the firm. Telephone, e-mail or letter follow ups were also performed as part of the data collection protocol.

The purpose of the pilot study was to ensure that the concepts and wording used in the instruments were meaningful for the participants and that the data collection protocol worked as expected. The pilot study consisted of a small scale field study using two data points from the target population. Its objectives were similar to the pre-test except that (1) an actual population sample was used and (2) the data collection protocols were followed as closely as possible. The

only differences with the final field study was that first, the sample size (two companies) was too small to perform any significant statistical analysis; and second, the IS and business participant were interviewed (by e-mail) after taking the survey to obtain feedback about the survey and data collection method. One of the companies was a South American-based company and the respondents, although fluent in English, were not native speakers. The second company was Pittsburgh-based and both participants were English native speakers. The most interesting result was that the U.S. participant took 10 minutes to complete the IS survey while the non-native participant took 30 minutes to complete it. This is important because one of the initial concerns prior to the pilot has been the length of the IS survey. Also, an important modification to the IS survey was dropping the evaluation items corresponding to evaluation of needs. The reason for this was that these items were word by word identical to the evaluation items corresponding to evaluation of technologies. The only difference was that the first set used the word "needs" while the second set used the word "technologies." This was confusing for the participants who initially thought there was a duplicate set of items. Also, one of the participants convincingly argued that when the IS function evaluates a technology, it has to be within the context of specific needs. He argued that it is not possible to evaluate a technology without keeping in mind the need it is expected to fulfill. Finally, in terms of survey interest, the South American participants rated the survey as more interesting (6 in the 1-7 scale) than the U.S. participants (3 or 4 in the 1-7 scale). This may be due to less exposure to surveys in Latin America or to cultural differences (e.g. being nice with colleagues). Finally, the most important result from the pilot study was to show that both the survey invitation protocol and the web-based surveys themselves operated as expected. **Table 9** - **Table 10** shows the feedback obtained from these pilot

participants and the final surveys are shown in **Appendix A**. Also, a summary of the constructs

and items to measure them is shown in **Appendix B**.

Table 9: Pilot Study: First Data Point

Petrol Company in South America

E-mail Interview	IS Participant 1 (Project Coordinator)	Business (SAP) Participant 1 (Senior Operations Engineer)
1. Did you have any problems understanding the questions?	Just a little but is due to my English knowledge	What is R & D?? I don't know, that is why I didn't answer that question
2. Were there any problems in using the web-based system?	No	No
3. How long did it take to complete the survey?	30 minutes	30 minutes
4. In a scale going from 1- very boring to 7- very interesting, how would you rate this survey? - be honest!	6	6
5. Any observations /suggestions to improve this questionnaire?	Aditional issues: 5.1 Ratio cost/benefits 5.2 Process visión v.s Tool vision 5.3 Best practices 5.4 Consulting: responsabilities and support 5.5 Majors problems like integrtión, new SAP versions, etc 5.6 Localizatión 5.7 Global models, global roll outs 5.8Optimization process 5.9 Change management and managing projects. 5.10 Evaluation items seem to be duplicated	Would be interesting to see comments about: Training and support Aditional processes that help to the strengthening of the system (For example: Communication, global knowledge about internal processes in the company for all the users, resources, etc) Interaction of all the areas Testing phase of the system.

Table 10: Pilot Study: Second Data Point

Medical Equipment Manufacturer based in Pittsburgh, PA.

E-mail Interview	IS Participant 2 (Director, Global IT Applications)	Business (SAP) Participant 2 (Manager, Operations)
1. Did you have any problems understanding the questions?	There were a few I did not quite understand your perspective. Some I was unsure how to answer since it has been so long since we began our implementation. For example, one question asked how long it had been since we implemented our last module. That was just this past April. - but I was not sure if you meant relative to our initial scope or really our last module. In this case, that module did not even exist 2 years ago let alone when we first implemented.	In general, no. About half way through, the questions repeated. I had to go back and ensure I answered correctly within the context in which you were asking the questions.
2. Were there any problems in using the web-based system?	One section of questions seemed to repeat.	No
3. How long did it take to complete the survey?	About 15 mins	7-10 minutes
4. In a scale going from 1- very boring to 7- very interesting, how would you rate this survey? - be honest!	4	3
5. Any observations /suggestions to improve this questionnaire?	Might clarify your perspective just a bit in 2 areas - are you referring to all of IT or just the portion that supports SAP - and are you referring to the initial install of SAP or everything that has happened since?	One question that was not asked that will impact the outcome is the level that SAP is implemented. We have a lot of operational needs that SAP can address, but as an organization we have not invested in the specific module. In addition, there were no questions about backoffice operations. One challenge that I see with SAP within my organization is the lack of accessibility to information to support macro level decision making. Also, the training at MEDRAD is not sufficient for this type of system. Being a new SAP user, it is not intuitive nor very user-friendly. Depending on how the organization manages that aspect of the system will influence its value within the organization.

4.3   FIELD STUDY.

The last step in the data collection effort was the primary data collection. Initially, the plan was to contact only organizations with SAP systems; however, the pilot study showed that the terminology used was generic enough that it could be used for all types of ERP systems. The selection process of the target firms was done in two ways: First, a list of postal addresses for members of the Association for Operations Management (APICS) was obtained. Second, a sample of convenience based on business associate contacts was also used.

APICS is the largest association for operations management in the United States. They provide training and a forum to exchange expertise in operations for their individual members. Members of this organization are usually middle and top managers working for companies with sophisticated operations and we were assured by an APICS spokesperson that the large majority of APICS firms would have some sort of enterprise resource planning system. Another reason to use the APICS members list was that they provided not only the names and postal addresses but also the area of the firm (MIS, Operations, Supply Chain, and R&D) in which the contact worked.

From the APICS list, 800 members (500 from the IS function and 300 from operations) were contacted by postal mail. An invitation letter along with a questionnaire was mailed to each member. The IS questionnaire was sent to 500 APICS members from the IS function and included the independent and dependent variables. As part of the survey, respondents were asked to identify a colleague from the operations area in their firm that could be contacted to complete the ERP business survey.   An invitation letter along with the ERP business survey, containing only the dependent variable, was mailed to the 300 APICS members from the area of operations and respondents were similarly asked to identify a colleague from the IS function that could

complete the corresponding survey. A follow-up letter was sent two weeks later for those who had not responded. Also, whenever available, a third follow up via email and/or telephone was done.

In parallel to this effort, approximately 189 individuals recruited from the list of MBA alumni (77), current EMBA and MBA students (50), as well as current and past business associates (62) were contacted.

The data collection efforts produced 113 IS and 66 business usable responses (which combined corresponded to 33 matched pairs) for the current study. This constitutes an IS survey response rate of approximately 19.02 % at the firm level. The alumni list proved to be extremely inaccurate. Katz alumni are provided an alumni email address to keep in permanent contact with the Katz school; however, when emailing these contacts, it became clear that hardly anybody used them. Similarly, the postal addresses and phone numbers were extremely outdated. For this reason, in addition to 40 wrong emails, it was conservatively assumed that at least 50% of the remaining alumni contacts were wrong for the purpose of calculating the reported IS survey response rate[3]. On the contrary, the APICS list was quite accurate and the mail return due to wrong addresses was less than 3%.

A caveat is in order here. Although individual members were targeted, the data unit was the firm; so, the goal was to have one IS survey and one ERP business survey per firm. For this purpose only one IS survey and one ERP survey was sent to each firm. In a few cases, more than one individual in each firm was contacted but there was rarely a case of either multiple IS or ERP business respondents from the same firm. In two cases where 2 responses from the same firm were received, only the first one to arrive was used. After tallying the surveys, the final

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[3] The response rate was calculated as 113 / (500 + 189 - 0.5*189) = 19.02%

count showed a usable number of 113 IS surveys, 66 ERP business surveys and 33 matched pairs. **Appendix E** shows a summary of responses for both the IS function and business participants.

This response rate is comparable to similar studies. A study on IT assimilation by Armstrong and Sambamurthy (1999) used a sampling frame of 1,200 with response rates of 21% and 32% for the IS and business participant questionnaire respectively (the study required matched pairs). However, they targeted any company with an IS system which was practically every company contacted. This dissertation research targeted companies that had an ERP system in production for six months or more to ensure they had moved beyond the shakedown phase of the ERP life cycle ((Deloitte 1999; Markus et al. 2000; Markus and Tanis 2000). Because of this, several companies declined to participate because either they did not have an ERP system in place or were still in the process of deploying one. Also, it is likely that many companies that did not qualify simply discarded the survey upon receiving it.

A more recent study by the European Business School (EBS) in Germany surveyed 2,000 SAP banks worldwide and obtained an 11% response rate (Fuss et al. 2005). Interestingly enough, in this last case, the surveys were addressed to the "CIO or COO" in the institution rather than to a specific person. Mailing surveys to generic job titles is less effective than mailing to specific individuals. In our study, almost all surveys were mailed to specific individuals, which may have contributed to obtain a higher response rate.

5.0   DATA ANALYSIS

After the data collection stage was completed, the next step consisted of analyzing the collected data. The initial data collection protocol was designed to measure the dependent variable, assimilation, from the ERP business participant survey and the independent variables, mindfulness, scanning, and evaluation from the IS participant surveys (although the dependent variable was also included in the IS surveys). However, since the number of IS participant surveys (113) was much bigger than the number of matched pairs (33), a decision was made to use the IS surveys, that included independent and dependent variables, for the bulk of the data analysis. The small number of matched pair constituted a serious problem for the use of factor analysis techniques and use of the data for testing the hypothesized moderation effects. The use of a larger sample size, 113 IS survey responses, ensures a more reliable data statistical analysis albeit at the risk of common method bias.

Based on Bagozzi and Fornell (1982) and Gefen, Straub and Boudreau (2000), there are two approaches to the statistical analysis appropriate for this kind of study: first generation statistical tools (e.g. regression) and second generation statistical tools (e.g. LISREL or PLS). Although first generation tools have the disadvantage of not being able to simultaneously analyze the measurement and structural model, they have the advantage of being well known, suitable for exploratory analysis, and relatively straightforward to apply. The use of second

generation tools, also called structural equation modeling (SEM) techniques, is commonly used in the case of more complex models.

The research model in this study is relatively simple and regression is more suitable for this analysis because first, the sample size is rather small for SEM techniques where N > 200 is desirable (Marsh and Hau 1999, p. 252) ; second, they can be applied in a straightforward manner to analyze moderation effects (in comparison to SEM techniques); and third, there are still some discussions in the literature about the convenience of using SEM techniques when regression is more adequate; in particular in relation to power (Goodhue, Lewis and Thompson 2006).

5.1   MEASUREMENT MODEL ASSESSMENT.

The measurement model specifies the observed variables (i.e. indicators) for each construct and assesses the reliability of the scales, and the convergent and discriminant validity of each construct in the model[4].

5.1.1 Data Screening.

The first step was to screen the data prior to factor analysis. Missing data (approximately 10 values out of a total of 1500 values) was replaced with the average value of the appropriate

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[4] A preliminary analysis was made using the control variables for measurement and regression analysis. Results showed that neither IT Turbulence nor the Number of ERP Users had any significant effect in the model; therefore, they were not further used either in the measurement nor in the regression model analysis to obtain better use of the existing data.

indicator variable. This avoided getting rid of a whole case simply for missing a single value. Next, using the EXPLORE procedure from SPSS, a box and whisker plot of each variable was obtained and the outliers identified. A value is an outlier if it falls below the 1.5 box-lengths from the 25th percentile or above 1.5 box-lengths from the 75th percentile (SPSS 1999, p. 41) The few data outliers were dealt with by replacing them with the lowest (or highest) value that was not an outlier. This is a well known and conservative procedure to avoid deleting the whole case based on a single outlier (Mertler and Vannatta 2001, p. 41)[5]. Finally, the indicators corresponding to each construct were averaged to obtain the construct variable values needed for the regression analysis. None of the variables passed the Kolmogorov-Smirnov statistical test of normality; however, a visual examination of the frequency distribution and Q-Q plots showed no drastic departure from normality. Most importantly for factor analysis, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO = 0.798) was above the cutoff value of 0.5 which showed the sample size to be adequate for factor analysis (Field 2000, p. 445). Similarly the Bartlett's sphericity procedure that tests the null hypothesis that the variables in the population correlation matrix are uncorrelated, was rejected (Mertler and Vannatta 2001, p. 259). Once the variables were deemed fit for analysis, the first step was to analysis its discriminant validity.

5.1.2   Convergent and Discriminant Validity.

Convergent validity involves measures that should be related being related while discriminant validity refers to measures that should not be related being unrelated. A common way to test for both convergent and discriminant validity is to perform a factor analysis of all the indicators used

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[5] However, following common practice, the statistical analysis made in this section was repeated including the outliers to ensure robust results. Results were basically the same.

in the model. Factor analysis allows identifying the number of components present in the data. Typically, all components with eigenvalues greater than one are extracted. It is expected that first, each factor extracted will correspond to a construct in the model; and second, that the indicators for each construct will correlate much more highly with their own factor than with any other in the model. For factor analysis, it is recommended to use the principal component method along with varimax rotation to obtain all the possible independent components within the most simple solution from the infinity of rotations (Kline 1994). A factor analysis was performed with all the indicators collected in the study to validate the presence of the different constructs used in this study: Scanning, Assimilation, Mindfulness, and Evaluation. The initial results are shown in **Table 11**.

Table 11: Initial Model Factor Analysis

	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
MND01	.090	.174	.700	.239	-.029	-.043	.069
MND02	.077	.126	.782	.100	.053	-.107	-.016
MND03	.052	.008	.850	.109	.058	-.076	.050
MND04	.194	-.044	.371	.728	.042	-.175	-.041
MND05	.139	.281	.551	.183	.385	.120	-.049
MND06	.088	.044	.711	.404	-.061	-.075	.052
MND07	-.034	.228	.126	.790	.131	-.079	.097
MND08	.040	.220	.288	.744	-.007	.265	.037
MND09	.079	.208	.288	.669	.192	-.021	-.086
SCNN1	.277	.093	.088	.094	.839	.191	-.017
SCNN2	.265	.213	.020	.142	.771	.178	.072
SCNN3A	.019	-.163	-.243	.024	.278	.621	-.100
SCNN4	.123	.037	.063	-.006	.109	-.167	.891
SCNN5	.528	.141	.101	.007	.528	.013	.299
SCNT1	.825	.229	.200	.031	.061	.180	.013
SCNT2	.798	.108	.149	.008	.228	.337	-.016
SCNT3A	.108	-.141	-.107	-.043	.189	.751	-.069
SCNT4	.796	.140	.066	-.062	.153	.123	.194
SCNT5	.626	.071	.069	.225	-.144	.093	.498
EVLT1	.511	.234	-.014	.442	-.192	-.127	.259
EVLT2	.604	.344	.023	.217	.345	-.135	-.116
EVLT3	.770	.160	.053	-.077	.425	.087	-.067
EVLT4	.818	.097	.129	.012	.252	-.093	.118
EVLT5	.707	.149	.049	.151	-.090	-.106	-.039
EVLT6	.634	-.045	-.132	.073	.310	-.528	-.006
EVLT7	.650	-.102	-.011	.180	.258	-.403	.087
ISERPS	.216	.788	.192	.079	.102	-.111	.092
ISERPA	.158	.842	.049	.117	.097	-.186	-.003
ISERPR_R	.297	.787	.061	.195	.109	.120	.085
ISERPALL	.055	.854	.186	.199	.077	-.071	-.039

Extraction Method: Principal Component Analysis. Eigenvalues > 1
Rotation Method: Varimax with Kaiser Normalization.
N =99 - Rotation converged in 8 iterations.

In this table, the factor loadings are correlations of the variables with the factors. It is usual to regard factor loadings as high if they are greater than 0.6 (Kline 1994). For this analysis, a cutoff point of 0.4 has been used since this is common practice (Field 2000, p. 463) and this value is considered appropriate for interpretative purposes (Stevens 1992). Since the reliability of factor analysis is dependent on sample size, a few words about sample size adequacy is in order. The most conservative approach recommends having 10 data points per indicator (Nunnally 1978); however, other researchers estimate that having 5 to 10 subjects per variable up to a total of 300 (beyond which test parameters tend to stabilize) is acceptable (Kass and Tinsley 1979). More recently, some researchers have shown through simulation that other aspects of factor analysis may be more important than the subject to variable ratio; for example, they have shown that as commonalities extracted increase above 0.6, small samples of less than 100 are perfectly adequate to obtain reliable results (MacCallum, Widaman, Zhang and Hong 1999). Finally, Kline (1994) has emphasized that in data with clear factor structures, samples of 100 are quite sufficient and that large factors emerge with clarity even with samples of ratios of 2:1. Hence, given that the sample size for the factor analysis in this study was N = 101 and the subject to variable ratio was 3:1; this factor analysis can be considered reliable for the purpose of identifying the large factors present in the data.

Reviewing **Table 11** it is possible to notice the following:

Mindfulness seems to have two underlying dimensions: One composed of the indicators MNDFL01, 2, 3, 5 and 6; and another one formed by the indicators MNDFL04, 7, 8 and 9. Based on inspection of the indicators of mindfulness (**Table 12**), it seems that the first underlying dimension corresponds to "alertness/attention" while the second dimension

corresponds to being aware of or knowing about an unprecedented "changes/situations" in the organization.

Table 12: Mindfulness Indicators and Underlying Dimensions.

Abbrev.	Item	Source
Mindfulness as "Alertness/Attention"		
MNDO1	We feel the need to be **alert** at all times.	Knight (2004)
MNDO2	People here are always on the **look-out** for ways to meet clients' needs.	Knight (2004)
MNDO3	We are quite **attentive** to the different needs of different clients.	Knight (2004)
MNDO5	We are always on the **look-out** for new opportunities.	New Item
The following item loads equally on both dimensions		
MNDO6	The staff pays careful **attention** to when and why our customers might be affected.	New Item
Mindfulness as awareness of "Changes/Situations"		
MNDO4	Personnel here pay great attention to **changes** that arise while doing their work.	New Item
MNDO7	Personnel here are quite aware of **changes** in the firm.	New Item
MNDO8	We quickly notice if an unexpected **change** occurs.	New Item
MNDO9	We promptly realize if an **unprecedented situation** appears.	New Item

The "alertness/attention" dimension of *mindfulness* was measured using the indicators **MNDFL01, MNDFL02, MNDFL03 and MNDFL05;** while the "change/situation" dimension of *mindfulness* was assessed using the indicators **MNDFL04, MNDFL07, MNDFL08, MNDFL09** (MNDFL06 was dropped because it loaded comparably similar into both mindfulness dimensions). Given that *Mindfulness*, in the context of this study, has been defined

as "an elevated state of collective alertness" (Langer 1989; Weick et al. 1999); this study used the "alertness/attention" dimension of mindfulness measures to test the proposed hypotheses.

Continuing the examination of **Table 11**, *scanning* also appears to consist of two dimensions. One formed by the indicators SCNN1, 2 and 5; and another one composed of the indicators SCNT1, 2, 4 and 5 (the reversed items SCNN3A and SCNT3A load on components of their own). The scanning indicators have been reproduced in **Table 13** for analysis purposes.

Table 13: Scanning Indicators and Underlying Dimensions.

Scanning of Needs

Abbrev.	Item	Source
SCNN1	The IS staff here frequently meets formally with colleagues from other functional areas (e.g. marketing, finance, etc.) to discuss emerging SAP-related **business needs.**	New
SCNN2	The IS unit continuously collects information about new ERP-related **business needs** in other functional areas of the organization.	New
SCNN5	The IS unit performs formal reviews to identify new **business needs** on a regular basis.	New

Scanning of Technology

Abbrev.	Item	Source
SCNT1	The IS staff here frequently meets with vendors to get information about new ERP-related **technologies.**	New
SCNT2	The IS unit continuously collects information about new ERP-related **technologies.**	New
SCNT4	The IS staff here spends a significant amount of time collecting information about new ERP-related **technologies.**	New
SCNT5	In the IS unit, there are specific people assigned to collect information about new ERP-related **technologies.**	New

Scanning has been defined in this study as "the process of monitoring the appearance of ERP adaptation opportunities in the IS function's environment," where adaptation opportunities include both emerging organizational needs and new ERP technologies. The scanning measures SCNN1, 2, and 5 refer to the scanning of emerging organizational needs; while the measures SCNT1, 2, 4 and 5 refer to the scanning of new ERP technologies as shown in **Table 13**. Therefore, the underlying dimensions identified by factor analysis are consistent with the theoretical discussion of the construct. However, **Table 11** shows that there is a significant cross-loading between the indicators corresponding to scanning of technology (SCNT1, 2, 4 & 5) and the evaluation construct. This is understandable since all the evaluation items refer to the evaluation of new ERP technologies; that is, similar to the scanning of technology items. This suggests using only the *scanning of needs* as the scanning construct in the analysis to keep *evaluation* in the research model. Also, from a theoretical point of view, scanning of needs offers richer research possibilities than scanning of technology that has been widely studied in the literature. For this reason, SCNN1, SCNN2, and SCNN5 were initially selected as the scanning measures; however, SCNN5 loads strongly not only on the scanning of needs component but also in the evaluation component. When examining SCNN5 in **Table 13**, the use of the expression "formal reviews" seems to create the confusion with the evaluation items. To make sure that only clearly distinct indicators will be used in the analysis; therefore **SCNN1** and **SCNN2,** and **SCNN4**[6] were kept as indicators of scanning of needs[7].

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[6] Although SCNN4 loads on a component of its own rather than with the other two scanning indicators, a decision was made to keep it for the next round of factor analysis since it was not crossloading with any other component.
[7] It is important to mention that the initial factor analysis showed in Table 1 suggested very strong multicollinearity problems and therefore, strict selection of indicators was needed to ensure discriminant validity in the research model. This is particularly important to manage due to the small sample size.

Most of ERP *Evaluation* items load on a single component. However, EVLT1 loads high on both components 1 and 4 and EVLT3 loads high on components 1 and 5 (this last component corresponding to *scanning of needs*). After reviewing these items (see **Table 14**), it was concluded that dropping these items would not compromise the integrity of the evaluation construct and therefore, *Evaluation* was comprised of items EVLT **2, 4, 5, 6 and 7**. Notice that all the items in this construct refer to the *Evaluation* of technologies.

Table 14: Analysis of Evaluation Items

Abbrev.	Item	Source
EVLT1	The IS unit hires consultants to help evaluate new ERP-related technologies	New
EVLT2	The IS unit uses consultants to help plan for new ERP-related technologies.	New
EVLT3	The IS unit regularly analyzes new SAP-related technologies.	New
EVLT4	The IS unit regularly conducts experiments with new ERP-related technologies.	New
EVLT5	The IS unit uses vendors to help plan new ERP-related technologies.	New
EVLT6	There is a formal committee responsible for evaluating new ERP-related technologies.	New
EVLT7	A formal procedure is used to assess new ERP-related technologies.	New

The construct ERP *Assimilation* did not show any cross-loading problem as can be seen in **Table 11**. A second factor analysis was run again to verify that the refined construct measures could be clearly discriminated. The results are shown in **Table 15**.

Table 15: Second Model Factor Analysis

	Component				
	1	**2**	**3**	**4**	**5**
MND01	.054	.167	.257	.718	-.014
MND02	.102	.133	.176	.756	.054
MND03	.070	-.014	.141	.885	.012
MND04	.265	-.024	.769	.312	-.056
MND05	-.009	.209	.283	.543	.462
MND07	.009	.175	.813	.089	.065
MND08	-.046	.236	.754	.198	.123
MND09	.110	.202	.705	.219	.170
SCNN1	.222	.064	.091	.068	.906
SCNN2	.207	.208	.082	-.001	.875
SCNN4	.399	.134	-.102	.167	-.056
EVLT2	.592	.378	.247	-.004	.337
EVLT4	.757	.158	.029	.134	.318
EVLT5	.637	.215	.094	.065	.099
EVLT6	.869	.026	.033	-.084	.132
EVLT7	.851	-.012	.163	.029	.047
ISERPS	.249	.833	.079	.205	.031
ISERPA	.166	.852	.153	.014	.078
ISERPR_R	.189	.806	.151	.045	.258
ISERPALL	.022	.843	.231	.188	.077

Extraction Method: Principal Component Analysis. Eigenvalues > 1
Rotation Method: Varimax with Kaiser Normalization.
N = 99. Rotation converged in 6 iterations.

As can be seen in **Table 15** the indicators clearly separate into different components, corresponding to each of the constructs. SCNN4 is cross-loading with the evaluation measures. The only indicators that still cross-load on different components are EVLT2 and MNDFL5. EVLT2 cross-loads with Assimilation while MNDFL5 cross-loads with Scanning of Needs. After reviewing their potential impact in measuring the constructs, they were dropped from their respective scales. To confirm the results, a final factor analysis was run. The results, shown in **Table 16**, indicated that discriminant validity was acceptable for the study.

Table 16: Final Model Factor Analysis

	Component				
	1	**2**	**3**	**4**	**5**
MND01	.178	.032	.258	.731	-.008
MND02	.141	.060	.170	.791	.078
MND03	.004	.057	.155	.877	.016
MND04	-.011	.280	.757	.321	-.078
MND07	.164	-.012	.824	.082	.065
MND08	.233	-.043	.772	.172	.121
MND09	.211	.129	.715	.202	.158
SCNN1	.074	.219	.112	.067	.912
SCNN2	.214	.193	.106	.000	.897
EVLT4	.189	.748	.020	.144	.311
EVLT5	.244	.643	.060	.113	.123
EVLT6	.062	.885	.010	-.066	.116
EVLT7	.026	.872	.149	.027	.016
ISERPS	.847	.220	.087	.185	.024
ISERPA	.859	.141	.153	.005	.073
ISERPR_R	.809	.149	.157	.045	.273
ISERPALL	.850	.010	.233	.167	.051

Extraction Method: Principal Component Analysis. Eigenvalues > 1
Rotation Method: Varimax with Kaiser Normalization.
N = 99. Rotation converged in 6 iterations.

5.1.3   Item Reliability.

To ensure that the chosen indicators could hold as a measurement scale of their respective variables a reliability test was performed. The summary of results appears in **Table 17** along with the descriptive statistics for the final measures. The Cronbach's Alpha coefficients were always above the minimum cutoff value of 0.7. As can be seen in this table, the scales are reliable and the variables were deemed fit for the model regression analysis.

Table 17: Descriptive Statistics, Reliability and Inter-correlations of ERP Assimilation and Predictor Variables

Variable	Items	Alpha	Mean	SD	1		2		3		4	
ERP Assimilation	4	0.905	4.922	1.126	0.33	**	0.322	**	0.267	**	0.323	**
Predictors												
1. ERP Scanning ("Needs")	2	0.897	4.662	1.568			0.355	**	0.125		0.176	
2. ERP Evaluation	4	0.825	3.838	1.457					0.127		0.167	
3. IS Mindfulness ("Alertness")	3	0.791	5.296	0.855							0.514	**
4. IS Mindfulness ("Change")	4	0.825	5.296	0.817								

$* p < 0.05$, $**p < 0.01$ (N=101)

5.2   MODEL REGRESSION ANALYSIS.

Hierarchical multiple regression was employed to test both the main effect of scanning on assimilation (H1) and the moderating effects of mindfulness (H2) and evaluation (H3) on this relationship.

5.2.1   Hypothesis Testing: Regression of ERP Assimilation on ERP Scanning of Needs, ERP Evaluation, and IS Mindfulness.

For this analysis, the *Scanning of Needs* dimension (indicators SCNN 1 and 2) and both the "alertness/attention" (indicators MNDFL1, 2, & 3) and the awareness of "change/situation" (indicators MNDFL4, 7, 8 & 9) dimensions of *Mindfulness* were used, as discussed in the

previous section. To test the hypotheses, hierarchical regression was used following Baron and Kenny (1986)'s suggestion to test moderation effects. The regression equations to be tested are:

$$\text{Assimilation} = b0 + b1 \, (\text{ScanningNeeds}) + b2 \, (\text{MindfulnessAlertness})$$

$$+ b3 \, (\text{MindfulnessChange}) + b4 \, (\text{Evaluation})$$

$$+ b5 \, (\text{ScanningNeeds} * \text{MindfulnessAlertness})$$

$$+ b6 \, (\text{ScanningNeeds} * \text{MindfulnessChange})$$

$$+ b7 \, (\text{ScanningNeeds} * \text{Evaluation})$$

This equation reflects the hypothesized model shown in **Figure 1**. Following hierarchical regression procedures, the independent variables (ScanningNeeds, MindfulnessAlertness, MindfulnessChange and Evaluation) were entered in the first step of the regression (model 1); and in the second step, the appropriate cross-product terms ("ScanningNeeds * MindfulnessAlertness," "ScanningNeeds * MindfulnessChange," and "ScanninngNeeds*Evaluation") were entered (model 2) to test for interaction effects (Venkatram 1989). The R square change in the first step was .0218 and in the second step was .053. The overall relationship was significant, $R^2 = 0.272$, $R2adj = 0.217$, $F(3, 93) = 2.261$, $p < 0.1$. . The summary of results is reported in **Table 18.**

Table 18: Hierarchical Regression Analysis Summary for ERP Scanning, ERP Evaluation and IS Mindfulness as Predictors of ERP Assimilation

Variable	B	SEB	Beta		R^2	R^2 Change	
Model 1					0.218	0.218	*
ERP Scanning	0.133	0.068	0.193	+			
ERP Evaluation	0.145	0.075	0.192	+			
IS Mindfulness ("alertness")	0.15	0.136	0.114				
IS Mindfulness ("change")	0.276	0.143	0.202	+			
Model 2					0.272	0.053	**+**
ERP Scanning * IS Mindfulness ("alertness")	0.177	0.072	0.246	*			
ERP Scanning * IS Mindfulness ("change")	-0.056	0.081	-0.073				
ERP Scanning * ERP Evaluation	0.036	0.042	0.082				

$^+p < 0.1$, $*p < 0.05$, $**p < 0.01$ (N = 101)

5.3   SUMMARY OF RESULTS.

The results from **Table 18** provide support for H1 and H3. For H1, main effect of scanning of needs on assimilation, the results of model 1 showed that there is a statistical significance (p = 0.054). For H2, the moderating effect of evaluation on the scanning-assimilation, model 2 results showed this relationship to be non-significant. For H3, the moderating effect of mindfulness on the scanning-assimilation relationship, model 2 results showed that there is statistical significance only for the "alertness/attention" dimension of mindfulness (p = 0.016). The interaction for the awareness of "change/situation" dimension of mindfulness was not found significant (p = 0.489). One non-hypothesized finding is that evaluation has a significant direct effect on assimilation (p = 0.055).

Following common practices to test the reliability of these results, the same analysis was repeated using the variables with and without outliers. The results were found to be the same as in the previous analysis which indicated that the use of variables with or without outliers did not change the results significantly and therefore, this regression analysis provided robust results. A summary of the hypothesis results is provided in **Table 19**.

Table 19: Summary of Results for Main Hypothesis Analysis

Hypothesis	Description*	Result
H1:	The extent of ERP scanning will have a direct positive effect on the level of ERP assimilation	**Supported**
H2:	The effect of ERP scanning on the level of ERP assimilation will be positively moderated by the extent of ERP evaluation activities	Rejected
H3:	The degree of IS Mindfulness will have a positive moderating effect on the relationship between ERP scanning and ERP assimilation	**Supported**
*Notes	ERP Scanning refers to the "Scanning of Needs" dimension IS Mindfulness refers to the "alertness/attention" dimension	

6.0 DISCUSSION OF RESULTS, ALTERNATIVE MODEL AND LIMITATIONS OF THE STUDY.

In this chapter, a discussion of the results, an alternative model, and limitations of the study will be addressed.

6.1 DISCUSSION OF RESULTS.

The major results of this study (**Table 17**) have been the support of Hypothesis 1, that is, the main effect of *scanning* ("scanning of needs" dimension) on *assimilation*; and the support of Hypothesis 3, the moderating effect of *mindfulness* (for the case of the "alertness/attention" dimension) on this relationship. Hypothesis 2, the moderating effect of evaluation was not supported.

Additional findings, not originally hypothesized, consist of the presence of two dimensions of *mindfulness* and the direct effect of *evaluation* on *assimilation*. Similarly, *scanning* was found to consist of two dimensions: scanning of needs and scanning of technologies. These findings and their implications will be discussed next in detail.

6.1.1   Dimensions of ERP Scanning.

ERP Scanning was found to have two dimensions: *scanning of needs* and *scanning of technologies*. This is consistent with the theoretical discussion of this construct in chapter 3.0 . In effect, ERP scanning has been defined as "the process of monitoring the appearance of new ERP adaptation opportunities in the IS function's environment." Furthermore, ERP adaptation opportunities are constituted by both emerging organizational needs and new ERP technologies. From here, it follows that monitoring adaptation opportunities consists of monitoring along two dimensions: emerging organizational needs and new ERP technologies; which explains the two underlying dimensions of *ERP scanning*. The survey instrument addresses this bi-dimensionality explicitly by having two different sets of items for the scanning of needs (SCNN1-5) and for the scanning of technology (SCNT1-5) respectively.   The results from this study (**Table 16**) support this bi-dimensionality and found that there was a significant direct effect of *scanning of needs* on *ERP assimilation,* as originally hypothesized. The effect of the scanning of new ERP-related technologies on *assimilation* could not be initially tested due to the lack of discriminant construct validity between *scanning of technology* and the *evaluation* of ERP-related technologies; however, it is also important to study the effect of the *scanning of technology* dimension to fully understand the role of ERP scanning on ERP assimilation. For this purpose, a model that explicitly acknowledged the two dimensions of ERP scanning, along with the two dimensions of mindfulness but excluding ERP evaluation, was tested (**Figure 3**).
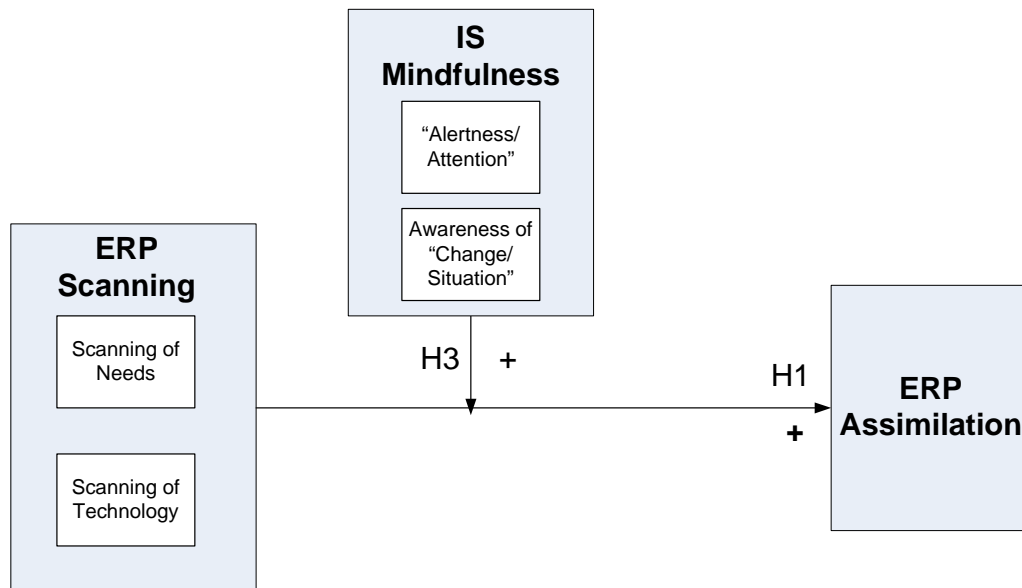
Figure 3: Research Model without ERP Evaluation

First, a factor analysis was run with all the original indicators used in **Table 11** but without including any evaluation item. After selecting and discarding items based on the loads on the different components and their measurement importance, the indicators shown in **Table 20** were obtained as measures for the constructs in the model

Table 20: Final Factor Analysis for Model Including Two Dimensions of ERP Scanning

	Component				
	1	**2**	**3**	**4**	**5**
SCNN1	.082	.097	.160	.076	.934
SCNN2	.197	.112	.158	.003	.898
SCNT1	.240	.020	.768	.169	.286
SCNT4	.159	-.032	.839	.054	.224
SCNT5	.072	.234	.844	.007	-.067
ISERPS	.849	.061	.185	.223	.057
ISERPA	.859	.150	.097	.027	.079
ISERPR_R	.772	.170	.274	.044	.234
ISERPALL	.869	.230	.009	.161	.058
MND01	.193	.244	.128	.729	-.007
MND02	.126	.185	.058	.784	.060
MND03	.047	.162	.008	.878	.044
MND04	.003	.748	.182	.340	-.036
MND07	.177	.824	-.012	.047	.052
MND08	.180	.781	.097	.172	.070
MND09	.210	.699	.021	.235	.209

Extraction Method: Principal Component Analysis. Eigenvalues > 1
Rotation Method: Varimax with Kaiser Normalization.
N = 113. Rotation converged in 6 iterations.

After screening and verifying the scale reliability of scanning of the variables, a multiple regression analysis was run for these variables and the summary of results is shown in **Table 21**. From this table, it is clear that both dimensions of ERP scanning, scanning of needs and scanning of technology, have a significant direct effect on ERP assimilation; however, only scanning of needs and the alertness dimension have an interaction effect.

Table 21: Regression Analysis Summary for ERP Scanning and IS Mindfulness as the only Predictors of ERP Assimilation

Variable	B	SEB	Beta		R^2		R^2 Change	
Model 1					0.237	*	0.237	*
ERP Scanning ("needs")	0.118	0.065	0.174	+				
ERP Scanning ("technology")	0.186	0.073	0.246	*				
IS Mindfulness ("alertness")	0.175	0.132	0.135					
IS Mindfulness ("change")	0.229	0.139	0.169					
Model 2					0.311	*	0.074	*
ERP Scanning ("needs") * IS Mindfulness ("alertness")	0.181	0.076	0.256	*				
ERP Scanning ("needs") * IS Mindfulness ("change")	0.07	0.086	0.009					
ERP Scanning ("technology") * IS Mindfulness ("alertness")	-0.107	0.081	-0.135					
ERP Scanning ("technology") * IS Mindfulness ("change")	-0.073	0.096	-0.082					

$^+p < 0.1$, $*p < 0.05$, $**p < 0.01$ (N=101)

The previous results suggest that both, scanning of emerging organizational needs ($p = 0.07$) and scanning of new ERP-related technologies ($p = 0.01$) are important to identify an ERP adaptation opportunity with the greater potential to increase the level of ERP assimilation. Also, the interaction of scanning of needs and mindfulness ("alertness") has a significant positive effect on the level of ERP assimilation ($p = 0.019$). On the other hand, the interaction of scanning of needs and mindfulness ("change") is not significant ($p = 0.191$). It is necessary to discuss why is it that only scanning of needs interacts with collective mindfulness ("alertness/attention" dimension). The explanation may reside in the fact that detecting emerging organizational needs is a more subtle process than learning about the presence of new ERP-related technologies. Information about new ERP-related technologies is constantly publicized by vendors and trade

magazines. Information about new ERP technology is pushed by vendors into organizations, even if the IS function is not actively seeking for them. On the other hand, organizational needs emerge rather slowly and it may take a long time before (and if) they are explicitly acknowledged by the organization and the IS function. It is due to this subtle characteristic that the presence of collective mindfulness, a high degree of alertness and attention in the IS function (the "alertness/attention" dimension), may play a fundamental difference in detecting and managing an emerging organizational need. A less mindful IS function may not detect the presence or assess the importance of an emerging organizational need until much later than the competitors or the need may not be addressed at all. This difference – due to mindfulness ("alertness/attention") - in the ability to detect and manage emerging organizational needs will imply a difference in the ability to seize ERP adaptation opportunities with great potential for a higher level of ERP assimilation.

6.1.2   The Role of ERP Evaluation.

The results of the initial factor analysis in section 5.1.2 (**Table 11**) showed that scanning of technology and evaluation loaded on the same component. In that section, a decision was made to analyze the model without the scanning of technology items; however, another alternative to explore is the possibility that scanning of technology and ERP evaluation were indeed the same construct.

First, it is important to notice that the ERP evaluation construct refers only to the evaluation of new ERP-related technology. The reason that the evaluation items refer only to ERP technology and did not include any reference to evaluation of needs was the fact that during the pilot test, practitioners argued that it was not possible to formally evaluate a new technology

without considering the need it was expected to fulfill. However, a similar argument could be made for scanning of technology. Is it possible to notice a new ERP technology unless there is a preliminary evaluation of its potential usefulness? So, the challenge is where scanning ends and evaluation begins. So, conceptually, it is possible to argue for an integration of the scanning of technology construct and the evaluation of technology construct; however, it is necessary to examine the data to see if this integration makes sense. For this purpose, beginning with the factor analysis in **Table 11**, indicators were selected making sure to keep only those indicators from scanning of technology and evaluation that were loading on the same component. For this purpose, it was necessary to run two additional factor analyses using varimax rotation and extracting components with eigenvalues greater than one. Similar to the previous cases, loads of 0.4 or more were considered important. The final factor analysis is shown in **Table 22**.

Table 22: Final Factor Analysis Combining Scanning of Technology and Evaluation

	Component				
	1	2	3	4	5
MND01	.066	.203	.238	.738	.026
MND02	.114	.117	.192	.779	.036
MND03	.078	.034	.168	.873	.027
MND04	.183	-.007	.769	.316	-.073
MND07	-.058	.188	.813	.056	.085
MND08	.085	.184	.778	.171	.071
MND09	.092	.203	.716	.216	.165
SCNN1	.289	.071	.106	.068	.893
SCNN2	.242	.193	.105	.007	.892
SCNT1	.849	.209	.061	.120	.163
SCNT2	.808	.081	.031	.060	.361
SCNT4	.840	.141	.002	.016	.115
EVLT4	.832	.117	.062	.108	.196
EVLT5	.714	.145	.143	.069	-.042
ISERPS	.212	.843	.069	.213	.034
ISERPA	.149	.850	.157	.015	.056
ISERPR_R	.291	.772	.168	.044	.215
ISERPALL	.055	.864	.222	.165	.068

Extraction Method: Principal Component Analysis. Eigenvalues > 1
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 6 iterations.

The results from **Table 22** showed that it was possible to treat scanning of technology and evaluation as a single construct; however, it was necessary to verify if they also made conceptual sense as measures for the integrated construct. An examination of the items SCNT1-4 and EVLT4-5 in **Table 13** and **Table 14** respectively showed that these items complemented appropriately in terms of measuring a construct that combines the scanning/evaluation of technology. The theoretical argument for this integrated construct has been previously provided

and **Table 22** results showed that this integration made also statistical sense. The next step was to run a regression analysis using the indicators from **Table 22** for the proposed model (**Figure 4**); namely, a regression analysis with ERP Assimilation as the dependent variable and MindfulnessAlertness (MND01-3), MindfulnessChange (MND04, 7-9), ScanningNeeds (SCNN1-2) and Scanning/Evaluation of Technology (SCNT1-2, 4, EVLT4-5) as predictors. The regression results are shown in **Table 23**.
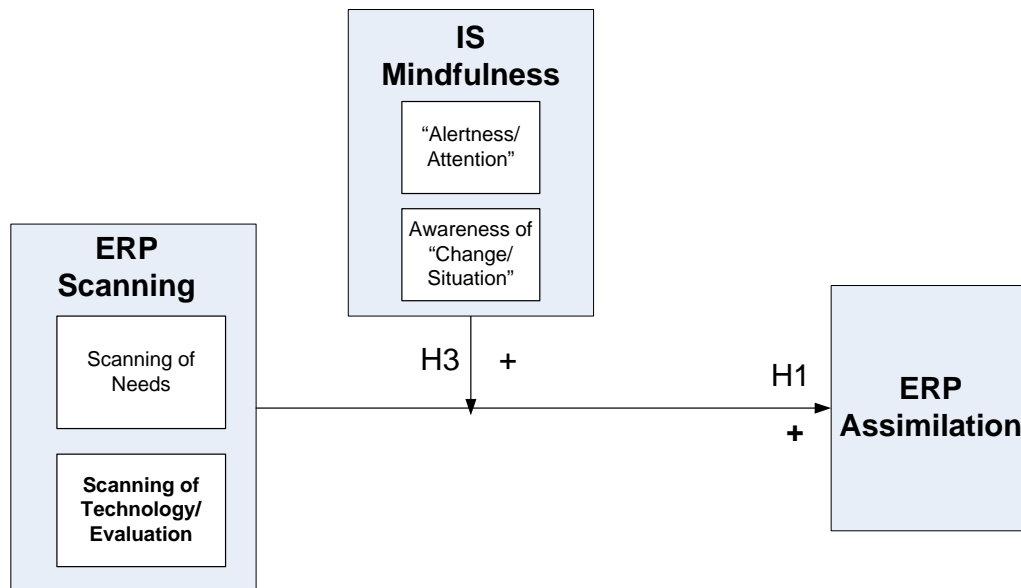
Figure 4: Research Model Combining Scanning of Technology with ERP Evaluation

Table 23: Regression Analysis Combining Scanning of Technology and Evaluation into a Single Construct to Predict ERP Assimilation

Variable	B	SEB	Beta		R^2		R^2 Change	
Model 1					0.239	**	0.239	**
ERP Scanning ("needs")	0.091	0.069	0.134					
ERP Scanning("technology")/Evaluation	0.207	0.08	0.268	*				
IS Mindfulness ("alertness")	0.157	0.134	0.121					
IS Mindfulness ("change")	0.254	0.139	0.188	+				
Model 2					0.321	*	0.082	*
ERP Scanning ("needs") * IS Mindfulness ("alertness")	0.201	0.078	0.286	*				
ERP Scanning ("needs") * IS Mindfulness ("change")	0.035	0.092	0.045					
ERP Scanning ("technology")/Evaluation * IS Mindfulness ("alertness")	-0.138	0.087	-0.166					
ERP Scanning ("technology")/Evaluation * IS Mindfulness ("change")	-0.109	0.103	-0.119					

$^+p < 0.1$, $*p < 0.05$, $**p < 0.01$ (N=101)

The results from **Table 23** indicated that both the integrated scanning/evaluation of technology ($p = 0.011$) and MindfulnessChange ($p = 0.07$) have significant direct effects on ERP assimilation; however, only the interaction of scanning of needs and mindfulness ("alertness") is significant ($p = 0.011$).

The explanation of these results is similar to the one provided in the previous section. The scanning/evaluation of new ERP technology is a more formal and straightforward process than the detection of emerging organizational needs; therefore, it is only on the relationship between scanning of needs and assimilation that the presence of collective mindfulness is important.

6.1.3   The Role of IS Mindfulness

The results of this study have suggested the presence of two dimensions of *mindfulness*: "alertness/attention" and "change/situation." The first dimension, "alertness/attention" consists of a vigilant state of alertness, by the IS function, to the appearance of distinctive events (Weick and Sutcliffe 2001). This approach is also fully consistent with the traditional understanding of mindfulness as a state of mind (Langer 1989). Interestingly, the measures that proved reliable to measure this dimension, MNDFL1, MNDFL2, and MNDFL3 (**Table 12**) are the measures previously used by Knight (2004) in his exploration of the nomological network of collective mindfulness. In this sense, the present study validates the reliability of these measures. The second dimension, "change/situation" consists of an awareness of changes and unprecedented situations in the organization; that is, awareness or knowledge that something unprecedented has occurred. These two dimensions do not seem to be an artificial result of the statistical analysis. An elevated state of "alertness/attention" and awareness or knowledge of an unprecedented "situation/change" constitute two different collective cognitive phenomena as can be observed in the study. In other words, the two dimensions of mindfulness seem consistent with our understanding of the construct.

Also, the results of the present study support hypothesis 3, that is, the moderating effect of mindfulness ("alertness/attention" dimension) on the relationship between scanning (scanning of needs) and assimilation. However, results also showed that this is not true for the "change/situation" dimension of mindfulness. This means that for the effect of scanning of needs on assimilation, the state of alertness is more important than the knowledge of changes or unprecedented situations . This result suggests that being alert is more important than being knowledgeable. The presence of a high degree of "alertness/attention" may be important not only

to detect weak signals of change in the environment but most importantly to act upon that knowledge rather than remain passive. For example, even if the IS function becomes aware of changes in the environment, only being attentive for ways to satisfy customers' needs may move the IS function to take action on this knowledge using the ERP system; that is to seize an ERP adaptation opportunity that will lead to a greater level of assimilation. The regression analysis results were shown in **Table 18**; a summary of results in terms of hypothesis testing for the two dimensions of mindfulness is shown in **Table 24**.

Table 24: Summary of Main Hypothesis Testing Results for Both Dimensions of Mindfulness

	Main Hypothesis Testing (**Table 18**)	Main Hypothesis Testing (**Table 18**)
Description	Mindfulness as *Alertness/Attention* (MNDFL123)	Mindfulness as *Awareness of Change/Situation* (MNDFL4789)
H1: Scanning of Needs ---> Assimilation	**Supported** (Beta = 0.193)[+]	**Supported** (Beta = 0.133)[+]
H2: Evaluation moderates H1	Not Supported (Beta = 0.082)	Not Supported (Beta = 0.082)
H3: Mindfulness moderates H1	**Supported** (Beta = 0.246)*	Not Supported (Beta = -0.073)
OTHER FINDINGS		
Evaluation -→ Assimilation	*Significant* (Beta = 0.192)[+]	*Significant* (Beta = 0.192)[+]
Mindfulness → Assimilation	n.s. (Beta = 0.114)	*Significant* (Beta = 0.202)[+]

+Significant at alpha = 0.1 or less   Beta – Standardized Coefficient
*Significant at alpha = 0.05 or less

From the previous table it is possible to conclude that a greater extent of *scanning of needs* will have a positive direct effect on the level of ERP assimilation. Also, that only the presence of the "alertness/attention" dimension of collective mindfulness has a significant effect

on the relationship between ERP scanning ("needs") and ERP assimilation; that is, a greater degree of IS mindfulness will have a positive effect on the scanning of needs-assimilation relationship.

6.2 ALTERNATIVE MODEL: IS MINDFULNESS AS A MODERATOR FOR THE RELATIONSHIP OF BOTH ERP SCANNING OF NEEDS AND ERP EVALUATION ON ERP ASSIMILATION

Given that evaluation activities of new ERP-related technologies have a direct impact on the assimilation of ERP systems (**Table 24**), it is possible to argue that similar to the case of the scanning-assimilation relationship, IS mindfulness may have a moderating effect on the evaluation-assimilation relationship. In other words, IS mindfulness may have a moderating effect on both the effect of scanning of needs on assimilation and the effect of evaluation on assimilation. The alternative model is shown in **Figure 5** and the results of the corresponding regression analysis are summarized in **Table 25**.
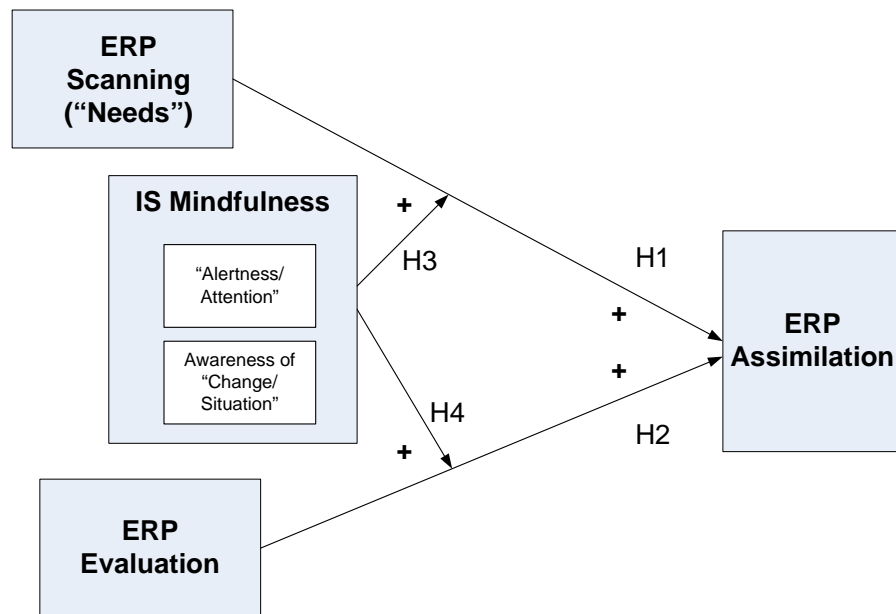
Figure 5: IS Mindfulness as Moderator for Both Main Effects of ERP Scanning of Needs

and ERP Evaluation on ERP Assimilation

Table 25: IS Mindfulness as Moderator of the Main Effects of Scanning and Evaluation on Assimilation

Description	Mindfulness as *Alertness/Attention* (MNDFL123)	Mindfulness as *Awareness of Change/Situation* (MNDFL4789)
H1: Scanning of Needs ---> Assimilation	**Supported** (Beta = 0.193)[+]	**Supported** (Beta = 0.193)[+]
H2: Evaluation -→ Assimilation	**Supported** (Beta = 0.192)[+]	**Supported** (Beta = 0.192)[+]
H3: Mindfulness moderates H1	**Supported** (Beta = 0.194)[+]	Not Supported (Beta = 0.024)
H4: Mindfulness moderates H2	Not Supported (Beta = 0.0337)	Not Supported (Beta = -0.143)
OTHER FINDINGS		
Mindfulness → Assimilation	n. s. (Beta = 0.114)	Significant (Beta = 0.202)[+]

+Significant at alpha = 0.1 or less Beta – Standarized Coefficient
*Significant at alpha = 0.05 or less
**Significant at alpha = 0.01 or less

As can be seen in **Table 25**, the results do not lend support to this alternative model and are rather consistent with the original model of this study. Scanning of needs has a positive main effect on ERP assimilation (p = 0.054) and IS Mindfulness ("alertness") moderates the relationship Scanning of needs with ERP assimilation (p = 0.093). Although ERP evaluation has a main effect on ERP Assimilation (p = 0.055), this relationship is not moderated by IS Mindfulness (p = 0.760 for "alertness/attention" and p = 0.209 for "change/situation").

6.3   LIMITATIONS OF THE STUDY.

The findings of this study must be interpreted in recognition of its limitations and like all empirical studies, this research exhibits some limitations that will be discussed next.

6.3.1   Single Respondent.

The use of a single respondent to provide survey data raises concerns of common method bias. The two primary forms to control this is either through procedural or statistical techniques (Podsakoff, MacKenzie and Lee 2003).

Among the recommended procedural techniques to minimize common method bias, it is recommended that the measures of the predictor and the criterion variables be obtained from different sources. For this purpose, the original data collection protocol considered measuring the independent variables (*scanning, evaluation, and mindfulness*) from the IS survey respondent, and the dependent variable (*assimilation*) from the business participant survey; however, the small number of matched pairs obtained led to the use of the IS survey respondents for both the independent and dependent variable. One criticism of this approach is that one particular form of common method bias, social desirability could occur. In effect, IS respondents may not be fully impartial in their assessment of the ERP assimilation (the dependent variable) given the fact that the IS function is responsible for the deployment and maintenance of these systems. To rule out this possibility, two tests were performed. First, a bivariate correlation analysis was run for the variables ISERPALL and ISIMPACT from the IS survey against the corresponding variables ERPALL and ERPIMPCTC from the ERP business survey. The first variable ISERPALL is a single generic question: How well does the ERP system support your firm's overall business

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strategy? The second variable, ISIMPACT, is an aggregate of 6 questions about the general

business impact of the ERP system one the firm (see question 23 in the IS survey, **Appendix A**).

For example, one of the indicators for ISIMPACT is the statement: "The ERP has seriously

improved this firm's overall business performance." The correlation results are shown in **Table

26**.

Table 26: Inter-Correlation of Variables Between IS and ERP Respondents

			1		2		3		4	
1	ISERPALL	r^2	1		0.772	**	**0.423**	*	0.347	+
		N	103		100		26		26	
2	ISIMPCTC	r^2	0.772	**	1		0.488	**	**0.491**	**
		N	100		107		31		31	
3	ERPALL	r^2	0.423	*	0.488	**	1		0.849	**
		N	26		31		68		68	
4	ERPIMPCTC	r^2	0.347	+	0.491	**	0.849	**	1	
		N	26		31		68		68	

Pearson Correlation two-tailed
$+p < 0.1$, $*p < 0.05$, $**p < 0.01$

As can be seen from **Table 26**, there is a significant inter-correlation, above 0.4, between

the responses of the IS survey respondents (ISERPALL, ISIMPCTC) and the ERP survey

respondents (ERPALL, ERPIMPCTC). In other words, where the business respondent rated the

ERP system as more (less) successful, the IS respondent rated the ERP success similarly more

(less) successful. This means that the IS survey respondent can be trusted to honestly assess the

ERP system in the firm.

To further verify that having a single respondent is not an issue, a t-test for each of the

two questions on overall ERP support of business strategies (ERPOVALL) and the overall

business ERP impact (IMPCTC) was performed. These t-tests checked the hypothesis that the

means corresponding to the answers to the target questions were not significantly different between the IS and business respondents. The t-tests performed corresponded to independent samples. Levene's test results showed that equality of variance could be assumed. The results for these analyses are shown in **Table 27** and **Table 28**. These results suggest that common method bias due to social desirability is not an issue.

Table 27: Means and S.D. for IS and Business Respondents

		IS Respondents			Business Respondents		
Variable		N	Mean	SD	N	Mean	SD
ERP Overall Support	ERPALL	26	5.27	1.373	33	5.18	1.309
ERP Business Impact	IMPCTC	31	5.01	1.04	33	4.96	1.315

Table 28: T-test Results of Dependent Variables for IS and Business Respondents

Variable	t	df	Sig (2-tailed)	Mean Difference	S.E. Difference	95% C.I.	
						Lower	Upper
IMPCTC	0.149	62	0.882	0.4427	0.29766	-0.55074	0.63929
ERPOVALL	0.249	57	0.804	0.08741	0.35083	-0.61511	0.78994

Another procedural consideration to deal with common method bias consists in the temporal, proximal, psychological, or methodological separation of measurements. Although the temporal separation in measuring the predictors (ERP Scanning, ERP Evaluation, and IS Mindfulness) and the criterion variable (ERP Assimilation) was not possible; some methodological separation was present in the survey. The assessment of the criterion variable required a different approach than in the case of the independent variables since it was necessary to estimate the criticality of each indicator prior to rating the extent of support in the Likert scale. As part of the procedural considerations, it is also recommended to protect respondent anonymity and reducing evaluation apprehension. The rationale is that by reducing people's evaluation apprehension they will be "less likely to edit their responses to be more socially desirable, lenient, acquiescent, and consistent with how they think the researcher wants them to respond" (Podsakoff et al. 2003). In this respect, participants in this dissertation research were aware that the study was conducted by a reputable research university, they were told there were no right and wrong answers and their anonymity was explicitly guaranteed in the survey invitation letter. As a matter of fact, many participants did so anonymously while others identified their companies but not themselves. Some participants showed to identify themselves to participate in a prize drawing but in general, they had full control of their degree of anonymity.

Finally, Podsakoff et al (2003) suggest that it is possible to reduce common method bias through the careful construction of the items themselves. Tourangeau et al (2000) has emphasized the importance of avoiding item ambiguity. In this respect, the survey instrument

used in this study was submitted to several rounds of pre-tests and tests prior to its use. So, this research survey was pre-tested and scrutinized beyond what constitutes common practice.[8]

One of the most popular statistical techniques to assess common method bias is the Harman's single-factor analysis. In this test, all the indicators are loaded into an exploratory factor analysis and examine the unrotated factor solution. The basic idea is that if a large amount of common method variance is present, a single factor will emerge or will account for most of the variance (Podsakoff and Organ 1986). This method has also been used in the information research field (cf. (Patnayakuni, Rai and Seth 2006). One of the concerns about this technique is its lack of reliability as the number of variables increase; however, given the small number of variables in this study (three independent variables and one dependent variable), the application of this method is way within safe limits. The factor analysis made for the indicators[9] used in the original research model showed an unrotated solution with five factors (eigenvalues > 1) where the first factor accounted for 33.2% of the total variance and the five factors together accounted for 74.8% of the total variance. Since a single factor did not emerge or account for most of the variance, these results suggest that common method bias is unlikely to be a significant issue in this study.

In conclusion, although single respondents is a valid reason for concern; the thoroughness in the pre-test stage of the survey, the guarantee of anonymity to decrease survey anxiety, the comparison between IS and business respondents and the use of the Harman's test suggest that although common method bias cannot be totally ruled out it is not a likely explanation for this

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[8] The methodological advisor for this study stated that there had bee an "excellent, thorough process of pre-test" of the survey instrument used in the study.
[9] The indicators used in this test were taken from **Table 11**.

dissertation research findings. Also, single respondent studies constitute an important part of the body of research published in top MIS journals.[10]

6.3.2   Sample Size.

The sample size of 113 IS surveys is acceptable for this type of study but it is borderline for the use of exploratory factor analysis (EFA), given the number of indicators (30) in the model. Conservative approaches suggest between 5 and 10 data points per indicator. However, Kline (1994) has emphasized that, in his experience, samples of 100 are quite sufficient for EFA and that clear factor structures emerge even from samples with 2 to 1 ratios of data points per indicator. Given that the ratio for this study was 3 to 1 and the sample size was 101, it is considered here that the sample size was reasonable for factor analysis. Still, the sample size is not big enough to test the research hypotheses (in particular those that involved moderation effects) using a confirmatory factor analysis (CFA).

6.3.3   Multinational Sample.

Finally, the fact that approximately 20% of respondents were from companies outside the U.S. may generate a concern about the possibility of obtaining distorted responses due to either the presence of cultural elements or the fact that English was not the respondent's native language.

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[10] As a recent example of an ERP study recently published in MIS Quarterly using a single respondent for the independent and dependent variables see Gattiker, T. F. and D. L. Doodhue (2005). "What Happens After ERP Implementation: Understanding the Impact of Inter-Dependence and Differentiation on Plant-Level Outcomes." <u>MIS Quarterly</u> **29**(3): 559-585.

With respect to the first concern, even if cultural differences could account for different levels of mindfulness, it is unlikely that the relationships among the different variables could be affected, even if the specific correlation values were. Also, with the exception of mindfulness – which is clearly a perceptual variable-, the other independent variables (scanning and evaluation) referred to the presence (or absence) of very specific management activities (e.g. existence of a formal committee to evaluate new ERP technologies, presence of specialized individual(s) to monitor organizational needs).

With respect to the second concern, it is important to notice that participants approached, in particular outside the U.S., where middle and upper managers in their firms. For IS professionals outside the U.S., in particular in managerial positions, it is very common to read English even if they speak it with difficulty. Furthermore, the nature of the data collection process, in particular outside the U.S. where participants were located based on the researcher's business contacts, allowed for the clarification of questions as needed.

To test for these assumptions a dummy variable ISCOUNTRY was coded (1 for U.S. and 2 for Non-US data points). Next the regression analysis for the original research model was ran for ISCOUNTRY=1; that is, for the U.S. sample alone[11], and the results are shown in **Table 29**. As can be seen, these results, do not differ drastically from the ones originally found (**Table 18**), H1 is significant ($p = 0.090$)and H3 is almost significant ($p = 0.115$); however, as before H2 is not. Therefore, it was concluded that the presence of international respondents did not have an effect on the hypothesis testing results.

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[11] Since the number of international respondents was only 20% of the total sample, the sample size was too small to run a regression analysis on these data points. For this reason, the regression was run on the U.S. sample alone.

Table 29: Results from Hierarchical Regression Analysis for U.S. Data Points Only.

Variable	B	SEB	Beta	R^2	R^2 Change
Model 1				0.217 **	0.217 **
ERP Scanning ("needs")	0.116	0.068	0.186 +		
ERP Evaluation	0.102	0.071	0.155		
IS Mindfulness ("alertness")	0.186	0.125	0.169		
IS Mindfulness ("change")	0.222	0.134	0.192 +		
Model 2				0.255 **	0.038
ERP Scanning ("needs") * IS Mindfulness ("alertness")	0.107	0.067	0.181		
ERP Scanning ("needs") * IS Mindfulness ("change")	-0.051	0.078	-0.078		
ERP Scanning ("needs") * ERP Evaluation	0.047	0.041	0.125		

$^+p < 0.1$, $*p < 0.05$, $**p < 0.01$ (N=83)

6.3.4 Non-response Bias.

Finally, another important issue in this type of research is to understand the importance of non-response bias in the study. From the approached participants that did not fill in the research instruments, it is not possible to know if they did so due to the fact that they did not receive the surveys and reminders, they lacked time or simply because they did not feel comfortable participating in the study. This last reason is important because it may be argued that there will be a better chance that a participant from a firm with a successful ERP system may be more inclined to participate than one where the ERP has been a disaster. So, there may be a non-response bias in this study. However, the hypothesized relationships refer to a firm with an ERP system fully in production; that is, one where the ERP has been considered successful enough as

to be in normal use by the organization. As a matter of fact, the invitation to potential participants clearly expressed that their firms were candidates to participate in the study only if their company was running an ERP system in production.   Clearly, failed projects were of no interest for the present study so non-responses due to this situation did not affect the outcome of the present study.

7.0   CONCLUSIONS AND IMPLICATIONS OF THE STUDY.

In this chapter, there will be a discussion of the main conclusions and implications of this study for the IS academic literature and for practitioners in the field.

7.1   ERP SCANNING

The scanning construct in the IS literature has been treated exclusively as scanning of technology –see for example, Maier et al (1997); however, this dissertation research has shown that Scanning is bi-dimensional and that both Scanning of needs and Scanning of technology have a main effect on the assimilation of complex information systems such as ERPs (**Table 21**). This bi-dimensionality of the scanning process must be taken into account in future research exploring scanning in the IS literature.

For the practitioner, the implications of the bi-dimensionality of ERP scanning ("needs" and "technology") are that as much as focusing in the monitoring of new ERP-related technologies –which has been an accepted practice in the IS function (e.g. key managers typically attend trade shows and vendor presentations); it is also important to put in place effective processes to monitor the emergent needs within the organization since they will have both, a main and an interaction effect (along with mindfulness) on the level of ERP Assimilation. What can an IS manager do for this purpose? One of the observations that were made by some

participants in this research study was that IS function managers typically do not know peer managers in other areas of the organization. Given that emergent needs tend to appear in a subtle way and become "official" when there is an urgency to fulfill them; mindful IS managers would be better off by creating mechanisms to allow formal and informal meetings between key IS function managers and their counterparts in other areas of the organization. This would allow IS function managers to "anticipate" emergent organizational needs –and perhaps, to shape the form of these requirements before they appear as full blown urgent requirements by the firm.

7.2   ERP SCANNING AND ERP EVALUATION.

The results from this study have shown not only that ERP scanning has two dimensions: ERP Scanning of Needs and ERP Scanning of Technology but also that it is not possible to distinguish between the ERP Scanning of Technology Dimension and the ERP Evaluation construct. Notice that ERP evaluation refers specifically to the evaluation of technologies as shown in the measures from **Table 14**. Therefore, the conclusion of this study is that ERP Scanning and ERP evaluation of technology are inter-mixed; that is, it is not possible to scan emergent ERP technology without performing a simultaneous, even if tentative, ERP Evaluation. In effect, new ERP technologies will be noticed only if they are candidates to fulfill emergent or existing organizational needs; that is, they are noticed only if a quick evaluation identifies those new technologies that are candidates for further evaluation and deployment in the organization, based on their potential for greater assimilation.

Although this focus of this study was the IS function, the previous discussion is consistent with the view of organizations as interpretation systems proposed by Daft and Weick

(1984). In this view, an organization can be seen as a collection of three key processes: scanning, interpretation and action (or learning). The first process allows the identification of changes in the environment that may be relevant for the organization, the second process allows the interpretation of the meaning and value of the scanned information, and the third process consists of taking proper action based on the interpreted information. Daft and Weick argued that the separation of the first two organizational processes: scanning and interpretation was purely theorical since scanning and interpretation were probably inseparable in practice. Applying this same argument to the IS function (which can be considered a small organization in itself), it can be argued that the processes of ERP scanning of technology and ERP Evaluation (which can be seen as interpretation of the monitored information) are also intrinsically together. This idea has been confirmed by the empirical results of this study.

This is an important contribution to the IS literature since technology scanning has been traditionally discussed without any reference to the associated evaluation process used in this study. However, the results in this study suggest that evaluation activities are also important to achieve greater levels of ERP assimilation as shown by the significant main effect (**Table 18**). From a practical point of view, this means that IS function managers should put in place managerial processes that associate scanning with evaluation; for example, by allocating the same people to perform both activities since it has been found that it is not possible to clearly separate both activities in practice.

7.3   IS MINDFULNESS

From an academic point of view there are two conclusions to discuss with respect to IS Mindfulness, the collective mindfulness present in the IS function: First, its bi-dimensional character; and second, its moderating role on the main effect of ERP Scanning of Needs on ERP Assimilation.

Although, the rationale for the two dimensions of mindfulness: "alertness/attention" and awareness of "change/situation" based on the empirical results has been previously argued in this study (see section 6.1.3); one important still pending issue is how this bi-dimensionality of IS Mindfulness fits with the existing research literature. Collective Mindfulness is "an elevated state of collective alertness toward expectations in the face of new and unprecedented situations, with nuanced appreciation of the specific context (Weick et al. 1999)." This construct is fundamentally an extension of Individual Mindfulness which has been defined as "a heightened state of involvement and wakefulness of being in the present" (Langer and Moldoveanu 2000). In both cases, the common characteristics are an elevated state of "alertness/attention" (heightened state of involvement) and awareness of context-related "changes/situations" (what being in the present refers about). The measures developed for IS Mindfulness (**Table 12**) reflect these two key characteristics as underlying dimensions.

On the other hand, Collective Mindfulness has been discussed in the literature as having three characteristics: openness to novelty, that is, avoiding automatic behaviors that preclude new information; alertness to distinction, or paying active, vigilant attention to distinctive characteristics of unfolding events; and implicit awareness of multiple perspectives to continuously challenge existing assumptions and expectations (Weick and Sutcliffe 2001; Fiol and O'Connor 2003). Still, it may be argued that for the first and the last dimension: openness to

novelty to avoid automatic behavior and implicit awareness of multiples perspectives to challenge existing assumptions, an elevated state of attention and awareness of the situation is required.

The discrepancy in terms of the number of dimensions found in this study and discussed in the literature may be explained in two possible ways. Either, the measures used for collective mindfulness tap only the second dimension of "vigilant attention to distinctive characteristics of unfolding events" proposed by Weick and Sutcliffe (Weick and Sutcliffe 2001), which in turn has two sub-dimensions of "alertness/attention" and awareness of unprecedented "changes/situations;" or the measures used in the study better reflect two fundamental underlying characteristics of Mindfulness at the individual and collective level (Langer 1989; Weick et al. 1999). In this last case, the characteristics of openness to novelty and the implicit awareness of multiple perspectives would be part of the two mindfulness dimensions of "alertness/attention" and awareness of unprecedented "change/situation." This assertion makes sense since –as mentioned previously-, an elevated state of attention and situational awareness is required to have openness to novelty, to distinguish the distinctive characteristics of unfolding events and to have an implicit awareness of multiple perspectives to challenge assumptions and expectations. It is proposed here that the two dimensions found in this study: "alertness/attention" and awareness of unprecedented "changes/situations" better represent the fundamental underlying dimensions of the mindfulness construct; although further studies are needed to fully corroborate this assertion.

To discuss the moderating role of IS mindfulness on the relationship between ERP scanning and ERP Assimilation, it is necessary to refer to the results of the main research model (**Table 18**). These results showed that the "alertness/attention" dimension of IS mindfulness

acted as a moderator of the main effect of ERP scanning of needs on ERP assimilation. This moderating effect is shown in graphical form in **Figure 6**.
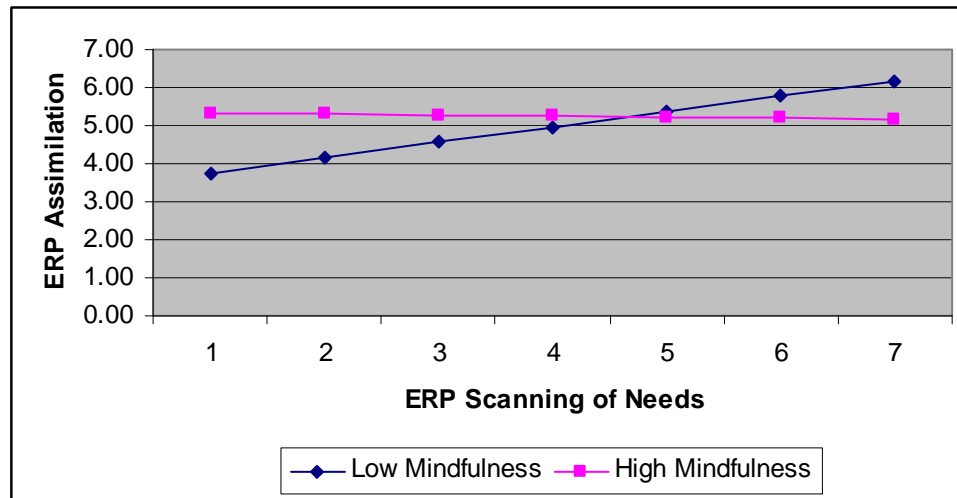
Figure 6: IS Mindfulness Interaction Graph

To draw this graph, the original sample was split into two groups: data points where the degree of IS mindfulness was above the value (mean + 1 Std. Dev.) and, data points where IS mindfulness was below the value (mean – 1 Std. Dev). The first group was labeled "High Mindfulness" and the second one was labeled "Low Mindfulness." Based on Sharma (1981), IS Mindfulness ("alertness/attention") can be described as a pure moderator since it has neither relation with the predictor -ERP scanning of needs (as shown by the low no-significant inter-correlation in **Table 17**) nor with the criterion variable –ERP Assimilation (as shown by the lack of significant main effect in **Table 18**). Basically, **Figure 6** shows that for IS functions that perform low levels of ERP scanning ("needs') activities, the presence of a high degree of IS mindfulness is important to obtain high levels of ERP assimilation. The reason is that in the

absence of strong ERP scanning activities, the IS units with higher degree of alertness toward customers' needs will be the ones that will have the capability to obtain greater levels of ERP assimilation by proper and early identification and assessment of these needs leading to relevant deployment of ERP-related solutions. However, as the extent of ERP scanning activities increase, the presence of high levels of IS mindfulness becomes detrimental to ERP assimilation. The explanation may lie in the fact that as the extent of ERP scanning activities increase, it may become too difficult to keep the same degree of elevated alertness and attention while dealing with an ever growing amount of information. This may lead to a degradation of the whole process leading from ERP scanning to effective ERP assimilation. An analogy to understand this situation may be given by the perennial conflict between informal and formal management processes. Informal processes (such as IS mindfulness) may be useful in the absence of formal ones (such as ERP scanning) but high levels of informality tend to be counter-productive in the presence of formal structures.

The implications for practitioners consist of first, deploying effective ERP scanning processes to monitor the emergent needs of the organization since the more intense this effort, the greater chance to identify and take action on relevant ERP adaptation opportunities for the organization; and second, to keep above average levels of IS mindfulness but keeping in mind that an excessive degree of alertness/attention in the IS function may be counterproductive for the effectiveness of the whole process.

7.4   RESEARCH MODEL AND ABSORPTIVE CAPACITY

The research model analyzed in this study and in particular, the collective mindfulness construct used in this research, invite comparisons with the concept of Absorptive Capacity (ACAP) developed originally by Cohen and Levinthal (1990) to explain the differences in innovativeness among firms. Cohen and Levinthal (1990) defined the construct as "a firm's ability to identify, assimilate, and exploit knowledge from the environment." The popularity of this idea is based on its importance for firms since it pertains to explain the process through which firms learn, develop, and assimilate new knowledge necessary for competitive advantage. Since its appearance, a large number of peer-reviewed academic papers have used this concept in the management literature and the construct has gone through extensions and rejuvenation processes (Zahra and George 2002; Lane, Koka and Pathak 2006). For example, Zahra et al (2002) have proposed a process-oriented ACAP model and a re-conceptualization of ACAP as "a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain a competitive advantage." They consider ACAP as a two-step conversion process from potential absorptive capacity (PACAP) to realized absorptive capacity (RACAP) and state that variations in the conversion efficiency factor, ratio of RACAP to PACAP, reflect the differences in firms' capabilities to transform and exploit knowledge which will lead to differences in their ability to create business value. They also proposed an ACAP model that sheds light on the ACAP process mechanisms, as shown in **Figure 7**.
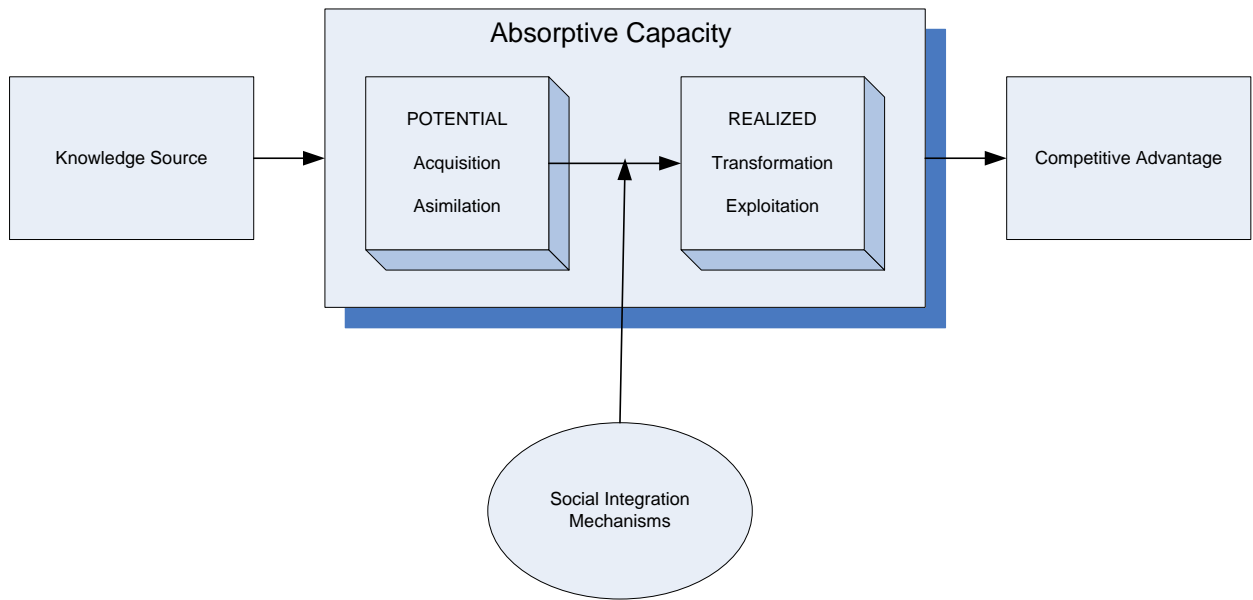
Figure 7: A Model of Absorptive Capacity (ACAP)

George (2002)'s model: acquisition, assimilation, transformation, and exploitation. Acquisition is a firm's capability to identify and acquire externally generated knowledge that is critical to its operations. Assimilation refers to the firm's routines and processes that allow it to analyze, process, interpret, and understand the information obtained from external sources. Transformation denotes a firm's capability to develop and refine routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge. Exploitation reflects a firm's ability to harvest and incorporate knowledge into its operations and it was this aspect of ACAP that was emphasized by Cohen and Levinthal (1990). The outcomes of

exploitation are the persistent creation of new goods, systems, processes, knowledge, or new organizational forms (Spender 1996).

Analyzing the dissertation research model (**Figure 1**) in terms of the ACAP conceptual framework, it is possible to describe ERP scanning as an ACAP acquisition process since scanning is a set of activities conducting to the identification or recognition of ERP-related knowledge (either emerging needs or technology). However, the ACAP dimension of acquisition is much broader than the scanning construct used in this study. In effect, Zahra and George (2002) described acquisition as having several components such as intensity, speed, direction, prior knowledge, and investments. Still, ERP scanning can be considered as tapping into the first two components for the case of ERP-related knowledge about emerging needs and technologies. Similarly, ERP evaluation can be described as a process that allows the IS function to analyze, interpret, and understand the ERP-related information obtained from external sources; which is also consistent with the assimilation[12] dimension of ACAP. These two ACAP dimensions: acquisition and assimilation would correspond to the potential new knowledge about emerging needs and technology that a firm's IS function may utilize.

In the ACAP model, acquired and assimilated new knowledge may be lost unless the firm has the ability to realize the latent benefits through transformation and exploitation. In the context of ERP systems, this transformation process is equivalent to the deployment of new ERP-technology and its adaptation with organizational practices until it is ready for the exploitation. In the ACAP model, exploitation is the firm's capability to harvest and incorporate new knowledge into its operations. This exploitation capability concept is similar to the ERP

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[12] The definition of the term assimilation in the ACAP terminology has no relation with the use of the word in ERP assimilation which is evident when comparing both definitions.

assimilation definition used in this dissertation research; that is, the firm's ability to effectively use ERP technologies to effectively support the firm's business strategies and activities.

Finally, the ACAP model considers that social integration mechanisms are required to share relevant knowledge among members of the firm (Spender 1996) and to facilitate the eventual exploitation of new knowledge. There may be structural, cognitive, behavioral and political barriers that may stifle knowledge sharing and integration. In a sense, these social integration mechanisms will act as a moderator for the effectiveness of the conversion process from potential to realized knowledge. IS mindfulness may be considered one of those social integration mechanisms that acts as a catalyzer for the conversion process. In effect, collective mindfulness provides a shared mental model among the organizational members characterized by an elevated state of alertness and attention to new knowledge (e.g. emerging customers' needs) that will encourage a greater efficiency in the conversion from potential to realized knowledge which in turn will translate into competitive advantage for the firm. **Figure 8** illustrates the previous ERP discussion within the framework of the ACAP model.
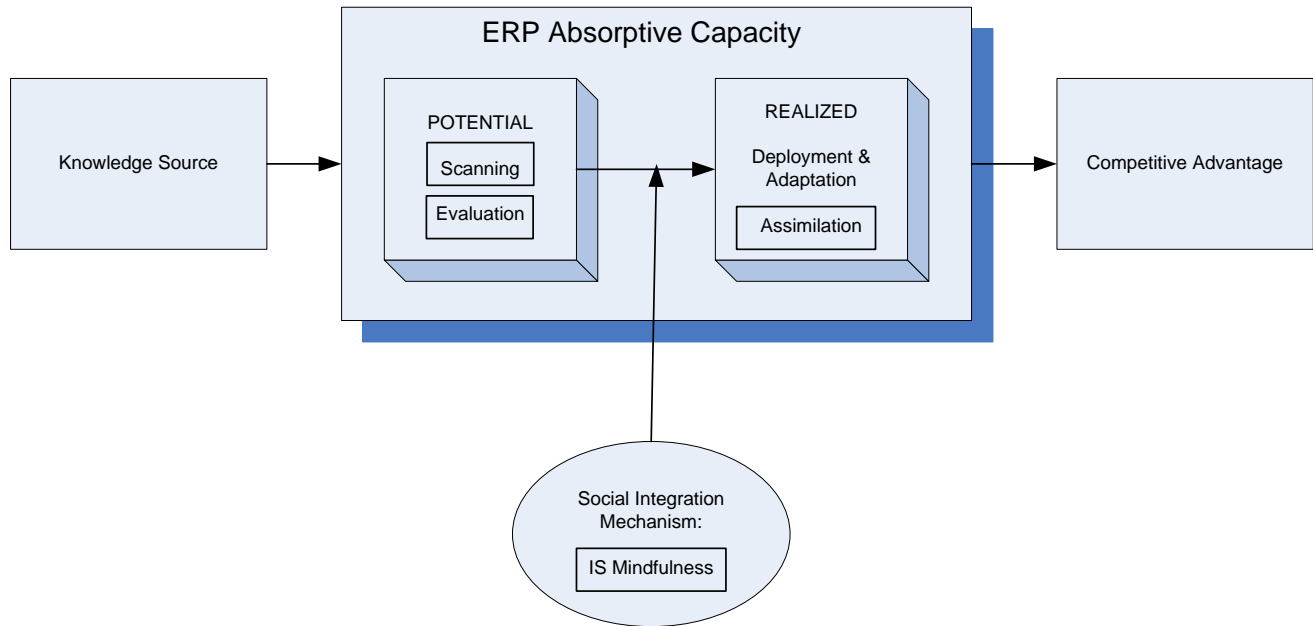
Figure 8: ERP Dissertation Research in ACAP Model Framework

In summary, it is possible to frame this dissertation research model within the context of the APAC model where the studied ERP assimilation model can be seen as a particular application (ERP-related knowledge) of the ACAP model (see **Figure 8**); in which, the acquisition, assimilation, transformation, and exploitation dimensions have been operationalized as scanning, evaluation, deployment & adaptation[13], and assimilation[14] respectively.

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[13] ERP deployment & adaptation has not been explicitly discussed in the dissertation research model; however, without a successful deployment of the ERP technology, it is not possible to discuss the extent of effective use of the system; that is, its ERP assimilation.

Furthermore, given the empirical results obtained in this dissertation research study that shows the difficulty of separating scanning of technology from its evaluation and the fact that ERP deployment has not been part of the research as such; it is still possible to refine the ERP research model to have a better fit in the ACAP framework as shown in **Figure 9**.
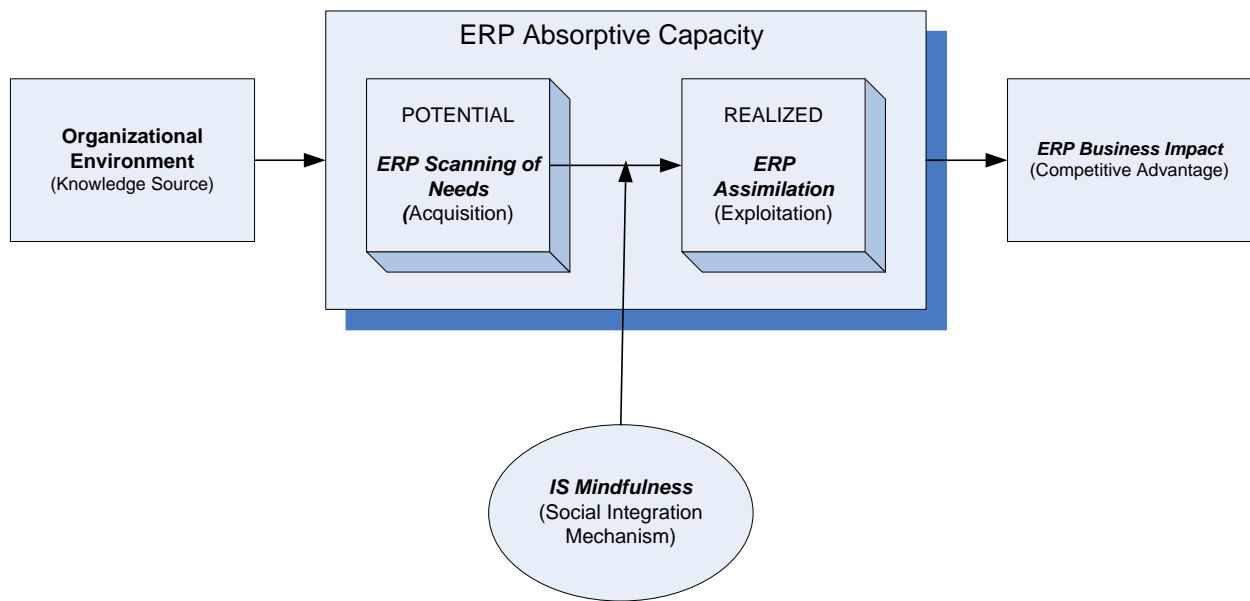
Figure 9: Refined ERP/ACAP Model Based on Findings of the Dissertation Research Study

The research implications of this discussion is that it may be possible to set the current research within a broader theoretical framework, combining the new stream of collective mindfulness research with the absorptive capacity stream of research.

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[14] Again, it is important that due to the different research stream sources for the constructs; ACAP assimilation and ERP assimilation are different concepts. ACAP assimilation can be compared to ERP evaluation while ACAP exploitation can be compared to ERP assimilation.

7.5 FUTURE RESEARCH

The contributions from this dissertation open several avenues of future research. Since ERP systems were chosen because they constitute a typical example of an advanced complex information systems; that is, one that requires adaptation between the information system and the organizational practices; the following discussion will be done referring to these type of systems as IT in general.

First, the traditional IT literature has considered IT scanning as the set of activities to monitor the emergence of new information technologies in the external environment (Maier et al. 1997). This dissertation has extended this construct to include also the monitoring of emerging needs within the organization and has found that this internal scanning is extremely important to achieve greater levels of IT assimilation (**Table 18**). This raises the question of what type of mechanisms can be put in place to perform an effective scanning of needs. What is the difference in the process of monitoring internal organizational needs and external new technologies? Intuitively, it seems that there must be some differences in each case; still, it is not clear what mechanisms are currently used by IS functions or what are the most effective ones. This is an important area of follow-up research.

Second, based on the findings of this dissertation, it has been argued that scanning and evaluation are intrinsically related; that is, it is not possible to perform scanning without performing an evaluation –even if preliminary- to filter what will be noticed. The question is if the scanning/evaluation process used to select new IT is (or should be) the same as the process used to scan/evaluate adaptation opportunities in the post-implementation phase. For example, it is common practice to create inter-department teams to spearhead the deployment of ERP systems; however, in many cases, these teams are disbanded after initial deployment. This poses

the question of what would be the best way to approach scanning/evaluation decisions concerning new modules, upgrades, etc. In particular, because these decisions will be key for effective IT assimilation, as it has been found in this dissertation.

Third, collective mindfulness has been treated, in the academic literature, as a three-dimensional construct consisting of openness to novelty, alertness to distinction, and multiple awareness of different perspectives to challenge assumptions and expectations. The results of this dissertation suggest that collective mindfulness can be also understood as a two-dimensional construct comprised of "alertness/attention" to customers' needs and awareness of unprecedented "changes/situations." Still, an alternative explanation may be simply that the measures used in this study are not tapping the full extent of the collective mindfulness construct but only the "alertness to distinction" dimension; leaving the other two original dimensions unmeasured. This requires further empirical study to resolve satisfactorily.

Fourth, although there have been several studies exploring the antecedents of IT assimilation, this dissertation has identified IS mindfulness as an important contributor to effective IT assimilation. This provides a fresh lens into the IT assimilation phenomenon. Given that constructs related to the role of IT personnel, such as the presence of IT leadership, top management support, etc. has been also found to be important for effective IT assimilation; one interesting question for further study is if the presence of *mindful IT managers* may be also important not only for IT assimilation but also for the success of the IS function in the organization.

Finally, this dissertation has shown that it is possible to frame the research model used in this study within the broader theoretical perspective of absorptive capacity (**Figure 8**). Because of this, it is suggested here that a paper presenting the findings of this dissertation should discuss

the model (**Figure 3**) that contains the constructs ERP scanning (with both dimensions –scanning of needs and technology), IS Mindfulness (with both dimensions –"alertness/attention" and awareness of "change/situation"), and ERP Assimilation (see **Table 21** for regression results) but within the framework of absorptive capacity (ACAP) as shown in **Figure 9**. This is a rich area to explore since it would allow obtaining synergies from the convergence of research streams related to absorptive capacity, collective mindfulness and IT assimilation. **Table 30** shows a summary of the contributions and future areas of research discussed in this section.

Table 30: Dissertation Contributions and Opportunities for Future Research

Issue	Traditional View	Dissertation Contributions	Areas of Future Research
ERP Scanning	Monitoring of emerging information technology only	- Comprises two dimensions: new technologies (environment external to the organization) and emerging needs (environment internal to the organization) - Scanning of emerging needs extremely important for the assimilation of advanced complex IS such as ERPs	- IS function mechanisms that can facilitate scanning of emerging needs in the organization - More importantly, scanning of needs is a totally new concept in the IS management literature so it is open for further study
ERP Evaluation	Focus is on the decision to select an implementation system (pre-implementation stage)	- Sheds light on the after-implementation stage and the process of updating and upgrading the ERP system after deployment (onward/upward phase) - Scanning and Evaluation are inherently joined like the two sides of a coin	- Is there a difference in the scanning/evaluation process to decide the implementation of a new IT and the process to decide about an update/upgrade? Should they be different?
Collective Mindfulness	- Considered to have three dimensions: openness to novelty, alertness to distinction, and awareness of multiple perspectives - All published empirical studies use proxies for operationalization of the construct	- It has been found to be described by two dimensions: "alertness/attention" and awareness of unprecedented "changes/situations" "Alertness/Attention" dimension has been found to have an interaction effect management processes such as "scanning" - Formal measures have been developed for this construct	- Although this research suggests the presence of two dimensions of mindfulness related to the "alertness to distinction" characteristis; it is still open to discussion if it is possible to measure "openness to novelty" and "awareness to multiple perspectives to challenge assumptions and expectations"

Table 30 (continued)

Issue	Traditional View	Dissertation Contributions	Areas of Future Research
IT Assimilation	Previous research has studied its antecedents such as IT leadership, top management involvement, etc.	- IS Mindfulness has been identified as a contributor to IT assimilation - The effect of IS Mindfulness interaction with IT scanning on IT assimilation has also been studied	- Do IT mindful managers play a role in effective IT assimilation? - The theoretical lens of "ERP Absorptive Capacity" is still an interesting area to explore

In conclusion, this dissertation has made contributions to the academic literature by proposing the importance of performing internal (emergent needs) and external (new technologies) scanning, understanding the duality of the scanning/evaluation process, and by exploring the dimensions and role of collective mindfulness in IT assimilation. Future areas of research are constituted by exploring the best mechanisms for effective scanning of needs in the organization, the differences in the scanning/evaluation process for new IT in the pre-implementation phase versus scanning/evaluation of IT upgrades and add-ons, and finally, further studying the proposed bi-dimensionality of IS mindfulness and its place in the absorptive capacity theoretical framework. .For the practitioner, this dissertation highlights the importance of deploying effective mechanisms for the scanning of organizational emergent needs –an area that has not been properly tapped in the trade literature, and the need to be alert to customers' needs in the IS function but without taking it to extremes when this elevated state of alertness may become counterproductive, in particular in the presence of an intensive scanning process.

APPENDIX A

FINAL SURVEYS

A.1   IS PARTICIPANT WEB-BASED SURVEY

SurveyMonkey.com
because knowledge is everything

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Friday, March 16, 2007

Design Survey   Show All Pages and Questions

<< Back   Preview

To change the **look** of your survey, select a choice
below. Click 'Add' to create your own custom theme.

Theme: Copy of Purple Passion   Add   Edit   Delete

IS Function Participant's ERP Survey (A)   Edit Title   Edit Numbering   Edit Logo

Add Page

1. Introduction   Edit Page   Delete Page   Copy/Move   Add Logic

Thanks for your participation in this study. This survey has 40
questions and should take 15 minutes to complete. It is very
important that you answer ALL the questions. Also, rest assured that
this survey data will be used only on an aggregate basis and only for
academic research purposes. Upon completion of this survey, you are
entitled to request a copy of a managerial report, based on the results
of this study.

Add Question   Add Page

2. ERP System --- (After this section, 30% of survey completed)   Edit Page

The following questions refer to the ERP system in use in your organization. T
consist of a single site installation serving a large geographical area or multipl
installed in multiple sites. This questionnaire will refer to the enterprise-wide E

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1. Indicate the provider(s) of ERP systems currently in use in your
organization

☐   SSA Global

☐   Oracle (includes PeopleSoft and JD Edwards)

☐   SAP

☐   Others (please specify)

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2. What are the current ERP products in use in your organization?

- Don't Know
- SAP R/3
- SAP R/3 Enterprise
- mySAP ERP
- PeopleSoft Enterprise
- JD Edwards EnterpriseOne
- JD Edwards World
- Oracle Applications
- Oracle e-Business Suite
- Oracle Enterprise Manager 10G
- Others (please specify)

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3. Approximately, how many ERP installations are there in your firm?

1	2	3	4	5	more than 5	Don't know
○	○	○	○	○	○	○

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4. Which of the following ERP modules are in production?

- AM Asset Management
- CO Controlling
- FI Financials
- HR Human Resources
- MM Materials Management
- PP Production Planning
- PS Project System
- QM Quality Management
- SD Sales & Distribution
- Don't know
- Others (please specify)

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5. Approximately how many users does the ERP system have in your organization?

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6. Which of the following statements best reflects ERP in your organization?

- It is installed in a single site only
- It is installed in multiple sites in one region or state
- It is installed in multiple sites in multiple regions or states
- It is installed in multiple sites internationally

Add Question | Add Page

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7. Approximately how long ago did the first ERP module go "live" (i.e. become a production system)?

- 0 - 6 months ago
- 7 - 12 months ago
- 13 - 18 months ago
- 19 - 24 months ago
- 25 -36 months ago
- 37 - 48 months ago
- 49 - 60 months ago
- More than 60 months ago

Add Question | Add Page

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8. Approximately how long ago did the last ERP module go "live"?

- 0 - 6 months ago
- 7 - 12 months ago
- 13 -18 months ago
- 19 - 24 months ago
- 25 - 36 months ago
- 37 - 48 months ago
- 49 - 60 months ago
- More than 60 months ago

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9. How would you rate the extent of configuration done to the ERP system to reflect organizational features?

7-Very

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1-Very little	2	3	4	5	6	much
○	○	○	○	○	○	○

Add Question   Add Page

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10. How would you rate the extent of code modification done to the ERP system to perform unique business processes?

1-Very little	2	3	4	5	6	7-Very much
○	○	○	○	○	○	○

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11. Approximately what percentage (%) of employees in your firm found their activities changed as a consequence of re-engineering the business processes?

0 - 5%	6 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
○	○	○	○	○	○

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12. Which statement best describes the breadth of business process reengineering?

○ Changed activities of a small number of people within a department

○ Changed activities of a whole department

○ Changed activities in more than one department

○ Changed activities in a region or state

○ Changed activities in more than one region or state

○ Changed activities in multiple regions internationally

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13. Which of the following best reflects your firm's business strategy?

○ Low-Cost Producer

○ Differentiation

○ Market Niche

○ Other (please specify)

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14. Indicate the ERP add-ons currently in use in your organization.

☐ Industry-Specific Add-Ons

☐ Strategic Planning

☐ Advanced Planning Systems

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☐ Supply Chain Management
☐ Customer Relationship Management
☐ Supplier Relationship Management
☐ Product Lifecycle Management
☐ Portal
☐ Data Warehouse
☐ Mobile Infrastructure
☐ Enterprise Application Integration (or Business Process Management System)
☐ Application Server
☐ Others (please specify)

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3. Unit Collective Attitudes --- (After this section, 40% of survey comp

In this section, you will be asked questions about generic collective attitudes i

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15. To what extent do you agree/disagree that the following statements about generic collective attitudes apply to your unit or department?

	Strongly disagree			Neutral			Strongly agree
We quickly notice if an unexpected change occurs.	○	○	○	○	○	○	○
We are quite attentive to the unique needs of different clients.	○	○	○	○	○	○	○
People here are always on the lookout for ways to meet clients' needs.	○	○	○	○	○	○	○
The staff pays careful attention to when and why	○	○	○	○	○	○	○

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our customers might be affected.							
Personnel here are quite aware of changes in the firm.	◔	◔	◔	◔	◔	◔	◔
We feel the need to be alert at all times.	◔	◔	◔	◔	◔	◔	◔
We promptly realize if an unprecedented situation appears.	◔	◔	◔	◔	◔	◔	◔
Personnel here pay great attention to changes that arise while doing their work.	◔	◔	◔	◔	◔	◔	◔
We are always on the lookout for new opportunities.	◔	◔	◔	◔	◔	◔	◔

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4. Information Systems (IS) Scanning Activities --- (After this section,

In this section you will be asked questions about the scanning activities of nev by the IS function.

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16. To what extent you agree/disagree that the following statements describing scanning activities of ERP-related business needs apply to your unit.

	Strongly disagree			Neutral			Strongly agree
The IS Staff here frequently meets with colleagues from other functional	◔	◔	◔	◔	◔	◔	◔

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areas (e.g. marketing, finance.) to discuss emerging ERP-related business needs.							
The IS unit continuously collects information about new ERP-related business needs in other functional areas of the organization.	○	○	○	○	○	○	○
The IS unit investigates new ERP-related business needs only in response to specific requests.	○	○	○	○	○	○	○
The IS unit counts on a specialized individual(s) assigned to collect information about emerging ERP-related business needs in other areas of the organization.	○	○	○	○	○	○	○
The IS unit performs formal reviews to identify new business needs on a regular basis.	○	○	○	○	○	○	○

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Add Question   Add Page

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17. Indicate to what extent you agree/disagree with the following statements about scanning activities of new ERP-related technologies. New SAP-related technologies refer to new technologies such as ERP add-ons, upgrades, third-party modules, etc. that have not been implemented in your organization yet.

	Strongly disagree			Neutral			Strongly agree
The IS staff here frequently meets with vendors to get information about new ERP-related technologies.	○	○	○	○	○	○	○
The IS unit continuously collects information about new ERP-related technologies.	○	○	○	○	○	○	○
The IS unit collects information about new ERP-related technologies only in response to specific requests.	○	○	○	○	○	○	○
The IS staff here spends a significant amount of time collecting information about new ERP-related technologies.	○	○	○	○	○	○	○
In the IS unit there are specific people assigned to collect	○	○	○	○	○	○	○

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information
about new
ERP-related
technologies.

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5. IS Evaluation Activities --- (After this section, 60% of survey compl

In this section, you will be asked questions about evaluation activities perform

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18. To what extent do you agree/disagree with the following statements describing IS evaluation activities of new ERP-related technologies (e.g. add-ons, upgrades) to satisfy emerging organizational needs?

	Strongly disagree			Neutral			Strongly agree
The IS unit hires consultants to help evaluate new ERP-related technologies.	○	○	○	○	○	○	○
The IS staff widely discusses the pros/cons of new ERP-related technologies.	○	○	○	○	○	○	○
The IS unit regularly analyzes new ERP-related technologies.	○	○	○	○	○	○	○
The IS unit regularly conducts experiments with new ERP-related technologies.	○	○	○	○	○	○	○
The IS unit uses vendors to help plan new ERP-related technologies.	○	○	○	○	○	○	○

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| There is a formal committee responsible for evaluating new ERP-related technologies. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| A formal procedure is used to assess new ERP-related technologies. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

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6. ERP System in the Firm --- (After this section, 80% of survey compl

In this section you will be asked to indicate the level of support that the ERP s activities in your firm.

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19. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Being a low-cost producer	○	○	○	○	○	○	○	○
Having operations flexibility	○	○	○	○	○	○	○	○
Enhancing supplier linkages	○	○	○	○	○	○	○	○
Enhancing customer linkages	○	○	○	○	○	○	○	○
Providing value-added services	○	○	○	○	○	○	○	○
Enhancing existing products/services	○	○	○	○	○	○	○	○
Entering new markets	○	○	○	○	○	○	○	○

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20. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Inbound Logistics (e.g. purchasing inputs)	◯	◯	◯	◯	◯	◯	◯	◯
Outbound Logistics (e.g. warehousing)	◯	◯	◯	◯	◯	◯	◯	◯
Operations	◯	◯	◯	◯	◯	◯	◯	◯
Marketing	◯	◯	◯	◯	◯	◯	◯	◯
Sales	◯	◯	◯	◯	◯	◯	◯	◯
Customer Services	◯	◯	◯	◯	◯	◯	◯	◯
Linkages among key activities	◯	◯	◯	◯	◯	◯	◯	◯

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21. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Procurement (i.e. purchasing inputs to be used in the value chain)	◯	◯	◯	◯	◯	◯	◯	◯
Technology Development	◯	◯	◯	◯	◯	◯	◯	◯
Human Resource	◯	◯	◯	◯	◯	◯	◯	◯

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Management

Firm
Infrastructure
(i.e. general
management,
planning,
finance,
accounting,
legal,
government
affairs, and
quality
management)

Linkages
among key
support
activities

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22. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Supports Very Poorly			Neutral			Supports Very Well
How well does the ERP system support your firm's overall business strategy?							

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7. Business Impact of ERP on the Firm --- (After this section, 90% of s

In this section, you will be asked to assess the business impact of the ERP sys

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23. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly disagree			Neutral			Strongly agree
ERP has seriously							

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improved this firm's overall business performance.

In terms of its business impacts on the firm, the ERP system has been a success.

Our firm has realized significant measurable financial benefits from our ERP investment.

Our firm is more competitive as a result of our ERP system.

From the perspective of this firm, the costs of ERP outweigh the benefits.

ERP has had a significant positive impact on this firm.

Our ERP system is meeting our firm's expectations.

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8. Information Technology (IT) Turbulence --- (After this section, 95%

In this section, you will be asked questions about IT-related changes in your in

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24. To what extent do you agree/disagree that the following statements

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apply to your industry?

	Strongly disagree			Neutral			Strongly agree	Don't know
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Virtually no R&D in information technology is done in our principal industry.	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
The use of information technology in our industry is changing very fast.	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
In our principal industry, the modes of production and service change often due to novel information technology.	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙

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9. Demographics and Industry Background --- (After this section, 100%

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These questions are required to analyze the survey results in the context of fi

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25. Select your firm's primary industry

- Chemical & Pharmaceutical
- Computer
- Consultants
- Education
- Finance
- Government
- Legal
- Manufacturing & Processing
- Medical
- Petroleum
- Trade
- Transportation Services
- Utilities
- Other (please specify)

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26. How many employees are there in your firm (approximately)?

- Less than 500
- From 501 to 5,000
- From 5,001 to 20,000
- Above 20,000

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27. What are the approximate annual revenues of your firm?

- Less than US$ 1 million
- From US$ 1million to US$ 100 million
- From US $101 million to US$ 1 billion
- Above US$ 1 billion

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28. What is your current job title?

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29. What is the name of the unit you work for?

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30. Which of the following best represents your role in your firm?

◯ Executive decision-maker (e.g. COO, CFO or above)

◯ Unit decision-maker (e.g. Unit Director)

◯ Manager (managerial position within the unit)

◯ Staff

◯ Other (please specify)

Add Question   Add Page

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31. What is the job title of the person you report to?

Add Question   Add Page

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32. Indicate the number of employees in your unit (approximately)

◯ Less than 50

◯ From 50 to 100

◯ From 101 to 500

◯ Above 500

Add Question   Add Page

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33. How many years have you been in your current position in your firm?

◯ Less than one

◯ Between 1 and 5 years

◯ Between 5 and 10 years

◯ More than 10 years

Add Question   Add Page

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34. Approximately how many levels of management are there between you and your firm's CEO?

0	1	2	3	4	5	more than 5
◯	◯	◯	◯	◯	◯	◯

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35. How many levels of management are there between you and the head of your unit?

0	1	2	3	4	5	more than 5
◯	◯	◯	◯	◯	◯	◯

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36. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit of analysis.

Company Name:

Add Question   Add Page

10. Acknowledgements --- Edit Page | Delete Page | Copy/Move | Add Logic

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37. For research purposes, we would like to obtain the views of an operations manager or similar senior officer in operations. Who would you advise us to contact to ask additional questions about the business impact of ERP in your firm? We will email him/her an invitation to participate in our study.

Colleague's Name:

Job Title:

E-mail Address:

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38. Thank you! A managerial report, based on this study, will be available for those participants who wish to receive it.

E-mail Address:

Participant's Name:

Add Question   Add Page

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39. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address if you would like to participate in this drawing and receive your gift. Thanks again!

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Add Question   Add Page

<< Back   Preview

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A.2 BUSINESS PARTICIPANT WEB-BASED SURVEY

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Friday, March 16, 2007

Design Survey   Show All Pages and Questions

<< Back   Preview

To change the **look** of your survey, select a choice below. Click 'Add' to create your own custom theme.

Theme: Copy of Purple Passion   Add   Edit   Delete

Business Participant's ERP Survey (B)   Edit Title   Edit Numbering   Edit Logo

Add Page

1. Introduction   Edit Page   Delete Page   Copy/Move   Add Logic

Thanks for your participation in this study. This survey has 21 questions and should take 10-15 minutes to complete. It is very important that you answer ALL the questions. Also, rest assured that this survey data will be used only on an aggregate basis and only for academic research purposes. Upon completion of this survey, you are entitled to request a copy of a managerial report based on the results of this study.

Add Question   Add Page

2. Demographics and Industry Background --- (After this section, 50%

These questions are required to analyze the survey results in the context of th

Add Question   Add Page

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1. Select your firm's primary industry

- ○ Chemical & Pharmaceutical
- ○ Computer
- ○ Consultants
- ○ Education
- ○ Finance
- ○ Government
- ○ Legal
- ○ Manufacturing & Processing
- ○ Medical
- ○ Petroleum

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◯ Trade

◯ Transportation Services

◯ Utilities

◯ Other (please specify)

_____

[Add Question] [Add Page]

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2. How many employees are there in your firm (approximately)?

◯ Less than 500

◯ From 501 to 5,000

◯ From 5,001 to 20,000

◯ Above 20,000

[Add Question] [Add Page]

[Edit] [Delete] [Copy/Move] [Add Logic]
3. What are the approximate annual revenues of your firm?

◯ Less than US$ 1 million

◯ From US$ 1million to US$ 100 million

◯ From US $101 million to US$ 1 billion

◯ Above US$ 1 billion

[Add Question] [Add Page]

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4. What is your current job title?

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5. What is the name of the unit you work for?

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6. Which of the following best represents your role in your firm?

◯ Executive decision-maker (e.g. COO, CFO or above)

◯ Unit decision-maker (e.g. Unit Director)

◯ Manager (managerial position within the unit)

◯ Staff

◯ Other (please specify)

[Add Question] [Add Page]

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7. What is the job title of the person you report to?

Add Question | Add Page

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8. Indicate the number of employees in your unit (approximately)

- Less than 50
- From 50 to 100
- From 101 to 500
- Above 500

Add Question | Add Page

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9. How many years have you been in your current position in your firm?

- Less than one
- Between 1 and 5 years
- Between 5 and 10 years
- More than 10 years

Add Question | Add Page

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10. Approximately how many levels of management are there between you and your firm's CEO?

0	1	2	3	4	5	more than 5
●	●	●	●	●	●	●

Add Question | Add Page

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11. How many levels of management are there between you and the head of your unit?

0	1	2	3	4	5	more than 5
●	●	●	●	●	●	●

Add Question | Add Page

3. ERP System in the Firm --- (After this section, 80% of survey compl

In this section you will be asked to indicate the level of support that the ERP s activities in your firm.

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12. Which of the following best reflects your firm's business strategy?

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⚪ Low-Cost Producer
⚪ Differentiation
⚪ Market Niche
⚪ Other (please specify)

_____

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13. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Being a low-cost producer	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Having operations flexibility	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Enhancing supplier linkages	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Enhancing customer linkages	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Providing value-added services	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Enhancing existing products/services	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪
Entering new markets.	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪

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14. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Inbound Logistics (e.g. purchasing inputs)	⚪	⚪	⚪	⚪	⚪	⚪	⚪	⚪

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Outbound Logistics (e.g. warehousing)	○	○	○	○	○	○	○	○
Operations	○	○	○	○	○	○	○	○
Marketing	○	○	○	○	○	○	○	○
Sales	○	○	○	○	○	○	○	○
Customer Services	○	○	○	○	○	○	○	○
Linkages among key activities	○	○	○	○	○	○	○	○

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15. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical
Procurement (i.e. purchasing inputs to be used in the value chain)	○	○	○	○	○	○	○	○
Technology Development	○	○	○	○	○	○	○	○
Human Resource Management	○	○	○	○	○	○	○	○
Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	○	○	○	○	○	○	○	○
Linkages among key support	○	○	○	○	○	○	○	○

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activities

Add Question   Add Page

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16. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Very Poorly			Neutral			Very Well
How well does the ERP system support your firm's overall business strategy?	◉	◉	◉	◉	◉	◉	◉

Add Question   Add Page

4. Business Impact of ERP on the Firm ---   Edit Page   Delete Page   Copy/Move   Add Logic

In this section, you will be asked to assess the business impact of the ERP system on your firm.

Add Question   Add Page

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17. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly disagree			Neutral			Strongly agree
Our firm has realized significant measurable financial benefits from our ERP investment.	◉	◉	◉	◉	◉	◉	◉
In terms of its business impacts on the firm, the ERP system has been a success.	◉	◉	◉	◉	◉	◉	◉
ERP has seriously improved this	◉	◉	◉	◉	◉	◉	◉

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firm's overall business performance.

Our firm is more competitive as a result of our ERP system.

ERP has had a significant positive impact on this firm.

Our ERP system is meeting our firm's expectations.

From the perspective of this firm, the costs of ERP outweigh the benefits.

[Add Question] [Add Page]

5. Information Technology (IT) Turbulence --- [Edit Page] [Delete Page] [Copy/Move] [Ad

In this section, you will be asked questions about IT-related changes in your industry.

[Add Question] [Add Page]

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18. To what extent do you agree/disagree that the following statements apply to your industry?

	Strongly disagree			Neutral			Strongly agree	Don't know
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	○	○	○	○	○	○	○	○

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In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
Virtually no R&D in information technology is done in our principal industry.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
The use of information technology in our industry is changing very fast.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜
In our principal industry, the modes of production and service change often due to novel information technology.	⬜	⬜	⬜	⬜	⬜	⬜	⬜	⬜

[Add Question] [Add Page]

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19. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit for the data analysis.

Company Name: _____

[Add Question] [Add Page]

6. Acknowledgements --- [Edit Page] [Delete Page] [Copy/Move] [Add Logic]

[Add Question] [Add Page]

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20. Thank you! A managerial report, based on the present study, will be available for those participants who wish to receive it.

Participant's Name [_____]

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E-mail Address

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21. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address if you would like to participate in this drawing and receive your gift. Thanks again!

[Add Question] [Add Page]

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A.3   IS PARTICIPANT PAPER-BASED SURVEY

University of Pittsburgh

Katz Graduate School of Business

ERP Research
IS Function's
Participant Survey (A)

Introduction

Thanks for your participation in this study. This survey has 40 questions and should take approximately 10 minutes to complete. It is very important that you answer ALL the questions. Also, rest assured that this survey data will be used only on an aggregate basis and only for academic research purposes. Upon completion of this survey, you are entitled to request a copy of a managerial report, based on the results of this study.

PART I: ERP System

The following questions refer to the ERP system in use in your organization. The ERP system may consist of a single site installation serving a large geographical area or multiple ERP systems installed in multiple sites. This questionnaire will refer to the enterprise-wide ERP system.

1. **Indicate the provider(s) of ERP systems currently in use in your organization**
   - ☐ SSA Global
   - ☐ SAP
   - ☐ Oracle (includes PeopleSoft and JD Edwards)
   - ☐ Others (please specify)

2. **What are the current ERP products in use in your organization?**
   - ☐ Don't Know
   - ☐ SAP R/3
   - ☐ SAP R/3 Enterprise
   - ☐ mySAP ERP
   - ☐ PeopleSoft Enterprise
   - ☐ Others (please specify)_____
   - ☐ JD Edwards EnterpriseOne
   - ☐ JD Edwards World
   - ☐ Oracle Applications
   - ☐ Oracle e-Business Suite
   - ☐ Oracle Enterprise Manager 10G

3. **Approximately, how many ERP installations are there in your firm?**
   - ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   ☐ More than 5   ☐ Don't know

4. **Which of the following ERP modules are in production?**
   - ☐ Don't Know
   - ☐ AM Asset Management
   - ☐ CO Controlling
   - ☐ FI Financials
   - ☐ HR Human Resources
   - ☐ Others (please specify)_____
   - ☐ MM Materials Management
   - ☐ PP Production Planning
   - ☐ PS Project System
   - ☐ QM Quality Management
   - ☐ SD Sales & Distribution

5. **Approximately how many users does the ERP system have in your organization?**

   _____

6. Which of the following statements best reflects ERP in your organization?

☐ It is installed in a single site only
☐ It is installed in multiple sites in one region or state
☐ It is installed in multiple sites in multiple regions or states
☐ It is installed in multiple sites internationally

7. Approximately how long ago did the first ERP module go "live" (i.e. become a production system)?

☐ 0–6 months ago	☐ 7–12 months ago
☐ 13–18 months ago	☐ 19–24 months ago
☐ 25–36 months ago	☐ 37–48 months ago
☐ 49–60 months ago	☐ More than 60 months ago

8. Approximately how long ago did the last ERP module go "live"?

☐ 0–6 months ago	☐ 7–12 months ago
☐ 13–18 months ago	☐ 19–24 months ago
☐ 25–36 months ago	☐ 37–48 months ago
☐ 49–60 months ago	☐ More than 60 months ago

9. How would you rate the extent of configuration done to the ERP system to reflect organizational features?

Not at all	To a slight extent	To some extent	To a moderate extent	To a large extent	To a very large extent	To an extreme extent
1	2	3	4	5	6	7

10. How would you rate the extent of code modification done to the ERP system to perform unique business processes?

Not at all	To a slight extent	To some extent	To a moderate extent	To a large extent	To a very large extent	To an extreme extent
1	2	3	4	5	6	7

11. Approximately what percentage (%) of employees in your firm found their activities changed as a consequence of re-engineering the business processes?

☐ 0-5%   ☐ 6-20%   ☐ 21-40%   ☐ 41-60%   ☐ 61-80%   ☐ 81-100%

12. Which statement best describes the breadth of business process reengineering?

☐ Changed activities of a small number of people within a department
☐ Changed activities of a whole department
☐ Changed activities in more than one department
☐ Changed activities in a region or state
☐ Changed activities in more than one region or state
☐ Changed activities in multiple regions internationally

13. Which of the following best reflects your firm's business strategy?

☐ Low-Cost Producer ☐ Differentiation
☐ Market Niche ☐ Other (please specify)

14. Indicate the ERP add-ons currently in use in your organization.

☐ Industry-Specific Add-Ons ☐ Strategic Planning
☐ Advanced Planning Systems ☐ Supply Chain Management
☐ Customer Relationship Management ☐ Supplier Relationship Management
☐ Product Lifecycle Management ☐ Portal
☐ Data Warehouse ☐ Mobile Infrastructure
☐ Enterprise Application Integration (or Business Process Management System)
☐ Application Server
☐ Others (please specify)_____

PART II: Unit Collective Attitudes

In this section, you will be asked questions about generic collective attitudes in your unit or department.

15. To what extent do you agree/disagree that the following statements about generic collective attitudes apply to your unit or department

	Strongly Disagree		Neutral				Strongly Agree
Personnel here are quite aware of changes in the firm.	1	2	3	4	5	6	7
We promptly realize if an unprecedented situation appears.	1	2	3	4	5	6	7
Personnel here pay great attention to changes that arise while doing their work.	1	2	3	4	5	6	7
People here are always on the lookout for ways to meet clients' needs.	1	2	3	4	5	6	7
We are quite attentive to the unique needs of different clients.	1	2	3	4	5	6	7
We are always on the lookout for new opportunities.	1	2	3	4	5	6	7
We quickly notice if an unexpected change occurs.	1	2	3	4	5	6	7
The staff pays careful attention to when and why our customers might be affected.	1	2	3	4	5	6	7
We feel the need to be alert at all times.	1	2	3	4	5	6	7

PART III: Information Systems (IS) Scanning Activities

In this section you will be asked questions about the scanning activities of new ERP-related business needs and technologies performed by the IS function.

16. To what extent you agree/disagree that the following statements describing scanning activities of ERP-related business needs apply to your unit.

	Strongly Disagree			Neutral			Strongly Agree
The IS Staff here frequently meets with colleagues from other functional areas (e.g. marketing, finance.) to discuss emerging ERP-related business needs.	1	2	3	4	5	6	7
The IS unit continuously collects information about new ERP-related business needs in other functional areas of the organization.	1	2	3	4	5	6	7
The IS unit investigates new ERP-related business needs only in response to specific requests.	1	2	3	4	5	6	7
The IS unit counts on a specialized individual(s) assigned to collect information about emerging ERP-related business needs in other areas of the organization.	1	2	3	4	5	6	7
The IS unit performs formal reviews to identify new business needs on a regular basis.	1	2	3	4	5	6	7

17. Indicate to what extent you agree/disagree with the following statements about scanning activities of new ERP-related technologies. New SAP-related technologies refer to new technologies such as ERP add-ons, upgrades, third-party modules, etc. that have not been implemented in your organization yet.

	Strongly Disagree			Neutral			Strongly Agree
The IS staff here frequently meets with vendors to get information about new ERP-related technologies.	1	2	3	4	5	6	7
The IS unit continuously collects information about new ERP-related technologies.	1	2	3	4	5	6	7
The IS unit collects information about new ERP-related technologies only in response to specific requests.	1	2	3	4	5	6	7
The IS staff here spends a significant amount of time collecting information about new ERP-related technologies.	1	2	3	4	5	6	7
In the IS unit there are specific people assigned to collect information about new ERP-related technologies.	1	2	3	4	5	6	7

PART IV: IS Evaluation Activities

In this section, you will be asked questions about evaluation activities performed by the IS function.

18. To what extent do you agree/disagree with the following statements describing IS evaluation activities of new ERP-related technologies (e.g. add-ons, upgrades) to satisfy emerging organizational needs.

	Strongly Disagree			Neutral			Strongly Agree
The IS unit hires consultants to help evaluate new ERP-related technologies.	1	2	3	4	5	6	7
The IS staff widely discusses the pros/cons of new ERP-related technologies.	1	2	3	4	5	6	7
The IS unit regularly analyzes new ERP-related technologies.	1	2	3	4	5	6	7
The IS unit regularly conducts experiments with new ERP-related technologies.	1	2	3	4	5	6	7
The IS unit uses vendors to help plan new ERP-related technologies.	1	2	3	4	5	6	7
There is a formal committee responsible for evaluating new ERP-related technologies.	1	2	3	4	5	6	7
A formal procedure is used to assess new ERP-related technologies.	1	2	3	4	5	6	7

PART V: ERP System in the Firm

In this section you will be asked to indicate the level of support that the ERP system provides to the different activities in your firm.

19. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and supports very poorly			Neutral			Critical and supports very well
Being a low-cost producer	0	1	2	3	4	5	6	7
Having operations flexibility	0	1	2	3	4	5	6	7
Enhancing supplier linkages	0	1	2	3	4	5	6	7
Enhancing customer linkages	0	1	2	3	4	5	6	7
Providing value-added services	0	1	2	3	4	5	6	7
Enhancing existing products/services	0	1	2	3	4	5	6	7
Entering new markets	0	1	2	3	4	5	6	7

20. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and supports very poorly			Neutral			Critical and supports very well
Inbound Logistics (e.g. purchasing inputs)	0	1	2	3	4	5	6	7
Outbound Logistics (e.g. warehousing)	0	1	2	3	4	5	6	7
Operations	0	1	2	3	4	5	6	7
Marketing	0	1	2	3	4	5	6	7
Sales	0	1	2	3	4	5	6	7
Customer Services	0	1	2	3	4	5	6	7
Linkages among key activities	0	1	2	3	4	5	6	7

21. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and supports very poorly			Neutral			Critical and supports very well
Procurement (i.e. purchasing inputs to be used in the value chain)	0	1	2	3	4	5	6	7
Technology Development	0	1	2	3	4	5	6	7
Human Resource Management	0	1	2	3	4	5	6	7
Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	0	1	2	3	4	5	6	7
Linkages among key support activities	0	1	2	3	4	5	6	7

22. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Supports very poorly		Neutral			Supports very well
How well does the ERP system support your firm's overall business strategy?	1	2	3	4	5	6	7

PART VI: Business Impact of ERP on the Firm

In this section, you will be asked to assess the business impact of the ERP system on your firm.

23. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly Disagree			Neutral			Strongly Agree
ERP has seriously improved this firm's overall business performance.	1	2	3	4	5	6	7
Our ERP system is meeting our firm's expectations.	1	2	3	4	5	6	7
In terms of its business impacts on the firm, the ERP system has been a success.	1	2	3	4	5	6	7
Our firm has realized significant measurable financial benefits from our ERP investment.	1	2	3	4	5	6	7
Our firm is more competitive as a result of our ERP system.	1	2	3	4	5	6	7
ERP has had a significant positive impact on this firm.	1	2	3	4	5	6	7
From the perspective of this firm, the costs of ERP outweigh the benefits.	1	2	3	4	5	6	7

PART VII: Information Technology (IT) Turbulence

In this section, you will be asked questions about IT-related changes in your industry.

24. To what extent do you agree/disagree that the following statements apply to your industry?

	Don't Know	Strongly disagree			Neutral			Strongly Agree
The use of information technology in our industry is changing very fast.	0	1	2	3	4	5	6	7
Virtually no R&D in information technology is done in our principal industry.	0	1	2	3	4	5	6	7
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	0	1	2	3	4	5	6	7
In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	0	1	2	3	4	5	6	7
In our principal industry, the modes of production and service change often due to novel information technology.	0	1	2	3	4	5	6	7

PART VIII: Demographics and Industry Background

25. Select your firm's primary industry

☐ Chemical & Pharmaceutical   ☐ Manufacturing & Processing
☐ Computer   ☐ Medical
☐ Consultants   ☐ Petroleum
☐ Education   ☐ Trade
☐ Finance   ☐ Transportation Services
☐ Government   ☐ Utilities
☐ Legal   ☐ Other (please specify)_____

26. How many employees are there in your firm (approximately)?

☐ Less than 500   ☐ From 501 to 5,000
☐ From 5,001 to 20,000   ☐ Above 20,000

27. What are the approximate annual revenues of your firm?

☐ Less than US$ 1 million   ☐ From US$ 1million to US$ 100 million
☐ From US $101 million to US$ 1 billion   ☐ Above US$ 1 billion

28. What is your current job title?

_____

29. What is the name of the unit you work for?

_____

30. Which of the following best represents your role in your firm?

☐ Executive decision-maker (e.g. COO, CFO or above)
☐ Manager (managerial position within the unit)
☐ Unit decision-maker (e.g. Unit Director)
☐ Staff
☐ Other (please specify)_____

31. What is the job title of the person you report to?

_____

32. Indicate the number of employees in your unit (approximately)

☐ Less than 50   ☐ From 51 to 100
☐ From 101 to 500   ☐ Above 500

33. How many years have you been in your current position in your firm?

☐ Less than one   ☐ Between 1 and 5 years
☐ Between 5 and 10 years   ☐ More than 10 years

34. Approximately how many levels of management are there between you and your firm's CEO?

☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   ☐ More than 5

35. How many levels of management are there between you and the head of your unit?

☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   ☐ More than 5

36. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit for the data analysis.

COMPANY NAME: _____

PART IX: Acknowledgements

37. For research purposes, we would like to obtain the views of an operations manager or similar senior officer in operations. Who would you advise us to contact to ask additional questions about the business impact of ERP in your firm? We will email him/her an invitation to participate in our study.

COLLEAGUE'S NAME: _____

JOB TITLE: _____

E-MAIL ADDRESS: _____

38. Thank you! A managerial report, based on this study, will be available for those participants that wish to receive it.

PARTICIPANT'S NAME: _____

E-MAIL ADDRESS: _____

39. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address (or attach your business card) if you would like to participate in this drawing and receive your gift. Thanks again!

POSTAL ADDRESS: _____

_____

_____

_____

Thanks for taking the time to complete this survey. Your assistance in providing this information is very much appreciated. If there is anything else you would like to add to this survey or if you have any questions concerning this research, do not hesitate to contact the principal researcher: Enrique Mu at enmu@katz.pitt.edu

Please return your completed survey in the envelope provided to:
Enrique Mu
University of Pittsburgh
Joseph M. Katz Graduate School of Business
345 Mervis Hall
Pittsburgh, PA 15260

A.4 BUSINESS PARTICIPANT PAPER-BASED SURVEY

Business Participant's ERP Survey (B)

Introduction

Thanks for your participation in this study. This survey has 19 questions and should take 10 minutes to complete. It is very important that you answer ALL the questions. Also, rest assured that this survey data will be used only on an aggregate basis and only for academic research purposes. Upon completion of this survey, you are entitled to request a copy of a managerial report based on the results of this study.

PART I: Demographics and Industry Background

These questions are required to analyze the survey results in the context of the firm size and the respondents' job functions.

1. Select your firm's primary industry

_____	Chemical & Pharmaceutical	_____	Manufacturing & Processing
_____	Computer	_____	Medical
_____	Consultants	_____	Petroleum
_____	Education	_____	Trade
_____	Finance	_____	Transportation Services
_____	Government	_____	Utilities
_____	Legal	_____	Other (please specify)

2. How many employees are there in your firm (approximately)?

_____	Less than 500	_____	From 501 to 5,000
_____	From 5,001 to 20,000	_____	Above 20,000

3. What are the approximate annual revenues of your firm?

_____	Less than US$ 1 million	_____	From US$ 1million to US$ 100 million
_____	From US $101 million to US$ 1 billion	_____	Above US$ 1 billion

4. What is your current job title? _____

5. What is the name of the unit you work for? _____

6. Which of the following best represents your role in your firm?

_____	Executive decision-maker (e.g. COO, CFO or above)	_____	Manager (managerial position within the unit)
_____	Unit decision-maker (e.g. Unit Director)	_____	Staff
_____	Other (please specify)_____		

7. What is the job title of the person you report to? _____

8. Indicate the number of employees in your unit (approximately)

_____	Less than 50	_____	From 51 to 100
_____	From 101 to 500	_____	Above 500

9. How many years have you been in your current position in your firm?

     _____ Less than one   _____ Between 1 and 5 years
     _____ Between 5 and 10 years   _____ More than 10 years

10. Approximately how many levels of management are there between you and your firm's CEO?

    _____1   _____2   _____3   _____4   _____5   _____More than 5

11. How many levels of management are there between you and the head of your unit?

    _____1   _____2   _____3   _____4   _____5   _____More than 5

PART II: ERP System in the Firm

In this section you will be asked to indicate the level of support that the ERP system provides to the different activities in your firm.

12. Which of the following best reflects your firm's business strategy?

    _____ Low-Cost Producer   _____ Differentiation
    _____ Market Niche   _____ Other (please specify)_____

13. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and support very poorly		Neutral			Critical and supports very well
Being a low-cost producer	0	1	2	3	4	5	6	7
Having operations flexibility	0	1	2	3	4	5	6	7
Enhancing supplier linkages	0	1	2	3	4	5	6	7
Enhancing customer linkages	0	1	2	3	4	5	6	7
Providing value-added services	0	1	2	3	4	5	6	7
Enhancing existing products/services	0	1	2	3	4	5	6	7
Entering new markets	0	1	2	3	4	5	6	7

14. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and support very poorly			Neutral		Critical and supports very well
Inbound Logistics (e.g. purchasing inputs)	0	1	2	3	4	5	6	7
Outbound Logistics (e.g. warehousing)	0	1	2	3	4	5	6	7
Operations	0	1	2	3	4	5	6	7
Marketing	0	1	2	3	4	5	6	7
Sales	0	1	2	3	4	5	6	7
Customer Services	0	1	2	3	4	5	6	7
Linkages among key activities	0	1	2	3	4	5	6	7

15. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Not Critical	Critical and support very poorly			Neutral		Critical and supports very well
Procurement (i.e. purchasing inputs to be used in the value chain)	0	1	2	3	4	5	6	7
Technology Development	0	1	2	3	4	5	6	7
Human Resource Management	0	1	2	3	4	5	6	7
Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	0	1	2	3	4	5	6	7
Linkages among key support activities	0	1	2	3	4	5	6	7

16. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Support very poorly		Neutral		Support very well
How well does the ERP system support your firm's overall business strategy?	1	2	3	4	5	6	7

PART III: Business Impact of ERP on the Firm
In this section, you will be asked to assess the business impact of the ERP system on your firm.

17. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly disagree			Neutral			Strongly agree
ERP has seriously improved this firm's overall business performance.	1	2	3	4	5	6	7
Our ERP system is meeting our firm's expectations.	1	2	3	4	5	6	7
In terms of its business impacts on the firm, the ERP system has been a success.	1	2	3	4	5	6	7
Our firm has realized significant measurable financial benefits from our ERP investment.	1	2	3	4	5	6	7
Our firm is more competitive as a result of our ERP system.	1	2	3	4	5	6	7
ERP has had a significant positive impact on this firm.	1	2	3	4	5	6	7
From the perspective of this firm, the costs of ERP outweigh the benefits.	1	2	3	4	5	6	7

PART IV: Information Technology (IT) Turbulence
In this section, you will be asked questions about IT-related changes in your industry.

18. To what extent do you agree/disagree that the following statements apply to your industry?

	Strongly disagree			Neutral			Strongly agree	Don't know
In our principal industry, the modes of production and service change often due to novel information technology.	1	2	3	4	5	6	7	X
Virtually no R&D in information technology is done in our principal industry.	1	2	3	4	5	6	7	X
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	1	2	3	4	5	6	7	X
In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	1	2	3	4	5	6	7	X
The use of information technology in our industry is changing very fast.	1	2	3	4	5	6	7	X

19. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit for the data analysis.

Company Name: _____

Part V: Acknowledgements

20. Thank you! A managerial report, based on the present study, will be available for those participants that wish to receive it.

Participant's Name: _____

E-mail Address: _____

21. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address (or attach your business card) if you would like to participate in this drawing and receive your gift. Thanks again!

_____

APPENDIX B

CONSTRUCT AND ITEMS

B.1   SUMMARY OF CONSTRUCTS AND MEASURE ITEMS.

B.1.1   Construct: ERP Scanning (ERPSCN).

Definition: ERP scanning is the process of monitoring the appearance of new ERP adaptation opportunities in the IS function's environment. ERP adaptation opportunities are constituted by both emerging organizational needs and new ERP technologies.

Table 31: Items for Scanning of Needs

The following items[15] measure the scanning of ERP needs in the organization:

Abbrev.	Item	Source
SCNN1	The IS staff here frequently meets formally with colleagues from other functional areas (e.g. marketing, finance, etc.) to discuss emerging ERP-related business needs.	New
SCNN2	The IS unit continuously collects information about new ERP-related business needs in other functional areas of the organization.	New
SCNN3	The IS unit investigates new ERP-related business needs only in response to specific requests. **R*.**	New
SCNN4	The IS unit counts on a specialized individual(s) assigned to collect information about emerging ERP-related business needs in other areas of the organization.	New
SCNN5	The IS unit performs formal reviews to identify new business needs on a regular basis.	New

* **R** means reverse-coded

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[15] These items are based on items from Choo, C. W. (1993). Environmental Scanning: Acquisition and Use of Information by Chief Executive Officers in the Canadian Telecommunications Industry. Ph.D. Dissertation., University of Toronto.

; and Maier, J. L., K. Rainer Jr. and C. A. Snyder (1997). "Environmental Scanning for Information Technology: An Empirical Investigation." Journal of Management Information Systems **14**(2): 177 - 200.

Table 32: Items for Scanning of Technology

These items measure scanning of new ERP-related technologies[16]:

Abbrev.	Item	Source
SCNT1	The IS staff here frequently meets with vendors to get information about new ERP-related technologies.	New
SCNT2	The IS unit continuously collects information about new ERP-related technologies.	New
SCNT3	The IS unit collects information about new ERP-related technologies only in response to specific requests. **R*.**	New
SCNT4	The IS staff here spends a significant amount of time collecting information about new ERP-related technologies.	New
SCNT5	In the IS unit there are specific people assigned to collect information about new ERP-related technologies.	New

* **R** means reverse-coded

B.1.2 Construct: ERP Assimilation (ERPASM)

Definition: ERP assimilation is the effective application of ERP information technology in supporting, shaping, and enabling the firm's business strategies and value-chain activities. An effective application of ERP involves fulfilling the intended firm's strategic and operational objectives once the system is being normally used by the firm.

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[16] As explained in the field survey instructions, *new SAP-related technologies* refer to new technologies such as SAP add-ons, upgrades, third-party modules, etc. that have not been implemented in this organization yet.

Strategic Activities: How well does your ERP system support each of the following business strategies?

Table 33: Items for Strategic Activities

Abbrev.	Item	Source
ERPS1	Being a low-cost producer	Armstrong & Sambamurthy (1999)
ERPS2	Having manufacturing /operations flexibility	Armstrong & Sambamurthy (1999)
ERPS3	Enhancing supplier linkages	Armstrong & Sambamurthy (1999)
ERPS4	Enhancing customer linkages	Armstrong & Sambamurthy (1999)
ERPS5	Providing value-added services	Armstrong & Sambamurthy (1999)
ERPS6	Enhancing existing products/services	Armstrong & Sambamurthy (1999)
ERPS7	Entering new markets	Armstrong & Sambamurthy (1999)

Primary Activities: How well does your ERP system support each of the following activities of your firm?

Table 34: Items for Primary Activities

Abbrev.	Item	Source
ERPA1	Inbound logistics (e.g. purchasing)	Armstrong & Sambamurthy (1999)
ERPA2	Outbound logistics (e.g. warehousing)	Armstrong & Sambamurthy (1999)
ERPA3	Manufacturing/Operations	Armstrong & Sambamurthy (1999)
ERPA4	Marketing	Armstrong & Sambamurthy (1999)
ERPA5	Sales	Armstrong & Sambamurthy (1999)
ERPA6	Customer services	Armstrong & Sambamurthy (1999)

Support Activities: How well does your ERP system support each of the following activities of

your firm?

Table 35: Items for Support Activities

Abbrev.	Item	Source
ERPR1	Procurement (i.e. purchasing inputs to be used in the value chain)	New
ERPR2	Technology Development	New
ERPR3	Human Resource Management	New
ERPR4	Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	New
ERPR5	Linkages among key support activities	New

Overall Strategic Support

Table 36: Item for Overall Support

Abbrev.	Item	Source
ERPALL	How well does the ERP system support your firm's overall business strategy?	Muscatello (2002)

Table 37: Items for Business Impact

To what extent do you agree or disagree with the following statements about your SAP system?

Abbrev.	Item	Source
ERPO1	Our SAP system is meeting our firm's expectations.	Muscatello (2002)
ERPO2	Our firm is more competitive as a result of our SAP system.	Muscatello (2002)
ERPO3	Our firm has realized significant measurable financial benefits from our SAP investment.	Muscatello (2002)
ERPO4	In terms of its business impacts on the firm, the ERP system has been a success.	Gattiker and Doodhue (2005)
ERPO5	ERP has seriously improved this firm's overall business performance.	Gattiker and Doodhue (2005)
ERPO6	From the perspective of this firm, the cost of ERP outweigh the benefits. R*.	Gattiker and Doodhue (2005)
ERPO7	ERP has had a significant effect on this firm.	Gattiker and Doodhue (2005)

* **R** means reverse-coded

B.1.3 Construct: ERP Evaluation (ERPEVAL).

Definition: ERP evaluation is the set of activities engaged by the IS function to analyze and select specific ERP adaptation opportunities upon which to take action.

To what extent do you agree/disagree with the following statements describing IS evaluation activities of new ERP-related technologies (e.g. add-on, upgrades).

Table 38: Items for Evaluation

Abbrev.	Item	Source
EVLT1	The IS unit hires consultants to help evaluate new ERP-related technologies.	New
EVLT2	The IS unit uses consultants to help plan for new ERP-related technologies.	New
EVLT3	The IS unit regularly analyzes new SAP-related technologies.	New
EVLT4	The IS unit regularly conducts experiments with new ERP-related technologies.	New
EVLT5	The IS unit uses vendors to help plan new ERP-related technologies.	New
EVLT6	There is a formal committee responsible for evaluating new ERP-related technologies.	New
EVLT7	A formal procedure is used to assess new ERP-related technologies.	New

B.1.4 Construct: IS Mindfulness (ISMIND).

Definition: IS mindfulness is an elevated state of collective alertness toward expectations in the IS function, in the face of new and unprecedented situations, with nuanced appreciation of the specific context.

Table 39: Items for Collective Mindfulness

Abbrev.	Item	Source
MNDO1	We feel the need to be alert at all times.	Knight (2004)
MNDO2	People here are always on the look-out for ways to meet clients' needs.	Knight (2004)
MNDO3	We are quite attentive to the different needs of different clients.	Knight (2004)
MNDO4	Personnel here pay great attention to changes that arise while doing their work.	New Item
MNDO5	We are always on the look-out for new opportunities.	New Item
MNDO6	The staff pays careful attention to when and why our customers might be affected.	New Item
MNDO7	Personnel here are quite aware of changes in the firm.	New Item
MNDO8	We quickly notice if an unexpected change occurs.	New Item
MNDO9	We promptly realize if an unprecedented situation appears.	New Item

B.1.5 Control Variable: IT Turbulence (ITURB).

Definition: IT turbulence is the rate to which frequent and unpredictable changes in IT within an industry accentuate risk and uncertainty in the selection and assimilation of information technologies.

Table 40: Items for Information Technology (IT) Turbulence

Abbrev.	Item[17]	Source
ITURB1	The use of information technology in our industry is changing very fast.	Calantone et al (2003)
ITURB2	A large number of new product ideas have been made possible through information technology breakthroughs in our industry.	Calantone et al (2003)
ITURB3	In our principal industry, the modes of production and service changes often due to novel information technology.	Calantone et al (2003)
ITURB4	Virtually no R&D in information technology is done in our principle industry. R*.	Calantone et al (2003)
ITURB5	In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	Calantone et al (2003)

* **R** means reverse-coded

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[17] In these items, the original term "technology" has been replaced by "information technology." Otherwise, they have remained unchanged from their original source.

APPENDIX C

SCHEDULE FOR COMPLETION

Table 41: Schedule of Dissertation Research Activities

Activities	Status	Completion Date
1. Initial Compilation of Survey Items	Done	April 30, 2005.
2. Completion of Draft Survey Instrument	Done	March 30, 2005.
3. Proposal Meeting with Committee	Done	June 23, 2005
4. Survey Pre-test	Done	September30, 2005.
5. Preparation of preliminary job packet	Done	October 15, 2005.
6. Pilot	Done	October 30, 2005.
7. Dissertation Overview	Done	November 21, 2005
8. Remittance of Job application packets	Ongoing	Ongoing
9. Data Collection	Done	September 15, 2006
10. Job Interviews (ICIS)	Ongoing	Ongoing
11. Data Analysis	Completed	November 14, 2006
12. Dissertation Defense	Completed	January 26, 2007

APPENDIX D

SURVEY INVITATION LETTERS

March 3, 2006

John Doe
IT Manager
Company ABC

Sub: ERP Research Study – University of Pittsburgh

Dear **John Doe**:

We invite you to participate in a voluntary research study of current IS management practices and the use of ERP systems to support a firm's business strategies and activities. We are surveying multiple firms and upon completion of our study we will provide you with a management report so you can analyze how effectively your firm uses ERP systems. Also, this report may allow you to take actions toward improving the effective use of ERP systems in your firm.

To participate in this study, you will need to fill in a survey about management practices in the IS unit and general characteristics of the ERP system in use. The survey should take 15 minutes to complete and is available at:

Survey: http://www.surveymonkey.com/s.asp?u=552281627576
Password: ISsurvey

Only aggregate results will be used in the study and neither participant firms nor individual responses will be either identified or released.

We have sent you this letter because our records show that your firm may have an ERP system in production. However, if this is not the case or if you are unable to participate, please let us know, so we can remove your name from our participant database.

Free Samsung 7" DVD portable player prize draw for all completed surveys!

As a token of our thanks for completing this survey we will e-mail you a managerial report of the results of this study plus you will automatically be entered in a free prize drawing for a Samsung 7" DVD portable player. Also, the first 100 respondents will receive free of charge a beautiful jotter pad as an additional token of appreciation.

If you have any questions about this study, feel free to contact us at your convenience.

Thank you for considering this request.

Very Sincerely,

Enrique Mu
Director, MIS Program
Katz Graduate School of Business
University of Pittsburgh
345 Mervis Hall
Pittsburgh, PA 15260
Phone: (412) 648 2268
Email: enmu@katz.pitt.edu

Brian Butler
Associate Professor
Katz Graduate School of Business
University of Pittsburgh
226 Mervis Hall
Pittsburgh, PA 15260
Phone: (412) 648 1614
Email: bbutler@katz.pitt.edu

March 3, 2006

Jane Doe
[Note – SPOC has been referred by FPOC]
Company ABC

Sub: ERP Research Study

Dear **Jane Doe**:

You were referred to us by Mr FPOC as the most suitable person to participate in our study. Therefore, we invite you to participate in our voluntary research study of how certain management practices influence the effective application of ERP systems to support a firm's business strategies and activities. We are surveying multiple firms and we will provide you with a management report so you can analyze how effectively your firm uses ERP systems, compared to others. Also, this report may allow you to take actions toward improving the effective use ERP in your firm.

To participate in this study, you will need to fill in a survey about your ERP system contribution in supporting your firm's business strategies and activities. The survey should take 15-20 minutes to complete and is available at

> Survey: http://www.surveymonkey.com/s.asp?u=689111358036
> Password: ERPsurvey

Only aggregate results will be used in the study and neither participant firms nor individual responses will be either identified or released.

We have contacted you based on **John Doe's** reference; however, if you are unable to participate, please let us know so we can remove your name from our contact database. If you have any questions about our study, feel free to contact us at your convenience.

Free Samsung 7" DVD portable player prize draw for all completed surveys!

As a token of our thanks for completing this survey we will e-mail you a managerial report of the results of this study plus you will automatically be entered in a free prize drawing for a SAMSUNG 7" DVD portable player. Also, the first 100 respondents will receive free of charge a beautiful jotter pad as an additional token of appreciation.

If you have any questions about this study, feel free to contact us at your convenience.

Thanks for considering this request.

Very Sincerely,

Enrique Mu	Brian Butler
Director, MIS Program	Associate Professor
Katz Graduate School of Business	Katz Graduate School of Business
University of Pittsburgh	University of Pittsburgh
345 Mervis Hall	226 Mervis Hall
Pittsburgh, PA 15260	Pittsburgh, PA 15260
Phone: (412) 648 2268	Phone: (412) 648 1614
Email: enmu@katz.pitt.edu	Email: bbutler@katz.pitt.edu

APPENDIX E

SUMMARY OF RESPONSES

E.1 SUMMARY OF IS SURVEY RESPONSES

SurveyMonkey.com
because knowledge is everything

Home | New Survey | My Surveys | List Management | My Account | Help Center

Monday, January 08, 2007

Results Summary   Show All Pages and Questions   Export... View

Filter Results

To analyze a subset of your data, you can create one or more filters.

Add Filter... **Total:** 125
               Visible: 125

Share Results

Your results can be shared with others, without giving access to your account.

Configure... **Status:** Enabled
              Reports: Summary and Detail

2. ERP System --- (After this section, 30% of survey completed)

1. Indicate the provider(s) of ERP systems currently in use in your organization

	Response Percent	Response Total
SAP	33.3%	41
Oracle (includes PeopleSoft and JD Edwards)	36.6%	45
SSA Global	7.3%	9
Others (please specify)	**39.8%**	**49**
Total Respondents		**123**
(skipped this question)		**2**

2. What are the current ERP products in use in your organization?

	Response Percent	Response Total
Don't Know	2.6%	3
SAP R/3	15.4%	18
SAP R/3 Enterprise	15.4%	18
mySAP ERP	6%	7
PeopleSoft Enterprise	12.8%	15
JD Edwards EnterpriseOne	4.3%	5
JD Edwards World	3.4%	4
Oracle Applications	17.9%	21
Oracle e-Business Suite	13.7%	16
Oracle Enterprise Manager 10G	3.4%	4
Others (please specify)	**43.6%**	**51**

179

	Total Respondents	117
	(skipped this question)	8

3. Approximately, how many ERP installations are there in your firm?
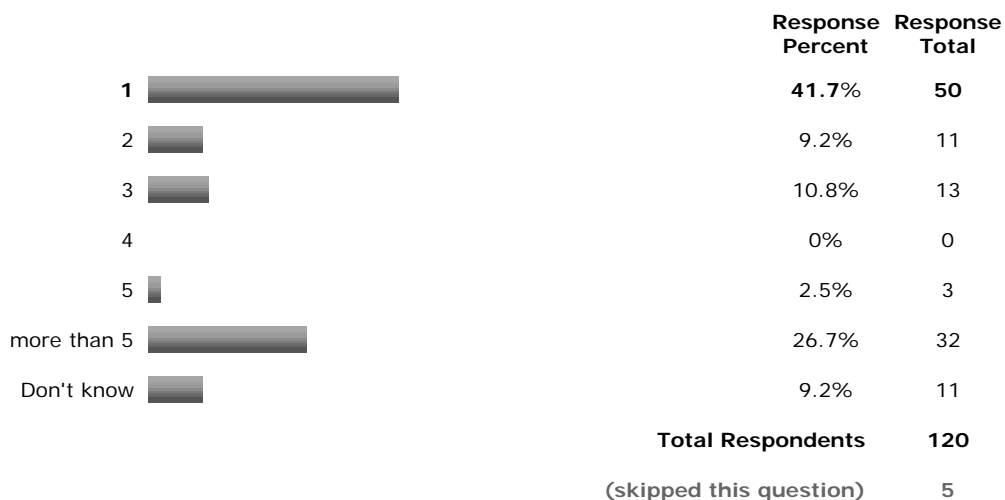
		Response Percent	Response Total
1		**41.7**%	**50**
2		9.2%	11
3		10.8%	13
4		0%	0
5		2.5%	3
more than 5		26.7%	32
Don't know		9.2%	11
	Total Respondents	120
	(skipped this question)	5

4. Which of the following ERP modules are in production?

		Response Percent	Response Total
AM Asset Management		33.3%	41
CO Controlling		34.1%	42
FI Financials		**85.4**%	**105**
HR Human Resources		48%	59
MM Materials Management		74.8%	92
PP Production Planning		63.4%	78
PS Project System		24.4%	30
QM Quality Management		30.9%	38
SD Sales & Distribution		54.5%	67
Don't know		4.1%	5
View Others (please specify)		22%	27
	Total Respondents	123
	(skipped this question)	2
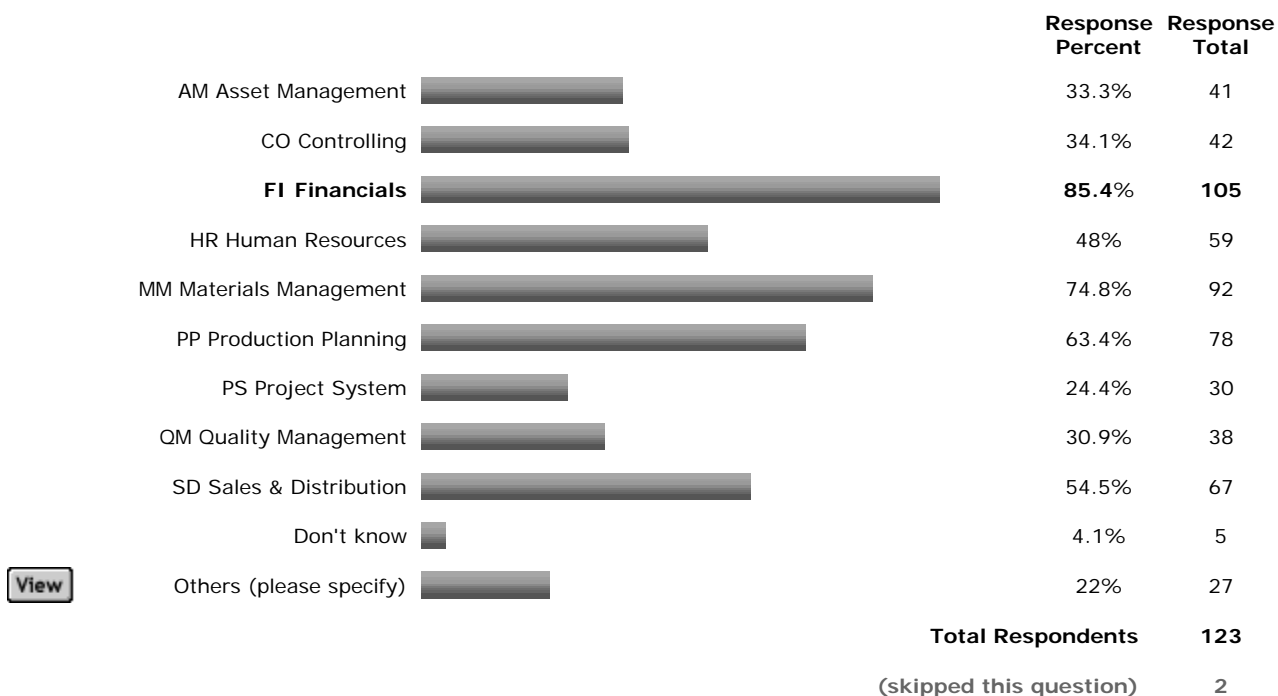
5. Approximately how many users does the ERP system have in your organization?

	View Total Respondents	117
	(skipped this question)	8

180

6. Which of the following statements best reflects ERP in your organization?

	Response Percent	Response Total
It is installed in a single site only	**43.8**%	**53**
It is installed in multiple sites in one region or state	6.6%	8
It is installed in multiple sites in multiple regions or states	16.5%	20
It is installed in multiple sites internationally	33.1%	40
Total Respondents		**121**
(skipped this question)		4

7. Approximately how long ago did the first ERP module go "live" (i.e. become a production system)?

	Response Percent	Response Total
0 - 6 months ago	1.7%	2
7 - 12 months ago	5.8%	7
13 - 18 months ago	5%	6
19 - 24 months ago	6.6%	8
25 -36 months ago	8.3%	10
37 - 48 months ago	9.1%	11
49 - 60 months ago	4.1%	5
More than 60 months ago	**59.5**%	**72**
Total Respondents		**121**
(skipped this question)		4

8. Approximately how long ago did the last ERP module go "live"?

	Response Percent	Response Total
0 - 6 months ago	21.8%	26
7 - 12 months ago	16%	19
13 -18 months ago	12.6%	15
19 - 24 months ago	9.2%	11
25 - 36 months ago	5%	6
37 - 48 months ago	6.7%	8
49 - 60 months ago	4.2%	5
More than 60 months ago	**24.4**%	**29**
Total Respondents		**119**
(skipped this question)		6

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9. How would you rate the extent of configuration done to the ERP system to reflect organizational features?

	Response Percent	Response Total
1-Very little	3.4%	4
2	9.3%	11
3	8.5%	10
4	**26.3**%	**31**
5	**26.3**%	**31**
6	11%	13
7-Very much	15.3%	18
Total Respondents		**118**
(skipped this question)		7

10. How would you rate the extent of code modification done to the ERP system to perform unique business processes?

	Response Percent	Response Total
1-Very little	17.8%	21
2	16.1%	19
3	8.5%	10
4	**22.9**%	**27**
5	14.4%	17
6	11.9%	14
7-Very much	8.5%	10
Total Respondents		**118**
(skipped this question)		7

11. Approximately what percentage (%) of employees in your firm found their activities changed as a consequence of re-engineering the business processes?

	Response Percent	Response Total
0 - 5%	5.1%	6
6 - 20%	15.3%	18
21 - 40%	22%	26
41 - 60%	**23.7**%	**28**
61 - 80%	18.6%	22
81 - 100%	15.3%	18
Total Respondents		**118**

182
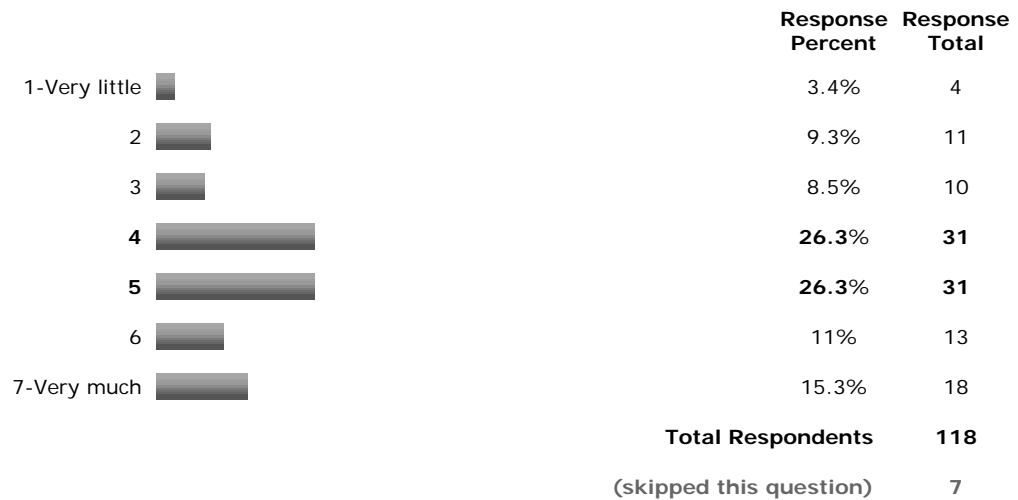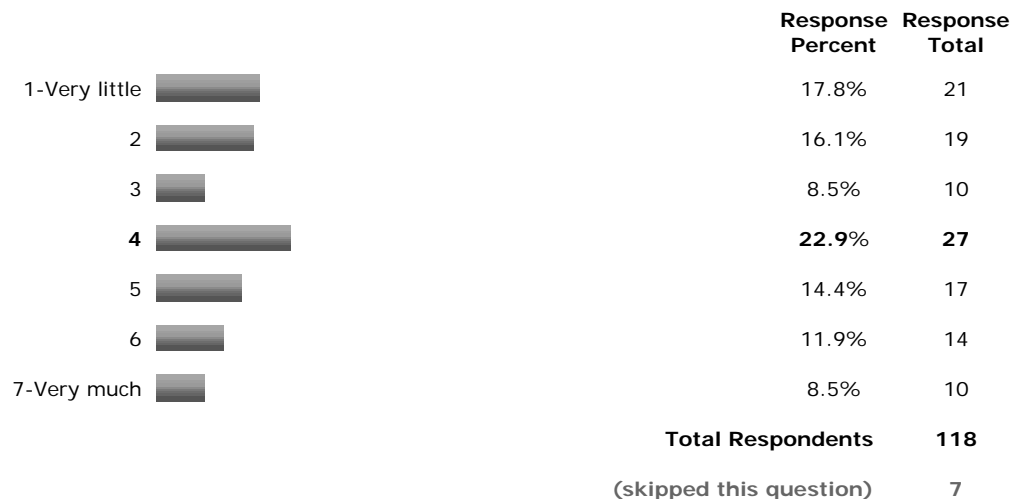
12. Which statement best describes the breadth of business process reengineering?

	Response Percent	Response Total
Changed activities of a small number of people within a department	10.2%	12
Changed activities of a whole department	5.9%	7
Changed activities in more than one department	**39.8**%	**47**
Changed activities in a region or state	5.1%	6
Changed activities in more than one region or state	13.6%	16
Changed activities in multiple regions internationally	25.4%	30
Total Respondents		**118**
(skipped this question)		7

13. Which of the following best reflects your firm's business strategy?

	Response Percent	Response Total
Low-Cost Producer	20.2%	24
Differentiation	**34.5**%	**41**
Market Niche	30.3%	36
Other (please specify)	15.1%	18
Total Respondents		**119**
(skipped this question)		6

View

14. Indicate the ERP add-ons currently in use in your organization.

	Response Percent	Response Total
Industry-Specific Add-Ons	22%	24
Strategic Planning	7.3%	8
Advanced Planning Systems	24.8%	27
Supply Chain Management	32.1%	35
Customer Relationship Management	25.7%	28
Supplier Relationship Management	9.2%	10
Product Lifecycle Management	14.7%	16
Portal	33%	36
Data Warehouse	**50.5**%	**55**
Mobile Infrastructure	16.5%	18

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Enterprise Application Integration (or Business Process Management System)		19.3%	21
Application Server		30.3%	33
Others (please specify)		20.2%	22

Total Respondents	**109**
(skipped this question)	**16**

3. Unit Collective Attitudes --- (After this section, 40% of survey completed)

15. To what extent do you agree/disagree that the following statements about generic collective attitudes apply to your unit or department?

	Strongly disagree			Neutral			Strongly agree	Response Average
We feel the need to be alert at all times.	0% (0)	2% (3)	4% (5)	11% (13)	25% (30)	**39% (47)**	20% (24)	**5.52**
People here are always on the lookout for ways to meet clients' needs.	1% (1)	2% (2)	0% (0)	11% (14)	30% (36)	**45% (55)**	11% (14)	**5.48**
We are quite attentive to the unique needs of different clients.	0% (0)	2% (3)	3% (4)	11% (13)	30% (37)	**33% (40)**	20% (25)	**5.49**
Personnel here pay great attention to changes that arise while doing their work.	2% (2)	4% (5)	7% (8)	11% (14)	27% (33)	**39% (48)**	10% (12)	**5.16**
We are always on the lookout for new opportunities.	1% (1)	1% (1)	6% (7)	6% (7)	30% (36)	**34% (42)**	23% (28)	**5.57**
The staff pays careful attention to when and why our customers might be affected.	0% (0)	2% (3)	4% (5)	9% (11)	32% (39)	**34% (41)**	18% (22)	**5.45**
Personnel here are quite aware of changes in the firm.	2% (2)	0% (0)	8% (10)	15% (18)	29% (35)	**39% (48)**	7% (9)	**5.16**
We quickly notice if an unexpected change occurs.	1% (1)	2% (3)	6% (7)	12% (15)	28% (33)	**41% (49)**	10% (12)	**5.26**
We promptly realize if an unprecedented situation appears.	1% (1)	1% (1)	5% (6)	16% (20)	27% (33)	**39% (48)**	11% (13)	**5.29**

Total Respondents	**122**
(skipped this question)	**3**

4. Information Systems (IS) Scanning Activities --- (After this section, 50% of survey completed)

16. To what extent you agree/disagree that the following statements describing scanning activities of ERP-related business needs apply to your unit.

	Strongly disagree			Neutral			Strongly agree	Response Average
The IS Staff here frequently meets with colleagues from other functional areas (e.g. marketing, finance.) to discuss emerging ERP-related business needs.	4% (5)	10% (12)	12% (14)	12% (14)	**29% (35)**	19% (23)	14% (17)	**4.66**
The IS unit continuously collects information about new ERP-related business needs in other functional areas of the organization.	4% (5)	9% (11)	10% (12)	16% (19)	22% (27)	**28% (34)**	10% (12)	**4.68**

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	Strongly disagree			Neutral			Strongly agree	Response Average
The IS unit investigates new ERP-related business needs only in response to specific requests.	3% (4)	8% (10)	10% (12)	12% (15)	**32% (39)**	27% (32)	7% (8)	**4.69**
The IS unit counts on a specialized individual(s) assigned to collect information about emerging ERP-related business needs in other areas of the organization.	10% (12)	11% (13)	7% (8)	17% (20)	**24% (29)**	21% (25)	11% (13)	**4.40**
The IS unit performs formal reviews to identify new business needs on a regular basis.	10% (12)	15% (18)	12% (15)	**20% (24)**	19% (23)	14% (17)	9% (11)	**4.03**

Total Respondents	**120**
(skipped this question)	5

17. Indicate to what extent you agree/disagree with the following statements about scanning activities of new ERP-related technologies. New SAP-related technologies refer to new technologies such as ERP add-ons, upgrades, third-party modules, etc. that have not been implemented in your organization yet.

	Strongly disagree			Neutral			Strongly agree	Response Average
The IS staff here frequently meets with vendors to get information about new ERP-related technologies.	9% (11)	13% (15)	7% (8)	20% (24)	**24% (29)**	18% (21)	9% (11)	**4.28**
The IS unit continuously collects information about new ERP-related technologies.	5% (6)	10% (12)	13% (16)	18% (21)	22% (26)	**24% (29)**	8% (9)	**4.45**
The IS unit collects information about new ERP-related technologies only in response to specific requests.	3% (4)	9% (11)	13% (16)	23% (27)	**26% (31)**	19% (23)	6% (7)	**4.40**
The IS staff here spends a significant amount of time collecting information about new ERP-related technologies.	8% (9)	24% (28)	15% (18)	**26% (31)**	14% (17)	10% (12)	3% (3)	**3.57**
In the IS unit there are specific people assigned to collect information about new ERP-related technologies.	17% (20)	16% (19)	10% (12)	18% (22)	**21% (25)**	13% (16)	4% (5)	**3.68**

Total Respondents	**119**
(skipped this question)	6

5. IS Evaluation Activities --- (After this section, 60% of survey completed)

18. To what extent do you agree/disagree with the following statements describing IS evaluation activities of new ERP-related technologies (e.g. add-ons, upgrades) to satisfy emerging organizational needs?

	Strongly disagree			Neutral			Strongly agree	Response Average
The IS unit hires consultants to help evaluate new ERP-related technologies.	12% (14)	12% (14)	8% (10)	12% (15)	**32% (38)**	18% (21)	7% (8)	**4.20**
The IS staff widely discusses the pros/cons of new ERP-related technologies.	3% (4)	10% (12)	11% (13)	18% (22)	**25% (30)**	24% (29)	8% (10)	**4.58**
The IS unit regularly analyzes new ERP-related technologies.	5% (6)	16% (19)	12% (15)	15% (18)	**27% (32)**	20% (24)	5% (6)	**4.23**
The IS unit regularly conducts experiments with new ERP-related technologies.	11% (13)	**22% (26)**	12% (14)	21% (25)	17% (20)	14% (17)	3% (4)	**3.67**

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								Response Average
The IS unit uses vendors to help plan new ERP-related technologies.	7% (8)	12% (15)	10% (12)	12% (14)	**33% (40)**	18% (21)	8% (10)	**4.38**
There is a formal committee responsible for evaluating new ERP-related technologies.	21% (25)	12% (15)	10% (12)	**22% (27)**	16% (19)	11% (13)	8% (9)	**3.63**
A formal procedure is used to assess new ERP-related technologies.	**18% (22)**	13% (16)	13% (15)	18% (21)	17% (20)	15% (18)	6% (7)	**3.70**

Total Respondents	**120**
(skipped this question)	**5**

6. ERP System in the Firm --- (After this section, 80% of survey completed)

19. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical	Response Average
Being a low-cost producer	5% (5)	5% (5)	8% (9)	18% (20)	18% (20)	18% (20)	10% (11)	**19% (21)**	**4.66**
Having operations flexibility	3% (3)	5% (5)	8% (9)	15% (17)	**28% (31)**	23% (25)	16% (18)	3% (3)	**4.99**
Enhancing supplier linkages	5% (6)	5% (6)	5% (5)	**21% (23)**	20% (22)	19% (21)	10% (11)	15% (16)	**4.66**
Enhancing customer linkages	3% (3)	10% (11)	8% (9)	16% (18)	13% (14)	**30% (33)**	11% (12)	9% (10)	**4.76**
Providing value-added services	2% (2)	6% (7)	7% (8)	16% (18)	**22% (24)**	**22% (24)**	13% (14)	12% (13)	**4.89**
Enhancing existing products/services	2% (2)	9% (10)	4% (4)	**23% (26)**	22% (24)	14% (15)	16% (18)	11% (12)	**4.79**
Entering new markets	3% (3)	9% (10)	6% (7)	**25% (27)**	15% (17)	15% (16)	10% (11)	17% (19)	**4.51**

Total Respondents	**111**
(skipped this question)	**14**

20. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical	Response Average
Inbound Logistics (e.g. purchasing inputs)	4% (4)	4% (4)	6% (7)	7% (8)	25% (28)	**28% (31)**	19% (21)	7% (8)	**5.22**
Outbound Logistics (e.g. warehousing)	2% (2)	5% (5)	7% (8)	7% (8)	**25% (28)**	19% (21)	20% (22)	15% (17)	**5.19**
Operations	3% (3)	4% (4)	4% (4)	10% (11)	25% (27)	**28% (31)**	25% (28)	2% (2)	**5.41**
Marketing	6% (6)	9% (10)	11% (12)	**26% (28)**	13% (14)	7% (8)	6% (7)	22% (24)	**4.01**
Sales	4% (4)	6%	8%	18%	**21%**	17%	11% (12)	15%	**4.66**

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		(7)	(9)	(20)	**(23)**	(19)		(16)	
Customer Services	2% (2)	8% (9)	4% (4)	14% (15)	24% (26)	**27% (30)**	15% (16)	7% (8)	**5.04**
Linkages among key activities	5% (5)	5% (6)	6% (7)	12% (13)	23% (25)	**30% (33)**	14% (15)	6% (7)	**4.98**

	Total Respondents	**111**
	(skipped this question)	**14**

21. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			**Neutral**		**Critical and Supports Very Well**	**Not Critical**	**Response Average**
Procurement (i.e. purchasing inputs to be used in the value chain)	4% (4)	4% (4)	5% (5)	14% (15)	26% (29)	**29% (32)**	15% (17)	4% (4)	**5.12**
Technology Development	5% (5)	6% (7)	10% (11)	**27% (30)**	14% (15)	14% (15)	7% (8)	17% (19)	**4.32**
Human Resource Management	6% (7)	9% (10)	1% (1)	**22% (24)**	18% (20)	16% (17)	11% (12)	17% (18)	**4.53**
Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	2% (2)	4% (4)	6% (7)	15% (16)	26% (28)	**28% (30)**	18% (20)	2% (2)	**5.19**
Linkages among key support activities	3% (3)	5% (6)	7% (8)	**24% (26)**	21% (23)	**24% (26)**	6% (7)	10% (11)	**4.68**

	Total Respondents	**110**
	(skipped this question)	**15**

22. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Supports Very Poorly		**Neutral**			**Supports Very Well**	**Response Average**
How well does the ERP system support your firm's overall business strategy?	2% (2)	5% (5)	4% (4)	12% (13)	33% (36)	**34% (37)**	10% (11)	**5.14**

	Total Respondents	**108**
	(skipped this question)	**17**

7. Business Impact of ERP on the Firm --- (After this section, 90% of survey completed)

23. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly disagree		**Neutral**			**Strongly agree**	**Response Average**
Our ERP system is meeting our firm's expectations.	1% (1)	5% (6)	9% (10)	13% (15)	**33% (38)**	31% (36)	9% (10)	**4.99**
Our firm is more competitive as a result of our ERP system.	3% (3)	4% (5)	4% (5)	25% (29)	**30% (35)**	25% (29)	9% (10)	**4.85**

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Our firm has realized significant measurable financial benefits from our ERP investment.	2% (2)	4% (5)	9% (10)	23% (27)	**26% (30)**	24% (28)	11% (13)	**4.86**
In terms of its business impacts on the firm, the ERP system has been a success.	2% (2)	2% (2)	4% (5)	14% (16)	33% (38)	**34% (39)**	11% (13)	**5.22**
ERP has seriously improved this firm's overall business performance.	3% (3)	2% (2)	4% (5)	19% (22)	**34% (40)**	29% (34)	9% (10)	**5.03**
From the perspective of this firm, the costs of ERP outweigh the benefits.	12% (14)	14% (16)	15% (17)	**23% (26)**	17% (19)	11% (13)	9% (10)	**3.86**
ERP has had a significant positive impact on this firm.	2% (2)	2% (2)	7% (8)	19% (22)	**32% (37)**	21% (25)	18% (21)	**5.13**

Total Respondents	**117**
(skipped this question)	**8**

8. Information Technology (IT) Turbulence --- (After this section, 95% of survey completed)

24. To what extent do you agree/disagree that the following statements apply to your industry?

	Strongly disagree		Neutral			Strongly agree	Don't know	Response Average
The use of information technology in our industry is changing very fast.	4% (5)	11% (13)	8% (9)	15% (18)	20% (23)	**22% (26)**	20% (23)	0% (0)	**4.80**
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	10% (12)	9% (11)	12% (14)	**24% (28)**	12% (14)	16% (19)	12% (14)	4% (5)	**4.20**
In our principal industry, the modes of production and service change often due to novel information technology.	12% (14)	15% (18)	**19% (22)**	15% (18)	15% (17)	12% (14)	11% (13)	1% (1)	**3.86**
Virtually no R&D in information technology is done in our principal industry.	17% (20)	13% (15)	**18% (21)**	17% (20)	15% (18)	13% (15)	4% (5)	3% (3)	**3.58**
In our principal industry, the modes of production and service change in major ways as opposed to slowly evolving.	9% (11)	15% (17)	19% (22)	**21% (24)**	15% (17)	10% (12)	9% (10)	3% (4)	**3.84**

Total Respondents	**117**
(skipped this question)	**8**

9. Demographics and Industry Background --- (After this section, 100% of survey completed)

25. Select your firm's primary industry

		Response Percent	Response Total
Chemical & Pharmaceutical		7.6%	9
Computer		0.8%	1
Consultants		5.1%	6
Education		3.4%	4
Finance		1.7%	2

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Government		3.4%	4
Legal		0%	0
Manufacturing & Processing		**46.6**%	**55**
Medical		1.7%	2
Petroleum		1.7%	2
Trade		1.7%	2
Transportation Services		2.5%	3
Utilities		1.7%	2
Other (please specify)		22%	26
		Total Respondents	**118**
		(skipped this question)	7

26. How many employees are there in your firm (approximately)?

	Response Percent	Response Total
Less than 500	29.1%	34
From 501 to 5,000	**35.9**%	**42**
From 5,001 to 20,000	12.8%	15
Above 20,000	22.2%	26
Total Respondents		**117**
(skipped this question)		8

27. What are the approximate annual revenues of your firm?

	Response Percent	Response Total
Less than US$ 1 million	4.4%	5
From US$ 1million to US$ 100 million	**34.5**%	**39**
From US $101 million to US$ 1 billion	26.5%	30
Above US$ 1 billion	**34.5**%	**39**
Total Respondents		**113**
(skipped this question)		12

28. What is your current job title?

View	**Total Respondents**	**117**
	(skipped this question)	8

29. What is the name of the unit you work for?

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		Total Respondents	116
		(skipped this question)	9

30. Which of the following best represents your role in your firm?

		Response Percent	Response Total
Executive decision-maker (e.g. COO, CFO or above)		5.9%	7
Unit decision-maker (e.g. Unit Director)		24.6%	29
Manager (managerial position within the unit)		**44.1**%	**52**
Staff		22%	26
Other (please specify)		3.4%	4
	Total Respondents		118
	(skipped this question)		7

31. What is the job title of the person you report to?

		Total Respondents	115
		(skipped this question)	10

32. Indicate the number of employees in your unit (approximately)

		Response Percent	Response Total
Less than 50		**59**%	**69**
From 50 to 100		15.4%	18
From 101 to 500		16.2%	19
Above 500		9.4%	11
	Total Respondents		117
	(skipped this question)		8

33. How many years have you been in your current position in your firm?

		Response Percent	Response Total
Less than one		9.3%	11
Between 1 and 5 years		**45.8**%	**54**
Between 5 and 10 years		27.1%	32
More than 10 years		17.8%	21
	Total Respondents		118
	(skipped this question)		7

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34. Approximately how many levels of management are there between you and your firm's CEO?

	Response Percent	Response Total
0	8.8%	10
1	**25.4**%	**29**
2	19.3%	22
3	16.7%	19
4	15.8%	18
5	6.1%	7
more than 5	7.9%	9
Total Respondents		**114**
(skipped this question)		11

35. How many levels of management are there between you and the head of your unit?

	Response Percent	Response Total
0	36%	41
1	**39.5**%	**45**
2	13.2%	15
3	6.1%	7
4	3.5%	4
5	1.8%	2
more than 5	0%	0
Total Respondents		**114**
(skipped this question)		11

36. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit of analysis.

	Response Percent	Response Total
View Company Name:	100%	114
Total Respondents		**114**
(skipped this question)		11

10. Acknowledgements ---

37. For research purposes, we would like to obtain the views of an operations manager or similar senior officer in operations. Who would you advise us to contact to ask additional

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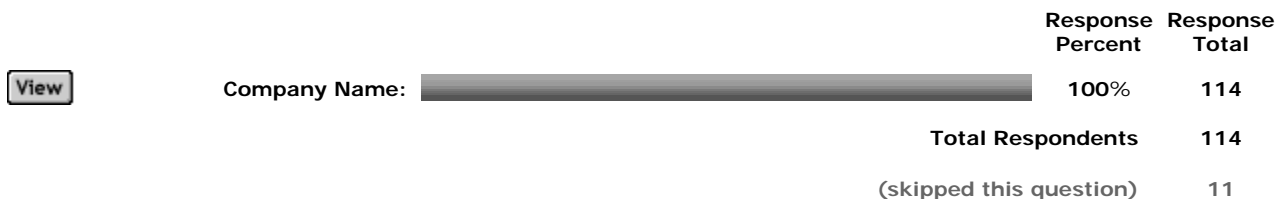
questions about the business impact of ERP in your firm? We will email him/her an invitation to participate in our study.

		Response Percent	Response Total
View	**Colleague's Name:**	**100**%	**46**
View	Job Title:	91.3%	42
View	E-mail Address:	93.5%	43
	Total Respondents		**46**
	(skipped this question)		**79**

38. Thank you! A managerial report, based on this study, will be available for those participants who wish to receive it.

		Response Percent	Response Total
View	**Participant's Name:**	**100**%	**97**
View	E-mail Address:	99%	96
	Total Respondents		**97**
	(skipped this question)		**28**

39. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address if you would like to participate in this drawing and receive your gift. Thanks again!

View	**Total Respondents**	**84**
	(skipped this question)	**41**

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E.2   SUMMARY OF BUSINESS SURVEY RESPONSES

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Monday, January 08, 2007

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2. Demographics and Industry Background --- (After this section, 50% of survey completed)

1. Select your firm's primary industry

	Response Percent	Response Total
Chemical & Pharmaceutical	4.3%	3
Computer	0%	0
Consultants	4.3%	3
Education	5.8%	4
Finance	2.9%	2
Government	1.4%	1
Legal	0%	0
Manufacturing & Processing	**47.8%**	**33**
Medical	4.3%	3
Petroleum	5.8%	4
Trade	2.9%	2
Transportation Services	4.3%	3
Utilities	2.9%	2
Other (please specify)	13%	9
Total Respondents		**69**
(skipped this question)		1

2. How many employees are there in your firm (approximately)?

	Response Percent	Response Total

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	Response Percent	Response Total
Less than 500	**50.7**%	**35**
From 501 to 5,000	21.7%	15
From 5,001 to 20,000	15.9%	11
Above 20,000	11.6%	8
Total Respondents		**69**
(skipped this question)		**1**

3. What are the approximate annual revenues of your firm?

	Response Percent	Response Total
Less than US$ 1 million	0%	0
From US$ 1million to US$ 100 million	**43.3**%	**29**
From US $101 million to US$ 1 billion	34.3%	23
Above US$ 1 billion	22.4%	15
Total Respondents		**67**
(skipped this question)		**3**

4. What is your current job title?

		Response Total
View	**Total Respondents**	**69**
	(skipped this question)	**1**

5. What is the name of the unit you work for?

		Response Total
View	**Total Respondents**	**67**
	(skipped this question)	**3**

6. Which of the following best represents your role in your firm?

	Response Percent	Response Total
Executive decision-maker (e.g. COO, CFO or above)	7.4%	5
Unit decision-maker (e.g. Unit Director)	38.2%	26
Manager (managerial position within the unit)	**41.2**%	**28**
Staff	11.8%	8
View Other (please specify)	1.5%	1
Total Respondents		**68**
(skipped this question)		**2**

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7. What is the job title of the person you report to?

View Total Respondents	69
(skipped this question)	1

8. Indicate the number of employees in your unit (approximately)
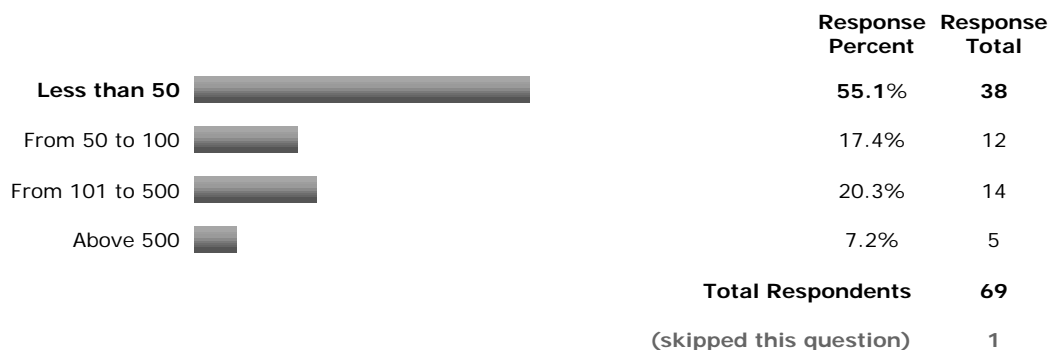
	Response Percent	Response Total
Less than 50	**55.1**%	**38**
From 50 to 100	17.4%	12
From 101 to 500	20.3%	14
Above 500	7.2%	5
Total Respondents		**69**
(skipped this question)		1

9. How many years have you been in your current position in your firm?

	Response Percent	Response Total
Less than one	10.1%	7
Between 1 and 5 years	**53.6**%	**37**
Between 5 and 10 years	27.5%	19
More than 10 years	8.7%	6
Total Respondents		**69**
(skipped this question)		1

10. Approximately how many levels of management are there between you and your firm's CEO?

	Response Percent	Response Total
0	9.1%	6
1	**27.3**%	**18**
2	**27.3**%	**18**
3	18.2%	12
4	7.6%	5
5	7.6%	5
more than 5	3%	2
Total Respondents		**66**
(skipped this question)		4

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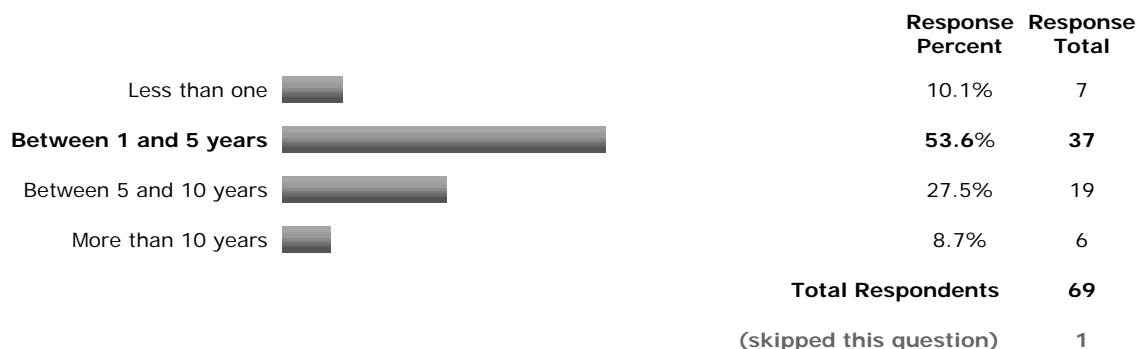
11. How many levels of management are there between you and the head of your unit?

	Response Percent	Response Total
0	43.9%	29
1	43.9%	29
2	7.6%	5
3	4.5%	3
4	0%	0
5	0%	0
more than 5	0%	0
Total Respondents		**66**
(skipped this question)		4

3. ERP System in the Firm --- (After this section, 80% of survey completed)

12. Which of the following best reflects your firm's business strategy?

	Response Percent	Response Total
Low-Cost Producer	13%	9
Differentiation	**39.1%**	**27**
Market Niche	37.7%	26
Other (please specify) [View]	10.1%	7
Total Respondents		**69**
(skipped this question)		1

13. From the business activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical	Response Average
Being a low-cost producer	1% (1)	6% (4)	6% (4)	**25% (17)**	21% (14)	15% (10)	1% (1)	**25% (17)**	4.43
Having operations flexibility	4% (3)	12% (8)	6% (4)	10% (7)	18% (12)	**22% (15)**	21% (14)	6% (4)	4.87
Enhancing supplier linkages	1% (1)	16% (11)	7% (5)	15% (10)	15% (10)	18% (12)	9% (6)	**19% (13)**	4.40
Enhancing customer linkages	4% (3)	19% (13)	7% (5)	4% (3)	16% (11)	**24% (16)**	15% (10)	9% (6)	4.54
Providing value-added services	3% (2)	7% (5)	10% (7)	12% (8)	18% (12)	**22% (15)**	16% (11)	12% (8)	4.87
Enhancing existing products/services	1% (1)	6% (4)	10% (7)	13% (9)	16% (11)	**24% (16)**	13% (9)	15% (10)	4.91

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Entering new markets.	1% (1)	16% (11)	7% (5)	**32% (22)**	9% (6)	10% (7)	9% (6)	15% (10)	**4.14**

Total Respondents	**68**
(skipped this question)	**2**

14. From the value-chain primary activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical	Response Average
Inbound Logistics (e.g. purchasing inputs)	4% (3)	9% (6)	3% (2)	7% (5)	19% (13)	**26% (18)**	19% (13)	12% (8)	**5.08**
Outbound Logistics (e.g. warehousing)	4% (3)	7% (5)	7% (5)	7% (5)	19% (13)	**28% (19)**	15% (10)	12% (8)	**4.95**
Operations	1% (1)	10% (7)	7% (5)	13% (9)	18% (12)	**25% (17)**	19% (13)	6% (4)	**4.98**
Marketing	4% (3)	9% (6)	12% (8)	**25% (17)**	21% (14)	9% (6)	3% (2)	**18% (12)**	**4.05**
Sales	7% (5)	10% (7)	7% (5)	**21% (14)**	18% (12)	13% (9)	10% (7)	12% (8)	**4.29**
Customer Services	6% (4)	12% (8)	9% (6)	13% (9)	19% (13)	**21% (14)**	19% (13)	1% (1)	**4.69**
Linkages among key activities	3% (2)	9% (6)	13% (9)	12% (8)	13% (9)	**25% (17)**	13% (9)	12% (8)	**4.72**

Total Respondents	**68**
(skipped this question)	**2**

15. From the value-chain support activities below, select those that are critical to your firm and specify how well your ERP system supports these key activities. For the remaining activities, just check the "Not Critical" option.

	Critical and Supports Very Poorly			Neutral			Critical and Supports Very Well	Not Critical	Response Average
Procurement (i.e. purchasing inputs to be used in the value chain)	4% (3)	3% (2)	9% (6)	12% (8)	19% (13)	**26% (18)**	19% (13)	7% (5)	**5.10**
Technology Development	6% (4)	10% (7)	10% (7)	15% (10)	19% (13)	10% (7)	7% (5)	**21% (14)**	**4.17**
Human Resource Management	7% (5)	10% (7)	7% (5)	19% (13)	10% (7)	12% (8)	3% (2)	**30% (20)**	**3.89**
Firm Infrastructure (i.e. general management, planning, finance, accounting, legal, government affairs, and quality management)	6% (4)	1% (1)	7% (5)	12% (8)	**24% (16)**	18% (12)	19% (13)	13% (9)	**5.02**
Linkages among key support activities	7% (5)	0% (0)	13% (9)	16% (11)	**24% (16)**	16% (11)	9% (6)	13% (9)	**4.55**

Total Respondents	**68**
(skipped this question)	**2**

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16. Answer the question about the level of support that the ERP system provides to the overall strategy of your firm.

	Very Poorly			Neutral		Very Well	Response Average
How well does the ERP system support your firm's overall business strategy?	6% (4)	1% (1)	12% (8)	10% (7)	31% (21)	**34% (23)**	6% (4)	**4.84**

	Total Respondents	68
	(skipped this question)	2

4. Business Impact of ERP on the Firm ---

17. Indicate to what extent do you agree/disagree with the following statements about the overall impact of the ERP system on your firm.

	Strongly disagree			Neutral			Strongly agree	Response Average
Our ERP system is meeting our firm's expectations.	10% (7)	4% (3)	9% (6)	13% (9)	**32% (22)**	21% (14)	10% (7)	**4.56**
Our firm is more competitive as a result of our ERP system.	9% (6)	4% (3)	7% (5)	12% (8)	21% (14)	**29% (20)**	18% (12)	**4.90**
Our firm has realized significant measurable financial benefits from our ERP investment.	9% (6)	4% (3)	6% (4)	21% (14)	**24% (16)**	21% (14)	16% (11)	**4.72**
In terms of its business impacts on the firm, the ERP system has been a success.	4% (3)	4% (3)	10% (7)	10% (7)	24% (16)	**28% (19)**	19% (13)	**5.04**
ERP has seriously improved this firm's overall business performance.	6% (4)	6% (4)	4% (3)	15% (10)	**29% (20)**	22% (15)	18% (12)	**4.93**
From the perspective of this firm, the costs of ERP outweigh the benefits.	15% (10)	18% (12)	7% (5)	**22% (15)**	21% (14)	13% (9)	4% (3)	**3.74**
ERP has had a significant positive impact on this firm.	5% (3)	3% (2)	9% (6)	12% (8)	23% (15)	**33% (22)**	15% (10)	**5.06**

	Total Respondents	68
	(skipped this question)	2

5. Information Technology (IT) Turbulence ---

18. To what extent do you agree/disagree that the following statements apply to your industry?

	Strongly disagree			Neutral			Strongly agree	Don't know	Response Average
The use of information technology in our industry is changing very fast.	4% (2)	4% (2)	4% (2)	14% (7)	**24% (12)**	22% (11)	**24% (12)**	2% (1)	**5.21**
A large number of new product ideas have been made possible by information technology breakthroughs in our industry.	4% (2)	10% (5)	10% (5)	16% (8)	**22% (11)**	14% (7)	18% (9)	4% (2)	**4.66**
In our principal industry, the modes of production and service change often due to novel information technology.	2% (1)	12% (6)	10% (5)	23% (11)	**25% (12)**	21% (10)	4% (2)	2% (1)	**4.38**
Virtually no R&D in information technology is done in our principal industry.	**37% (18)**	10% (5)	10% (5)	8% (4)	4% (2)	14% (7)	8% (4)	8% (4)	**3.09**

In our principal industry, the modes of

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production and service change in major ways as opposed to slowly evolving.	4% (2)	8% (4)	15% (7)	17% (8)	19% (9)	**21% (10)**	10% (5)	6% (3)	**4.51**

	Total Respondents	**49**
	(skipped this question)	21

19. For statistical purposes, it is necessary to keep track of the number of responses received from each firm so they can be aggregated as a single unit for the data analysis.

		Response Percent	**Response Total**
View	**Company Name:**	100%	64
	Total Respondents		64
	(skipped this question)		6

6. Acknowledgements ---

20. Thank you! A managerial report, based on the present study, will be available for those participants who wish to receive it.

		Response Percent	**Response Total**
View	**Participant's Name**	98.2%	54
View	**E-mail Address**	98.2%	54
	Total Respondents		55
	(skipped this question)		15

21. As a token of our thanks for completing this survey you will be automatically entered in a drawing for a Samsung 7" DVD portable player. As an additional incentive, we will send a thank you gift, free of charge, to the first 100 respondents. Please, enter below your address if you would like to participate in this drawing and receive your gift. Thanks again!

View	**Total Respondents**	**36**
	(skipped this question)	34

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