Factors impacting the Success of ERP Implementations in Small and Medium Enterprises: An empirical assessment from Latin America.

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Abstract.

Enterprise Resource Planning (ERP) systems implementations are consolidating as a critical information technology initiative among small and medium enterprises (SMEs). Even though research exists aimed at analyzing the adoption and success of ERP implementations, there is a significant gap in the literature studying the SME niche. This article investigates the factors determining the success of ERP implementations, specifically considering the niche of SMEs operating in developing regions such as Latin America. The proposed model is corroborated empirically with data from 49 Latin American SMEs. The regression analysis technique allows corroborating 7 of the 8 hypotheses. Some results are consistent with previous research but others seem to be unique to the Latin American context. These results indicate that *Ease to Use* the capacities provided by ERP, as well as *Project Implementation Success* and *User Satisfaction* of an ERP initiative are key factors influencing the overall success of an ERP implementation. However, Change *Management* seems to be not as critical as the other factors. The crucial role of *User Satisfaction* as a *mediating* variable is also corroborated. The success of an ERP implementation is measured in terms of improvements in business performance. The implications of the findings for research and practice are discussed, and additional promising research streams are outlined.

Keywords: ERP Success, Small and Medium Enterprise, Latin America, Critical Success Factors, CSF, SME.

Theoretical Background.

Organizations are continually facing challenges that incite them to rethink and adapt their structures, goals, processes and technologies. They must act promptly and make those changes to sustain their competitive advantage. Many have adopted Enterprise Resource Planning (ERP) systems as enablers to facilitate related shifts and become more adaptable so as to operate better in such dynamic business environments (Kwahk et al., 2008; Beheshti, 2006).

Enterprise Resource Planning (ERP) system is a business management system that encompasses different software components aimed at managing, integrating and optimizing all business processes within an organization. Researchers estimated investments in ERP implementations at around US$ 300 Billion in the last decade. Specifically in 2004, expenditures were expected to reach around US$ 79 Billion (Carlino et al., 2000). These facts are a strong reference point on the priority and importance that current business environment attach to adopting ERPs. Moreover, Ross et al. (2000) have called the global trend to adopting ERP as a true "ERP Revolution".

Why are researchers and practitioners increasingly interested in analyzing ERP implementations? One such reason may be the series of contradictory success and failure outcomes experienced so far. Mabert et al. (2003) acknowledge that there is no consensus on the impacts associated to any specific ERP adoption, a notion Al-Mashari (2003A) also supports. When ERP is properly implemented and assimilated, the incremental benefits accrued can be extremely relevant, leveraging most of the key strategic drivers in organizations (Shang et. al, 2000). Case studies have revealed that successful ERP implementations can contribute dramatic cost savings because of underlying process

integration, which enables different ways to manage business processes inducing a positive impact on profits. Other studies have also analyzed ERP systems' impact on revenue-creating core processes, such as customer services, sales and distribution, resulting in a strong bottom line (Davenport, 2000). In an empirical research, Hitt et al. (2000) reveal that organizations committed to implementing ERP performed better across a wide variety of financial metrics.

But even though implementing ERP may have leveraged the competitive advantages of many organizations, in other cases, the underlying implementations have led to dramatic failures with irreversible effects. For instance, Davenport (1998) reports FoxMeyer Drugs directly attributed its financial crisis and subsequent bankruptcy to their having introduced an ERP system. Gargeya et al. (2005) refer that 70 percent of all ERP projects are never entirely implemented, even after efforts lasting longer than 3 years. The importance of ERP and the connected risks make it indispensable for organizations to focus on ways to improve ERP implementation processes (Somers et al., 2004).

From a different perspective, and assuming that ERP can be successfully implemented, organizations still face serious barriers and challenges before deriving concrete benefits. A large enterprise may need thousands or even millions of US dollars to embrace these projects (Robey et al., 2002). Implementation time is another critical issue, since it affects the company's regular business and reduces the availability of organizational resources. The existing evidence shows significant fluctuations in the time needed for accomplishing the results expected from ERP implementations. In some cases, those results are markedly disappointing compared to initial expectations (Bajwa et al., 2004).

Such contradictory outcomes raise concerns among companies evaluating ERP as a crucial strategic initiative (Davenport, 1998). Loh et al. (2004) sustained these

contradictory findings offer a unique opportunity for conducting studies oriented to identify key factors that can influence the success of ERP implementations.

A comprehensive review of the literature related to ERP success has revealed several gaps that are addressed in this study. My findings lead to several implications that support and expand current knowledge about ERP and the actual dimensions of its success.

Motivation of the Research.

The extensive adoption of ERP by large and small and medium-size organizations has attracted particular interest in recent times. This "ERP Revolution" (Ross et al., 2000) has taken place because of the increasing need in organizations to integrate and streamline their internal processes as a requisite to remain competitive. The analysis of such "ERP Revolution" is attracting the interest of researchers not only from the Information Technology discipline, but also from all major disciplines in business research (Wieder et al., 2006). Nevertheless, as Al-Mashari (2003A) recognized, there is still much research needed before we can understand the ERP phenomenon. The following motivations underlie my interest in examining new dimensions of this phenomenon.

Motivation #1: ERP Success and Related Critical Factors.

Despite the significant investments in ERP initiatives made by organizations around the world, formal efforts to determine their success and the underlying causes have been very limited (Gable et al., 2003). Even though some organizations begin to realize and expand the benefits from these systems, in many other cases, ERP success has been very limited and has not resulted in significant organizational improvements (Kamhawi, 2007). There is no consensus either on the perception of benefits that an ERP system can bring to an organization or on the underlying factors of its ERP success (Ifinedo, 2007). Finney et al. (2007) explicitly recognize this situation, emphasizing the gap in the literature about the scrutiny of critical factors involved in ERP success. Finney et al. (2007) also emphasize the importance of assessing ERP success in terms of *business value* generated through its implementation.

Motivation #2: ERP Success in Small and Medium-size Enterprises context (SMEs).

ERP implementations have been traditionally associated with large enterprises. However, SMEs are getting more interested in implementing ERP not only to improve their business processes but also to align themselves with the partnering prerequisites established by large enterprises (Rao, 2000). Many multinational companies have restricted partnering for their operations only to those SMEs that use ERP software. Moreover, the literature suggests that the interest of ERP vendors in SMEs has also increased as a natural consequence of the saturation of the large enterprise niche (Van Everdingen et al., 2000; Gable et al., 1999). More affordable offerings are being provided to SMEs (McGaughey et al., 2007).

But besides the increasing adoption of ERP by SMEs, ERP research has been primarily conducted in the context of large enterprises (Loh et al., 2004). Given that SMEs are inherently different from large organizations (Ghobadian et al., 1996), there may exist both a need and an opportunity in following a line of research focusing on the success factors of ERP adoptions at SMEs.

Motivation #3: ERP Success in Developing Economies.

Organizations in less developed economies have begun to use ERP actively (Kamhawi, 2007). Nevertheless, Nah et al. (2007) and Kamhawi (2007) affirm that there are very limited studies aimed at examining ERP systems' success in developing nations. Koh et al. (2006) support this standpoint and also sustain that, from the very few studies available, it appears that significant differences exist in how those ERP systems are adopted and implemented across geographies. In addition, no research was found in this field focused specifically in the Latin American perspective.

Research Questions.

This study is aimed to address the following research questions:

- Considering the Small and Medium Enterprises (SMEs) of Latin America, what factors influence the success of ERP implementations?
- Considering the Small and Medium Enterprises (SMEs) of Latin America, what relationship exists between successful ERP and some selected factors?

Purpose of the Study.

This study is aimed at accomplishing the following objectives:

- To propose an *ERP Success* model, identifying factors that have an effect on such success.
- To validate empirically the proposed model, examining specific relationships between factors and ERP success.
- To circumscribe the research to the SMEs niche operating in developing countries, specifically Latin America.

Significance of the Study.

The literature suggests that research in the area of *ERP Success* is just beginning to appear (Gable et al., 2003). In addition, such existing literature has mainly focused on large enterprises and only few studies have attempted to validate proposed models empirically (Somers et al., 2004; Hitt et al., 2002). This gap is even more noticeable when SMEs are the subject of study (Shehab et al., 2004). An even greater challenge emerges when those studies target organizations operating in developing economies. It is

expected that research that aims at investigating ERP's success in the SMEs niche in developing countries, by proposing a model and attempting to validate it empirically, will definitely contribute to expand limited present knowledge. In addition, findings from such research should trigger additional research as well as provide guidelines to practitioners eager to ensure the successful infusion of ERP in their organizations. The results from this research will definitely contribute to the understanding of the ERP phenomenon.

Scope of the Study.

This research is defined by the following delimitations:

Delimitation #1: ERP Success perspective.

As Markus et al. (2000a) emphasize, the success of ERP implementation is not restricted to an identifiable single dimension and it admits diverse perspectives. On the other side, success can be also perceived differently by several actors such as managers, end-users, and investors. This implies that "success" can be defined in diverse ways and can also mean different things depending on the underlying perspective. For instance, Markus et al. (2000a) distinguish between two types of success of an ERP implementation: project success and business value success.

In this study, ***ERP Success*** will mean the extent of the improvement in business and performance value generated in the organization by means of the ERP implementation. This definition of *ERP Success* is also supported by Finney et al. (2007), who reinforce the importance of conducting empirical studies in companies that have completed their ERP implementation to evaluate the tangible business effects inherent to such adoption.

Delimitation #2: SME Definition.

The literature also suggests that there is not an internationally-agreed definition of Small and Medium Enterprises. Katerattanakul et al. (2006) and Muscatello et al. (2008) describe SMEs as organizations having less than 500 employees. Koh et al. (2006) propose the SME term to define those companies ranging in size from 30 employees to 400 employees. Adam et al. (2000) adhere to the European definition of SMEs as companies employing less than 250 employees. Raymond et al. (2006) summarize these several perspectives emphasizing that in North American research, SMEs are defined as companies having less than 500 employees compared to less than 250 in Europe.

In this study, Small and Medium Enterprises will mean companies having less than 250 employees in size. This definition of the SMEs has been adopted in several researches, such as Laukkanen et al. (2007) and Raymond et al. (2006).

Literature Review.

Introduction: How was the Literature Review conducted?

The literature review in this research can be classified as a *theoretical review* in the sense that it is focused on extant theory that relates to the problem under study. The goal is to provide an integrative examination about past related research and highlighting its gaps.

The literature review in this study was conducted following the structured approach suggested by Webster et al. (2002):

- Main journal databases (including Proquest - ABI Inform, ScienceDirect, SpringerLink, Emerald) were consulted to accelerate the identification of relevant articles. Also, the AIS Electronic Library was examined to get access to major conference proceedings. Main key words used included ERP, ERP Success, ERP Adoption, SME, Small Businesses, Latin America and Enterprise Systems.
- With the relevant articles found in the previous steps, an examination on their own references was conducted to determine previous articles that should also be considered and analyzed (***Go backward*** approach).
- Once obtained this initial set of articles from the two previous steps, using the Social Sciences Citation Index (ISI Web of Knowledge), new articles citing any of these papers belonging to the initial set were also identified to determine if those should be also included in the review (***Go forward*** approach).

Next sections encompasses main references found related to the problem studied.

Enterprise Resource Planning (ERP): What is it?

According to Chang et al. (2008), the term ERP was formally used first by the Gartner Group in the early 1990s. In their definition, the ERP term designates an integrated set of software packages intended to tie together various business processes such as financial, human resources, supply chain and logistics. Nonetheless, there is not a single accepted definition on this technology and research usually describes the functionality of ERP to position this concept.

Klaus et al. (2000) describe ERP systems as "comprehensive, packaged software solutions [that] seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture."

O'Leary (2000) describes ERP systems as "computer-based systems designed to process an organization's transactions and facilitate integrated and real-time planning, production, and customer response."

Moon (2007) presents ERP as "an enterprise information system designed to integrate and optimize the business processes and transactions in a corporation".

Kamhawi (2007) outline an ERP system as "comprehensive software packages that seek to integrate the complete range of business processes and functions in order to present a holistic view of the business from a single information and information technology architecture."

From the perspective of many users, ERP system is the information backbone that supports every business function, from sales orders entry to post-sale customer service. But unlike other information technology (IT) systems, ERP implementations have encouraged companies to shift from the traditional "functional silos" paradigm to an organizational paradigm focusing on planning and execution. This new paradigm will definitely reshape business processes, allowing organizations to take advantage of the new automated, real-time and seamless value-added capabilities offered. ERP's promise is to provide an information technology platform aimed at improving "how business is done", allowing organizations to plan and manage their resources in an efficient, productive and profitable manner (Laukkanen et al., 2007).

Evolution of ERP.

Legacy systems are constituted by the early enterprise systems within organizations. When these legacy systems were conceptualized and implemented, processes were often envisioned within the paradigm of the division of labor. These systems usually solved particular departmental needs, but lacked the ability to integrate them. Therefore, it was usual to collect and process the same information multiple times in different places, creating a serious challenge when decision makers tried to retrieve the right piece of information in real time. This platform generated serious asymmetries between different functional groups within the same organization (Kang et al, 2008).

Organizations realized that those systems should be integrated to gain efficiencies. Manufacturing Resource Planning system, or MRP, was the first response to overcome such problems. MRP systems were basically inventory control systems focusing on materials and planning control. These systems were comprised of a set of decision rules designed to translate a master production schedule into concrete time-phased

requirements (Orlicky, 1975). In the early eighties, these systems were expanded in scope and incorporated additional capabilities to support other business functions such as production, marketing, sales and finance. This extended MRP was called then Manufacturing Resource Planning II (MRP II) (Barker, 2001).

But, although MRP II made significant progress in bringing together diverse processes and units within the organization, as Chung et al. (2000) states, it still failed in becoming a real enterprise-wide system, because of issues relating to its interoperability, interfacing, protocol incompatibility and ability to cover additional business processes.

To overcome the insufficiencies of MRP II, mainly those referring to integration flaws, a new generation of information technologies came to the scene and started evolving strongly. These new systems were known as "enterprise resource planning" (ERP) systems, a term coined by Gartner Group (Ragowsky et al. (2002)). ERP systems constituted the natural evolution of Material Resource Planning (MRP) solutions that emerged in the seventies (Davenport, 1998), integrating not only manufacturing processes, but also linking the wide spectrum of business functionalities and processes required within any organization. ERP systems emerged to honor the promise to flawlessly integrate the information from an entire enterprise, including processes such as production, customer orders, inventory, purchasing, sales and distribution, human resources, and supply chain (Kang et al, 2008). Since then, ERP systems have been acknowledged as one of the most innovative developments in the information technology arena (Al-Mashari, 2003A). By 1999, 70 percent of Fortune 1000 companies had either adopted or were in the process of implementing ERP systems (Brazel et al., 2008) (Cerullo et al., 2000).

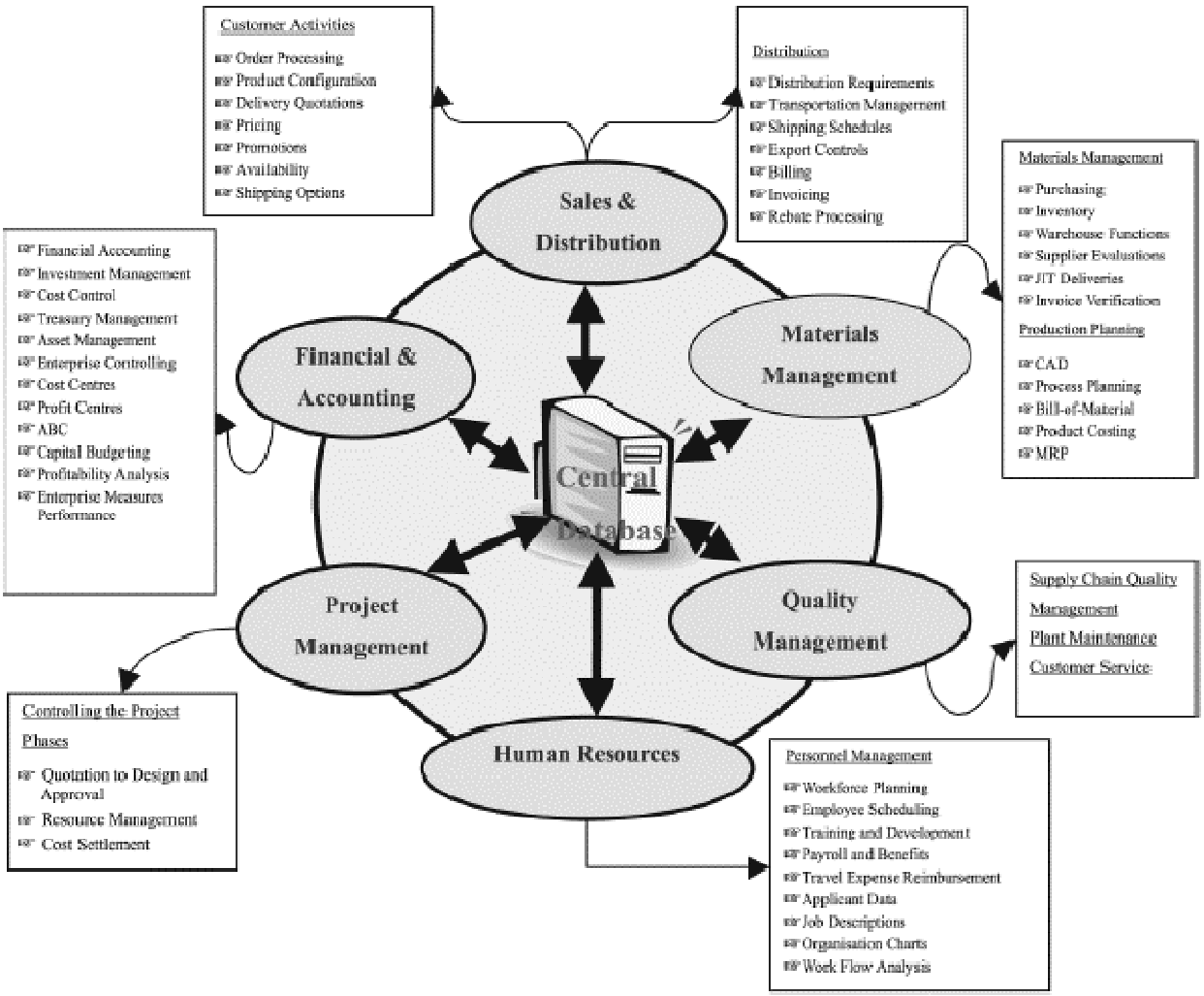
ERP: Main Functions and characteristics.

After reviewing the functions most commonly found in ERP packages, Siriginidi, (2000) proposes a list of the typical components of these packages:

- Finance (financial accounting, treasury management, enterprise control and asset management)
- Logistics (production planning, materials management, plant maintenance, quality management, project systems, sales and distribution)
- Sales, purchase and inventory (sales and distribution, inventory and purchase)
- Materials' requirements planning
- Human resources (personnel management, training and development, and skills inventory)
- Engineering data control (bill of material, process planning and work center data)
- Resource flow management (production scheduling, finance and human resources management)
- Works documentation (work order, shop order release, materials' release and route cards for parts and assemblies)
- Shop floor control and management and others like costing, maintenance management, logistics management
- Workflow (integrates the entire enterprise with flexible assignment of tasks and responsibilities to locations, positions, jobs, groups or individuals)

An overview of ERP systems' scope and processes covered, according to Shehab et al. (2004), is shown in Figure 1.

Figure 1 - ERP Traditional Scope.



Esteves et al. (2001) recognize that ERP not only provides the software architecture, but also offers process templates that embody *"industries' best practices"* already prepackaged. Kumar et al. (2000) underscore the exceptional value of those reference models offered as part of the ERP solution.

Kang et al. (2008) synthesized that these ERP systems exhibit four fundamental characteristics:

- ERP systems' can be considered as multinational systems since they reflect national laws and regulations from specific country environments.
- ERP systems' comprise reference models that reflect preferred business models in terms of best practices, data employed and organizational structure.
- ERP systems' integrate all business processes within an organization, enabling real time access to the same information.
- ERP systems' provide flexibility, allowing organizations to customize the system to fulfill specific scenarios and circumstances.

ERP: Advantages.

The market for ERP is very profitable and demand has grown consistently over the years (Bajwa et al., 2004). Kalakota (1999) discussed the reasons why organizations increasingly adopt ERP:

- The need to set up a technological platform aimed at improving customer order processing.
- The need to consolidate diverse information technology pieces under a central backbone. Share common data and practices in order to reduce errors.
- The need to manage business information so as to make it available anywhere, anytime, and to access information in real-time to facilitate better decisions.

- The need to establish a flexible infrastructure that allows organizations to adapt to the ever-changing environment. "Multi" capabilities (multi-currency, multi-language, multi-companies) are required to operate effectively in the global environment.

Rowe (1999) describes ERP implementation as the path to reach management's dream of unifying and centralizing all the information required by the firm in a single enterprise-wide system. ERP provides the common infrastructure, language and repository of information within the organization that may bring diverse benefits such as:

- Consolidation of information technology applications.
- Standardization of company procedures and operational reports.
- Optimization of business processes. Integration of these processes across organizational functions and locations.
- Strategic management of business information.

Koch (2002) summarizes the main benefits and reasons companies adopt ERP:

- Integrating financial information
- Integrating customer order information
- Standardizing and speed up manufacturing processes
- Reducing inventory
- Standardizing HR information

Brazel et al. (2008) and Winters (2004) agree with these benefits but also highlight the importance of ERP in reducing complications with Sarbanes-Oxley Act compliance. As Dillon (1999) states, ERP provides management with a unified enterprise-wide view of the firm's financial condition in real time, providing managers unparalleled access to accounting information and therefore, minimizing reporting lags, even those reports

aimed at disseminating good news to the market (Brazel et al., 2008). Anecdotal evidence supports the argument that ERP implementations definitely affect the timeliness of financial accounting and reporting information, by at least decreasing the financial close cycle (Wah, 2000).

Rowe (1999) also states that ERP provides a significant level of portability and flexibility in adapting to specific requirements of organizations and therefore ensuring efficient alignment in varied business environments. Al-Mashari (2003B) recognizes that ERP systems are considered as the standard technology for running businesses. Shehab et al. (2004) assure that firms recognize investments in ERP implementations as the "price of entry for operating a business". Markus et al. (2000b) state that successful ERP adoptions are critical not only from an organizational performance perspective, but also for business survival. Poston et al. (2001) sustain that one of the most relevant benefits of ERP implementations lies in allowing an enhanced managerial decision-making process via the provision of accurate and timely enterprise-wide information. Palanisamy (2008) reinforces this and sustains that organizations are implementing ERP systems to strengthen competitive advantages by integrating their business areas, and providing a single holistic view of the enterprise through real time information management.

Hunton et al. (2003) even found that the financial performance of non-ERP-adopters decreased, even affirming that it is necessary to implement ERP to stay as a market player. Brazel et al. (2008) sustain that ERP implementation announcements bring forth positive market responses.

Recognized corporations such as Nestle, Microsoft, Gillette, Airbus, Mercedes-Benz, Pioneer, and specifically Latin America corporations like Gruma, Grupo Gigante, Inelectra, Carsa, PDVSA, have already adopted ERP technology and reached tangible

benefits. Some of these benefits include cost reductions, strategic cost management and more efficient delivery times.

Documented ERP success stories are summarized in Table 1.

Table 1 – Some ERP Success Stories documented.

Case	Author	Highlights
Taikang Life	Chen (2007)	ERP implementation allowed the firm to increase efficiency, reduce costs, and control risks resulting in an impressive ROI of 398%, IRR of 80%, and payback period of 1.9 years (IDC, March 2007).
Multimedia Technology Holdings (TCL)	Xiao et al. (2007)	By deploying ERP, TCL improved production cycle time by 17%, finished good inventory turns by 15%, and shortened delivery time. The project will pay for itself in 2.1 years with 340% ROI and 65% IRR.
Telefonica Movistar Venezuela	Fierro et al. (2006)	Telefonica Movistar Venezuela automated financial processes, integrated business operations, and increased operational efficiency by implementing the ERP application while improving its control over income, costs, and expenses. Telefonica's return on the investment was 110% and internal rate of return was 23%.
Air France	Pang (2006)	Air France has experienced significant benefits after a successful ERP implementation that impacted growth initiatives, improved competitiveness, and boosted operational efficiency.
Checkpoint Systems	Lykkegaard (2007).	Checkpoint Systems Europe implemented the ERP application across its European subsidiaries in Germany, France, Poland, Benelux, Spain, the U.K., Norway and Finland. It automated business process, and increased efficiency, management transparency, speed, agility and industry compliance.
Smiths Manufacturing	IDC (2006)	ERP implementation reduced production and sales costs, improved planning processes, and increased employee efficiency. Raw materials warehousing throughput fell from an average 38 days to 31 days between 1999 and 2006. Finished product warehouse time fell from 11 to 4 days for the same period.

But this spectacular adoption rate is not a matter exclusively of the past. The solid path of growth seems to remain strong in the future: Ifinedo (2007) cites that this market will grow from US$47.9 billion in 2004 to US$64 billion by 2009. There are still many companies seeking the benefits offered by the "ERP dream".

ERP: Obstacles and Disadvantages.

One of the strongest concerns that a company faces when evaluating adopting an ERP system is created by its perception that it will require a significant investment of time and tied-in costs (Palanisamy, 2008). Even more so, many companies believe that only large enterprises can afford an ERP implementation because of the huge effort implied by the necessary redesigning of its business process. Besson (1999) commented on how quickly the managers charge ERP initiatives as the main reason of multiple company failures. It seems that any managerial underestimation on any aspect of these ERP implementations, but mostly those relating to the management of change, can bring about extremely high risks for the organization, in many cases with irreversible effects.

Davenport (2000) has summarized the main criticisms directed at ERP systems as follows:

- Inflexibility. Once ERP is installed in a company, it is too difficult to change how the company works and organizes its processes.
- Long implementation periods. It takes too long to implement ERP systems. A three to five year implementation period of ERP systems is fairly common for a large company.
- Promotes overly hierarchical structures. ERP systems presume that information will be centrally managed and that organizations have a well-defined hierarchical structure.

Some research such as Markus et al. (2000a), Gibson et al. (1999), Hunter et al. (2000), and Caldas et al. (2001) affirmed that the adoption of ERP systems has not necessarily turned out to be the right solution for those organizations desiring to improve their business processes and underlying capabilities. Indeed, in many instances, ERP implementation has resulted in dramatic misfortunes for those organizations.

Table 2 shows some documented dramatic experiences.

Table 2 – Some ERP Dramatic Failures documented.

Case	Author	Highlights
Hewlett-Packard	Lindquist (2008)	HP's 2004 ERP implementation followed Murphy's Law—everything that could have gone wrong, did. The project eventually cost HP $160 million in order backlogs and lost revenue—more than five times the project's estimated cost.
Nike	Lindquist (2008) Songini (2001)	ERP Implementation and integration with other systems caused $100 million in lost sales, a 20 percent stock dip and an assortment of class-action lawsuits.
Hershey Foods	Palanisamy (2008) Koch (2002) Stedman (2000)	ERP implementation prevented Hershey from delivering $100 million in pre-Halloween tooth rot. The day that former CEO announced the system problem, the stock experienced an 8 percent drop.
Volkswagen AG	Palanisamy (2008) Recktenwald (2000)	Experienced trouble delivering spare parts to car dealers.
FoxMeyer Drugs	Jesitus (1997) Wheatley (2000)	Following an ERP implementation in the mid- to late-1990s, the company's bankruptcy trustees filed a $500 million lawsuit in 1998 against ERP Software Provider, and another $500 million suit against co-implementer, claiming the companies' software and installation efforts had contributed to the drug company's demise.

As Palanisamy (2008) suggests, dramatic cases like those previously mentioned, have highlighted the importance of understanding issues that may arise during an ERP implementation, and more important, starting to learn how to overcome them. Deep research in this area is undoubtedly required: "The ERP journey can be amongst the most complex IT-related changes that an organization can undertake" (Kraemmergaard et al., 2002).

ERP: Research Agenda.

Esteves et al. (2001) emphasize that ERP research was a relatively new focus within the IT community. At that time, they stated that "despite the growing interest in ERP systems, publications on these systems within the academic Information Systems (IS) community, as reflected by contributions to journals and international conferences, is only now emerging. Research on ERP systems has been treated as a "secondary" and its importance has been neglected by the IS community". Gable (1999) supports this vision and reinforced the need to consolidate underlying research in the ERP arena. With the intent to measure current progress, Esteves et al. (2001) determine that in 1997, around 5 articles, related to ERP, were presented in journals and conferences. They notice that, in 2000, this number raises to 76. Between 1997 and 2000, they have estimated, in around 189, total articles presented. This fact backed the increasing interest and motivation in the ERP research community.

Al–Mashari (2003) confirms the widespread adoption of ERPs and proclaimed that "both IT practitioners and researches are still not able to determine the potential impact of ERP adoption on adopting organizations". Based on this scenario, he concludes that "the need for a new research agenda to address various issues in this context has never been more urgent".

Al–Mashari (2003) contributes also in a significant direction, summarizing the major streams in ERP research based on a comprehensive review he conducted based on what had been written up to 2003. His findings related to Taxonomy of ERP Research are exhibited in Figure 2.

Figure 2 – Taxonomy of ERP Research

In a more contemporaneous course, Brazel et al. (2008) have brought up to date current research streams, sustaining that, according to empirical research conducted, existing streams can be surrounded in three categories:

- **Critical Success Factors**. Given the inherent formidable challenge associated to ERP implementations, many studies have aimed at identifying factors that positively affect the success of ERP installations. Within this stream, some relevant studies include Brown et al. (2007), Kamhawi (2007), Finney et al. (2007), Soja (2006), Nah et al. (2006), Gargeya et al. (2005), Sun et al. (2005), Loh et al. (2004), Somers et al. (2004), Nah et al. (2003), among others.

- **ERP announcements and market reactions**. Diverse studies have focused on analyzing the positive reactions generated in the market when an organization announces its imminent ERP implementation. Representative studies in this stream include Hayes et al. (2001), Hunton et al. (2002).

- **ERP implementation and impact on performance.** Other researchers have focused on analyzing the impact of ERP systems on operational performance. Generally, these studies have adopted an accounting-based performance measures perspective (centered primarily on financial ratios). Distinctive studies in this stream include Poston et al. (2001), Hitt et al. (2002), Hunton et al. (2003).

ERP experiences at SMEs.

Even though ERP systems were initially thought to run on large enterprises, SMEs are increasingly motivated to introduce ERP implementations (Adam et al., 2000). Business drivers such as globalization have reconfigured the SMEs' competitive environment and these organizations are almost required to adopt institution-wide information technologies to compete properly in the new conditions (Lebre La Lovere, 1996). In fact, there is not necessarily much difference in the events that trigger an ERP implementation in SMEs compared to large enterprises. SMEs attempt to enhance their organizational performance thanks to the ability of an ERP implementation to help in providing real-time information, introducing best practices into core business processes, and updating obsolete technical platforms (Adam et al., 2000; Thong, 1999). Woodie (2005) restates that many small and medium size enterprises are still using obsolete applications which do not support emerging business practices. Koh et al. (2006) concludes that SMEs have the same needs as large enterprises but face different challenges in view of their limited financial resources and capabilities. Buonanno et al. (2005) confirm that SMEs either do not have sufficient resources or are not willing to devote a significant portion of their resources to a complex ERP implementation process. Rao (2000) also holds that SMEs are more fragile than large companies.

And the adoption of ERP is no longer limited to large enterprises (Loh et al., 2004). A deeper understanding of the ERP implementation at SMEs is needed to ensure a strong impact. Huin (2004) holds that unless differences between SMEs and large enterprises are clearly understood, ERP projects in SMEs will not reach the desired outcomes. Those facts reveal that the SME niche definitely demands specific research and analysis other than previous investigations primarily targeting large enterprises. This need has been

perceived so some researchers have started addressing specifically ERP implementation at SMEs.

Critical success factors (CSFs) and differences between SMEs and Large Enterprise considering the ERP selection processes are the main areas of current research on ERP implementation in SMEs. Sun et al. (2005) analyze the critical success factors of ERP implementation in order to propose a structured approach to help SMEs. Grounded on the literature, they consider five critical success factors: management and organization, process, technology, data and people. They emphasize that some CSFs are more important than others. For instance, "people" is the main CSF. In other relevant research, Muscatello et al. (2003) adopt a case study research methodology to analyze implementation activities in order to establish criteria that lead to a successful installation. They indicate that "effective executive management commitment can help a project to achieve success" and that the choice of the "executive sponsor" is significant. Based on a review of the literature, Loh et al. (2004) propose a framework depicting primary factors that may influence the success of ERP implementations in SMEs. Buonanno et al. (2005) contribute with an empirical research analyzing factors affecting ERP adoption and compare SMEs to large companies. This study presents a strong correlation between company size and ERP adoption. A similar comparison between large companies and SMEs is also embraced by Bernroider et al. (2001) but focused specifically in the ERP selection process. The differences they identify relate to "a different approach to staffing the group performing the selection process". Basically, large organizations engage more persons in decision making processes than SMEs. SMEs select ERP with less complex models and less expensive methods.

Table 3 summarizes main research focusing on this area.

Table 3 – Previous research analyzing ERP implementation in SMEs.

Authors	Purpose
Buonanno et al. (2008)	To provide insights about ERP adoption identifying significant differences between SMEs and large companies and the underlying process.
Ifinedo (2007)	To evaluate empirically the relationship between firm size and ERP success.
Raymond et al. (2006)	To provide and validate a framework for evaluating the level of readiness for ERP adoption in manufacturing SMEs. A field study including 11 SMEs was conducted.
Koh et al. (2006)	To examine the ERP adoption in Greek companies (Greek market consists largely of SMEs). Field research including 6 SMEs case studies was conducted.
Loh et al. (2004)	To define a reference framework identifying critical success factors impacting ERP implementations at SMEs. Interviews with 8 SMEs were conducted.
Muscatello et al. (2003)	To investigate the implementation process in small and midsize manufacturing firms in the US. A field research including 4 SMEs case studies was conducted. Nevertheless, these 4 organizations were subsidiaries of larger firms.
Adam et al. (2000)	To analyze relationships between organizations which attempt to implement ERP and their implementation partners. A field research including 14 SMEs was conducted.

In conclusion, most research addressing ERP implementations in SMEs has been concentrated primarily on ***identifying***, through literature reviews or exploratory studies, factors that may impact such implementations (CSFs). Also, additional existing research has hinged on proposing major differences between the SMEs and Large Enterprises' approaches to adopt an ERP (but mainly focused in the ERP selection process).

Unfortunately, what existing research has not yet explored in depth is the situation of SMEs *per se*, *empirically* addressing the success of ERP implementations and its underlying factors. Also, as Equey et al. (2008) clearly note when referring to ERP implementations at SMEs: "Perceived rates of success and satisfaction are scarcely explored in the literature". If, on top of this, we acknowledge the fact pointed out by Wresch (2003), who claimed that much of the research concerning IT adoption in SMEs (particularly in developing countries), is merely descriptive and lacks a strong theoretical foundation, the evident consequence is a substantial gap in the current literature. Precisely this is the intention of my study: To lead a research stream that will create knowledge in the area of ERP implementation success in SMEs, specifically those operating in developing regions such as Latin America.

SMEs and Technology Adoption in Latin America.

SMEs in Latin America: General Introduction.

Understanding small business is an important area of research (Lussier et al., 2008). The contribution of SMEs is extremely important to the economy and rapid growth. Two specific instances in Latin America illustrate this importance:

- In Chile, 80% of the economy is dominated by SMEs, while 49% of employment is created by SMEs (Nasco et al., 2008).
- In Mexico, the SME sector accounts for an important share of economic activity. There are an estimated 2 million SMEs in the formal sector throughout the country, or about 60% of all businesses. They contribute about 45% of the value added by the private sector and account for about 55% of private-sector employment. As is the case elsewhere in Latin America, Mexican SMEs are very heterogeneous and are distributed in the commerce, services and manufacturing sectors (Ramirez, 2005).

Traditionally, the management structure of Latin American SMEs is complex. In locally-owned firms, family business cliques have often made for ad hoc decision-making that was mostly opaque to outsiders. Many SMEs still operate under the weight of a legacy of substandard quality, exhibiting management that is either too personalized or bureaucratic. As a result, lack of access to investment capital, technology know-how and commercial linkages are among the broader challenges facing established SMEs in this region. Ramirez (2005) has summarized main challenges faced by SMEs in Latin America as follows:

- **Lack of training in and development of entrepreneurial skills**. An entrepreneurial culture has not fully taken hold in Latin America. Companies, especially micro and small ones, often begin as subsistence enterprises without a strong awareness of basic management techniques.

- **Limited training in and development of human resources**. Entrepreneurial and human-resource training constitutes one of the keys to raising productivity. Nevertheless, this need is often neglected by companies, due to budget and time constraints, among other factors.

- **Lack of information systems and of awareness of the market and marketing issues.**

- **Lack of efforts to promote technological innovation**. SMEs are hampered by the lack of a suitable policy to promote technological innovation and the failure to make technology a high priority.

- **Lack of access to appropriate financing.**

- **High costs of meeting regulatory requirements.** The excessive requirements entrepreneurs must meet when opening and running a business often limit their ability to expand output.

SMEs in Latin America: the Inter-American Development Bank (IDB) perspective.

As Carrillo (2007) points out, although SME statistics and research in Europe and North America are very fertile, unfortunately this is not the case in Latin America. Even more so, these kinds of analyses in our region are still very scarce and uncommon. According to Carrillo (2007), there are basically four institutions that have conducted the limited existing research about the current status and challenges of SMEs in Latin America: the International Labor Organization (ILO), the Organization of Economic Co-operation and Development (OECD), the Inter-American Development Bank (IDB), and ECLAC (Economic Commission for Latin America and the Caribbean).

The most updated and comprehensive facts and statistics about SME performance in Latin America were obtained from an IDB report titled *"Institutional Capacities for Small Business Policy Development in Latin America and the Caribbean"* (Angelelli et. al, 2006). The rest of the paragraphs in this section present excerpts from that report as the best snapshot considering the "SMEs Sector in Latin America" found.

SMEs in Latin America: Preliminary Facts.

SMEs are the drivers of growth in all Latin American and Caribbean (LAC) countries. Data from 18 countries reveals SMEs make up the bulk of businesses by far. Adding up the figures across countries indicates there are altogether more than 17 million micro-enterprises, accounting for about 94 percent of all enterprises in the region under study. Small businesses make up the next largest contingent of firms, with more than 3 percent

of all firms in the 18 LAC countries. The number of large firms compared to the total number of firms Latin America is small; they account for less than 0.5 percent of all firms in the region. OECD countries (members of the Organization for Economic Cooperation and Development) show a similar breakdown by firm size. In the European Union, SMEs (less than 250 employees) accounted for 99.8 percent of firms in 2003, or about 23 million SMEs. In all countries, the number of microenterprises has greatly increased. For example, more than 3 million new microenterprises were created in the Brazilian economy between 1995 and 2002, or 45 percent growth. This is in contrast with large firms, which grew only 11 percent over the same period. Only in Chile did large firms grow more in percent terms since 1995. Data on changes on the status of firms reveal that some large firms in 2004 actually graduated from what were micro or small firms in 1995.

SMEs by number of workers.

SMEs fluctuate considerably by number of workers. The average across the countries is just about 30 workers per SME, with a few countries greatly pulling this average up.

SMEs' Contribution to Employment.

The available information indicates that just as micro, small, and medium enterprises in LAC make up the bulk of the total number of firms, they also account for the majority of private employment. In 17 countries, SMEs account for about 77 percent of total employment. Nearly 65 percent of that is due to microenterprise employment alone. Large firms, which make up less than 0.5 percent of total firms in the region, account for

23 percent of employment. SMEs in Latin America have historically played an important role as generators of employment, and in some cases that role has increased.

SMEs in OECD countries also account for a large share of employment. SMEs in these countries are generally firms with fewer than 250 employees. SMEs so defined in the 25 European economies employed 66 percent of the private sector workers in 2003. Small businesses in the United States (fewer than 500 employees) generate 68 million jobs, employing about half of the private sector workforce. In both Europe and the United States, the general trend is that SMEs are adding more new jobs than large firms are, and that the share of SME employment has been increasing. Latin America in general reflects a similar trend, with the exception of Chile where large firms are growing faster than small firms.

Productivity Gap.

Analysis of eight LAC countries with available data indicates that SMEs contribute between 30 and 60 percent of GDP. However, SMEs' percentage contribution to GDP remains below 50 percent for most countries, revealing that there is room for SMEs to improve their productivity and contribution to national wealth.

By comparing annual sales and employment, we can also learn about worker productivity (annual sales per worker). In the case of Chile, annual sales per worker in a micro/small enterprise total about US$9,257, while for a medium/large firm the amount is about US$94,008. This productivity gap between micro/small and medium/large enterprises could be the consequence of different levels of access to hard and soft technologies, financing, markets, and human resources.

Economic Sectors.

Relatively few countries in Latin America provide employment data by sector and firm size. Most Latin American small firms are engaged in the commercial trade sector, which includes wholesale and retail trade. Jobs in the retail sector typically pay much lower wages and less job growth potential, skills upgrading, and job security. For example, in Brazil in 2002, the median salaries and wages paid in the retail sector across all firm sizes (US$1,304) was less than half of that in the industrial and service sectors. The trend prevails for all firm-size categories despite the fact that retail paid more total wages and salaries than manufacturing, and nearly as much as the services industry. This finding provides an insight into why micro and small businesses, despite their great numbers, do not earn correspondingly high revenues. The fact that nearly half of all micro and small firms in Latin America are located in the more volatile retail sector may also point to why these firms often have a shorter or more unstable life span than that of larger firms.

Financing.

Access to credit is one of the most significant barriers SMEs face in expanding production and reaching new markets. Credit inhibitors include inability of smaller firms to provide guarantees, high interest rates, and excessive red tape and requisites, among others. Smaller enterprises must defeat many obstacles before qualifying for a loan, compared to larger firms. It should be noted, however, that information about SME access to credit is scant in the region. Smaller firms' ties to the financial sector are much thinner than large firms' (Donato et al., 2003). This implies that smaller firms are less

aware of and less eligible for, interested in, and/or inclined to apply for mainstream financial products. Most small firms turn to other forms of credit, which may be either more expensive or more restrictive, impeding other investments.

A recent World Bank study shows most Latin American enterprises finance their new investment projects with their own funds or retained earnings. Small enterprises are more likely to use internal funds or retained earnings than large firms are. This may indicate that small firms have fewer opportunities to access formal or traditional sources of financing. Or it may indicate that they out away savings to draw from. Even if able to, small firms tap and use formal credit less than large firms. Conversely, small firms resort to informal financing 80 percent more often than large firms do.

There is somewhat of a reverse relationship between the use of informal and bank funds by small firms. That is, the smaller the firm, the less likely it is to use formal bank financing and the more likely it is to use informal financing. One reason small firms may rely less on formal bank loans is because they are generally required to provide a greater amount of collateral for a loan or an overdraft, often 3 to 7 percent more than the amount of collateral as a percent of the loan required from larger firms. SMEs also face disproportionately higher interest rates compared to larger businesses.

Innovation Management.

Technological and organizational innovation is a necessary strategy for all businesses. SMEs must innovate to maintain their market position, above all in sectors where technological change and/or competition are intense. Innovation may enhance product

quality and design, time to market, and more. Statistical comparisons show new and improved product introductions in markets and putting into practice new productive processes are less frequent among the smaller enterprises. And small enterprises introduce significantly less innovative commercialization tools than medium or large firms.

The World Bank's Enterprise Surveys have measured investment in research and development (R&D) as a percentage of total sales by firm size in four Latin American countries. According to the World Bank, large and medium-size firms invest about 64 percent more in R&D as a percentage of sales than smaller firms (World Bank Enterprise Surveys). This leads to the conclusion that although innovation is extremely important for small firms, they are unable to invest a significant amount to advance processes or products. The fact that smaller firms in LAC countries spend less on R&D than large firms do, and also innovate less, may be due to the inability of small firms to access the financing necessary to enhance internal R&D. In Argentina, 73 percent of small firms indicate that the greatest obstacle to innovation comes from the difficulties they face in accessing finance. By contrast, large firms in Argentina find that the rate of return is the most significant obstacle to innovation. Similar obstacles are found by small firms that did not innovate in Brazil. These firms identify economic risk and high costs of innovation as the largest obstacles to entering the innovation process.

Business Environment.

Although SMEs in LAC countries are numerous in both the informal and formal sectors, and significant overall to each national economy, their great numbers do not always reflect equally important profit generation and rates of success. While they export

less and innovate less, SMEs also have less access to finance and face other market impediments. These issues point to the fact that SMEs function in a difficult business environment, particularly in regard to regulations and taxation, and that they possess fewer resources to maneuver easily.

An uncertain regulatory and economic climate adds to the burden SMEs face. Tax regulations do not seem to be a significantly larger burden for SMEs in Latin America compared with large firms, but better information flows and assistance with regard to payment of tax liabilities is needed. Currently, firms in Latin America spend an average of nearly four days a year meeting with tax officials to understand tax requirements and obligations. High-income countries (OECD) spend about 1.65 days in meetings with tax officials (World Bank Enterprise Surveys).

Dealing with bureaucracy consumes a large amount of time and resources for many LAC enterprises. In LAC countries, senior management spends nearly 10 percent of a typical workweek's time dealing with government regulatory requirements (e.g., taxes, customs, labor regulations), including dealings with officials, completing forms, etc. Senior managers in high-income countries spend just under 3 percent of their time in meeting government requirements and regulations (World Bank Enterprise Surveys).

Finally, rampant corruption in many LAC countries further compounds the uncertain business environment. The effect on small businesses can be measured through determining the average value of gifts or informal payments businesses usually pay public officials to "get things done" with regard to customs, taxes, licenses, regulations, and services. Small businesses in many LAC countries devote a great percentage of their human resources and sales revenue both to meet the regulations imposed, as well as to provide officials with direct funds to advance their business.

Small firms are important in LAC because of their many contributions to the economy. Most start-up and new firms start out small. They must be nurtured to create dynamic firms providing higher wages and enhanced profits. The business and institutional environment affects firms of all sizes, but especially small firms, making it difficult for them to access the resources they need to grow, or even survive. Therefore, focus on the business environment and effective functioning of markets must be integral to the discussion of small versus large enterprises. Likewise, firm innovation, firm entry, the linkages between large and small firms, and the proper functioning of institutions should also be important topics for small businesses policy and institutional strategies.

Summary.

Another IDB Report titled *"HGSMEs in Latin American Emerging Economies"* (Llisterri et al., 2008) sums up the most important distinctive trends about SMEs in Latin America detailed in the previous sections. The following comments are based on that report.

It is safe to say that SMEs in LAC play a similar role to those in OECD countries in the sense that they represent a high share of firms in all countries (accounting for more than 95%), and make a significant contribution to employment (between 60% and 70%) and to GDP (between 20% and 35%). However, SMEs throughout LAC have their own particular traits. They operate in a much more polarized business environment, generally made up of a small number of large companies—usually in the natural resources and commodity sectors—and a large cohort of microenterprises, many of which barely break

even. This leaves a relatively small number of small and medium sized companies in between.

At the same time, SMEs in Latin America have three distinct characteristics in comparison to those in OECD countries. First, productivity gaps between SMEs and large companies are more pronounced than in advanced countries making it difficult for them to establish commercial relations. Secondly, as a direct result of the above characteristic, Latin American SMEs are more isolated, less specialized and find it more difficult to join global value chains. Last but not least, companies in general, and SMEs in particular, in Latin America have a higher degree of informality.

SMEs in Latin America: Why related research is so scarce and uncommon?

Carrillo (2007) has summarized some plausible reasons explaining why research on SMEs in Latin America is very rare and scarce. Basically he provides 3 arguments:

- First, SME research does not convert into consulting projects for scholars. Some scholars center his work on creating knowledge that can be commercialized. However, SMEs generally do not have enough resources to fund consulting projects.
- Second, SMEs tend to be less organized and disciplined than larger firms and also, they have shown very low response rates. It is more expensive to collect data, and most importantly, very difficult to diffuse the results, since the audience is broader and might be less interested in these academic outcomes.
- Third, the information systems that can track the developments and performance of SMEs as a sector are not structured or institutionalized.

Nevertheless, as Haar et al. (2004) have affirmed, one of the reasons why SME programs have failed in emerging economies is because of the lack of information in governments regarding the dynamics and realities of these enterprises. It is crucial for formal research to be conducted in this segment. And that is precisely one objective of this study.

SMEs in Latin America: Technology Adoption.

The ability to properly manage technology has begun to improve in recent years throughout Latin America. Academics and executives consider technology an important factor for increasing the competitive advantage of many firms. Therefore, technology management is also one of the main concerns in most companies in the region, with problems that do not totally differ from the typical implementation issues common in developed economies. One of the main challenges behind these problems is the lack of appropriate management processes leading to timely and high quality outcomes (Brenes et al., 2009).

Although Latin American SMEs are increasingly adopting information technology, many are still far from fully leveraging IT's potential. This is especially true of SMEs whose interaction with large clients or role in supply chains depends on their ability to share various types of information, such as about inventories, production, logistics and control. The lack of a more fully developed IT culture might explain the region's lagging international competitiveness. A new IT culture has begun to emerge within many large companies, and ERP systems have become a common initiative among them. Although ERP-based solutions also appear to be gaining acceptance among SMEs, in many cases such solutions are inadequate, because of the many obstacles preventing ERP from being

implemented according to the needs of individual companies. Most of the SMEs in Latin America lack a formal organizational structure or even personnel qualified in specialized tasks required for IT. In addition, SMEs are not fully knowledgeable of the ways in which available technologies can be applied. The good news is that SMEs are becoming aware of the need to innovate and to adapt to new technologies. Unfortunately, they are hampered by important weaknesses mentioned before, such as a lack of access to training and timely, affordable and targeted financing (Ramirez, 2005). Because of these restrictions, SMEs in Latin America are eager to know which factors and practices lead to IT success (Lussier et al., 2008) especially in the ERP arena (Ramirez, 2005). But, as suggested by many researchers, SMEs cannot be considered scaled-down large enterprises, and theories proved in large companies might not be suitable for small businesses. So, it is imperative, as Lussier et al. (2008) and Silva et al. (2006) highlight, to embrace solid research about the factors that discriminate successful ERP implementations in SMEs, specifically in the Latin America context.

To overcome the above-mentioned research gaps, the objective of this study is two-fold: A) To consolidate knowledge applying robust theory to demonstrate empirically some CSFs impacting in the Business Improvement Success as a result of ERP implementations in SMEs in Latin America. B) To motivate further analysis in this novel, but fascinating research stream.

Theoretical Foundations of the Research Framework.

ERP Success and Critical Factors.

Diverse studies have presented contrasting findings about the success of ERP adoptions. Some research underlines the solid benefits gained by organizations while others authors stress the dramatic experiences they have undergone. Dawson et al. (2008) underscore that the success or failure of an ERP implementation is closely determined by how a company manages the process. Critical Success Factors (CSFs) are then defined as those conditions that must be met for the implementation process to succeed (Finney et al., 2007).

Several authors have been studying those CSFs and have proposed a related framework. Table 4 summarizes the main studies conducted.

Table 4 – Previous research analyzing CSFs related to ERP Implementations.

Authors	Outcome
Ifinedo (2008)	Identification of the impacts of 3 CSFs on ERP Success. Those CSFs were verified empirically.
Kamhawi (2007)	Critical Success Factors Model encompassing 10 factors. This model was verified empirically.
Brown et al. (2005)	Critical Success Factors Model encompassing 5 factors. Their significance was corroborated by the use of 3 successful ERP case studies.
Al-Mashari (2003B)	Taxonomy of ERP Critical Success Factors describing 12 CSFs divided in three dimensions related to the stages of an ERP implementation.
Nah et al. (2001)	Critical Success Factors Model encompassing 11 factors. This model was verified empirically.
Esteves et al. (2000)	Unified ERP Implementation Critical Success Factors Model discriminated by strategic and tactical factors.
Holland et al. (1999)	Identification of 12 CSF divided into groups related with strategic and tactical factors.

From the above different perspectives, it is tangible that the proposed CSFs and the results of research differ considerably one to the other. A plausible explanation is that factors proposed by the researchers cover a wide range of aspects, representing various levels of generalization or even elements belonging to diverse phases within the ERP project's life cycle. According to Somers et al. (2004), this process approach has traditionally been neglected in the IS field.

ERP Success: Model proposed by Markus et al. (2000a).

Markus et al. (2000a) recognize the need to understand the antecedents of ERP's success and the underlying explanations. They accentuate that this understanding is critical when reviewing the ERP field because of the high costs and risks involved in these projects. They even acknowledge that, in many of the cases, the failure of ERP adoption processes may have led to the organization's bankruptcy.

Markus et al. (2000a) substantial contributions lay in two focal issues identified:

- **Measurement of Success.** They recognized that success depends "on the point of view from which you measure it", since "ERP success" often means different things to different people. For instance, ERP implementers are inclined to define success in terms of timely project completion without running budget overruns while users of ERP definitely evaluate success in terms of improvements to their business.
- **Timing and Measurement of Success.** They recognized that "measurement of success depends on when one measures it". "Different measures of success are appropriate at different points in the ERP experience cycle".

To address both issues, Markus et al. (2000a) propose to analyze ERP's success using a process approach, i.e. to assess success at three different stages during the ERP adoption experience or "ERP experience cycle" as they called it.

Markus et al. model (2000a) proposes three stages describing the ERP adoption process and the underlying metrics of success tied to each phase. Table 5 summarizes these stages and the related success metrics.

Table 5 – ERP Stages and underlying success metrics.

Phase in the ERP Experience Cycle	How to measure success in the phase
Project Phase: ERP is configured and rolled out to the organization.	Project cost relative to budget. Project completion time relative to schedule. Completed and installed system functionality relative to original project scope.
Shakedown Phase: Organization makes transition from "go-live" to "normal operations" using the ERP.	Short-term changes occurring after system 'go-live' in key business performance indicators such as operating labor costs. Length of time before key performance indicators achieve 'normal' or expected levels. Short-term impacts on the organization's adopters, suppliers and customers such as average time on hold when placing a telephone order.
Onward and Upward Phase: Organization captures the majority of business benefits/business improvements from ERP systems.	Achievement of business results expected for the ERP project, such as reduced IT operating costs and reduced inventory carrying costs. Ongoing improvements in business results after the expected results have been achieved. Ease in adopting new ERP releases, other new ITs, improved business practices, improved decision making, etc., after the ERP system has achieved stable operations.

Critical Factors for ERP Success in SME: Model proposed by Loh et al. (2004).

Loh et al. (2004) recognize the increasing demand for research into the ERP success area, motivated by the high failure rate noticed on ERP adoptions. Additionally, they acknowledge that most research has been conducted in the context of larger enterprises. Hence, their research pretends to address those gaps, by means of examining the CSFs that impact on a successful ERP implementation within the context of SME.

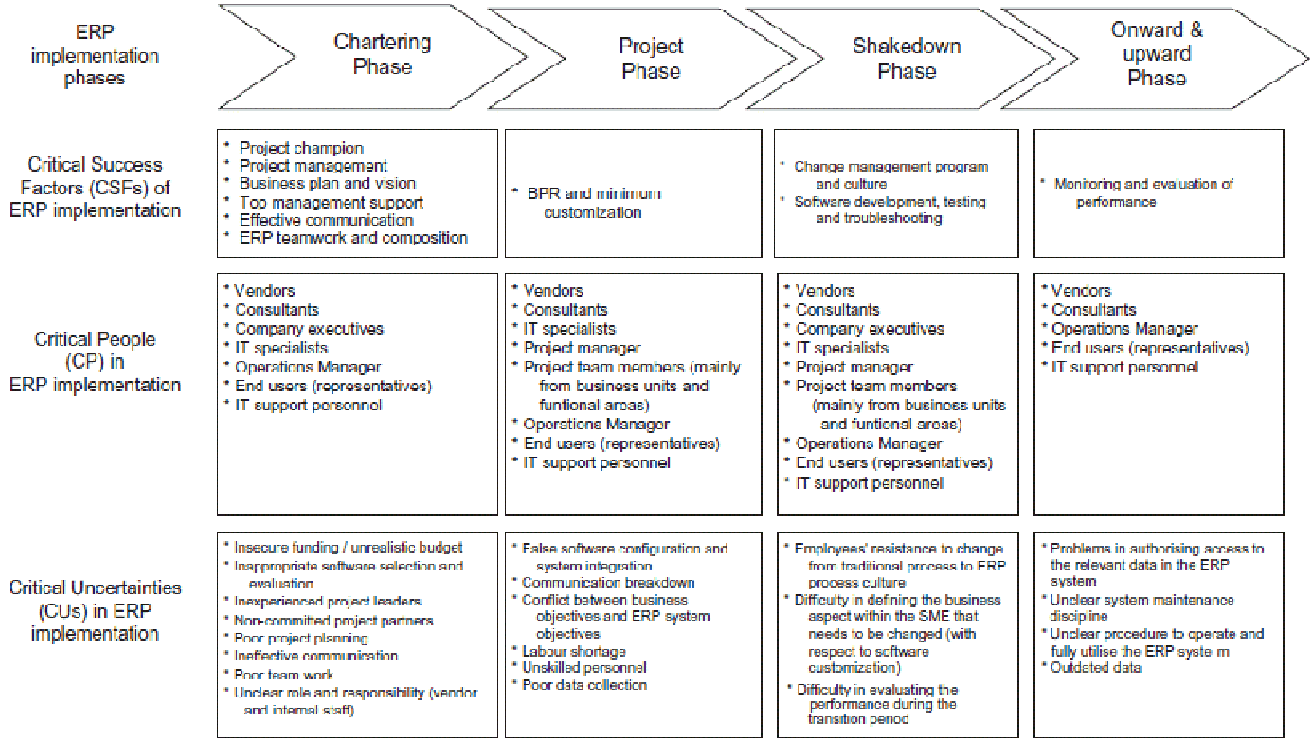
Loh et al. (2004) have made substantial contributions in the following directions:

- **Focus on SME.** They recognize the existing gap in the SMEs literature and propose a conceptual model aimed at this particular niche.
- **Identification of Critical Elements in ERP Success**. They identify Critical Success Factors, Critical People and Critical Uncertainties impacting the success of an ERP system.
- **Standardization of Critical Success Factors**. They recognize the literature presents different CSFs and acknowledge that in many cases, there are diverse ways of referring to the same factor. In consequence, they propose to filter this repetition and apply a method to derive key unique factors. Their model encompasses 10 CSFs.
- **Process Theory Approach**. They not only adopt the process approach described by Markus et al. (2000a), but also extend this framework to include the critical success factors specifically impacting every particular phase. As Loh et al. (2004) highlight, "the rationale of providing such a link was that different factors are critical at different stages in the ERP implementation process, and hence such a linkage would show academics and practitioners which factors will come into play at particular times during the actual practice and process, and this needs to be made clear". They

also took the recommendation from Markus et al. (2000b) and included the "Chartering Phase" as a critical one in the "ERP Life Cycle".

The model proposed by Loh et al. (2004) describing ERP Life Cycle Phases, which connects Critical Success Factors, Critical People and Critical Uncertainties is shown in Figure 3.

Figure 3 – Loh et al. (2004) Model: CSFs in ERP Implementations at SMEs.



Conceptual reference framework for a successful ERP implementation in SMEs.

The influence of Technology Adoption Theories: Current state of the debate.

Understanding the user's acceptance and continued use of information systems has taken center stage in IS research in the past two decades. Traditional models of IS adoption have focused on predicting the users' adoption intentions and behaviors. Current models include valid, reliable and easy to administer scales for the constructs involved and have been adopted as a paradigm that is frequently cited not only in IS, but also in other fields, with more than 1000 recognized public citations (Venkatesh et al., 2007).

But despite the significant contributions made by Technology Adoption Theories, some researchers have also recognized serious limitations and these models' predominantly static view. Even more, some authors have already started arguing whether those theories may have already been "over-studied" and that no more research should be produced if the analysis may be only just a continuation of past arguments with no substantive theoretical contribution (Venkatesh et al., 2007).

Benbasat et al. (2007) have criticized the dysfunctional outcomes resulting from these Technology Adoption-based research pieces as a consequence of the acceptance of existing paradigms:

- **The diversion of the researchers' attention away from the significant phenomenon: the IT Artifact.** First, such researchers have paid short attention to the antecedents of belief constructs involved, and the basic pillars of Perceived Usefulness or Perceived Ease of Use have been treated as black boxes. Second, related research has also provided very limited insights into the full range of consequences of IT adoption. Benbasat et al. (2007) also highlight that these models

have not extended the knowledge about what makes an IT useful, and have been focusing merely on "system use" as the key outcome, without considering any other relevant users' behaviors or interactions stemming from such use. Additionally, there is a crucial gap in theorizing the effect of system characteristics in the Technology Adoption Theories.

- **The creation of an illusion of progress in knowledge accumulation**. There has been diverse research that more or less replicates the original Technology Adoption Theories, using the same constructs and measures in reiterative empirical analysis: "technology adoption research seems to see a lot of replication with minor tweaking" (Venkatesh et al., 2007). There has not been much room for a broader or more specific set of relationships that would allow extending the models.

- **The inability of current theories to provide a systematic means of expanding and adapting its core model**. This has limited their usefulness in the constantly evolving IT adoption context. The need for an evolution of the Technology Adoption Theories is evident to some researchers who realize the importance of considering the changing nature of IT applications which necessarily determine the rising of new beliefs besides Perceived Usefulness or Perceived Ease of Use, such as the role of trust, image and other emotions.

Benbasat et al. (2007) sustain that current models have set a dominant paradigm that has limited the consolidation of new knowledge. To overcome this paralysis and "comfort zone", they suggest that future research addressing any analysis of an IT adoption should:

- Clearly identify the IT Artifact being studied. By theorizing about the IT Artifact, it may be possible to consider diverse beliefs involved in particular cases. Current IT changes have displaced the traditional view of IT as a productivity tools to more evolved roles such as communication mediators or intelligent decision-making

agents. The conceptualization of the related IT Artifact would definitely determine the resulting conclusions.

- Better conceptualize "system usage" so as to include a broader perspective of what users actually do, and get around the notion of system use.

Benbasat et al. (2007) conclude by affirming that current Technology Adoption Theories have already fulfilled their original purposes, reiterating the importance of moving outside of its current imposed limits.

Since this research does not escape from this controversy, it is important to take in consideration such guides. In this sense, it is convenient to clearly state the following:

- **IT Artifact**. The present study adopts the Ensemble View of Technology as defined by Orlikowsky et al. (2001). This vision sustains that while the technical artifact (in this study, the ERP) may be a central element, it is only an element within a "package" which also includes the components required to apply such technical artifact to some socio-economic context. Kling et al. (1982) substantiate that elements such as training, staff, development of organizational arrangements, policies and incentives oriented to get a better use of the new technology should be considered as key ingredients in the "package". The general aim of this research is to get a better understanding of how an ERP is introduced, used and embedded in the context of SMEs in Latin America, which poses a particular environment where socio-historical, cultural and political perspectives must be considered. This concurs precisely with the Technology as Embedded System perspective, which is a genuine variant of the "ensemble" view (Orlikowsky et al., 2001).

- **Perspective of System Usage**. The present study intends to analyze the success of ERP implementations in the context of SMEs. It definitely examines IT adoption

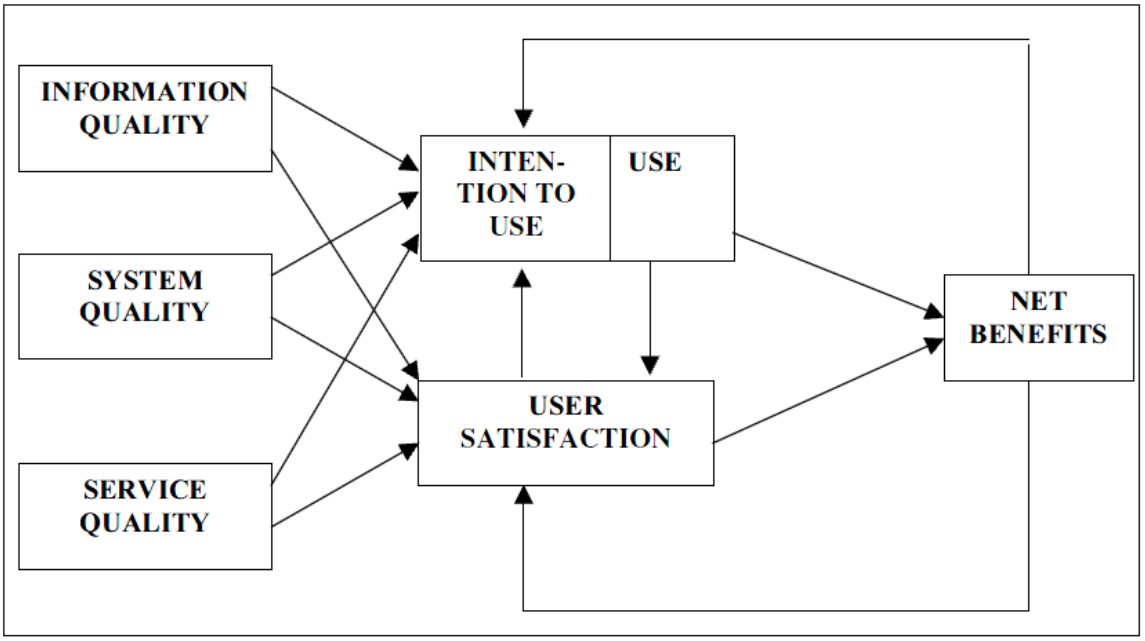
beyond the Acceptance stage: "Acceptance is not equivalent to Success, although Acceptance is a necessary precondition to Success" (Petter et al., 2008). Since my study will be focused on the improvement of performance as the benchmark of success, it will coincide with the perspective stated by Benbasat et al. (2007), stressing the importance of expanding the current Technology Adoption Models to measure usage not only in the traditional form of frequency, but considering what users do and the consequences of using the system, or its outcomes: The investigation of outcomes in Technology Adoption Research is very limited (DeLone et al., 2003; Venkatesh et al. 2003). Precisely this is another intended contribution of the present study: the focus on performance (outcome) as the measure of success.

Hypotheses.

Introduction: The DeLone and McLean Model (D&M).

The D&M Model (DeLone et al., 2003) is one of the most widely cited IS success models. It has been used as a foundation in several other research pieces aimed at getting a better understanding of IS Success, including Sabherwal et al. (2006), Bokhari (2005) and Mahmood et al. (2001). The value of the D&M Model is that it not only identifies six items of IS Success (System Quality, Information Quality, Service Quality, Intention to Use, User Satisfaction and Net Benefits) but also proposes relationships among them. The D&M Model appears in Figure 4.

Figure 4 – The Delone and McLean IS Success updated Model.



The objective is proposing hypotheses and a research model based on the identified CSFs, but matching them to the categories and framework established by the D&M Model. This match will definitely help in formulating rigorous hypothesis, while adopting the D&M Model as the reference theoretical framework. The relevance of this mapping is that D&M is regarded as a foundational and comprehensive IS assessment model in the IS field, and is widely cited and extensively used in theoretical and empirical research.

An extensive literature review was conducted to identify CSFs contributing to ERP implementation success in SMEs. This research focuses on identifying factors impacting the dimension of Improved Business Performance Success as a consequence of ERP adoption. From this perspective, the literature review provides an initial list of 10 related factors, most of them proposed by the previous work of Markus et al. (2000a) and Loh et al. (2004) (See Table 6 for details).

Table 6 - Top 10 CSFs identified.

Top 10 CSFs commonly identified by Literature Review
Top Management Support
Project Management
Change Management Program
External Consultants
Organizational Culture
User Training
Ease of Use capability of the ERP
User Satisfaction
Business Vision and Strategy
ERP Implementation Project Success

In order to validate and include such factors that lead to a more suitable analysis for developing countries, specifically in Latin America, this research follows a procedure similar to Kamhawi's (2007). This initial list of 10 factors was discussed with five IT experts with sound experience in ERP implementations in Latin America, with special regard to the SMEs niche. Since there was no previous research focusing on ERP implementations in SMEs in Latin America, a decision was made to conduct in-depth interviews to get insights into the essential CSFs within this context. Interviews and validations can provide useful insights when existing perspectives do not seem suitable in the context being analyzed (Stuart et al., 2002). Finally, when all CSFs where validated and accepted individually in the interviews, experts were required afterward to rank that initial list obtained from the literature review, from the highest importance to the lowest, based on the impact on such CSFs in the ERP Success, strictly considering the Latin America context. This ranking was conducted using the Delphi method. The method seeks iterative feedback from a group of experts and is particularly useful for aggregating the judgments of disperse individuals in order to improve the quality of decision-making (Bass, 1983).

The final rank obtained is showed in the Table 7.

Table 7 - Top 10 CSFs ranked by Local Experts

Top 10 CSFs ranked by experts according to impact in Latin America
1. User Satisfaction
2. Change Management Program
3. Ease of Use capability of the ERP
4. ERP Implementation Project Success
5. User Training
6. External Consultants
7. Project Management
8. Top Management Support
9. Business Vision and Strategy
10. Organizational Culture

It was agreed to keep the further analysis just being centered in the **top 4 CSFs** obtained in the rank. I discuss now each of the factors included in the final list.

ERP Business Improvement Success: Improved Business Performance.

Organizations show continuous interest in measuring the success of their investments in IT. Present competitive environments call for ever greater efficiency and unyielding review of the costs and benefits of technology. Organizations have been employing methods such as "return to investment" tools or more sophisticated ones like benchmarking (Seddon et al., 2002) or the balanced scorecard (Kaplan et al., 1996) to measure the success of their IS initiatives. Researchers have also been working actively in this area and have developed alternative models aimed at understating the notion of IS success.

In this research, ERP Business Improvement Success is the **dependent variable** established. There are different perspectives of *success,* but as Estevez (2009) pointed out, measuring it should be oriented at gauging the business benefits ERP provides to the organization, instead focusing on the ERP project's implementation success. Estevez (2009) also reiterates that the bridge between the benefits IT adoption brings to the SMEs is still missing. In accordance with this, Markus et al. (2000b) define *optimal success* as "the best outcomes the organization could achieve with enterprise systems, given its business situation, measured against business results". Given the importance of this, and based on Estevez's (2009) statement that "the question about the realization of the business value of ERP implementations still remains unanswered", this study adopts the business value and performance perspective of success in ERP implementation as a contribution to consolidate knowledge in this perspective. Although, according to my literature review, this study pioneers the analysis of *success* considering the ERP business value dimension in the SME niche, it is worth mentioning that other research studying

general (not ERP) IS/IT success has also adopted this perspective, such as Landgon (2006) and Tallon et al. (2006). However, not even this general analysis of IS/IT success was found considering to the Latin American context.

In this research, ERP Business Improvement Success fits the "Net Benefits" dimension in the D&M Model, consistently with the previous discussion about the business value and performance perspective of success when implementing ERP. Following the definition by Stratman et al. (2002), *ERP Business Improvement Success* refers to "the realization of business goals and improved enterprise operating capabilities as a result of ERP implementation". This perspective coincides also with the notion of IS Success or Effectiveness used by Gable et al. (2003) and it is a separate and different idea from ERP Project Implementation Success. ERP Business Improvement Success then refers to the incremental benefits achieved because of the use of the underlying ERP implemented. This definition excludes the technical installations' success in such systems (Martin, 1998) and this concept will be managed in a separate but related construct. The ERP Business Improvement Success construct encompasses both organizational efficiency and effectiveness-based performance improvements that capture the business benefits of the ERP Implementation.

It is worth mentioning that specifically in the area of ERP, the D&M Model has been used as a foundation framework in previous researches, including Law et al. (2007), Sedera et al. (2004), Kositanurit et al. (2006), and Gable et al. (2003).

ERP User Satisfaction.

Measuring the success of an IS has been found to be an ambitious task because intangible costs and the benefits of IS are difficult to recognize and convert into their monetary equivalent (Galletta et al., 1989). Therefore, surrogates are used. *User satisfaction* is regarded as a good surrogate measure of IS success (Seddon et al., 1994). User satisfaction is defined as the sum of one's feelings regarding an IS (Bailey et al., 1983). A system lacking user satisfaction is less likely to be used and to produce beneficial results to an organization (Guimaraes et al., 1997).

Wu et al. (2001) validated that user satisfaction is a good success measure in the ERP system context. Several researches have used this success measure in the ERP perspective, such as Holsapple et al. (2005). In an empirical research, Bradford at al. (2003) sustain that *User Satisfaction* is a demanded antecedent to *Business Results*. This is absolutely consistent with the relationship established in the D&M Model (DeLone et al., 2003).

In the context of SMEs, Equey et al. (2008) determine in an empirical research that the SMEs that are satisfied with the ERP acknowledge important benefits to the organization. Therefore, User Satisfaction is a determining component of ERP Success. Based on previous arguments, the following hypothesis is formulated:

H0:

Considering ERP implementations in Small and Medium Enterprises, the higher the ERP User Satisfaction, the greater the ERP Business Improvement Success.

Change Management.

In a competitive business environment, organizations must constantly adjust their organizational structures and strategic initiatives. Changes are desirable because, as Cherinton (1989) proposes, they are a solid path to help an organization avoid decline and rigidity. However, the envisioned effect of organizational changes can only be achieved through the proper management of the collective behavior of employees. Achieving the expected results through the adoption of change will depend on the reaction of the employees and their adaptive behavior (Chen, 2007).

Liu et al. (2007) hold that change management is critical if the members of the organization are to be inclined to learn, use and consolidate, i.e. accept, the new system. Liang et al. (2007) corroborates that change management is a key ingredient to motivate the members of the organization to adopt and use the new enterprise system. Aladwani (2001) suggests that change management positively influences system awareness, feelings towards the system and the intention of the users to effectively adopt the system

An ERP implementation is associated with notable organizational change. Adopting the ERP will need a change in the behavior of people who will have to interact with the system. Most approaches to change management use the "basic attitude to behavior" model (Ajzen et al., 1980). This model entails that, to change behavior, a change in attitudes is necessary and will directly lead to change in behavior. A behavioral change is made much easier if people's attitudes are characterized by high acceptance and commitment, thus minimizing resistance. Affecting attitudes to increase employees' acceptance of and commitment to the change that will occur because of ERP utilization then becomes the strategic focus of top management. Change management in this

context refers to the managerial strategies applied to overcome resistance to the operational changes caused by the ERP implementation process (Stratman et al., 2002).

Previous researches have emphasized the importance of designing a formal change management program as a critical factor for ERP success (Martin et al., 2007; Nah et al., 2001; Aladwani, 2001; Shanks et al., 2000; Holland et al., 1999). Empirical work conducted by Nah et al. (2003) confirms that Chief Information Officers (CIOs) recognize this factor as one of the most critical to manage in order to boost ERP's success. Authors like Wood et al. (2001) confirm the prominent importance of this factor suggesting that ERP implementations should be even considered as a change management initiative instead of a merely IT initiative. Kim et al. (2005) hold in their empirical work that without appropriate change readiness and management strategies, organizations might not be able to adapt to the new ERP platforms, preventing them from getting the expected performance gains.

Considering specifically the SME scenario, Forsman (2008) holds that these organizations face knowledge limits and lack of multi-skilled employees. So, it is expected that in early stages of the ERP Implementation, SMEs employees show an unfavorable attitude because of the confusion associated to the change, and limited knowledge and skills. This assertion is evidenced in the empirical work by Equey et al. (2008) on Swiss SMEs. Consequently, change management has a determining impact on the Intention to Use dimension according to the D&M Model (DeLone et al., 2003). Pursuing this model further, the Intention to Use dimension has a significant impact on User Satisfaction (as corroborated also empirically by Halawi et al. (2007), Chiu et al. (2007) and Iivary (2005)) and Business Improvement (as corroborated also empirically by Halawi et al. (2007), Kositanurit (2006) and Rai et al. (2002)).

Therefore, change management turns into a critical pillar to enable SMEs to use the ERP properly, influencing the underlying user satisfaction and allowing them to achieve the business's goals. The importance of change management to achieve business results because of the ERP implementation is also included in the model proposed by Loh et al. (2004) targeting the SME niche.

Based on the previous arguments, the following hypotheses are formulated:

H1A:

Considering ERP implementations in Small and Medium Enterprises, the stronger Change Management, the greater the ERP User Satisfaction.

H1B:

Considering ERP implementations in Small and Medium Enterprises, the stronger Change Management, the greater the ERP Business Improvement Success.

ERP Ease of Use.

Ease of Use refers to the degree to which a particular technology is perceived to be free of effort to be used (Davis, 1989). This is consistent with the definition provided by Rogers (1962) stressing that ease of use covers the degree to which an invention is seen as being not too difficult to understand, learn or operate.

From a general perspective, some studies have linked ease of use to IS success (Seddon, 1997). Authors like Ignatius et al. (2005) and Ramayah (2006) have confirmed that ease of use is a very important predictor of both the adoption and continued use of a technology that will permit organizations to reap the promised benefits. According to the Technology Acceptance Model (TAM) (Davis, 1989), an established model in explaining IS adoption behavior, usage of IS is determined by the users' intention to use the system, which in turn is determined by the users' beliefs about the system. According to this model, perceived ease of use of the system is one of the salient beliefs involved.

Several authors have made contributions in this area of ERP. Diverse studies have analyzed the impact of the "Ease of Use" concept in ERP implementations (Ramayah et al., 2007; Amoako-Gympah, 2007; Amoako-Gympah et al., 2004; Calisir et al., 2004). Wu et al. (2006) have related the "Ease of Use" concept to a dimension of ERP success. In an empirical research conducted in US firms, Kositanurit et al. (2006) emphasize that managers must make every possible effort to ensure users perceive ERP as easy to use since this is one of the most important factors contributing to individual performance when using the ERP System, and thereby, generates the expected benefits. Another empirical research developed among Finnish companies contributes also in this direction: Velcu (2007) corroborates that ERP systems generally begin to yield business benefits

when system utilization improves. Perceiving ERP systems as easy to use will unquestionably contribute to accelerate their adoption and result in positive impacts.

According to the D&M Model (DeLone et al., 2003), *Perceived Ease of Use* is the most common measure of the system's quality dimension as established in the model. And this dimension has a significant impact on user satisfaction as well as on business results. Diverse research pieces adopting the D&M as their foundational framework have empirically corroborated the impact of the relation between Perceived Ease of Use and User Satisfaction (Hsieh et al., 2007; Devaraj et al., 2002) as well as the impact of Perceived Ease of Use on Business Results (Kositanurit,2006).

In view of the previous arguments and aware of SMEs employees' limited IS skills (Bhagwat et al., 2007; Bruque et al., 2007), perceived ease of use becomes a significant pillar in ERP implementation, impacting user satisfaction as well as business results. Therefore, the following hypotheses are formulated:

H2A:

Considering ERP implementations in Small and Medium Enterprises, the greater the ERP's Ease of Use, the greater the ERP User Satisfaction.

H2B:

Considering ERP implementations in Small and Medium Enterprises, the greater the ERP's Ease of Use, the greater the ERP Business Improvement Success.

ERP Project Implementation Success.

According to Soja (2006), ERP project implementation success refers to the accomplishment of goals and implementation scope within a planned timeline and budget, while achieving user satisfaction.

Even though technology is not the only essential ingredient to guarantee the achievement of the expected benefits, successfully implemented IT technology projects can lead to significant improvements in organizational performance. Well-implemented IT projects contribute to organizational success by improving technology's functionality and reliability, and reducing operating costs (Markus, 2004).

Since some organizational changes simply cannot happen without IT, it is important that organizations focus preliminarily in achieving success of IT projects to gain later the intended business benefits. The real payoff of IT projects comes from creating new processes that tap the potential of IT, rather than just adjusting IT to the way the company works. And this gap analysis must be conducted as an essential part of the project design phase (Markus, 2004).

Pasanen (2003) holds that project implementation success also injects motivation into the organization, and that project success leads to success in other areas, thus creating an upward success spiral. Unfortunately, failure in project success seems to create a downward failure spiral, preventing the organization from achieving its original business goals (Forsman, 2008). If the implementation project is not a success, the users will not be strongly motivated to use the system, therefore limiting the business benefits initially foreseen (Markus, 2004). The technology must work acceptably well before creating

business value. And this is an essential condition of a successful implementation. If not, the solution will not pay off as expected (Markus, 2004).

Markus (2004) elaborates more on this generic vision and holds the longer IT projects take, the more likely they are to drift apart from the early envisaged business goals. The longer IT projects last, the more likely that business's needs will have changed. And, the longer IT projects take, the more likely the drop in management's attention. Project delays prevent organizations from capturing the intended benefits. These arguments concur with the Process Theory Approach model that Loh et al. (2004) established specifically to analyze ERP success in SMEs and also with earlier research conducted by Velcu (2007) and Kamhawi (2007) specifically centered in analyzing the impact of ERP's project success on business improvement.

Baccarini (1999) also holds that project success encompasses the conformance to functional and technical specifications. To be successful, the project "must produce what it said it would produce" on the scope. This means that, according to the D&M Model (DeLone et al., 2003), project success impacts the System Quality and Information Quality dimensions in such model, having a subsequent impact on User Satisfaction and Business Results. Liu et al. (2009) assert that a project must be successful in delivering a fully tested working system as a precondition to delivering the expected business results and user satisfaction.

Based on the previous arguments, and knowing that SMEs manage scarce resources, project success becomes a critical ingredient to achieve business results as well as user satisfaction. Premkumar (2003) holds that incremental project costs prevent or inhibit the final adoption of IT in small firms. Based on this, the following hypotheses are formulated:

H3A:

Considering ERP implementations in Small and Medium Enterprises, the higher the ERP Project Implementation Success, the greater the ERP User Satisfaction.

H3B:

Considering ERP implementations in Small and Medium Enterprises, the higher the ERP Project Implementation Success, the greater the ERP Business Improvement Success.

Mediating Role of ERP User Satisfaction.

Even though change management, ease of use and ERP project implementation success are expected to independently affect ERP business improvement success, there is the possibility that ERP user satisfaction may mediate those effects. Change management, ease of use and ERP project implementation can influence user satisfaction which in turn can affect the ERP business improvement success. Thus, controlling for ERP user satisfaction may reduce the impact of change management, ease of use and project implementation success on ERP business improvement success. A similar conjecture postulating the mediating influence of ERP user satisfaction on ERP business improvement success was already introduced by Bradford et al. (2003). Based on this, the following hypothesis is formulated:

H4:

Considering ERP implementations in Small and Medium Enterprises, ERP User Satisfaction will mediate the relationship between Change Management, Ease of Use, Project Implementation Success and ERP Business Improvement Success.

Control Variables.

Several control variables related to the phenomenon of ERP Implementation Success are considered. These include:

Years in the Market. Used extensively in IS research. Klein et al. (2008) sustains that although is important to control the effect of this variable, organizational studies show ambiguous results of their underlying effects.

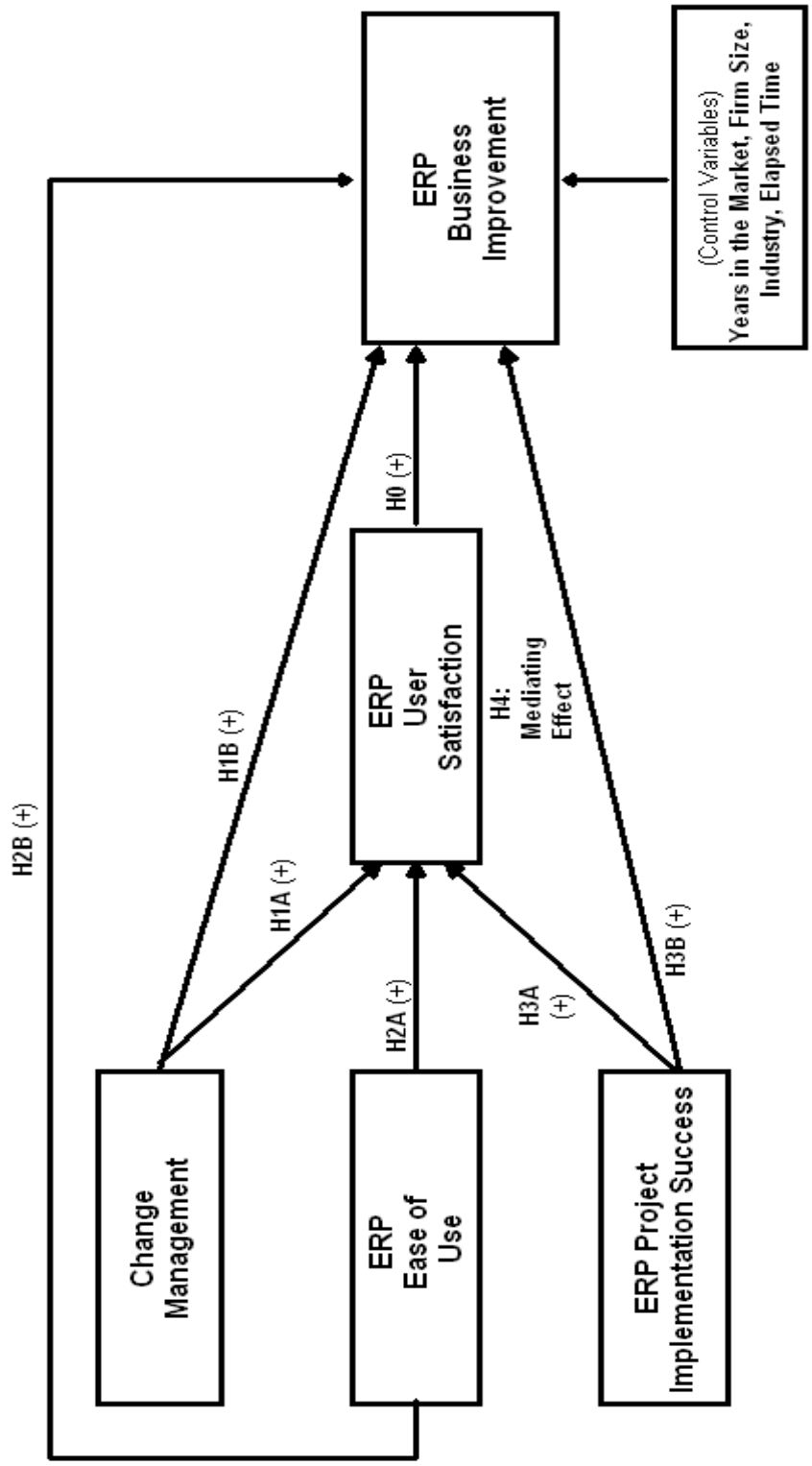
Firm Size. Analyzed in diverse ERP research including Kang et al. (2008), Karimi et al. (2007), Bradford et al. (2003).

Industry. Researchers like Shin (2006) have employed this variable in ERP research to control sectorial differences.

Elapsed time is employed as a control variable as suggested by Fichman (2000). It has been included in the models to capture the variation due to timing issues (Foster et al., 1997). Additionally, as Bradford et al. (2003) suggest, the longer the time elapsed, the more comfortable employees are with the ERP and thus the greater the results gained. This view is has been also endorsed by Kang et al. (2008).

Figure 5 summarizes the resulting research model.

Figure 5 – Research Model.



Research Model: Match with D&M Model.

As mentioned in the introduction of this section, the model proposed in this research has been inspired in the D&M Model, one of the most widely accepted model in the area of IS Success. In order to keep the alignment with such model, it was established a match between the 4 top CSFs chosen by the local experts and the 6 categories covered in the D&M Model. This match definitely helps to strength the rigorousness needed in the formulation of hypothesis. The final match is displayed in Table 8.

Table 8 - Match between Top CSFs and D&M Dimensions

CFS Validated by Local Experts	Match to the dimension in the D&M Model
Ease of Use capability of the ERP	System Quality
Change Management Program	Intention to Use
ERP Implementation Project Success	System Quality & Information Quality
User Satisfaction	User Satisfaction

Research Model: Distinctive aspects derived from Latin America.

The derived research model shares some similarities with those found in the existing literature, but also includes some elements that appear to be innovative with respect to existing knowledge. On the side of similarities, this study includes change management, ERP project success and ease of use as CSFs to ERP business improvement success. These have also been included in Kamhawi's research (2007), in the context of a developing region (although not specifically addressing the SMEs context). What has not been covered yet, according to the literature review, is the impact of ***End User Satisfaction***, which, as held by the D&M Model (DeLone et al., 2003), is a predicted critical factor strongly influencing the expected benefits.

Additionally, ***mediating*** factors have also being analyzed in previous research. Kamhawi (2007) demonstrates the influence of ERP project success as a mediating variable between other relevant CSFs and business success. Nevertheless, in the Latin America context, it was considered that *ERP User Satisfaction* is the most relevant mediator between business improvement and other CSFs, and not ERP project success. Several authors recognize the vital importance of "human capital" in the SMEs in Latin America. So, any innovation, to be effective, should consider any CSFs impacting indirectly on success through underlying user satisfaction (The Economist Intelligence Unit, 2008b).

No empirical research was found in my review addressing the importance of ***elapsed time*** as a control variable. Experts in ERP implementation in Latin America insisted, based on their experience, that as duration since going live increases, more categories of

benefits tend to be realized. My research considers analyzing this variable to be of critical import.

On the other side, some other CSFs examined in previous research were not included in this study because they were not relevant in the context of SMEs in Latin America. For instance, Nah et al. (2007) demonstrate the impact of ***Organizational Culture*** in the Success of ERP Implementation. Local experts in the context of ERP implementations in Latin America, based on their experience, argued that SMEs in Latin America exhibit an informal culture in comparison to large enterprises, and employees are expected to be adaptable and take additional responsibilities as needed. So, experts considered that organizational culture was not a relevant variable to be included considering the Latin America context. It is worth mentioning that it was verified later that a similar reasoning was applied and similar conclusions arrived at by Newman et al. (2008) in a research centered in China.

Research Methodology.

This chapter reviews the philosophical assumptions of the study and the research strategy used.

Philosophical Considerations.

According to Orlikowski et al. (1991), the philosophical foundations of IS research rely on three underlying epistemologies that guide the studies, namely the positivist, interpretative and critical traditions.

Positivist studies are premised on the existence of relationships within phenomena which are typically investigated using structured instrumentation. Such studies pretend to test theory, in an attempt to increase the understanding and prediction of such phenomena. Orlikowski et al. (1991) sustain that positivism is clearly the dominant epistemology in IS research.

Interpretative studies assume that people create and associate their own subjective meanings as they interact with the environment around them. Interpretative researches attempt to understand phenomena by getting the meanings from participants (Orlikowski et al., 1991).

Critical studies pretend to critique the status quo of what is believed by seeking structural contradictions within social systems (Orlikowski et al., 1991).

This study falls within Orlikowski's ***positivist*** category because it emphases the testing of relationships by using quantifiable variables, and deriving inferences about a phenomenon from a sample of a stated population.

Survey Method: General Design.

Surveys are the primary source of data collection for field studies conducted as part of this research. As Babbie (1990) claims, survey research is an appropriate method to generalize from a sample to a population, allowing in this sense, to establish inferences over the entire population. Additionally, this study chooses using surveys because of their economy of design and quick turnaround of data collection (Creswell, 2003). From a time dimension, this research adopts a one-time cross-sectional perspective. The unit of analysis of this study is the firm.

Questionnaire: Instrument Development.

Questionnaires are the essential functional component for survey research. They are among the most effective ways to operationalize the variables of a study (Babbie, 1998).

Operationalization of constructs implied.

The items used to measure the constructs incorporated in the proposed model were all corroborated by and adopted from previous research pieces. Nevertheless, each survey item was first discussed, evaluated and adapted by five experts in ERP implementations in SMEs in Latin America. Table 9 summarizes how this study operationalizes the underlying variables, citing previous research where such constructs were measured and sustained. An index for each of the variables was established by computing the mean score for the relevant items associated with each variable.

The main adjustments suggested by local experts to adapt previous operationalizations were reviewed in order to consider a better perspective of the SME Latin American context. These adjustments centered in the following constructs:

- **ERP Business Improvement Success.** Local experts confirmed the importance of measuring ERP success in terms of business value and the perspective of a successful performance of ERP implementation within SMEs in the Latin American context. Additionally, they highlighted the importance of the "people" dimension as a critical pillar to the success in business improvement. They argued that "internal" and "external" satisfaction is an essential business goal that most SMEs in Latin America try to achieve. So, they recommended to include two items addressing:
    - The increase of customer satisfaction resulting from the ERP implementation.
    - The increase of employee satisfaction with the job because of the ERP implementation.

  The construct was finally measured by means of the following 6 items:

    1. Company business processes have been rationalized through the use of the ERP system.
    2. The ERP provides real time information that have improved the decision making process.
    3. The ERP system has improved customer satisfaction.
    4. Employee job satisfaction and morale has improved through the use of the ERP System.
    5. Business flexibility has improved through the use of the ERP System.
    6. The company is satisfied with the business achievements reached through the use of the ERP System.

- **Change Management**. Local Experts highlighted that in SMEs in Latin America employees value the way organizations take in consideration their thoughts and inputs, especially when change is in progress. These experts strongly recommended measuring the level of feedback that employees provided during the implementation process as part of the measures integrating this construct. This suggestion was accepted and a new item was included.

The construct was finally measured by means of the following 4 items:

1. Management actively worked to alleviate employee concerns about ERP Implementation.
2. There were open communication channels to employees reporting current project status at any time during the implementation.
3. An ERP Support group was available to manage any employee problem or concern raised during the implementation.
4. Feedback sessions were conducted periodically to gauge employee satisfaction with the process.

- **ERP User Satisfaction**. Previous research reviewed operationalized this construct by basically using one item to assess the level of satisfaction with the ERP implementation. Local experts suggested that, in the Latin America context, it would be valuable to expand this vision and include two more items addressing:
  - The level of satisfaction of the management team with the ERP.
  - The level of satisfaction of employees (Users) with the ERP.

  Both items were included.

  The construct was finally measured by means of the following 3 items:

  1. Top Management is satisfied with the ERP System.
  2. End Users in my organization are satisfied with the ERP System.
  3. In general terms, the adoption of the ERP in my organization has been a Success.

- **Ease of Use**. A special note on this construct: It is worth mentioning that even though the following analysis is conducted on a sample using the same ERP, a variance on this measure is expected. As Davis (1989) asserts, the "Ease of use" construct is tied to individual assessments which may diverge from person to person. For instance, Venkatesh (2000) asserts that "Ease of use" is anchored to individual

differences' variables and general belief, as well as previous hands-on experience with computer/software in general. So, independently of the current design dealing with the ERP, variance might be coming from these "personal experiences" and "intrinsic motivations". Even more so, Venkatesh (2000) holds that such personal anchors also change over time.

The construct was finally measured by means of the following 3 items:

1. Users interact with our ERP naturally and without any significant complication.
2. Our ERP was easy to learn
3. In general terms, our ERP is easy to use.

- **ERP Project Implementation Success.** Local experts agreed with the items suggested. No further modifications or additions were suggested.

  The construct was finally measured by means of the following 4 items:

  1. The cost of ERP Project was significantly higher than the expected budget.
  2. The ERP Project took significantly longer time than expected.
  3. The system performance of ERP is significantly below the expected level.
  4. In general terms, my company is satisfied with the ERP implementation process.

Table 9 – Operationalization of Constructs: Previous references.

Variable	Previous Research sustaining operationalization.
ERP Business Improvement Success	Stratman et al. (2002) operationalize this construct by formalizing: • Content Validity through literature review and input from experts. • Reliability Analysis (Cronbach's Alpha (α: 0.94). • Convergent Validity. • Discriminant Validity.
Change Management	Stratman et al. (2002) operationalize this construct by formalizing: • Content Validity through literature review and input from experts. • Reliability Analysis (Cronbach's Alpha (α: 0.85). • Convergent Validity. • Discriminant Validity.
Ease of Use	Kamhawi (2007) in an empirical study operationalizes this construct by formalizing: • Content Validity through literature review and input from experts. • Reliability Analysis (Cronbach's Alpha (α: 0.83). • Discriminant Validity conducting a Factor Analysis.
ERP Project Success	Kamhawi (2007) in an empirical study, operationalizes this construct by formalizing: • Content Validity through literature review and input from experts. • Reliability Analysis (Cronbach's Alpha (α: 0.62). • Discriminant Validity conducting a Factor Analysis.
ERP User Satisfaction	Soja (2006) in an empirical study, operationalizes this construct by defining a single-item measure. Bradford et al. (2003) asserts that in their empirical research, *User satisfaction* was measured with one question ascertaining whether functional users are satisfied with the ERP package adopted by the organization.

Operationalization of Control Variables implied.

The items used to measure the control variables incorporated in the proposed model were all corroborated by and adopted from previous studies. Nevertheless, each item was discussed and evaluated by five experts in ERP implementations in SMEs in Latin America. Table 10 summarizes how this study operationalizes the underlying variables, citing previous research where such constructs were measured and sustained.

Table 10 - Operationalization of Control Variables.

Control Variable	Operationalization.
Years in the Market.	This variable is registered as a continuous variable measuring the period from firm establishment through the point of data collection. This operationalization has been employed in several research, including Klein et al. (2008).
Firm Size.	This variable has been measured basically using two different approaches in IS research: • As a continuous variable measuring the annual sales volume (suggested by Kang et al. (2008)) • As a continuous variable measuring the number of employees (suggested by Bradford et al. (2003), Karimi et al. (2007)). This research analyzes both perspectives.
Industry.	This variable is registered as a categorical variable. This operationalization has been employed in several researches, including Shin (2006).
Elapsed Time.	This variable is registered as a continuous variable measuring the period since the implementation of the ERP package. It has been used in several researches, including (Foster et al., 1997).

Questionnaire design guidelines.

The questionnaire was designed considering all recommendations from Babbie (1998) and Ng (2006), including:

- Guidelines to manage a self-administered questionnaire (this research planned to ask respondents to fill out the questionnaires by themselves). Specifically, it was planned to manage a Computerized Self-Administered Questionnaire Platform (CSAQ), where the respondent receives a web link to access and process the instrument. I followed all the recommendations regarding the format and look-and-feel for this kind of platform.
- Consideration of characteristics discriminating a good questionnaire: Valid, Reliable, Clear, Interesting and Succinct. (Ng, 2006).
- All questions were designed to be closed-ended. "Closed-Ended" questions provide options to the respondents and require them to choose one or more items from a list.
- Regarding options/choices for each question, these were presented using a five-point Likert-type scale with values raging from "Strongly disagree" (1) to "Strongly Agree" (5).
- The "Don't know" choice was also included as one of the responses in all items presented. According to Ng (2006) this is extremely critical because by not providing this option, the researcher is "forcing" the responder to make a choice by guessing.

Translation.

As Ng (2006) notices, respondents should answer questionnaires in the language in which they are most proficient. Since this study was centered in analyzing SMEs in Latin

America (excluding Brazil), a strong recommendation was to distribute the final questionnaire in Spanish. Translating the questionnaire was required because the proposed questionnaire was based on the above-referenced studies, in all of which the underlying instruments are in English. This translation is a critical step to avoid inaccuracies that can lead to erroneous results.

To manage this translation process, the "translate-back-translate" approach suggested by Ng (2006) was conducted: The researcher translated first the questionnaire from English to Spanish. Afterward, another independent resource, unaware of the original English version, back-translated the Spanish-questionnaire to English. After that, both English versions were compared to evaluate any discrepancies. Following a careful discussion, a preliminary Spanish version was adopted.

Pilot Test.

Testing the questionnaire is a critical step before collecting the data. This step helps to detect any flaws in the instrument, in terms of content, grammar or format (Ng, 2006). In this study, the questionnaire was first distributed to five experts and three companies as a pilot test. Recommendations were processed after these modifications and then, the final version in Spanish was accepted. Final version in English and Spanish are showed in Appendix A.

Data Collection.

One of the most important ERP vendors, a leader in ERP implementations within the SMEs niche in Latin America, agreed to sponsor this study. Since this ERP provider distributes and implements ERP through a channel network, the vendor was asked to

furnish the information about channels managing clients who had been using the implemented ERP for at least 2 years.

A list of eight 8 channels was determined: 3 of them operating in Mexico, 2 operating in Chile, 1 operating in Costa Rica, 1 operating in Colombia, and 1 operating in Venezuela. A contact was established with these channels to explain in detail the goal of the present research. All of them were motivated to support this study, providing their own client list. A consolidated list including 240 companies that are active customers of these 8 channels was processed as the initial target sample. It is worth mentioning that this *convenience sample* selection approach has been managed in other similar ERP studies such as the one conducted by Kwahk et al. (2008).

The primary source of data collection was an electronic survey. The basic means of distributing the survey was via email. The interviewer received a first email introducing the goal of the research as well as reinforcing the confidentiality of any information derived. A second email was sent to summarize the purpose of the research, containing also a web link allowing the interviewers to enter the Computerized Self-Administered Questionnaire Platform designed to process the questionnaire on-line. For those customers preferring to process the questionnaire off-line, a special template was also attached in the email as a valid alternative.

Surveys were specifically addressed and emailed to upper-level senior manager responsible for the information technology function in the organization, being also an active user of the implemented ERP. These respondents were chosen because they are among the most knowledgeable informants on ERP projects and the derived success in organizations (Ifinedo, 2007; Jones et al., 2006; Gable et al., 2003). However, in some cases and for different reasons, this executive might not have direct knowledge of the ERP Implementation project conducted in the company. Anticipating such cases, this

research took the practice stated by Jones et al. (2006), on introducing, in the second email, the option to forward the survey to the individual who was most directly involved in the ERP implementation project at senior level, should the original recipient lack the required information personally. Data was collected in 4 months: The main survey was conducted between August 18, 2008 and December 15, 2008.

Because this study used a convenience sample, it was not possible to test non-response bias by comparing the respondents versus the non-respondents. Instead, non-response bias was assessed by comparing the responses of early and late respondents, defined as the first as last 15 questionnaires received. Demographics items such as Year founded, Number of Employees and Revenue where used to assess differences, as suggested by Kwahk et al. (2008). By using t-Test, there were not significant differences in these items -Year founded ($t=-0.44$, $p=0.64$), Number of Employees ($t=0.10$, $p=0.92$), and Revenue ($t=1.47$, $p=0.16$) - , suggesting that non-response bias was low. Detailed data on this analysis is presented in Table 11.

Table 11 – Non-Response Bias Analysis – t-Test.

t Test

The TTEST Procedure

Statistics

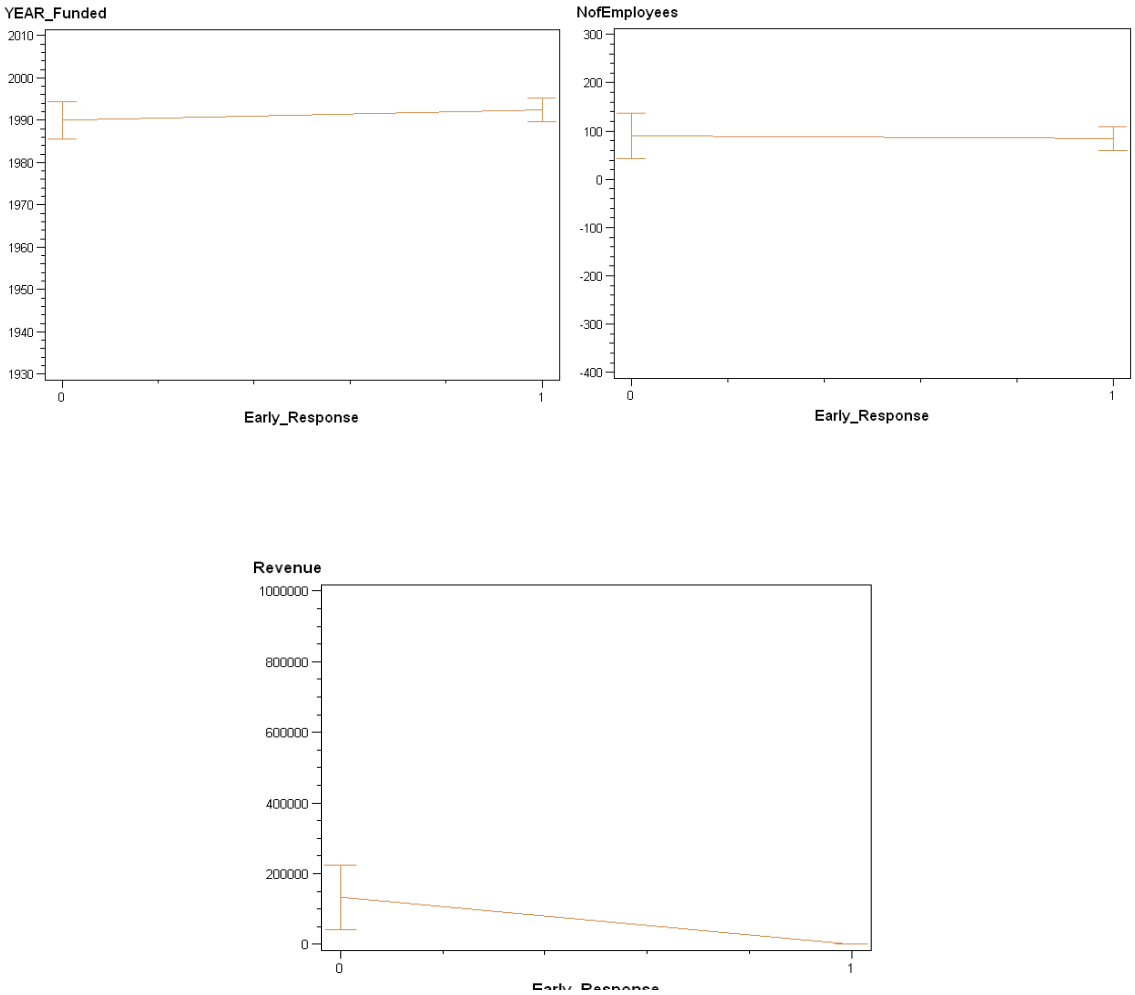
Variable	Early_Response	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
YEAR_Funded	0	15	1980.7	1990	1999.3	12.301	16.801	26.497	4.3381	1935	2006
YEAR_Funded	1	12	1986.2	1992.4	1998.6	6.8911	9.7277	16.517	2.8082	1969	2003
YEAR_Funded	Diff (1-2)		-13.69	-2.417	8.8559	11.083	14.132	19.508	5.4733		
NofEmployees	0	13	-13.8	89.846	193.49	122.99	171.51	283.12	47.568	-350	300
NofEmployees	1	11	30.887	84.545	138.2	55.808	79.872	140.17	24.082	20	300
NofEmployees	Diff (1-2)		-111.6	5.3007	122.24	106.45	137.64	194.81	56.387		
Revenue	0	15	-61520	133336	328192	257609	351864	554925	90851	1	999999
Revenue	1	15	2.4706	3.2667	4.0628	1.0525	1.4376	2.2672	0.3712	1	6
Revenue	Diff (1-2)		-52767	133333	319432	197447	248806	336498	90851		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
YEAR_Funded	Pooled	Equal	25	-0.44	0.6626
YEAR_Funded	Satterthwaite	Unequal	23	-0.47	0.6444
NofEmployees	Pooled	Equal	22	0.09	0.9260
NofEmployees	Satterthwaite	Unequal	17.6	0.10	0.9219
Revenue	Pooled	Equal	28	1.47	0.1534
Revenue	Satterthwaite	Unequal	14	1.47	0.1643

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
YEAR_Funded	Folded F	14	11	2.98	0.0754
NofEmployees	Folded F	12	10	4.61	0.0215
Revenue	Folded F	14	14	5.99E10	<.0001


YEAR_Funded
2010
2000
1990
1980
1970
1960
1950
1940
1930
0
1
Early_Response
NofEmployees
300
200
100
0
-100
-200
-300
-400
0
1
Early_Response
Revenue
1000000
800000
600000
400000
200000
0
0
1

Description of the ERP used by the sample.

The ERP Provider: Business in Brief.

The supplier of the ERP analyzed in this research was the first company which introduced a functional enterprise system. At present, it is acknowledged as the world's leading provider of business software. With more than 30 years in the market, this supplier has a rich history of innovation and growth as a true industry leader. This firm lists more than 95,000 customers in more than 120 countries, and 69% of the Forbes 2000 companies run software from this provider – from distinct solutions addressing the needs of small businesses and midsize companies to suite offerings for global organizations. This firm currently has more than 45,000 employees at sales and development locations in more than 50 countries worldwide.

The ERP Artifact: Business Overview.

The ERP analyzed in this research is an application aimed at integrating all core business functions across small businesses, typically with fewer than 100 employees and 30 users, which are looking for an affordable, single system to cover core operations such as financials, sales, and customer support. Customers can deploy this ERP typically in less than one month. The solution is commercialized and supported through a global network of approximately 1,200 certified partners. There are over 550 extensions available from independent software vendors (ISVs) and more than 40 country versions. By the end of 2009, the ERP analyzed in this study had a base of approximately 25,000 customers worldwide. According to the provider, “depending on project scope, pricing

from this ERP can start as low as US$20,000 for five users, including software licensing and implementation".

In Latin America this product has been implemented since 2004, offering an ERP that complies with local taxes and regulations in each Latin America country, as well as being deployed in local language. The product was designed with an open architecture which means it can be customized/expanded to suit the customers or industries' particular needs. At present this product has been launched in more than 90% of the countries in Latin America, with Mexico and Chile as strongest installation bases in Latin America.

The ERP Artifact: Technical Overview.

The ERP used for the sample is an affordable product built exclusively for small businesses. As a complete, integrated software application, this ERP eliminates the cost and hassle of integrating multiple stand-alone applications. Its intuitive interface and vast configurability minimize IT complexities for implementation and ongoing maintenance. The ERP gives the organization powerful tools to tailor forms, queries, and reports to meet specific business requirements without the need for specialized technical training.

This ERP software manages the following functionality:

- **Financial management** – Automate, integrate, and manage all your financial and accounting processes. Detailed functionality included:
  - General ledger and journal entries
  - Basic cost accounting and monitoring of project costs
  - Budget management
  - Banking and bank statement processing
  - Payment processing and reconciliation
  - Financial statements and reporting
  - Sales tax and value-added tax

- Multicurrency support

- **Warehouse and production management** – Manage inventory across multiple warehouses, track stock movements, and manage production orders based on material requirements planning. Detailed functionality included:
  - Items management and item queries
  - Receipt to stock, release from stock, and stock transactions
  - Stock transfer between multiple warehouses
  - Serial number management
  - Inventory revaluation
  - Customer and vendor catalog
  - Price lists and special pricing
  - Batch management
  - Pick and pack

- **Customer relationship management** – Grow customer profitability and increase customer satisfaction with effective sales and opportunity management, and after-sales support. Detailed functionality included:
  - Opportunities and pipeline management
  - Customer contact and activity management
  - Sales quotations and orders
  - Invoicing and crediting
  - Sales and pipeline forecast
  - Service contract management
  - Service-call management entry and tracking

- **Purchasing** – Automate the entire procurement process from purchase order to vendor invoice payment. Detailed functionality included:
  - Purchase proposals
  - Purchase orders and deliveries
  - Goods receipts and returns
  - Accounts payable invoice and credit notes
  - Bill of materials
  - Production orders
  - Forecasting and material requirements planning

- **Reporting** – Act on instant and complete information with comprehensive, real-time reports. Detailed functionality included:
- **Customization**. Customizable for specific industry and business needs.

Description of the implementation model used by the sample.

The vendor developed an accelerated implementation methodology for the ERP application to provide a clear, proven framework to manage the project and customer expectations and provide guidelines for communication and documentation. Every organization implementing this ERP manages an implementation process that encompasses five critical steps.

Five-Phase Implementation

The implementation methodology divides the implementation projects into phases. It starts when the customer signs the contract – the time when the sales organization hands the project over to the consulting and implementation organization. It goes on to cover the entire implementation process and the concluding review and optimization conference, which takes place several weeks after the project is handed over to the customer. The fives phase of the methodology are described below.

Phase 1: Project Preparation

The purpose of this phase is to provide initial planning and preparation for the ERP implementation. Although each ERP implementation has its own unique objectives, scope, and priorities, the steps in the project preparation phase help identify and plan the primary focus areas that need to be considered. This includes technical issues as well as project management topics. With the kickoff meeting, the implementation team communicates the project plan along with the expected commitment the organization will have to make in terms of time and resources. Roles and responsibilities of the various participants in the project are identified. In addition, the ERP software is delivered and the preliminary installation of a test system is completed.

Major Milestones

The major milestones of the project preparation phase are:

- Project handover to implementation
- Customer kickoff meeting
- Delivery and installation of test system for the ERP software
- Project phase review and sign-off from customer

Phase 2: Business Blueprint

This crucial phase examines how the client would like to run the ERP to support his business. One or more workshops for gathering the requirements are conducted during which business processes and individual functional requirements of the organization are identified and analyzed. The workshops provide the opportunity to fine-tune the original project goals and objectives as well as to revise the overall project schedule, if necessary. The result is the business blueprint, which documents in detail the results gathered during

the requirements workshops. The business blueprint serves as a technical and functional guide during the subsequent phases of the implementation project.

Major Milestones

The major milestones of the business blueprint phase are:

- Workshops to gather business requirements with the customer's functional leads
- Creation of the detailed business blueprint document
- Determination of changes to initial project scope and time schedule (if applicable)
- Project phase review and sign-off from customer

Phase 3: Project Realization

The goal of project realization is to implement all the business process and technical requirements gathered during the previous phases and documented in the business blueprint. The consultants validate and update the configuration and demonstrate processes while the project team updates the work instructions (business process procedures, for example) and performs unit and integration tests.

Major Milestones

The major milestones of the project realization phase are:

- Software installation and customization based on the business blueprint
- Data migration (if applicable)
- Validation of system setup
- System testing
- Definition of training and cutover plan
- Project phase review and sign-off from customer

Phase 4: Final Preparation

This phase focuses on preparing both ERP and the customer for going live. Key activities during this phase include completing user and administrator training as well as final fine-tuning of ERP. As part of final system tests, necessary adjustments are made to resolve all remaining critical open issues.

Major Milestones

The major milestones of the final preparation phase are:

- Key-user and administrator training
- System readiness for going live
- Completion of cutover activities
- Project phase review and sign-off from customer

Phase 5: Going Live and Support

Completing this phase is the ultimate goal and the most exciting step of the implementation project. This is when the organization goes live with the ERP software and starts managing all daily activities independently. The going-live and support phase consists of two distinct subphases. First, the project is completed with a formal project closing. During this time, the software is used productively in day-to-day operations, all issues and problems are resolved, transition to the production support team is finalized, knowledge transfer is completed, and the project is signed off. Subsequently, the continuous improvement subphase begins during which the production support team monitors the software and resolves live business process issues. Proper change management procedures are established and ongoing end-user training is conducted. Plans are made to continuously review and improve business processes.

Major Milestones

The major milestones of the going-live and support phase are:

• Full production implementation of ERP

• Project phase review and sign-off from customer for going live and support as well as for final project completion

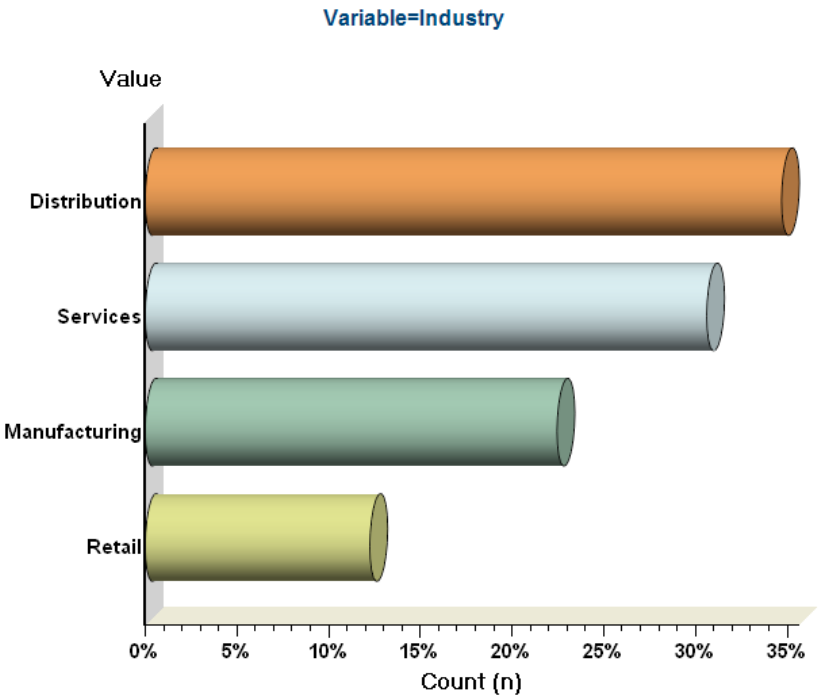
Results.

General Sample Profile.

240 companies agreed to participate in the research with 54 completed questionnaires returned. 5 responses were considered inadequate or incomplete and discarded, leaving 49 valid responses for statistical analysis, or a response rate of 23%. This response rate can be considered particularly satisfactory, considering the general difficulty of getting responses from executives at the level approached. Similar studies implying this level of executives just have reached approximately 7% reported final response rate (Jones et al. (2006), Mabert et al. (2003)).

Figure 6 shows the sample distribution by industry.

Figure 6 - Distribution by Industry



Note that the majority of firms in the sample are engaged in the commercial trade sector, which includes wholesale and retail trade. This concurs with the distribution of SME by Economics Sectors overall in Latin America, as depicted in the IDB Snapshot section.

Figure 7 shows more detailed information about Sample Profile.

Figure 7 - Sample Profile: Descriptive Statistics

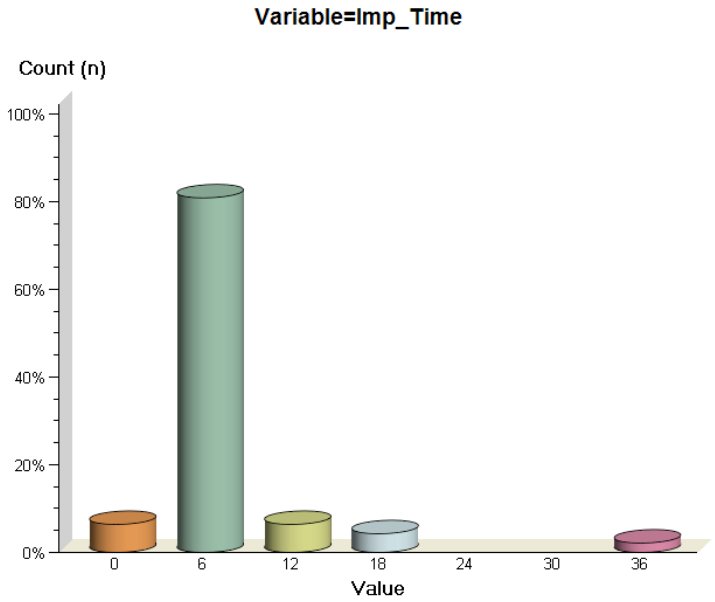
Variable	Label	Value	Frequency Count	Percent of Total Frequency
Invoicing		[US$10, US$50)	18	36.7347
		[US$2, US$5)	9	18.3673
		< US$ 2	8	16.3265
		[US$5, US$10)	8	16.3265
		[US$50, US$100)	4	8.1633
		[US$100, US$500)	2	4.0816

Variable	Label	N	NMiss	Total	Min	Mean	Median	Max	StdMean
Employees	**Employees**	49	0	5069.0	18	103.449	65	250	11.7745
Imp_Time	**Imp_Time**	47	2	308.5	1	6.564	6	36	0.8188
Years_in_Market	**Years in Market**	49	0	954.0	3	19.469	17	74	2.0776

On average, these companies have operated in markets for around 19 years, employ 100 workers, and generate revenues between US$ 5 million to US$10 million per year.

ERP project implementations lasted about 7 months for more than 80% of these companies. This fact concurs with the expectation of shorter implementation time in SMEs. Just few companies have exceeded on such implementation time. Figure 8 shows SMEs in the sample distributed by underlying implementation time consumed.

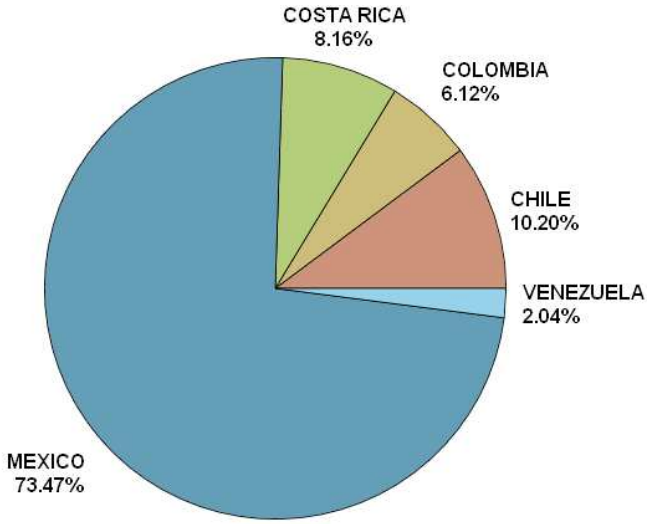
Figure 8 - Distribution by Implementation Time



On the other side, these companies have been using their ERP systems actively for 2 years (in average). Executives who filled out the questionnaire have been linked to their present ERP project for 3 years.

Regarding country of origin, most of the participants are based in Mexico and Chile. Figure 9 shows SMEs in the sample distributed by country of origin.

Figure 9 - Distribution by Country



Reliability Analysis.

To assess internal consistency, I used Cronbach's Alpha coefficients. Rates above 0.6 allow concluding that the measure is reliable (Hair et al., 1998). Table 12 shows the reliability assessment for the independent and dependent variables. Detailed information is showed in **Appendix C**.

Table 12 – Summary of Reliability Analysis.

Variable	Code	Number of Items	Cronbach's Alpha
ERP Business Improvement Success	BIZSUCCESS	6	0.8815
Change Management	CHANGE	4	0.6879
Ease of Use	EOFUSE	3	0.88
ERP Project Success	PROYSUCCESS	4	0.5577
ERP User Satisfaction	SATISFACTION	3	0.8979

It is worth mentioning that *Discriminant Validity* was also tested on the proposed constructs, following the same approach suggested by Kamhawi (2007). Detailed information is showed in **Appendix B**.

Descriptive Statistics.

Table 13 shows descriptive statistics of the research constructs.

Table 13 – Summary Statistics of Variables

Summary Statistics
Results

The MEANS Procedure

Variable	Label	Mean	Std Dev	Minimum	Maximum	N
CHANGE	CHANGE	4.8265306	0.6275035	3.2500000	6.0000000	49
EOFUSE	EOFUSE	4.7142857	0.8221471	2.0000000	6.0000000	49
PROYSUCCESS	PROYSUCCESS	3.9030612	0.8049591	2.5000000	6.0000000	49
SATISFACTION	SATISFACTION	4.8571429	0.7817360	2.6666667	6.0000000	49
BIZSUCCESS	BIZSUCCESS	4.8503401	0.8023727	2.6666667	6.0000000	49

Correlation Matrix.

Table 14 shows the correlation matrix between variables.

Table 14 – Correlation Matrix.

Pearson Correlation Coefficients, N = 49 Prob > |r| under H0: Rho=0	BIZSUCCESS	SATISFACTION	PROYSUCCESS	CHANGE	EOFUSE
BIZSUCCESS	1.00000	0.79556	0.43000	0.24218	0.56546
BIZSUCCESS		<.0001	0.0020	0.0936	<.0001
SATISFACTION	0.79556	1.00000	0.58726	0.31296	0.39619
SATISFACTION	<.0001		<.0001	0.0286	0.0048
PROYSUCCESS	0.43000	0.58726	1.00000	0.08975	0.23010
PROYSUCCESS	0.0020	<.0001		0.5397	0.1117
CHANGE	0.24218	0.31296	0.08975	1.00000	0.20816
CHANGE	0.0936	0.0286	0.5397		0.1512
EOFUSE	0.56546	0.39619	0.23010	0.20816	1.00000
EOFUSE	<.0001	0.0048	0.1117	0.1512	

Regression Analysis.

Structural Equation Modeling (SEM) is better suited for explaining complex relationships. However, when sample size is limited, regression analysis is a suitable path for analysis (Halawi et al.,2007).

In this study, the underlying hypotheses were analyzed using regression analysis. According to Hair et al. (1998), multiple regression analysis is a convenient statistical technique to be used when the researcher requires analyzing the relationship between a single dependent variable and several independent variables.

Also, since a mediating effect was defined in the model, the *Path Analysis* Technique was applied to test proposed hypotheses. *Path Analysis* is a regression-based technique widely used for analyzing the direct and indirect effects in model encompassing mediating variables like the research model proposed in this study. To assure the validity of Path Analysis, it is important to ensure the absence of multicollinearity problem. According to Billings et al. (1978) the correlation matrix should be analyzed to detect any correlation among predictors with values > 0.80. Examining Table 14, it can be observed that not obvious collinearity problem appears.

It was followed a three-step regression procedure to assess the hypotheses, as suggested by Frazier et al. (2004):

- Step 1: Regression between Mediator and Independent Variables.
- Step 2: Regression between Dependent Variable and Independent Variables.
- Step 3: Regression between Dependent Variable and Independent Variables plus Mediator.

Step 1: Mediator on the Independent Variables Regression.

Table 15 shows a summary of the regression model's output for this step.

Table 15 – Step 1: Regression Output Summary

R2 = 0.4624	Sig <.0001
Durbin Watson = 1.83	Satisfaction

VARIABLE	Beta	Sig	Tolerance	VIF
CHANGE	0.27	0.05	0.95	1.04
EOFUSE	0.22	0.04	0.91	1.09
PROYSUCCESS	0.49	<.0001	0.94	1.05

As shown in Table 15, the R^2 coefficient is 0.4624, implying that the 3 independent variables explain 46.24% of the variance of ERP User Satisfaction. Durbin-Watson's coefficient of 1.83 falls within the accepted range (Hair et al., 1998) permitting to assert that there is no apparent auto-correlation problem. Tolerance and VIF coefficients are also within the acceptable range (Hair et al., 1998) to maintain that there is no evident multi-colinearity problem. The Kolmogorov-Smirnov test and histograms of the regression models' residuals were plotted to validate the underlying assumed normal distribution. No apparent heteroscedasticity was detected. ***Appendix D*** and ***Appendix E*** shows more detailed information on Regression Analysis.

According to the results in Table 15, this step allows to corroborate hypotheses H1A, H2A, H3A.

Step 2: Dependent Variable on the Independent Variables Regression.

Table 16 shows a summary of the regression model's output for this step.

Table 16 – Step 2: Regression Output Summary

R2 = 0.4926	Sig <.0001
Durbin Watson = 2.3	BImprovement

VARIABLE	Beta	Sig	Tolerance	VIF
EOUSE	0.42	0.0004	0.89	1.11
PROYSUCCESS	0.32	0.0051	0.94	1.06
CHANGE	0.15	0.28	0.95	1.04

As shown in Table 16, the R^2 coefficient is 0.4926, implying that the 3 independent variables explain 49.26% of the variance of ERP Business Improvement. Durbin-Watson's coefficient of 2.3 falls within the accepted range (Hair et al., 1998) permitting to assert that there is no apparent auto-correlation problem. Tolerance and VIF coefficients are also within the acceptable range (Hair et al., 1998) to maintain that there is no evident multi-colinearity problem. The Kolmogorov-Smirnov test and histograms of the regression models' residuals were plotted to validate the underlying assumed normal distribution. No apparent heteroscedasticity was detected. ***Appendix D*** and ***Appendix E*** shows more detailed information on Regression Analysis.

This step allows to corroborate hypotheses H2B and H3B but no H1B.

Step 3: Dependent Variable on the Independent Variables and Mediator Regression.

Table 17 shows a summary of the regression model's output for this step.

Table 17 – Step 3: Regression Output Summary

R2 = 0.7388	Sig <.0001
Durbin Watson = 2.34	BImprovement

VARIABLE	Beta	Sig	Tolerance	VIF
EOUSE	0.27	0.001	0.82	1.2
PROYSUCCESS	-0.03	0.74	0.63	1.58
CHANGE	-0.04	0.7	0.87	1.13
SATISFACTION	0.7	< 0.0001	0.52	1.91

As shown in Table 17, the R^2 coefficient is 0.7388. Durbin-Watson's coefficient of 2.34 falls within the accepted range (Hair et al., 1998) permitting to assert that there is no apparent auto-correlation problem. Tolerance and VIF coefficients are also within the acceptable range (Hair et al., 1998) to maintain that there is no evident multi-colinearity problem. The Kolmogorov-Smirnov test and histograms of the regression models' residuals were plotted to validate the underlying assumed normal distribution. No apparent heteroscedasticity was detected. ***Appendix D*** and ***Appendix E*** shows more detailed information on Regression Analysis.

Table 17 also shows that the change in R^2 after introducing *Satisfaction* into the equation is significant (R^2 change = 0.7388 – 0.4926 = 0.2462; significance of R^2 change = $F(1, 45) = 41.47$, $p < 0.0001$).

According to Baron et al. (1986), to establish mediation, the following conditions must hold:

1. The independent variables must affect the mediator in Step 1. Table 15 confirms this condition.
2. The independent variables must be shown to affect the dependent variable in Step 2. Table 16 confirms this condition (except for Change Management).
3. The mediator must affect the dependent variable in the Step 3. Table 17 confirms this condition.
4. The effect of the independent variables on the dependent variable must be less in the Step 3 than in the Step 2. Analyzing Table 16 and Table 17 confirms this condition:
    a. Ease of Use: From Step 2 (β=0.42326, p=0.0004) to Step 3 (β=0.27922, p=0.0017). Partial Mediation.
    b. ERP Project Implementation Success: From Step 2 (β=0.32548, p=0.0051) to Step 3 (β=-0.03141, p=0.7494). Full Mediation.

According to the guidelines proposed by Baron et al. (1986), this step allows to corroborate hypothesis relating to Mediation (H4), specifically determining a *partial mediation* for Ease of Use and *full mediation* for Project Success. These results allow to corroborate the Mediation Hypothesis (H4).

Note: Authors like Shrout et al. (2002) recommend to consider (or not) the inclusion of the first step based on whether the predictor is distal or proximal to the outcome. They specifically recommend skipping the first step in cases in which the predictor is distal to the outcome (as it might the case in this study). Under this scenario, the *Sobel test* (Frazier et al., 2004; Baron et al., 1986) can be applied to determine the impact of mediating effects as showed:

- Ease of Use: p-value = 0.05309358. Consequence: Mediation.
- ERP Project Success: p-value = 0.00020371. Consequence: Mediation.
- Change Management: p-value = 0.06190454. Consequence: Mediation.

Under this assumption, it can be corroborated the mediation effect for all Independent Variables included in the model.

The three-step regression procedure explained before and the Correlation Matrix in Table 14 (to analyze the relationship between ERP User Satisfaction and ERP Business Improvement –Hypothesis H0–), allows to corroborate the hypotheses as showed in Table 18.

Table 18 – Summary of Hypotheses

Hypothesis	Relationship implying…	Corroborated?
H0	ERP User Satisfaction and ERP Business Improvement	**YES**
H1A	Change Management and ERP User Satisfaction	**YES**
H1B	Change Management and ERP Business Improvement	**NO**
H2A	Ease of Use and ERP User Satisfaction	**YES**
H2B	Ease of Use and ERP Business Improvement	**YES**
H3A	Project Implementation Success and ERP User Satisfaction	**YES**
H3B	Project Implementation Success and ERP Business Improvement	**YES**
H4	Mediating Role of ERP User Satisfaction	**YES** (for Ease of Use, ERP Project Success)

Additionally, it is worth mentioning that the control variable, ***Elapsed Time*** shows a significant impact on ERP Business Improvement Success (see more details in ***Appendix D*** and ***Appendix E).*** On the other hand***,*** although I also controlled for ***Years in the Market, Firm Size*** and ***Industry***, it was not possible to corroborate the impact of those variables on the ERP Business Improvement Success and were discarded for further analysis.

Regression Analysis: Summary of Assumptions.

Validation of underlying assumptions is a crucial step to ensure that results obtained can be generalized outside the sample employed (Berry, 1993). ***Appendix E*** provides detailed information. Table 19 renders a summary of the assumptions managed and corroborated individually in every regression analyzed, as follows:

- **STEP 1 (Mediator on Independents)**
- **STEP 2 (Dependant on Independents)**
- **STEP 3 (Dependant on Independents and Mediator)**

Table 19 - Regression Analysis - Briefing of Assumptions

Assumption	Verification
No Perfect Multicollinearity	Multicollinearity exists when there is a strong correlation between two or more predictors in a regression model. Perfect collinearity exists when at least one predictor is a perfect linear combination of the others. One alternative of identifying multicollinearity is to scan the correlation matrix of all of the variables and check if there are correlations of above .80. Based on the results obtained from current data there is not an evident course of multicollinearity, since all coefficient are less than .80. Another alternative consists in scanning 2 additional coefficients from the Regression Model: "Tolerance" (Tol) and "Variance Inflation" (VIF), and verify that the following conditions are met: (a) The largest value of VIF is less than 10. (b) The average VIF is substantially lesser than 1 (c) Tolerance values ought to be above 0.2. The three required conditions are fully met in every regression. Both ways suggest that there are no reasons to contradict the assumption of "No Perfect Multicollinearity".
Independent Errors	For any two observations the residual terms should be uncorrelated. This assumption can be tested with the Durbin-Watson test, which monitors for serial correlations between errors. The statistic can vary between 0 and 4 with a value of 2 meaning that the residuals are uncorrelated. A value greater than 2 indicates a negative correlation between residuals, whereas a value below 2 indicates a positive correlation. Values less than 1 or greater than 3 are definitely cause for concern. Results obtained from current data, suggest that there are no reasons to contradict the assumption of "Independent Errors", since values for this statistics move around 1.8 to 2.3.
Normally Distributed Errors	It is assumed that the residuals in the model are random, normally distributed variables with mean of 0. This assumption simply means that the differences between the model and the observed data are most frequently zero or very close to zero. There are two ways to test this assumption: First one is to work with a normal probability plot to analyze deviations from normality. In this plot the straight line represents a normal distribution and the points represent the observed residuals. In a perfectly normally case, all points will lie on the line. These plots can be checked in Appendix E. The other alternative is to apply a Kolmogorov-Smirnov test on the standardized residuals, to check whether they deviate significantly from normality. According to the test applied individually by regression, it was not possible to contradict null hypothesis ($p > 0.15$), therefore there were no reasons to contradict the assumption of "Normally Distributed Errors".
Homocedasticity	It is assumed that at each level of the variables, the variance of the residuals terms should be constant. This assumption is validated by analyzing the "Regression Standardized Residual" vs. "Regression Standardized Predicted Value" graph. This graph should look like a random array of dots evenly dispersed around zero. If this graph funnels out, then it suggests a potential heterocedascity trend in the data. Results obtained from current data, displayed in Appendix E, suggest that there are no reasons to contradict the assumption of "Homocedasticity". As an additional test, it is also suggested to work with partial plots. These plots are scatterplots of the residuals of the outcome variable and each of the predictors when both variables are regressed separately. These graphs can also detect any heterocedascity trend in the data.

Discussion of Results.

Relationships with ERP Business Improvement Success.

The impact of *Ease of Use* capability in the Business Improvement Success of ERP in SMEs was corroborated empirically in this study (β=0.42326, p=0.0004). This result is also supported by Velcu's (2007) case study research, which also confirms that the perception of end-users about the easiness of using the new system is a key element, since ERP systems start generating benefits as system utilization improves. It is worth mentioning that in a previous empirical research conducted in a developing region (Kamhawi, 2007), the impact of *Ease of Use* on business success was not corroborated. The fact that SMEs organizations in Latin America appraise the *Ease of Use* characteristic impact highly and distinctively in comparison to other developing regions could be explained by:

- The reality of SMEs in Latin America, in terms of lack of personnel qualified in tasks as specialized as those required for IT (Ramirez, 2005), makes them value the Ease of Use capability to minimize any related barriers and motivating the use of the ERP, producing expected results.
- The reality of SMEs in Latin America, in terms of lack of training and development of human resources due to budget and time constrains (Ramirez, 2005), makes them value Ease of Use as an important feature that can minimize required training, motivating the use of the ERP and generating expected business results.
- The culture of work in Latin America varies significantly by socio-economic level, age and educational achievement. Even at the risk of generalizing, work is considered an obligation. If given the choice, most people would do something else rather than

work. Latin Americans typically also used to look for "short-cuts" to do things. For instance, when using an information system, instead of reading the user's manual they will rather try and learn by *"trial and error",* choosing to interact and "play" with the system. Enhanced "ease of use" features should facilitate this interaction and motivate the employees to use the system to get better business results.

The impact of an *ERP Implementation Project Success* in the Business Improvement Success of SMEs is also supported empirically by this research (β=0.32548, p=0.0051). As Markus et al. (2000b) hold, ERP success can be conceptualized as a process, where the outcomes of one phase of the ERP life cycle become starting conditions for the next phase. Before reaching solid business benefits as a consequence of using ERP, the entire organization must agree that the ERP implementation project has been successful. This result is also consistent with similar findings highlighted by Velcu (2007) and Kamhawi (2007). But what this study finds is that SME in Latin America appraise the *ERP implementation project success'* impact in the Business Improvement Success highly and distinctively, in comparison to other developing regions. This could be explained by:

- The lack of a fully developed IT culture in SMEs in Latin America, as mentioned by Ramirez (2005). On this basis, an *ERP Implementation Project Success* imbues *motivation* and *trust* in the organization, leading to success in other areas, and creating an upward success spiral impacting afterwards on benefits.
- Considering any IT adoption, one of the most common causes why business improvement goals are not reached in SMEs in Latin America is because of the lack of management processes that guarantee timely and outstanding quality outcome of the underlying implementation (Brenes et al., 2009). So, once this outcome is accomplished, the SME will navigate in a better condition to the next level, focused on the use and obtainment of the expected results.

- Latin American business culture is characterized by various types of *collectivism*. Most Latin American SMEs are family companies where the collective spirit at the workplace is evident. Company celebrations play a major role in the workplace, and managers usually look for a reason to celebrate, get the "family" together and motivate them. Recognizing success as the "new member of the family" and celebrating it collectively impacts workers' morale, motivates them to use the ERP and commits them to accomplishing the intended business benefits.

The first surprising result of this study is that it was not possible to corroborate the impact of *Change Management* on the Business Improvement Success of SMEs (p=0.28). There are two possible explanations for this result. The first one can be drawn from empirical research by Somers et al. (2004). In this study, it was found that change management is a key task to be conducted mainly in the early stages of the project (such as the charting and technical implementation phase). After that, it is important to keep that task but its impact will decrease over time. The second one can be more related to the findings posted by Buonnano et al.(2005). They assert that *"SMEs are more inclined to a strategy of incremental innovation (local automation, internal integration) when implementing ERP system, whereas large companies seems to be more inclined to a radical-oriented attitude towards organizational innovation (business process reengineering and business process redesign)"*. According to this vision, which was also empirically shown in their research, change management seems to be a pillar primarily for large enterprises to get the expected business results, but not necessarily for SMEs engaged in ERP implementations. A previous study focused also on a developing region (Kamhawi, 2007) highlighted the same finding. Another plausible explanation was provided by local experts consulted, who assert that in Latin America, it appears that SMEs, contrary to expectations, chose to adapt the ERP software to current processes rather than the other way around. This implies that the main efforts associated to change

management take place during implementation. Once the ERP is implemented and proper training on how to use it has been conducted, there are no major roadblocks that need to be addressed with further change management initiatives.

The impact of *ERP User Satisfaction* in the Business Improvement Success of SMEs is also supported empirically by this research ($p=<0.0001$) as indicated in the correlation matrix. This result is consistent with the similar finding evidenced by Bradfort et al. (2003), where it was established that "*user satisfaction might be an antecedent to business improvement success*." In accordance with this, local experts asserted that SMEs in Latin America do not have a formal strategy, neither documented procedures. These organizations basically rely on the "human capital" and the business knowledge they have developed to obtain the expected business results. Experts argued that any initiative that increases user satisfaction will definitely promote a better environment for reaching the goals.

Relationships with ERP User Satisfaction.

The impact of *Ease of Use* capability in the *ERP User Satisfaction* in SMEs was corroborated empirically in this study ($\beta=0.22$, $p=0.04$). This result is consistent with the theoretical foundation established by the D&M Model (DeLone et al., 2003) as well as related research such as Hsieh et al. (2007) and Devaraj et al. (2002). Considering specifically the situation of SMEs in Latin America, local experts assert that a common restriction on such organizations is the lack of skilled resources for IT. So, any mechanism that prevents the perception of complexity in this arena will impact positively in accomplishing greater satisfaction.

The impact of *Change Management* capability in the *ERP User Satisfaction* in SMEs was corroborated empirically in this study (β=0.27, p=0.05). This result is consistent with the theoretical framework established by the D&M Model (DeLone et al., 2003) as well as related research such as Halawi et al. (2007), Chiu et al. (2007) and Iivary (2005). In accordance with this, local experts hold that in Latin America, SMEs lack skilled resources and that they are used to conduct business processes "as is", following the "tradition" on performing the tasks. However, if SMEs perceive a solid and feasible advantage as a consequence of a proposed change, they will be more eager to adopt such innovation. Therefore, experts argued that *Change Management* initiatives oriented to explain the benefits of a proposed change in the day-to-day activities, describing clearly how the innovation will enhance their activities, will definitely impact user satisfaction, consolidation also ties related to *trust*, *image* and *enjoyment*.

The impact of *ERP Project Implementation Success* capability in the *ERP User Satisfaction* in SMEs was also corroborated empirically in this study (β=0.49, p=0<0.0001). This result is consistent with the theoretical framework established by the D&M Model (DeLone et al., 2003) as well as related research such as Liu et al. (2009). Considering specifically the situation of SMEs in Latin America, local experts hold that SMEs are not fully aware of the ways in which available technologies can be applied, being reluctant to use IT because of their poor understating of it. But, once SMEs realize an implementation project has been completed successfully, on time and within budget, allowing the organization understand how processes and operations are now integrated in an ERP, the new project will motivate the organization to use the ERP, solidifying the *trust* towards the ERP, directly impacting user satisfaction.

Mediating Role.

Regarding the relationship between *ERP User Satisfaction* and *ERP Business Improvement Success*, this research not only corroborates the strong significant correlation between them (β=0.79, p=0.001) but also, empirically, exposes the ***mediating*** role of *ERP User Satisfaction* when considering the independent variables (ERP Project Success and Ease of Use) and the dependant variable (ERP Business Improvement Success), as derived from the D&M Model (DeLone et al., 2003) and specifically suggested by Bradford et al. (2003) in the context of ERP implementations. This finding definitely represents an innovative contribution not addressed in the literature reviewed.

Control Variables.

This research corroborates the significant role (β=0.11, p=0.0375) of the ***elapsed time*** control variable in the model, demonstrating the importance of controlling for its effects. This is also consistent with the Bradford et al. (2003) study, where it was suggested that, the longer the time elapsed, the more comfortable employees are with the ERP and therefore, the better the results achieved. This unique finding also concurs with the literature focusing on large enterprises, such as Weider et al. (2006), Gattiker et al. (2005), Markus et al. (2000a) and Hitt et al. (2000). Bendoly et al. (2005) summarize clearly the importance of this variable claiming that time is a critical requisite for extracting value from ERP: *the longer the time, the greater the benefits*.

Considering ERP implementations in SMEs in Latin America, local experts gather from their experience, that as the duration since going live increases, more categories of benefits tend to be realized. This finding is consistent with Gattiker et al. (2005) who hold that ERP impacts are expected to increase with time, but at a decreasing rate. Nicolaou (2004B) finds that there is a time lag of at least two years before ERP adopters begin to reap the incremental business benefits.

Even though the ***time elapsed*** effect seems to be well know in the IS literature, and it has been corroborated in some ERP studies focusing on large enterprises, a novel result from this research revolves around corroborating such effect in the context of SMEs.

Regarding the influence of the other control variables, findings suggest that *Years in the Market*, *Firm Size* and *Industry* are not determinants of ERP's business success. These findings disagree with other studies stressing the relevance of at least Firm Size

and Industry, such as Laukkanen et al. (2007), Buonnano et al. (2005). Plausible explanations might be oriented to: a) Those variables are not crucial in the context of SMEs or b) Possibly the lack of these relationships may stem from a lack of enough variance in a small sample.

Summary: Hypotheses and Findings.

Table 20 summarizes Hypotheses and Findings derived from the present study.

Table 20 - Hypotheses and Findings: Summary

Hypothesis	Relationship implying constructs	Theory – Reference Model	Measure	Validated?
H0	ERP User Satisfaction and ERP Business Improvement	**D&M Model (DeLone et al., 2003)** Bradford at al. (2003) Equey et al. (2008) Holsapple et al. (2005) Seddon et al. (1994) Wu et al. (2001)	ERP User Satisfaction: Based on Soja (2006), Bradford et al. (2003) and adaptations suggested by local experts. ERP Business Improvement: Based on Stratman et al. (2002) and adaptations suggested by local experts.	**YES**
H1A	Change Management ERP User Satisfaction	**D&M Model (DeLone et al., 2003)** **Loh et al. (2004) Model** Halawi et al. (2007) Chiu et al. (2007) Liu et al. (2007) Liang et al. (2007) Martin et al. (2007) Kim et al. (2005) Iivary (2005) Stratman et al. (2002) Aladwani (2001) Nah et al. (2001) Wood et al. (2001) Shanks et al. (2000) Holland et al. (1999) Ajzen et al. (1980)	Change Management: Based on Stratman et al. (2002) and adaptations suggested by local experts. ERP User Satisfaction: Based on Soja (2006), Bradford et al. (2003) and adaptations suggested by local experts.	**YES**
H1B	Change Management ERP Business Improvement	**D&M Model (DeLone et al., 2003)** **Loh et al. (2004) Model** Halawi et al. (2007) Liang et al. (2007) Martin et al. (2007) Kositanurit (2006) Kim et al. (2005) Nah et al. (2003) Rai et al. (2002) Stratman et al. (2002) Aladwani (2001) Wood et al. (2001)	Change Management: Based on Stratman et al. (2002) and adaptations suggested by local experts. ERP Business Improvement: Based on Stratman et al. (2002) and adaptations suggested by local experts	**NO**

Hypothesis	Relationship implying constructs	Theory – Reference Model	Measure	Validated?
H2A	Ease of Use ERP User Satisfaction	**Technology Acceptance Model (TAM) (Davis, 1989)** **D&M Model (DeLone et al., 2003)** Hsieh et al. (2007) Amoako-Gympah (2007) Ramayah (2006) Wu et al. (2006) Kositanurit et al. (2006) Ignatius et al. (2005) Amoako-Gympah et al. (2004) Calisir et al. (2004) Devaraj et al. (2002)	Ease of Use: Based on Kamhawi (2007) and adaptations suggested by local experts. ERP User Satisfaction: Based on Soja (2006), Bradford et al. (2003) and adaptations suggested by local experts.	**YES**
H2B	Ease of Use ERP Business Improvement	**Technology Acceptance Model (TAM) (Davis, 1989)** **D&M Model (DeLone et al., 2003)** Velcu (2007) Kositanurit (2006)	Ease of Use: Based on Kamhawi (2007) and adaptations suggested by local experts. ERP Business Improvement: Based on Stratman et al. (2002) and adaptations suggested by local experts	**YES**

Hypothesis	Relationship implying constructs	Theory – Reference Model	Measure	Validated?
H3A	Project Implementation Success ERP User Satisfaction	**Process Theory Approach model (Loh et al., 2004)** **D&M Model (DeLone et al., 2003)** **Markus et al. (2000a)** Liu et al. (2009) Pasanen (2003)	Project Implementation Success: Based on Kamhawi (2007) and adaptations suggested by local experts. ERP User Satisfaction: Based on Soja (2006), Bradford et al. (2003) and adaptations suggested by local experts.	**YES**
H3B	Project Implementation Success ERP Business Improvement	**Process Theory Approach model (Loh et al., 2004)** **D&M Model (DeLone et al., 2003)** Liu et al. (2009) Kamhawi (2007)	Project Implementation Success: Based on Kamhawi (2007) and adaptations suggested by local experts. ERP Business Improvement: Based on Stratman et al. (2002) and adaptations suggested by local experts	**YES**
H4	Mediating Role of ERP User Satisfaction	**Bradford et al. (2003)**		**YES (for Ease of Use, ERP Project Success)**
Control Variable: **Time Elapsed**	Time Elapsed and Business Improvement Success	Fichman (2000) Bradford et al. (2003)	Based on Foster et al. (1997).	**YES**

Hypothesis	Relationship implying constructs	Theory – Reference Model	Measure	Validated?
Control Variable: **Years in the Market**	Years in the Market and Business Improvement Success	Klein et al. (2008).	Klein et al. (2008)	**NO**
Control Variable: **Firm Size**	Firm Size and Business Improvement Success	Bradford et al. (2003)	Kang et al. (2008) Karimi et al. (2007)	**NO**
Control Variable: **Industry**	Industry and Business Improvement Success	Shin (2006)	Shin (2006)	**NO**

Conclusions.

Contributions.

A comprehensive review of the literature of ERP success carried out in this research identified several existing gaps. Findings provide several implications that support, but also extend, what is known about ERP and its dimensions of success.

ERP Success in terms of incremental business performance.

This study is among the few examining the success of ERP, and the related critical success factors, in the perspective of how organizations fare after implementing ERP. The notion of ERP success is analyzed explicitly by assessing the business value derived from implementing ERP. This gap was originally positioned as a critical area for future research by Al-Mashari (2003A). Jones et al. (2006) also reinforce this motivation, holding that there is little evidence about the extent to which organizations are being successful in terms of improving their business as of consequence of their ERP initiatives.

Another indirect contribution is that measurement of business performance in this study was not limited to or focused on financial metrics, but encompasses diverse business indicators and perspectives. It is worth mentioning that Brazel et al. (2008) identified this gap and proposed that future research centered in looking into the relationship between ERP and performance, should use non-financial measures when trying to gauge operational improvement.

Also, consistent with the D&M Model (DeLone et al., 2003), this research corroborates that *ERP Success* encompasses diverse components and relationships between them, as the one between ERP User Satisfaction and ERP Business Improvement Success.

What this study finds distinctively considering the SMEs Latin America context is:

- The participation of Latin American experts in ERP implementations at SMEs provided insightful details about the factors that were relevant to ERP Business Improvement Success in this region. The existing literature had not been able to identify such specific contextual information in order to propose a theoretical model suited to this region.
- SMEs perceive ERP success mainly in terms of business value obtained. To date, this is one of the first studies focusing in SMEs in Latin America that indirectly corroborates that SMEs that adopt IT expect to increase their competitiveness, and that success should be measured in terms of business value generated, as predicted by Lebre La Rovere (1998).
- It corroborates that there are particular CSFs related to success. Specifically, it was verified that *Ease of Use, ERP Project Implementation Success* and, specially, *End User Satisfaction* impact *ERP Business Improvement Success*. This is a very important contribution since discovering factors that lead to business success has been an unfulfilled purpose of business research (Lussier et al., 2008).
- An analysis of such unique cultural style yielded feasible explanations of the impacts in such CSFs. My analysis included examining trends like collectivism and paternalistic leadership, popular celebrations and an "easy way of doing things" attitude among employees. Table 21 summarizes the main cultural trends that might differentiate findings in this research from those studies of SMEs elsewhere.

Table 21 - Distinctive cultural trends as explanations to CSFs' impacts

Critical Success Factor impacting Business Performance	Cultural Explanation
Ease of Use	The culture of work in Latin America varies significantly by socio-economic level, age and educational achievement. Even at the risk of generalizing, work is considered an obligation. If given the choice, most people would do something else rather than work. Latin Americans typically also used to look for "**short-cuts**" to do things. For instance, when using an information system, instead of reading the user's manual they will rather try and learn by "**trial and error"**, choosing to interact and "play" with the system. Enhanced "ease of use" features should facilitate this interaction and motivate the employees to use the system to get better business results.
ERP Implementation Project Success	Latin American business culture is characterized by various types of collectivism. Most Latin American SMEs are **family** companies where the collective spirit at the workplace is evident. Company **celebrations** play a major role in the workplace, and managers usually look for a reason to celebrate, get the "family" together and motivate them. Recognizing ERP Project Implementation Success as the "new member of the family" and celebrating it collectively impacts workers' morale, motivates them to use the ERP and commits them to accomplishing the intended business benefits.
ERP User Satisfaction	It was discussed before that in Latin America culture, work is mostly considered an obligation and a way to enjoy the important things in life. Also, although employees accept the idea of getting involved in modern managerial practices, they still prefer to "avoid their individual risk of taking a decision related to work" and delegate or share decision-making to or with other individuals in the company. So, besides generic benefits that an ERP might bring to user satisfaction, in Latin America, if employees perceive also that the ERP will make easier their day-to-day activities and help them to make better decisions, they will be satisfied to use the system and get the business results. At the end of the day, employees are the drivers at SMEs, so, any initiative aimed at enhancing their working conditions and satisfaction will definitely impact the business positively.

Mediating Effect of ERP User Satisfaction in ERP Business Improvement Success.

This study corroborates the impact of Change Management, Ease of Use and ERP Project Implementation Success in ERP User Satisfaction and ERP Business Improvement Success. But also, motivated by the framework established in the D&M Model (DeLone et al., 2003), and the post hoc analysis conducted in Bradford et al.

(2003), it supports the mediating effect of ERP User Satisfaction. Mediators find out "how" and "why" one variable predicts an outcome variable (Frazier et al., 2004). And in this case, the findings confirm why *Ease of Use* and *ERP Project Success* are effective variables as they increase ERP User Satisfaction (and even Change Management, although the study does not reveal a direct effect on ERP Business Improvement Success). This is consistent with the hypothesis stated by Bradford at al. (2003) who hold that User Satisfaction is a required antecedent to Business Results.

The results from this study also contribute to the current literature by supporting the importance of understanding the antecedents and consequences of ERP User Satisfaction, a gap noticed by Wu et al. (2006).

What this study finds distinctively considering the Latin American SME context is:

- The importance of *User Satisfaction* as one of the most relevant CSFs in ERP implementation success, as predicted by local experts interviewed (see Hypotheses Section). Research to date focused on SME considered diverse variables, but *User Satisfaction* had not yet been empirically addressed. This study is among the first to corroborate that *User Satisfaction* is a required antecedent to accomplish *Business Results*, as predicted theoretically by Bradford at al. (2003).

ERP success in SMEs.

Loh et al. (2004) recognize that although the rate of ERP adoption in SMEs is increasing dramatically, ERP research still centers on large enterprises. To fill this gap, they propose a seminal framework of critical elements relevant to successful ERP implementations in SMEs. Nevertheless, they recognize that their framework is merely a

conceptual model that requires empirical validation. This study aims at closing this gap, not only validating empirically some elements of such framework, but also extending it.

What this study finds as distinctive in the SME context is that:

- While many studies have explored ERP implementation in large organizations, fewer have focused on SMEs. This is one of the first studies that propose to close the knowledge gap about ERP Implementation Success at SMEs. As Wresch (2003) states, much of the research concerning IT adoption in SMEs lacks a strong theoretical basis. This research proposed a rigorous model based on the D&M Model (DeLone et al., 2003) and corroborated such hypotheses empirically.
- The research model proposed in the study was designed to validate not only the available literature focusing on SMEs but also considered the input from experts devoted to this research niche. As highlighted by Federici (2009), the adoption of ERP by SMEs cannot just duplicate the experiences of larger companies. The related peculiarities were weighted in the proposed model.
- Although some factors discussed here have also been studied in the context of large enterprises, relevant differences were noticed. For instance, *Change Management* has been recognized as a CSF for large enterprises (Nat et al., 2006; Mabert et al., 2003). But concurring with Soja (2006), and contrary to initial expectations, this study finds that in SMEs this might not be necessary. This finding also corroborates that SMEs differ from large businesses in terms of IT adoption patterns and underlying factors influencing success as highlighted by Nasco et al. (2008).

ERP success in Latin America.

This study pioneers the analysis of ERP success and associated critical factors in SMEs in Latin America. No similar references were found in the literature. This is

important not only for Latin America, but also more generally for developing countries. Nah et al. (2007) and Kamhawi (2007) assert that few studies examine ERP success in developing nations, stressing the need to close this gap. Even more, Nah et al. (2007) assert that best practices and success factors related to ERP derived in the developed world will not necessarily apply to developing countries, reinforcing the importance of consolidating knowledge explicitly focusing on the latter.

What this study finds distinctively considering the SMEs Latin American context is that:

- One of the first researches in this field, this study aims at closing the knowledge gap about SMEs, proposing a model relating some CSFs to ERP success, specifically in regards of organizations operating in Latin America. To date, as Lussier et al. (2008) assert, there is limited empirical research on small business in the Latin American context and every contribution in this area would represent an important event.
- This study proposes (and validates empirically) a formal model grounded in the D&M Model (DeLone et al., 2003), which is a well-established, robust theory. Using this theoretical framework, a model was conceptualized to predict the impact of some CSFs on ERP Success. This is a significant contribution because much of the research concerning IT adoption in SMEs, particularly that focused on developing regions such as Latin America, is merely descriptive and lacks a strong theoretical foundation (Nasco et al., 2008; Wresch, 2003). Even more, this study allows recognizing differences with results obtained, not only in developed but also in developing regions. For instance, clear differences were established with the results obtained by Kamhawi (2007). Focusing just on Latin America is an important contribution, since the underlying infrastructure, awareness and availability of trained personnel vary greatly in comparison to other regions. This definitely determines distinctive expectations, experiences and outcomes in contrast to any other region in the world.

- The results of this study reveal that SMEs in Latin America value *User Satisfaction* as one of the most important CSFs to achieve ERP Business Success. Other CSFs analyzed here such as Change Management, ERP Project Success and Ease of Use basically expose the indirect effects on ERP Business Success, being *User Satisfaction* the significant mediator between them. This finding definitely represents an innovative contribution apparently not addressed in the past by previous research conducted in other developing regions, such as Kamhawi (2007) and Nah et al. (2007). This important finding also corroborates what a Latin American executive predicted as a distinctive factor in the region: "*Latin America businesses should begin to put people first*" if they want to achieve expected business results (The Economist Intelligence Unit, 2008a).
- This study was centered in Latin America. Several previous studies, such as Sheu et al., (2004), indicate that country differences might influence aspects of ERP implementation and usage. So, there is a valuable opportunity for replicating this research across different regions to analyze potential similarities and differences among SMEs.

ERP Success and the Current State of Debate of Technology Adoption Theories.

The results from this study also indirectly contribute to ongoing debate when they address the most frequent question about technology adoption research: Is technology adoption research dead? (Venkatesh et al., 2007).

My answer, based on the results from this research, is that technology adoption research is far from being dead.

Although Venkatesh et al. (2007) hold Technology Adoption Research is not dead, they do recognize new contributions and theoretical advances are required, resulting from fresh research, in contrast to merely reproducing the constructs and measures already studied. Venkatesh et al. (2007) also recognize the "tremendous opportunities that are still available to make substantial theoretical advances" in this field.

My main contributions to introduce an alternative to the status quo commanding the current Technology Adoption Research (Benbasat et al., 2007) can be summarized as follows:

- **Consideration of new salient beliefs other than Perceived Usefulness or Perceived Ease of Use**. It was discussed in my findings that ERP Implementation Success imbues trust in the organization, thereby motivating the users to engage more strongly to interaction with the ERP. Additionally, I analyzed the impact of Change Management capabilities in facilitating the users' attitudes for better interaction with the ERP, engaging salient beliefs such as trust, enjoyment and image. The importance of including such new salient beliefs in the analysis is precisely an area of opportunity to expand current technology adoption research as suggested by Benbasat et al. (2007).
- **Consideration of the "outcome".** Technology Adoption Research has centered in adoption/use as the central and relevant outcome. Nevertheless, as Venkatesh et al. (2007) advise, an interesting alternative to expand such models would be focused in moving away from using adoption/use as a dependent variable (outcome) and shift it to using it as an independent variable that might be exploited to understand other outcomes of interest. This is precisely a core goal of the present study: to analyze success in terms of business performance improvement as an outcome, a consequence of implementing and using the ERP.

Implications for Practice.

Understanding small business is an important area of research because it can benefit diverse actors: entrepreneurs (future and present); those who assist, train and advise them; those who provide capital for their ventures; universities; their suppliers; and public policy makers (Lussier et al., 2008). Specifically in the Latin American context, most SMEs innovate only when they clearly perceive business opportunities arising from innovation (Lebre La Rovere, 1998). This research can help in demonstrating how some CSFs can determine ERP business success, stimulating SMEs to embrace ERP projects that can impact their competitiveness.

This study extends the current knowledge on ERP systems' success in terms of incrementally improved business performance at SMEs and confirms some intuitive knowledge about ERP. Moreover, the corroborated findings provide valuable implications for practice. Since there is significant evidence that SMEs operate differently from large organizations, this study provides specific direction to SME management contemplating an ERP implementation.

Change Management.

Several organizations implementing ERP have not been able to reach a desirable degree of business improvement success because of their employees' resistance. In the same vein, this study corroborates the impact of change management on ERP User Satisfaction (although a direct impact on ERP business improvement success was not corroborated). Management must recognize the critical importance of introducing user involvement schemes from the onset of ERP implementations or even from the ERP

evaluation/selection process. Users should be involved and actively participate in the design and implementation of new business processes enabled by ERP.

In addition, it is extremely important to ensure strong management commitment in the execution of change readiness/change management strategies aimed at promoting the infusion of ERP in the workplace. Nah et al. (2003) suggest, as an example of this execution, establishing a support team entirely devoted to meeting the users' needs and concerns. As an additional reference for concerned practitioners, Aladwani (2001) has provided a first process-oriented approach for facing the complex social problems of workers' resistance to ERP.

ERP Ease of Use.

This study corroborates the importance of implementing a suitable ERP that considers the degree to which that system matches the users' skills, working style and, mainly, favorable perception about how easy it is to learn and use ERP systems, minimizing any potential locus of resistance. Although the use of an ERP system would be mandatory as it becomes integrated into daily operational activities, management must ensure that the new system is alleviating end-user activities instead of creating additional barriers and obstacles for strong ERP user satisfaction and business improvement success. As Holsapple et al. (2005) reveal, it is critical for management to recognize that a system that is perceived as complex to use, independently of its strong technical and business capabilities, is less likely to be used and to produce beneficial results to the organization. Therefore, ERP Ease of Use capabilities must be taken in consideration from the beginning of the ERP selection process. The greater the effort during ERP selection to consider the "ease of use" factor, the greater the chances of overall success. As Rogers

(2003) states, the complexity of an innovation comes from the practical perception of how easy it is to be understood and used. So, all those involved, from software providers to management teams, must pay crucial attention to this factor.

ERP Project Success.

This study corroborates that before achieving the anticipated business benefits, the ERP system must be implemented and actively used in the most effective way across the organization. Every possible effort must be made during the project implementation phase to ensure that the original expectations are fulfilled. The success or failure of an ERP project implementation is intimately associated to how a company manages the process (Dawson et al., 2008). Once this phase finishes as planned, a shared recognition across the organization about the "ERP project's success" will commit all the actors to appropriate this success and boost the ERP to the next level, namely achieving the expected business improvement success. As an additional reference, Loh et al. (2004) provide an excellent framework about the specific critical success factors involved specifically in this project phase.

ERP User Satisfaction.

This is probably the most distinctive outcome of the present study. It corroborates the importance of this variable as a **mediator** to achieve ERP business improvement success. As Holsapple et al. (2005) assert, it is crucial that management, during the ERP implementation process, "*pay more attention to user issues*". "A system that does not

provide *User Satisfaction* is less likely to be used and to produce beneficial results to the organization" (Guimaraes et al., 1995). This factor seems to be even more important in the Latin American context. According to the opinion of recognized practitioners: "*Latin American businesses should begin to put people first*" if they want to achieve expected business results (The Economist Intelligence Unit, 2008a). So, management at SMEs should be aware of the importance of *ERP User Satisfaction* as an essential CSF towards ERP business improvement success, and make every possible effort to manage and leverage this determining element.

Implications for ERP Vendors and Implementation Consultants.

Understanding small businesses is an important area of research because it can benefit diverse actors, including those who assist, train and advise them (Lussier et al., 2008). This study extends the current knowledge on ERP systems' success in terms of incrementally improved business performance at SMEs but also has valuable implications for practice. Vendors and implementation consultants should manage the following implications:

- **Importance of Ease of Use**. Vendors focused on SMEs in Latin America shall make all possible efforts to design their software to be operated as easily as possible. It should look natural, and be intuitive and flexible enough to incorporate any recommendations given by potential users. Interface in the local language is essential as well as regulatory considerations. ERP providers and consultants shall take into account users will rarely read any manual or on-line help, so, probably it would be a differentiator (or another business opportunity) for them to provide on-line or

telephone support (24/7) in local language to assist with any questions or doubt from users.

- **Importance of Change Management**. Besides standard change management practices, implementation consultants shall be aware of the importance of sustained communication flows, not only with the project's team, but also with potential users. Since Latin American culture values communication as well as personal relationships, it stands as good practice to schedule regular "get together" meetings in an informal and friendly atmosphere, to update stakeholders on the project's progress, and getting feedback from "the field".

- **Project Success**. ERP vendors and implementation consultants need to engage in all efforts possible to guarantee a successful project implementation. ERP vendors shall provide the best technical support channels as well as carefully supervise any escalation or problem raised during the implementation. The importance of "recognition and celebration" in Latin American culture was discussed. So, the ERP vendor and the consulting team should consider also a "Project Close" task. This milestone, besides the usual communication of the results and outcomes of the project, must include a special celebration, intended to recognize the effort of the employees and make them aware of the next level of benefits they will achieve by using the software. This activity will create a common understanding of the new adoption and will motivate the entire team to use enthusiastically the ERP in order to get the planned business benefits.

- **End User Satisfaction**. As this research demonstrates, user satisfaction is a fundamental CSF in these ERP adoptions. User satisfaction should be a goal to be monitored continuously by the ERP vendor, not only during the implementation phase, but all along the ERP's life cycle. Mechanisms to periodically collect feedback

from end users, such as surveys, focus groups, etc., need to be implemented. The ***elapsed time*** finding suggests that the continuous execution of these mechanisms might even be more important in the context of SMEs. This continuous feedback will be instrumental to improve previous dimensions discussed, such as "Ease of Use" capabilities, "Change Management" and "ERP Implementation strategies". Different perspectives (managers, users, etc) must be compiled separately to have an enriched and integrated vision of the customer and users.

ERP vendors and implementation consultants need to assimilate that the introduction of ERP into the SMEs segment cannot just replicate the experiences gained through large enterprises implementations: SMEs involve distinctive characteristics that should be managed.

Limitations and directions for Future Research.

This study is subject to several limitations. These limitations suggest caution in generalizing the study's findings.

First, there might be a selection bias because data was obtained from only *one primary* provider of ERP systems. Nevertheless, it is worth mentioning that authors like Nicolaou (2004A) consider that in this kind of research, results are stronger when the ERP system vendor is controlled. In any case, a prominent avenue for future research is to include several ERP vendors and establish comparisons among them.

Second, a *convenient sample* was used. Because only a small population was targeted, no random sampling was managed. The entire selected sample was processed. In any case, the discussion's findings were derived from examining a target group in Latin America. Organizations in Latin America may be different from organizations in other geographies. Thus, my findings should be interpreted cautiously when generalizing to other groups or environments. As a consequence, there is room for enhancing sample size. Another avenue for future research may consider including other Latin American countries, like Brazil, to expand the research target population.

Third, only one perspective in each organization was collected - top senior managers responsible for the information technology function in their organizations, being also an active user of the implemented ERP. Although several authors like Ifinedo (2007) and Jones et al. (2006) hold that these individuals are among the most knowledgeable informants regarding ERP projects and derived success in organizations, another

interesting avenue for future research may be to examine different levels/roles within the organization and conduct individual analyses by level.

Fourth, since only one respondent was chosen from each participant organization, it is not unreasonable to claim a method bias may limit the research findings. But even if the constructs measured were conceived as "perceptual" ones identified by a rater (upper-level senior manager responsible for the information technology function in the organization who is also an active user of the implemented ERP), additional guidelines might be used in future studies to minimize this potential limitation, including: a) To use different methods to measure the independent versus dependent variables. b) To call for multiple raters from different rater classes, such as managers and end-users. Burton-Jones (2009) provides a useful approach for dealing with method bias.

Fifth, a wider spectrum of Critical Success Factors *was not included* due to practical constrains such as cost and time. A similar analysis of other factors certainly provides another valuable opportunity for research.

Sixth, *ERP User Satisfaction* was a critical pillar identified in this study. But, because satisfaction is a state, it may change over time as will user perceptions while experience with the ERP will shape user reactions. *Longitudinal* evidence on ERP implementation stages may enhance our understanding of the relationships between variables that are important to ERP User Satisfaction.

Many researchers have claimed that few empirical studies have examined the impact of ERP systems on organizations (Kamhawi, 2007; Soja, 2006). Consequently, there are still numerous avenues for future research by just considering any natural extensions to the present study. For instance, it would be valuable to compare results obtained in

similar studies focusing on SMEs but in different geographies outside Latin America with a view at exploring ERP's success as it relates to cultural influences. Sheu et al. (2004) highlighted that country differences might impact critical aspects of ERP Implementation and usage. Therefore, there is a unique opportunity for replicating this research across different geographies. An additional interesting area would be to establish cross-industry comparisons of the results obtained.

Another attractive area may be to compare factors impacting ERP's success in large enterprises versus small and medium companies, and evaluating divergences (if any).

An additional interesting research stream should be oriented at including and analyzing additional variables as well as interactions theorized by the D&M Model (DeLone et al., 2003). The understanding of the interactions between "net benefits" and "user satisfaction" might be of special interest. Refining this and other related interactions could also offer a unique opportunity to expand the status quo of Technology Adoption Research. Al-Natour el al. (2009) already perceive the beginning of a new era in IS research in which IT artifacts can be recognized to assume roles beyond solely enhancing productivity, including serving as communication mediators. This new era will demand a new generation of adoption models with new constructs that capture such new roles and characteristics considering such perspective of IT artifacts. Al-Natour et al. (2009) believe that "how an IT artifact is used in a particular interaction establishes the basis for how this artifact is perceived and evaluated by its users". So, a clear understanding of such interactions would definitely help in expanding current knowledge about adoption and use behaviors.

Also, this research indirectly has illustrated the importance of analyzing critical success factors specifically tied to a concrete stage within ERP's life cycle. More research

along this line will certainly benefit current knowledge but also will dramatically help practitioners looking for a clearer understanding of the broad spectrum of factors highlighted in the existing literature.

And finally, this research does improve the understanding of the nature of ERP implementations at SMEs in Latin America. But as Lussier et al. (2008) highlighted, much more research is still needed in this context. This study sheds light on the various opportunities for creating and consolidating knowledge by taking advantage of this fertile region that are SMEs in Latin America. *"Wayfarer, there is no path; in going the path is made"…*

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Appendices.

Appendix A: Questionnaire.

English Version.

PhD - Management Sciences.

Survey: ERP Implementation and Business Impact in Latin America companies.

Dear Participant,

It is a pleasure meeting you! I am Miguel Maldonado, a Ph. D. candidate at ESADE in Barcelona, Spain. At present, I am conducting a formal research in the area of Enterprise Resource Planning Systems (ERP) and their impacts in the Latin America context.

This research is aimed to analyze several factors that may contribute to the success in the adoption of this ERP technology, as well as understand their afterward impact in the consolidation of competitive advantages. I am sure that Participants will certainly take advantage of the outcome derived from this research.

The key source of information for this research is centered on the opinion and knowledge from business leaders involved in any ERP adoption process. In that sense, your impressions are extremely valuable for this study and I want to invite you to manage a questionnaire designed for this purpose. Your answers will be strictly processed as CONFIDENTIAL and results from this research will be always presented in a consolidated approach, never mentioning any individual case. Additionally, any information gathered in this study will be merely used for it and no other use will be allowed.

I want to thank you in advance for your time and collaboration. To participate, please proceed to answer the questionnaire below. After the last item, please press the "SENT" button to close the questionnaire.

If you consider that any other person should be managing this information, please, feel free to forward it or let me know for further processing.

Thank you very much! Your opinion is very important for this research!

Best regards,

Miguel Maldonado

e-mail: esadedoc@gmail.com

ESADE.

All items will be managed strictly confidential. It is extremely important that your answers reflect the PRESENT AND REAL scenario in your company and NOT the ideal nor the desirable one to be planned for the future.

In case of any doubt or question, please don't hesítate to contact Miguel Maldonado at: **esadedoc@gmail.com**

Thank you very much for your participation!

1) Company:

2) Fax:

3) Country:

*****PART I *****

I want to know some general information about your organization. Please respond the following questions:

4) Your company operates in which industry? (Please select ONE, the most relevant):	
Manufacturing	
Retail	
Services	
Distribution	

5) In which year was your company established?

6) Number of Employees at your company:

7) Organizational Annual Revenue (yearly in US$)	
<= USD 2M	
> USD 2M and < =USD 5M	
> USD 5M and < =USD 10M	
> USD 10M and < =USD 50M	
> USD 50M and < =USD 100M	
> USD 100M and < =USD 500M .	
> USD 500M	
Other	

8) External Consultant Firm that supported your company during the ERP Implementation:

9) How long did it take (in months) the ERP implementation in your company, since the agreement/contract was closed to final letter of Project Ending was released?

10) How long has the ERP been running in your company's processes?	
< = 1 Year	
> 1 Year and < = 2 Years	
> 2 Years and < = 3 Years	
> 3 Years and < = 4 Years	
> 4 Years	

11) Please le tus know your current title in the organization:

12) Your position in your company:	
Managerial	
Non-Managerial	
Other, Please specify	

13) How long have you been in your company?	
< = 1 Year	
> 1 Year and < = 5 Years	
> 5 Years and < = 10 Years	
> 10 Years	

***PART II ***

Considering the ERP Implementation experience in your company, please indicate the extent to which you agree with below statements by marking "X" against the appropriate scale shown.

14) **CHANGE MANAGEMENT.**

Considering the ERP Implementation in my company…

	Don't know/Don't remember	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Management actively worked to alleviate employee concerns about ERP Implementation.						
There were open communication channels to employees reporting current project status at any time during the implementation.						
An ERP Support group was available to manage any employee problem or concern raised during the implementation.						
Feedback sessions were conducted periodically to gauge employee satisfaction with the process.						

15) **EASE OF USE.**

Considering the ERP Implementation in my company…

	Don't know/Don't remember	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Users interact with our ERP naturally and without any significant complication						
Our ERP was easy to learn						
In general terms, our ERP is easy to use.						

16) **USER SATISFACTION WITH ERP PERFORMANCE**

Considering the ERP implementation in my organization…

	Don't know/Don't remember	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Top Management is satisfied with the ERP System.						
End Users in my organization are satisfied with the ERP System.						
In general terms, the adoption of the ERP in my organization has been a Success.						

17) **ERP PROJECT IMPLEMENTATION SUCCESS.**

Considering the ERP Implementation in my company…

	Don't know/Don't remember	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
The cost of ERP Project was significantly higher than the expected budget.						
The ERP Project took significantly longer time than expected.						
The system performance of ERP is significantly below the expected level.						
In general terms, my company is satisfied with the ERP implementation process.						

18) **IMPROVED BUSINESS PERFORMANCE.**

Considering the ERP Implementation in my company…

	Don't know/Don't remember	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Company business processes have been rationalized through the use of the ERP system.						
The ERP provides real time information that have improved the decision making process.						
The ERP system has improved customer satisfaction.						
Employee job satisfaction and morale has improved through the use of the ERP System.						
Business flexibility has improved through the use of the ERP System.						
In general terms, my company is satisfied with the business achievements reached through the use of the ERP System.						

*****PART III *** (Optional)**

Your experience about ERP Implementation processes is very important for us. If you want to share any other comment or concern, please feel free to use this section.

19) Additional Remarks:

Thank you very much for your collaboration.

Spanish Version.

PhD en Management Sciences.
Encuesta sobre Implementación e Impacto de Sistemas ERP en Empresas Latinoamericanas.

Estimado Participante,
¡Mucho gusto en saludarle! Soy Miguel Maldonado, candidato a Doctor del ESADE, Barcelona, España, y estoy realizando una investigación sobre los sistemas de Planificación de los Recursos Empresariales (ERP) en el contexto latinoamericano.

Aspiro estudiar los factores que facilitan el éxito en las implementaciones de esta tecnología de la información, así como su impacto en el desarrollo de las ventajas competitivas empresariales. Las instituciones participantes de esta investigación podrán beneficiarse directamente de los resultados y conclusiones obtenidas.
Pretendo contactar a líderes de negocio involucrados en el proceso de adopción del ERP en sus respectivas empresas, por lo que agradecería nos dedicara unos minutos de su valioso tiempo para contribuir a la realización del presente estudio contestando unas preguntas concernientes a la implementación del ERP en su organización. Se garantiza la CONFIDENCIALIDAD absoluta de los datos que nos aporte y el tratamiento estadístico correspondiente se realizará siempre a nivel global y no se realizarán análisis individuales. Tampoco se utilizarán sus datos para ningún otro fin fuera del ámbito del presente estudio.

De antemano quiero darle las gracias por su tiempo y colaboración. Para participar, por favor conteste el cuestionario que se le presenta a continuación (por favor vaya bajando con la barra de navegación de su ventana -scroll down- para ir accediendo a las preguntas en el área azul, y complete los espacios en blanco de acuerdo a su selección). Posterior a la última pregunta, el sistema le desplegará inmediatamente el botón "ENVIAR" que deberá presionar para someter sus respuestas al sistema.
¡Sin su ayuda, esta investigación no sería posible!

Si considera que existen otras personas en su organización cuya opinión sería también muy valiosa para el presente estudio, le agradecería si puede transmitirles la encuesta, mediante el envío del presente correo electrónico para que puedan gestionarla.

Muchas gracias. Reciba un cordial saludo,

Dr. (c) Miguel Maldonado
e-mail: esadedoc@gmail.com
ESADE.

INICIO DE LA ENCUESTA Todas las respuestas serán tratadas con absoluta confidencialidad. Es de suma importancia para el estudio que las respuestas reflejen la situación REAL y ACTUAL en la empresa y NO lo que se desearía que fuera, o la que se tiene previsto sea en el futuro.

Si usted tiene cualquier pregunta con relación a este estudio y la encuesta, por favor comuníquese con Miguel Maldonado vía e-mail: esadedoc@gmail.com
¡Muchas gracias por su colaboración!.
Con el fin de hacerle llegar una copia del informe final con los resultados del estudio, le solicitamos nos proporcione los datos que se preguntan a continuación.

1) Empresa:

2) Número de Fax:

3) País:

*****SECCION I *****
Nos interesa conocer primeramente algunos rasgos demográficos de su empresa. Por favor responda las siguientes preguntas:

4) Indique el principal ramo industrial al que se dedica su empresa (Por favor seleccione UNO, el que usted considere más relevante):	
Manufactura	
Retail	
Servicios	
Distribución	

5) ¿En que año se fundó la empresa?

6) ¿Cuántos empleados tiene su empresa?

7) ¿Cuál es la facturación anual **(aproximada en dólares)** de su empresa?	
Menos de 2 Millones de US Dólares Anuales.	
Entre 2 y 5 Millones de US Dólares Anuales.	
Entre 5 y 10 Millones de US Dólares Anuales.	
Entre 10 y 50 Millones de US Dólares Anuales.	
Entre 50 y 100 Millones de US Dólares Anuales.	
Entre 100 y 500 Millones de US Dólares Anuales.	
Más de 500 Millones de US Dólares Anuales.	

Otro

8) ¿Cuál es la empresa consultora que lo ayudó en el proceso de implementación del ERP ?

9) ¿Cuánto tiempo **(en meses)** demoró la implementación del ERP en su empresa, contando desde que se acordaron los términos de compra del software (contrato) hasta que se terminó la implementación con la respectiva carta de liberación/finalización?

10) ¿Cuántos años tiene el ERP implementado y en uso efectivo en su empresa?	
Menos de 1 Año	
Entre 1 y 2 Años	
Entre 2 y 3 Años	
Entre 3 y 4 Años	
Más de 5 Años	

11) Favor coloque el título de su cargo en la organización:

12) Su cargo en la organización lo clasificaría como:	
Gerencial	
Funcional No-Gerencial	
Otro (Por favor especifique):	

13) ¿Por cuántos años ha estado vinculado a su empresa?	
Menos de 1 Año	
Entre 1 y 5 Años	
Entre 6 y 10 Años	
Más de 10 Años	

***SECCION II ***

Considerando la experiencia de implementación del ERP **en su organización**, por favor indique el nivel en el que usted concuerda con las siguientes proposiciones, en una escala que va de "Totalmente en Desacuerdo" hasta "Totalmente de Acuerdo", seleccionando para ello la casilla que mejor describa su opinión.

14) **GERENCIA DEL CAMBIO EN LA IMPLEMENTACION DEL ERP**

Considerando la implementación del ERP en mi organización...

	No sabe/No Contesta	Totalmente en Desacuerdo	En Desacuerdo	Neutral	De Acuerdo	Totalmente de Acuerdo
La Gerencia se involucró activamente para atenuar cualquier preocupación de los empleados relacionada con la implementación del ERP.						
Existieron canales de comunicación que permitieron informar a los empleados sobre el estado del proyecto de implementación.						
Existieron los mecanismos para resolver los problemas que enfrentaban los empleados durante la implementación del ERP.						
Se ejecutaron sesiones de retroalimentación para garantizar la satisfacción de los usuarios.						

15) **FACILIDAD DE USO DEL ERP**

Considerando la implementación del ERP en mi organización...

	No sabe/No Contesta	Totalmente en Desacuerdo	En Desacuerdo	Neutral	De Acuerdo	Totalmente de Acuerdo
Los usuarios interactúan con el ERP de forma sencilla y sin complicaciones.						
Aprender a operar con el sistema ERP ha sido fácil para nuestros empleados.						
En términos generales, el sistema ERP es fácil de usar.						

16) **SATISFACCION GENERAL CON EL DESEMPEÑO DEL ERP EN SU EMPRESA**

Considerando la implementación del ERP en mi organización...

	No sabe/No Contesta	Totalmente en Desacuerdo	En Desacuerdo	Neutral	De Acuerdo	Totalmente de Acuerdo
La Gerencia de la empresa está satisfecha con el sistema ERP.						
Los usuarios del ERP en la empresa están satisfechos con el sistema.						
En términos generales, la adopción del ERP en nuestra empresa ha sido éxitosa.						

17) ÉXITO EN EL PROYECTO DE IMPLEMENTACION DEL ERP

Considerando la implementación del ERP en mi organización...

	No sabe/No Contesta	Totalmente en Desacuerdo	En Desacuerdo	Neutral	De Acuerdo	Totalmente de Acuerdo
El costo del proyecto de implementación del ERP fue significativamente mayor a lo originalmente presupuestado.						
El proyecto de implementación del ERP consumió más tiempo a lo originalmente previsto.						
El desempeño del ERP fue significativamente menor al nivel originalmente esperado.						
En términos generales, la empresa está satisfecha con el proceso de implementación del ERP.						

18) ÉXITO DEL IMPACTO DEL ERP EN EL DESEMPEÑO DEL NEGOCIO

Considerando la implementación del ERP en mi organización...

	No sabe/No Contesta	Totalmente en Desacuerdo	En Desacuerdo	Neutral	De Acuerdo	Totalmente de Acuerdo
Los procesos de negocio de la compañía se mejoraron gracias al uso del ERP.						
El ERP provee información en tiempo real que facilita el proceso de toma de decisiones.						
El ERP ha permitido mejorar el nivel de satisfacción de los clientes de la empresa.						
La satisfacción y moral de los empleados ha mejorado como resultado de la implementación del ERP.						
La empresa cuenta con más agilidad y flexibilidad como resultado de la implementación del ERP.						
En términos generales, la empresa está satisfecha con los objetivos de negocio que se han logrado gracias al uso del sistema ERP.						

***** SECCION V *** OPCIONAL**

Su experiencia en el proceso de Implementación del ERP es muy importante para nosotros. Si desea compartir cualquier otro comentario o inquietud relacionada, será una retroalimentación muy valiosa.

20) Comentarios Adicionales:

Si ha completado sus respuestas, por favor proceda ahora a presionar el botón "Enviar" que se le presenta a continuación para finalizar su encuesta.

Appendix B: Discriminant Validity.

Factor Analysis, via "Principal Components extraction", was the technique used to test Discriminant Validity.

For Factor Analysis, Kaiser (1970) recommends accepting variables for this analysis on such variables having values on the Kaiser-Meyer-Olkinm measure of Sampling Adequacy greater than .5. From Table 22 it can be verified that, for most values, this condition is met.

Table 22 – Factor Analysis Adequacy Validation.

Kaiser's Measure of Sampling Adequacy: Overall MSA = 0.68015031

Change_1	Change_2	Change_3	Change_4	Eofuse_1	Eofuse_2	Eofuse_3	Satif_1	Satisf_2	Satisf_3	Proysuccesst_1	Proysuccesst_2	Proysuccesst_3
0.39	0.66	0.51	0.70	0.63	0.69	0.68	0.81	0.63	0.74	0.4660	0.7101	0.7493

Then, factoring method used was "Principal Components", applying an Orthogonal Varimax rotation with Kaiser's normalization. Based on these conditions, 4 Factors were obtained (Kaiser's criterion of retaining factors with eigenvalues greater than 1), which was consistent with the 4 variables used in my model. Table 23 shows related detail.

Table 23 – Principal Components Output

	Eigenvalue	Difference	Proportion	Cumulative
1	4.29543942	2.25418525	0.3304	0.3304
2	2.04125417	0.34729811	0.1570	0.4874
3	1.69395606	0.35644918	0.1303	0.6177
4	1.33750688	0.43868907	0.1029	0.7206
5	0.89881782	0.15695493	0.0691	0.7898
6	0.74186289	0.24116300	0.0571	0.8468
7	0.50069988	0.03362864	0.0385	0.8853
8	0.46707124	0.12925699	0.0359	0.9213
9	0.33781425	0.11759924	0.0260	0.9473
10	0.22021501	0.01950329	0.0169	0.9642
11	0.20071173	0.02554074	0.0154	0.9796
12	0.17517098	0.08569132	0.0135	0.9931
13	0.08947966		0.0069	1.0000

Then, Kaiser (1970) suggests checking the Rotated Factor Matrix to validate the association between Factors generated/proposed and underlying variables being loaded into them. For each variable, it should be noted the component for which each variable has the highest loading (loadings should be above .4, ignoring the plus/minus sign).

Exploratory Factor Analysis.

Table 24 – Exploratory Factor Analysis Output.

The FACTOR Procedure
Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2	3	4
1	0.75046	0.54430	0.36688	0.07708
2	-0.32789	0.03646	0.73982	-0.58637
3	0.49045	-0.83680	0.24252	-0.02029
4	-0.29792	-0.04659	0.50917	0.80611

Rotated Factor Pattern

		Factor1	Factor2	Factor3	Factor4
PROYSUCCESST_1	PROYSUCCESST_1	0.01931	0.05092	0.08602	0.80036
PROYSUCCESST_2	PROYSUCCESST_2	0.43190	-0.01309	-0.05862	0.65130
PROYSUCCESST_3	PROYSUCCESST_3	0.79952	0.09274	-0.00892	0.20473
EOFUSE_1	EOFUSE_1	0.31993	0.88766	-0.01912	0.00200
EOFUSE_2	EOFUSE_2	0.08762	0.84174	0.15631	0.22042
EOFUSE_3	EOFUSE_3	0.13521	0.87779	0.13505	-0.05395
Change_1	Change_1	0.11805	-0.08966	0.25072	-0.45980
Change_2	Change_2	0.06852	0.17563	0.71920	-0.35567
Change_3	Change_3	0.09327	0.01991	0.86704	0.19745
Change_4	Change_4	0.14263	0.11801	0.80725	-0.11386
SATISF_1	Q25a	0.89909	0.10265	0.15705	0.00553
SATISF_2	Q25b	0.79841	0.29365	0.04979	-0.20716
SATISF_3	Q25c	0.84667	0.18987	0.27777	0.07873

Based on results showed in Table 24, the following loadings are met:

Variables	Loading in Factor
Proysuccesst_1, Proysuccesst_2, Proysuccesst_3	Factor4 Note: Issues with Proysuccesst_3 being loaded in other Factor.
EofUse_1, EofUse_2, EofUse_3	Factor2
Change_1, Change_2, Change_3, Change_4	Factor3 Note: Issues with Change_1 being loaded in other Factor.
Satisf_1, Satisf_2, Satisf_3	Factor 1

These results provide evidence of Discriminant Validity, following the same analysis as the one conducted by Kamhawi (2007).

Appendix C: Cronbach's Alpha Analysis.

ERP Business Improvement Success: Improved Business Performance.

Table 25 shows detailed Cronbach's Alpha analysis output considering the variable *ERP Business Improvement Success*.

Table 25 – Cronbach's Alpha: ERP Business Improvement Success.

Correlation Analysis

The CORR Procedure

6 Variables:	BIZSUCCESS_1 BIZSUCCESS_2 BIZSUCCESS_3 BIZSUCCESS_4 BIZSUCCESS_5 BIZSUCCESS_6

Covariance Matrix, DF = 48

		BIZSUCCESS_1	BIZSUCCESS_2	BIZSUCCESS_3	BIZSUCCESS_4	BIZSUCCESS_5	BIZSUCCESS_6
BIZSUCCESS_1	BIZSUCCESS_1	0.895408163	0.524659864	0.386904762	0.321428571	0.540816327	0.416241497
BIZSUCCESS_2	BIZSUCCESS_2	0.524659864	0.944727891	0.601190476	0.565476190	0.736819728	0.607993197
BIZSUCCESS_3	BIZSUCCESS_3	0.386904762	0.601190476	1.375000000	0.583333333	0.607142857	0.532738095
BIZSUCCESS_4	BIZSUCCESS_4	0.321428571	0.565476190	0.583333333	0.958333333	0.747023810	0.550595238
BIZSUCCESS_5	BIZSUCCESS_5	0.540816327	0.736819728	0.607142857	0.747023810	1.164965986	0.790816327
BIZSUCCESS_6	BIZSUCCESS_6	0.416241497	0.607993197	0.532738095	0.550595238	0.790816327	0.812074830

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
BIZSUCCESS_1	49	4.97959	0.94626	244.00000	1.00000	6.00000	BIZSUCCESS_1
BIZSUCCESS_2	49	5.18367	0.97197	254.00000	2.00000	6.00000	BIZSUCCESS_2
BIZSUCCESS_3	49	4.57143	1.17260	224.00000	1.00000	6.00000	BIZSUCCESS_3
BIZSUCCESS_4	49	4.42857	0.97895	217.00000	1.00000	6.00000	BIZSUCCESS_4
BIZSUCCESS_5	49	4.95918	1.07934	243.00000	2.00000	6.00000	BIZSUCCESS_5
BIZSUCCESS_6	49	4.97959	0.90115	244.00000	2.00000	6.00000	BIZSUCCESS_6

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.881553
Standardized	0.885267

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables		
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
BIZSUCCESS_1	0.547017	0.883051	0.548932	0.888916	BIZSUCCESS_1
BIZSUCCESS_2	0.777051	0.847322	0.779542	0.851888	BIZSUCCESS_2
BIZSUCCESS_3	0.571322	0.885552	0.572023	0.885358	BIZSUCCESS_3
BIZSUCCESS_4	0.692230	0.860964	0.688395	0.866926	BIZSUCCESS_4
BIZSUCCESS_5	0.814248	0.839103	0.823143	0.844505	BIZSUCCESS_5
BIZSUCCESS_6	0.790174	0.847234	0.790110	0.850110	BIZSUCCESS_6

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	BIZSUCCESS_1	BIZSUCCESS_2	BIZSUCCESS_3	BIZSUCCESS_4	BIZSUCCESS_5	BIZSUCCESS_6
BIZSUCCESS_1 BIZSUCCESS_1	1.00000	0.57045 <.0001	0.34869 0.0141	0.34699 0.0146	0.52952 <.0001	0.48813 0.0004
BIZSUCCESS_2 BIZSUCCESS_2	0.57045 <.0001	1.00000	0.52748 <.0001	0.59430 <.0001	0.70235 <.0001	0.69414 <.0001
BIZSUCCESS_3 BIZSUCCESS_3	0.34869 0.0141	0.52748 <.0001	1.00000	0.50817 0.0002	0.47971 0.0005	0.50416 0.0002
BIZSUCCESS_4 BIZSUCCESS_4	0.34699 0.0146	0.59430 <.0001	0.50817 0.0002	1.00000	0.70700 <.0001	0.62413 <.0001
BIZSUCCESS_5 BIZSUCCESS_5	0.52952 <.0001	0.70235 <.0001	0.47971 0.0005	0.70700 <.0001	1.00000	0.81306 <.0001
BIZSUCCESS_6 BIZSUCCESS_6	0.48813 0.0004	0.69414 <.0001	0.50416 0.0002	0.62413 <.0001	0.81306 <.0001	1.00000

Change Management.

Table 26 shows detailed Cronbach's Alpha analysis output considering the variable Change Management.

Table 26 – Cronbach's Alpha: Change Management.

Correlation Analysis

The CORR Procedure

4 Variables:	Change_1 Change_2 Change_3 Change_4

Covariance Matrix, DF = 48

		Change_1	Change_2	Change_3	Change_4
Change_1	Change_1	0.444727891	0.100765306	0.066751701	0.122023810
Change_2	Change_2	0.100765306	0.749149660	0.344812925	0.494047619
Change_3	Change_3	0.066751701	0.344812925	0.647108844	0.497023810
Change_4	Change_4	0.122023810	0.494047619	0.497023810	1.208333333

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
Change_1	49	5.18367	0.66688	254.00000	3.00000	6.00000	Change_1
Change_2	49	4.79592	0.86553	235.00000	3.00000	6.00000	Change_2
Change_3	49	4.75510	0.80443	233.00000	2.00000	6.00000	Change_3
Change_4	49	4.57143	1.09924	224.00000	2.00000	6.00000	Change_4

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.687992
Standardized	0.673600

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables		
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
Change_1	0.189015	0.759549	0.187644	0.768668	Change_1
Change_2	0.566543	0.560329	0.548134	0.543759	Change_2
Change_3	0.576694	0.560630	0.543906	0.546731	Change_3
Change_4	0.598174	0.536350	0.582520	0.519282	Change_4

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	Change_1	Change_2	Change_3	Change_4
Change_1 Change_1	1.00000	0.17457 0.2303	0.12443 0.3943	0.16646 0.2530
Change_2 Change_2	0.17457 0.2303	1.00000	0.49523 0.0003	0.51927 0.0001
Change_3 Change_3	0.12443 0.3943	0.49523 0.0003	1.00000	0.56208 <.0001
Change_4 Change_4	0.16646 0.2530	0.51927 0.0001	0.56208 <.0001	1.00000

Ease of Use.

Table 27 shows detailed Cronbach's Alpha analysis output considering the variable Ease of Use.

Table 27 – Cronbach's Alpha: Ease of Use.

Correlation Analysis

The CORR Procedure

3 Variables:	EOFUSE_1 EOFUSE_2 EOFUSE_3

Covariance Matrix, DF = 48

		EOFUSE_1	EOFUSE_2	EOFUSE_3
EOFUSE_1	EOFUSE_1	0.9251700680	0.6530612245	0.6330782313
EOFUSE_2	EOFUSE_2	0.6530612245	0.8384353741	0.4995748299
EOFUSE_3	EOFUSE_3	0.6330782313	0.4995748299	0.7482993197

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
EOFUSE_1	49	4.69388	0.96186	230.00000	2.00000	6.00000	EOFUSE_1
EOFUSE_2	49	4.48980	0.91566	220.00000	2.00000	6.00000	EOFUSE_2
EOFUSE_3	49	4.95918	0.86504	243.00000	2.00000	6.00000	EOFUSE_3

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.880626
Standardized	0.880689

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables		
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
EOFUSE_1	0.831520	0.772772	0.831901	0.773539	EOFUSE_1
EOFUSE_2	0.734195	0.861441	0.731206	0.864196	EOFUSE_2
EOFUSE_3	0.747325	0.850970	0.745642	0.851562	EOFUSE_3

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	EOFUSE_1	EOFUSE_2	EOFUSE_3
EOFUSE_1 EOFUSE_1	1.00000	0.74150 <.0001	0.76087 <.0001
EOFUSE_2 EOFUSE_2	0.74150 <.0001	1.00000	0.63071 <.0001
EOFUSE_3 EOFUSE_3	0.76087 <.0001	0.63071 <.0001	1.00000

ERP Project Implementation Success.

Table 28 shows detailed Cronbach's Alpha analysis output considering the variable ERP Project Success.

Table 28 – Cronbach's Alpha: ERP Project Success.

Correlation Analysis

The CORR Procedure

3 Variables:	PROYSUCCESST_1 PROYSUCCESST_2 PROYSUCCESST_3

Covariance Matrix, DF = 48

		PROYSUCCESST_1	PROYSUCCESST_2	PROYSUCCESST_3
PROYSUCCESST_1	PROYSUCCESST_1	1.772959184	0.466411565	0.307823129
PROYSUCCESST_2	PROYSUCCESST_2	0.466411565	1.493197279	0.673894558
PROYSUCCESST_3	PROYSUCCESST_3	0.307823129	0.673894558	1.681122449

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
PROYSUCCESST_1	49	3.65306	1.33153	179.00000	0	6.00000	PROYSUCCESST_1
PROYSUCCESST_2	49	3.08163	1.22196	151.00000	1.00000	6.00000	PROYSUCCESST_2
PROYSUCCESST_3	49	4.16327	1.29658	204.00000	2.00000	6.00000	PROYSUCCESST_3

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.553881
Standardized	0.558693

Cronbach Coefficient Alpha with Deleted Variable

	Raw Variables		Standardized Variables		
Deleted Variable	Correlation with Total	Alpha	Correlation with Total	Alpha	Label
PROYSUCCESST_1	0.273434	0.596089	0.275384	0.596824	PROYSUCCESST_1
PROYSUCCESST_2	0.462573	0.302549	0.463803	0.302640	PROYSUCCESST_2
PROYSUCCESST_3	0.369501	0.444309	0.376297	0.445583	PROYSUCCESST_3

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	PROYSUCCESST_1	PROYSUCCESST_2	PROYSUCCESST_3
PROYSUCCESST_1	1.00000	0.28666	0.17830
PROYSUCCESST_1		0.0458	0.2203
PROYSUCCESST_2	0.28666	1.00000	0.42534
PROYSUCCESST_2	0.0458		0.0023
PROYSUCCESST_3	0.17830	0.42534	1.00000
PROYSUCCESST_3	0.2203	0.0023	

ERP User Satisfaction.

Table 29 shows detailed Cronbach's Alpha analysis output considering the variable ERP User Satisfaction.

Table 29 – Cronbach's Alpha: ERP User Satisfaction.

The CORR Procedure

3 Variables:	SATISF_1 SATISF_2 SATISF_3

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
SATISF_1	49	4.85714	0.91287	238.00000	2.00000	6.00000	Q25a
SATISF_2	49	4.83673	0.79966	237.00000	3.00000	6.00000	Q25b
SATISF_3	49	4.87755	0.85714	239.00000	3.00000	6.00000	Q25c

Cronbach Coefficient Alpha

Variables	Alpha
Raw	0.897959
Standardized	0.899036

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	SATISF_1	SATISF_2	SATISF_3
SATISF_1 Q25a	1.00000	0.73795 <.0001	0.77594 <.0001
SATISF_2 Q25b	0.73795 <.0001	1.00000	0.73010 <.0001
SATISF_3 Q25c	0.77594 <.0001	0.73010 <.0001	1.00000

Appendix D: Regression Analysis.

Regression Analysis Output.

Table 30 shows the Correlation Analysis Output. Table 31 shows the Regression analysis output.

Table 30 – Correlation Analysis – Output.

Correlation Analysis

The CORR Procedure

5 Variables:	BIZSUCCESS SATISFACTION PROYSUCCESS CHANGE EOFUSE

Simple Statistics

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
BIZSUCCESS	49	4.85034	0.80237	237.66667	2.66667	6.00000	BIZSUCCESS
SATISFACTION	49	4.85714	0.78174	238.00000	2.66667	6.00000	Q25F
PROYSUCCESS	49	3.90306	0.80496	191.25000	2.50000	6.00000	PROYSUCCESS
CHANGE	49	4.82653	0.62750	236.50000	3.25000	6.00000	CHANGE
EOFUSE	49	4.71429	0.82215	231.00000	2.00000	6.00000	EOFUSE

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

	BIZSUCCESS	SATISFACTION	PROYSUCCESS	CHANGE	EOFUSE
BIZSUCCESS BIZSUCCESS	1.00000	0.79556 <.0001	0.43000 0.0020	0.24218 0.0936	0.56546 <.0001
SATISFACTION Q25F	0.79556 <.0001	1.00000	0.58726 <.0001	0.31296 0.0286	0.39619 0.0048
PROYSUCCESS PROYSUCCESS	0.43000 0.0020	0.58726 <.0001	1.00000	0.08975 0.5397	0.23010 0.1117
CHANGE CHANGE	0.24218 0.0936	0.31296 0.0286	0.08975 0.5397	1.00000	0.20816 0.1512
EOFUSE EOFUSE	0.56546 <.0001	0.39619 0.0048	0.23010 0.1117	0.20816 0.1512	1.00000

Table 31 – Regression Analysis – Output.

ANALYSIS OF STEP 1 (Mediator on Independents)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: SATISFACTION SATISFACTION

Number of Observations Read	49
Number of Observations Used	49

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	13.56362	4.52121	12.90	<.0001
Error	45	15.76971	0.35044		
Corrected Total	48	29.33333			

Root MSE	0.59198	**R-Square**	0.4624
Dependent Mean	4.85714	**Adj R-Sq**	0.4266
Coeff Var	12.18778		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Tolerance	Variance Inflation
Intercept	Intercept	1	0.55297	0.80670	0.69	0.4966	.	0
CHANGE	CHANGE	1	0.27213	0.13935	1.95	0.0571	0.95482	1.04732
EOFUSE	EOFUSE	1	0.22098	0.10885	2.03	0.0483	0.91161	1.09696
PROYSUCCESS	PROYSUCCESS	1	0.49935	0.10918	4.57	<.0001	0.94522	1.05795

ANALYSIS OF STEP 2 (Dependant on Independents)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: BIZSUCCESS BIZSUCCESS

Number of Observations Read	49
Number of Observations Used	49

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	15.22265	3.80566	10.68	<.0001
Error	44	15.67984	0.35636		
Corrected Total	48	30.90249			

Root MSE	0.59696	R-Square	0.4926
Dependent Mean	4.85034	Adj R-Sq	0.4465
Coeff Var	12.30757		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Tolerance	Variance Inflation
Intercept	Intercept	1	0.44716	0.82405	0.54	0.5901	.	0
EOFUSE	EOFUSE	1	0.42326	0.11075	3.82	0.0004	0.89546	1.11675
PROYSUCCESS	PROYSUCCESS	1	0.32548	0.11028	2.95	0.0051	0.94212	1.06143
CHANGE	CHANGE	1	0.15263	0.14053	1.09	0.2834	0.95470	1.04745
ETIME	ETIME	1	0.16643	0.07013	2.37	0.0221	0.98133	1.01903

ANALYSIS OF STEP 3 (Dependant on Independents and Mediator)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: BIZSUCCESS BIZSUCCESS

Number of Observations Read	49
Number of Observations Used	49

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	22.83017	4.56603	24.32	<.0001
Error	43	8.07232	0.18773		
Corrected Total	48	30.90249			

Root MSE	0.43328	R-Square	0.7388
Dependent Mean	4.85034	Adj R-Sq	0.7084
Coeff Var	8.93291		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Tolerance	Variance Inflation
Intercept	Intercept	1	0.16171	0.59978	0.27	0.7887	.	0
EOFUSE	EOFUSE	1	0.27922	0.08351	3.34	0.0017	0.82972	1.20523
PROYSUCCESS	PROYSUCCESS	1	-0.03141	0.09772	-0.32	0.7494	0.63204	1.58217
CHANGE	CHANGE	1	-0.04037	0.10641	-0.38	0.7062	0.87720	1.13999
SATISFACTION	SATISFACTION	1	0.70470	0.11070	6.37	<.0001	0.52224	1.91483
ETIME	ETIME	1	0.11085	0.05164	2.15	0.0375	0.95328	1.04901

Appendix E: Regression Analysis: Checking Assumptions.

It is important to validate if findings derived from Regression Analysis can be generalized outside current sample. Although conclusions drawn from current particular sample are useful, it is more valuable if it can be assumed that such conclusions are true for a wider population. To draw conclusions about a population based on a regression analysis conducted, several assumptions must be fulfilled (Berry, 1993): No Perfect Multicollinearity, Independent Errors, Normally Distributed Errors and Homocedasticity.

Durbin-Watson Test.

Table 32 shows the Durbin-Watson Test Output.

Table 32 – Durbin-Watson Test – Output.

ANALYSIS OF STEP 1 (Mediator on Independents)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: SATISFACTION SATISFACTION

Durbin-Watson D	1.834
Number of Observations	49
1st Order Autocorrelation	0.077

ANALYSIS OF STEP 2 (Dependant on Independents)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: BIZSUCCESS BIZSUCCESS

Durbin-Watson D	2.306
Number of Observations	49
1st Order Autocorrelation	-0.160

ANALYSIS OF STEP 3 (Dependant on Independents and Mediator)

Linear Regression Results

The REG Procedure
Model: Linear_Regression_Model
Dependent Variable: BIZSUCCESS BIZSUCCESS

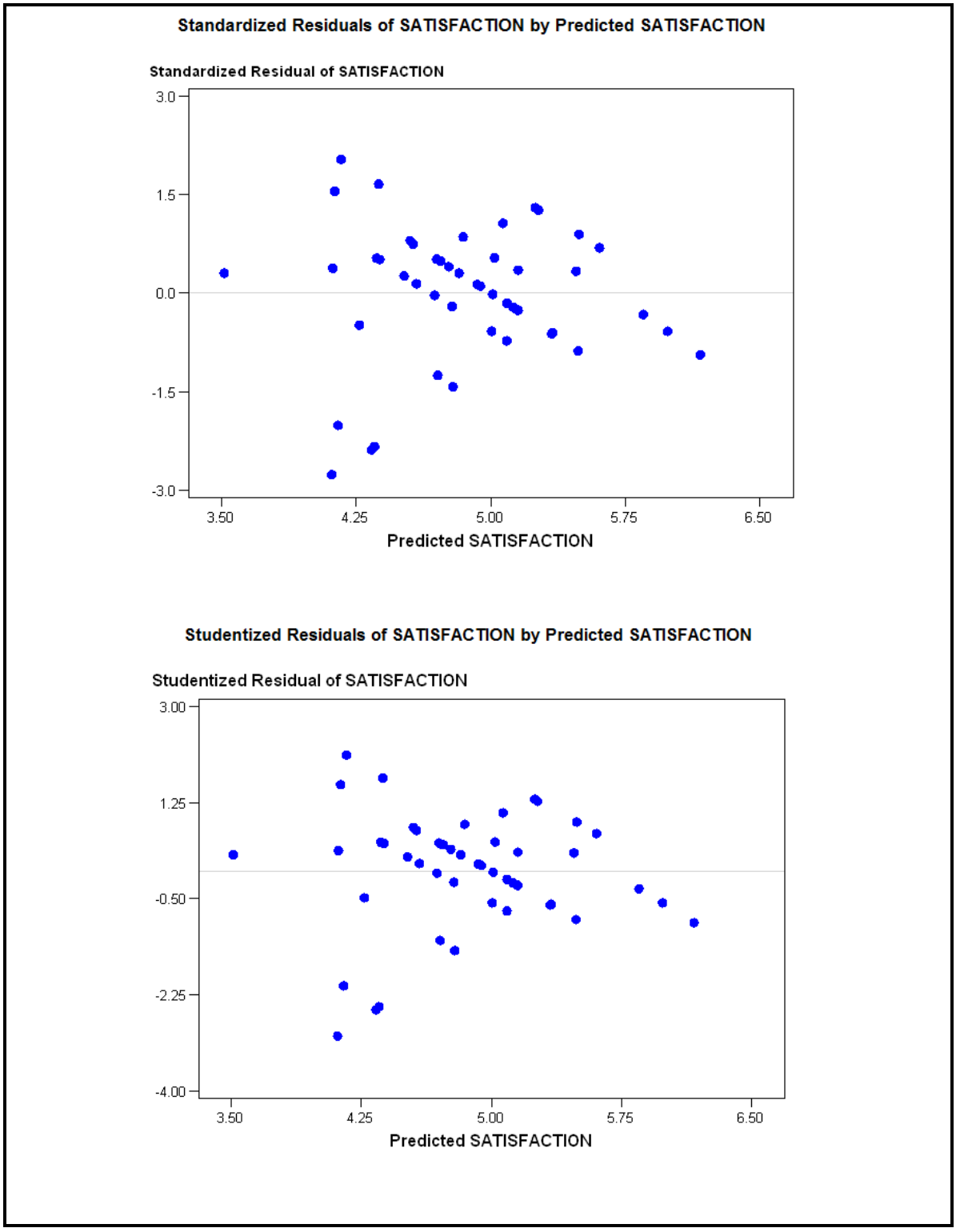
Durbin-Watson D	2.345
Number of Observations	49
1st Order Autocorrelation	-0.222

Analysis of Residuals.

Figure 10 shows the plot of "Regression Standardized Residual" vs. "Regression Standardized Predicted Value"

Figure 10 – Plot Standarized Residuals vs. Standarized Predicted Values.

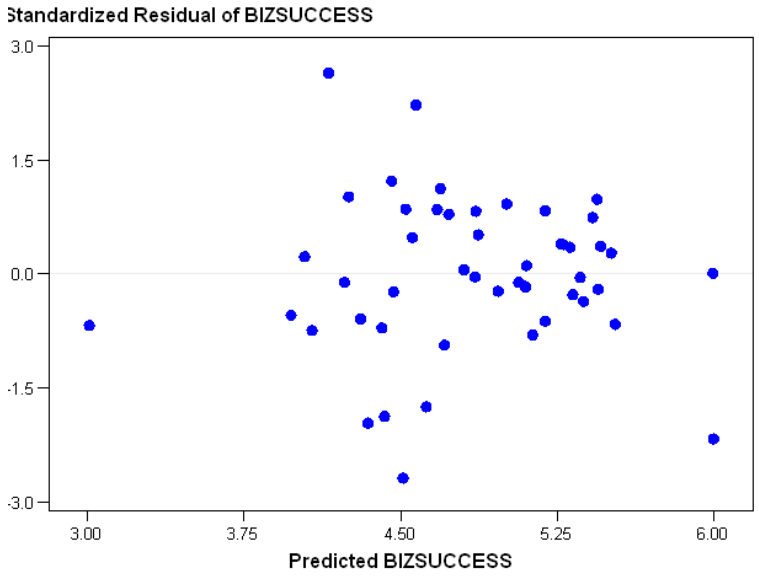
ANALYSIS OF STEP 1 (Mediator on Independents)

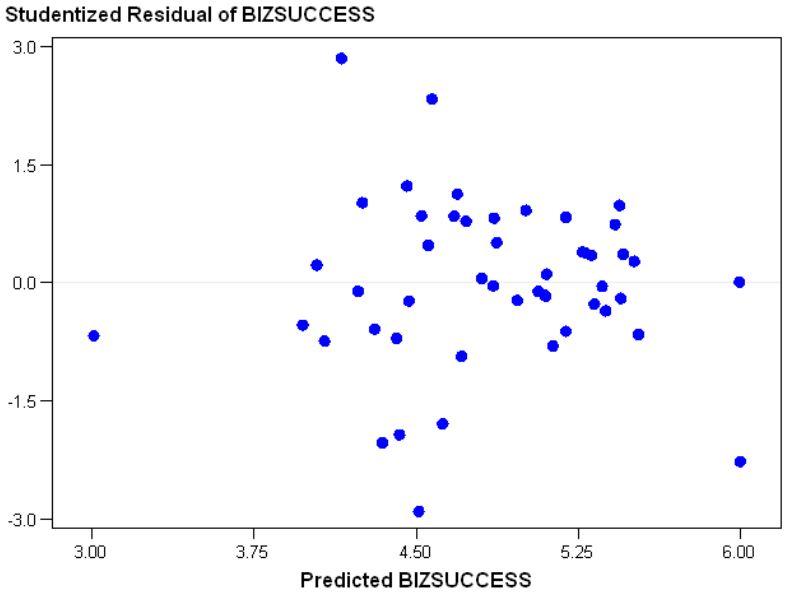


ANALYSIS OF STEP 2 (Dependant on Independents)

Regression Analysis Plots

Standardized Residuals of BIZSUCCESS by Predicted BIZSUCCESS





ANALYSIS OF STEP 3 (Dependant on Independents and Mediator)

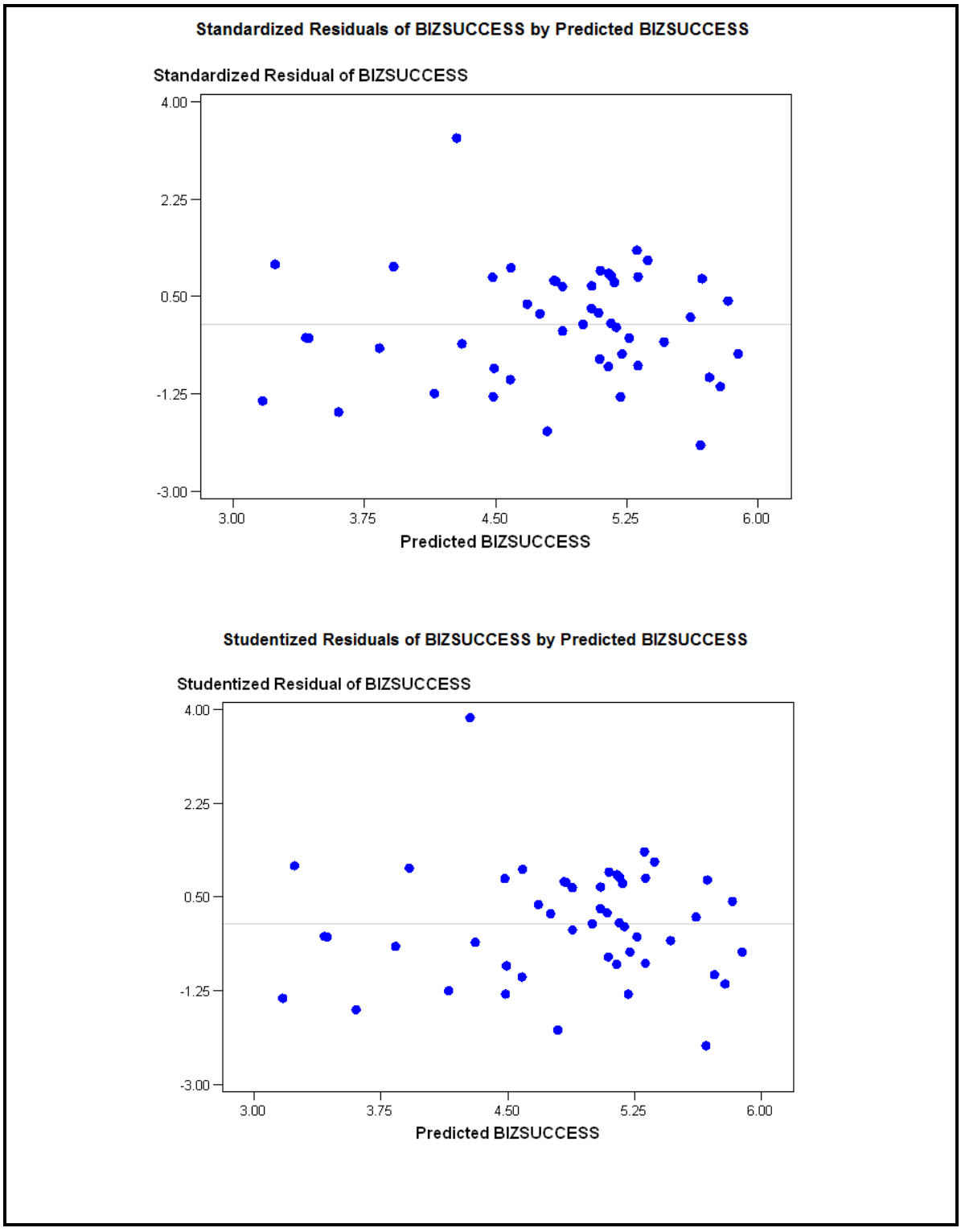
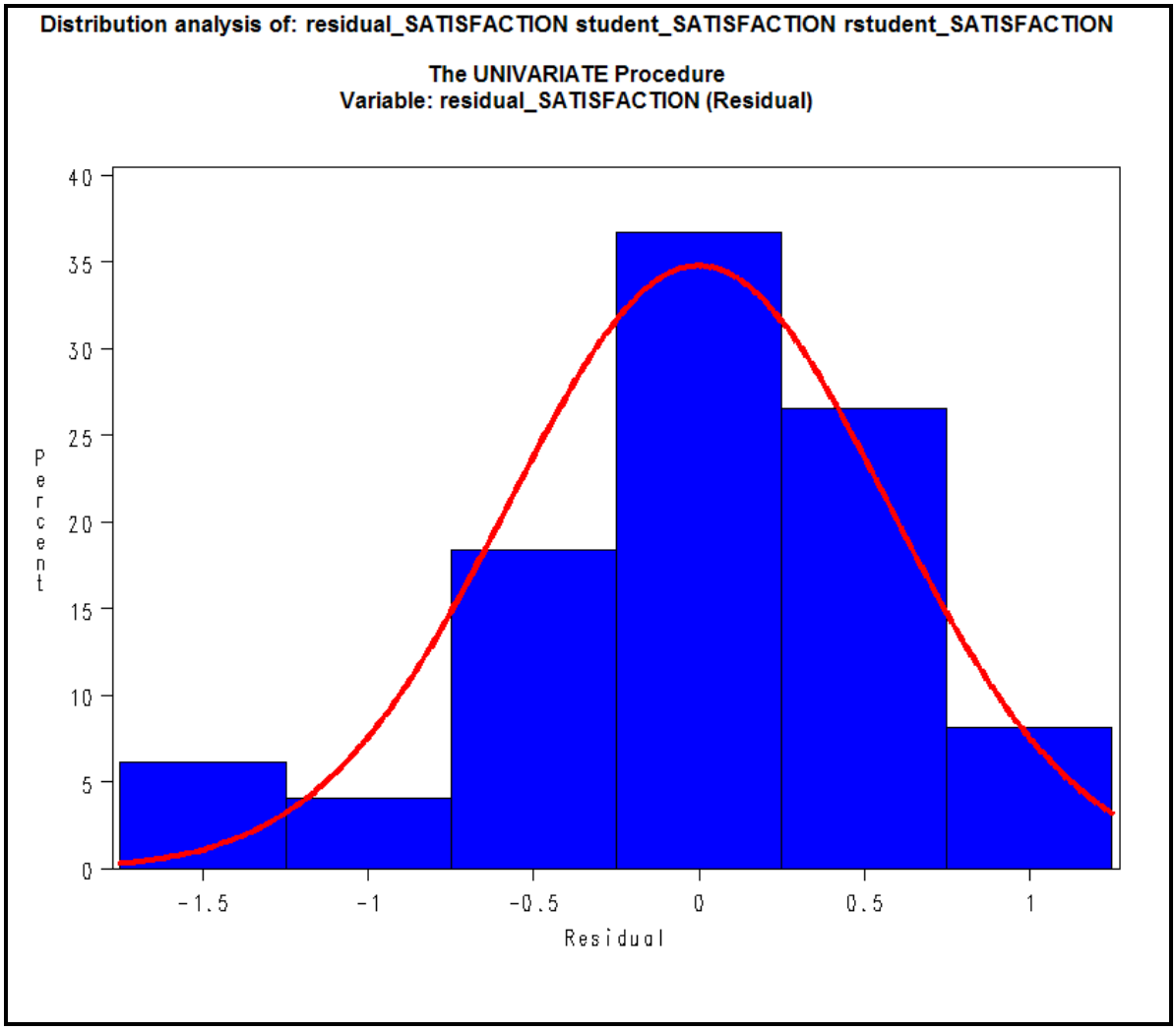
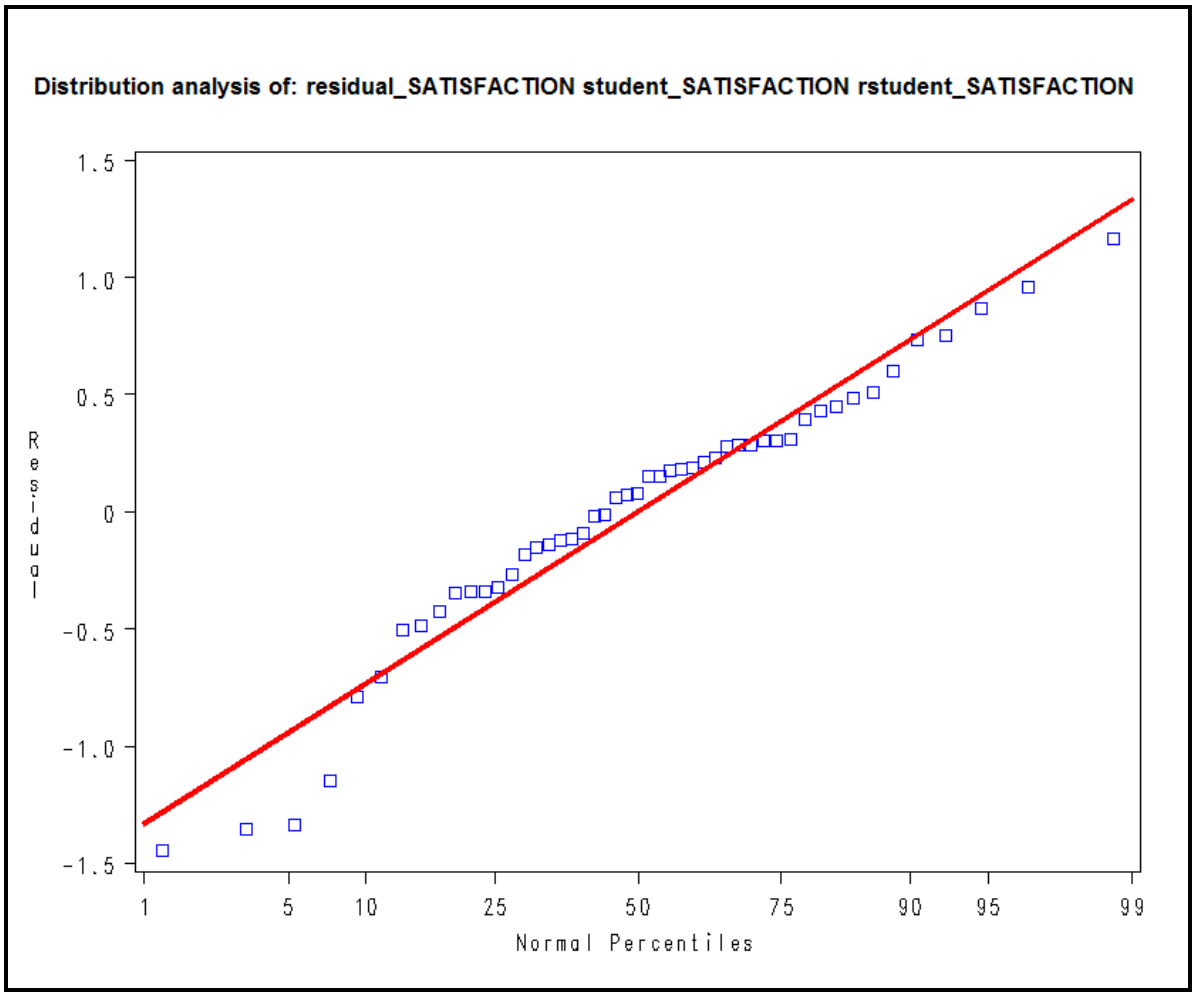


Figure 11 shows Normal Probability Plot of Residuals.

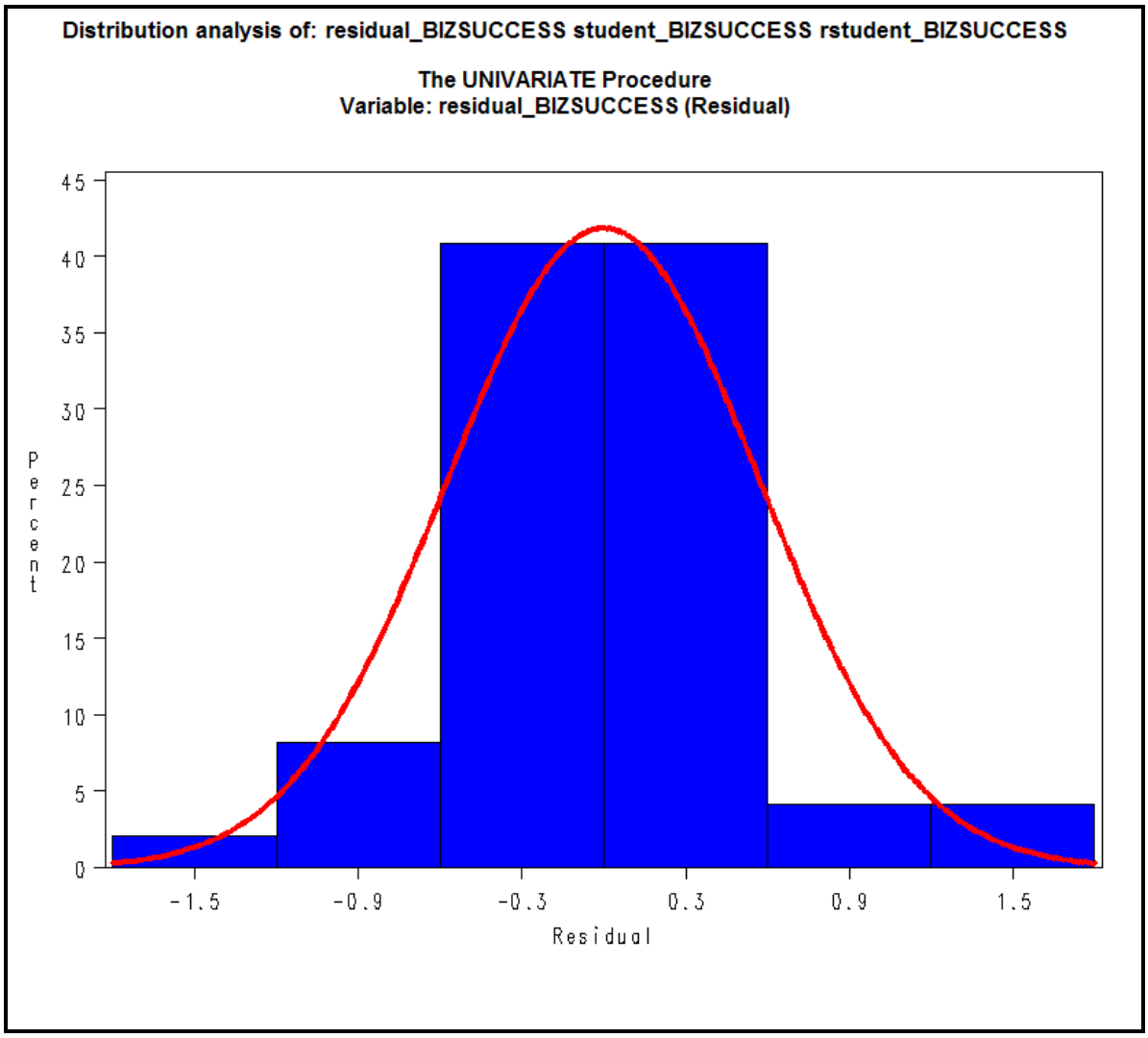
Figure 11 – Normal Probability Plot of Residuals.

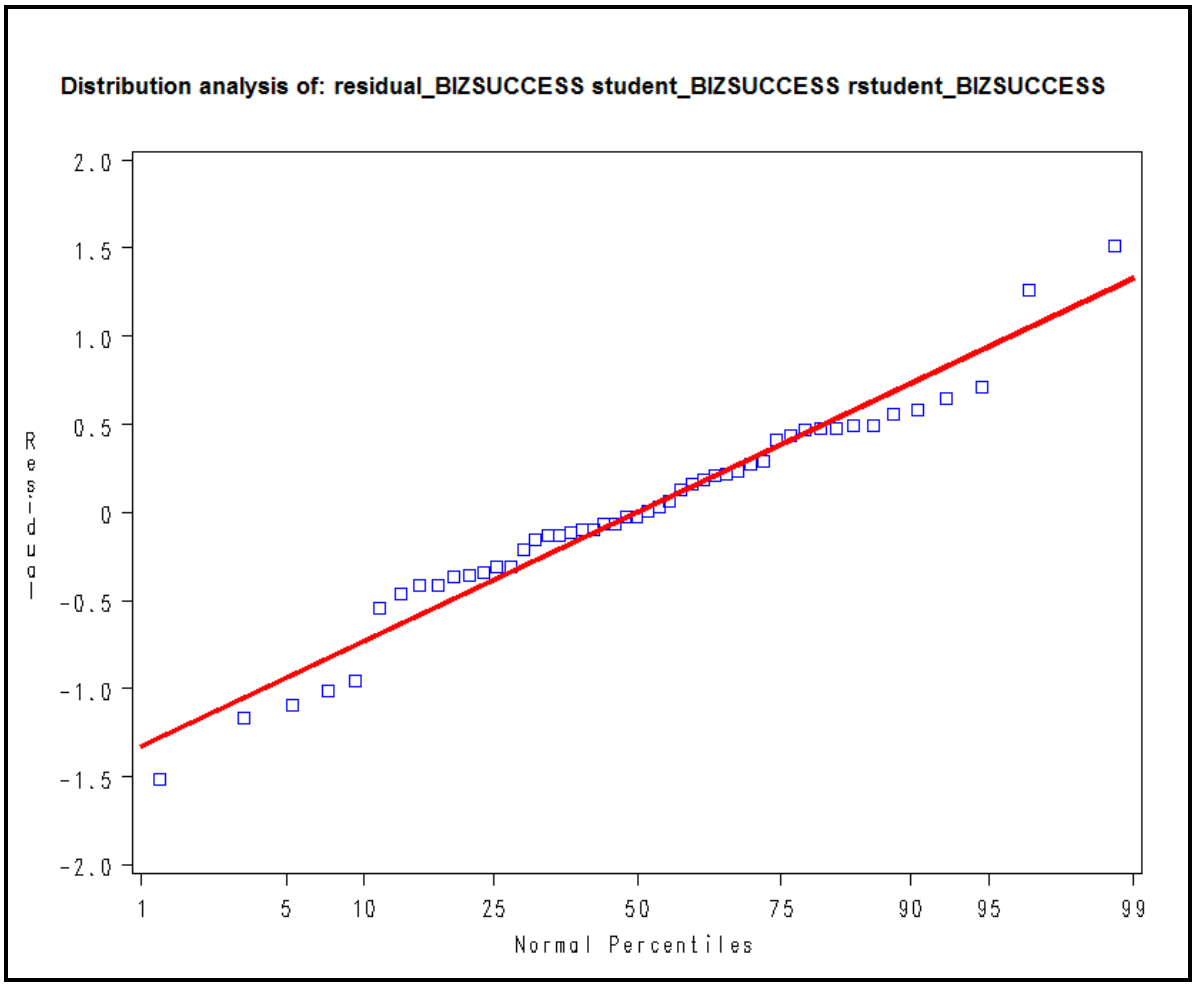
ANALYSIS OF STEP 1 (Mediator on Independents)



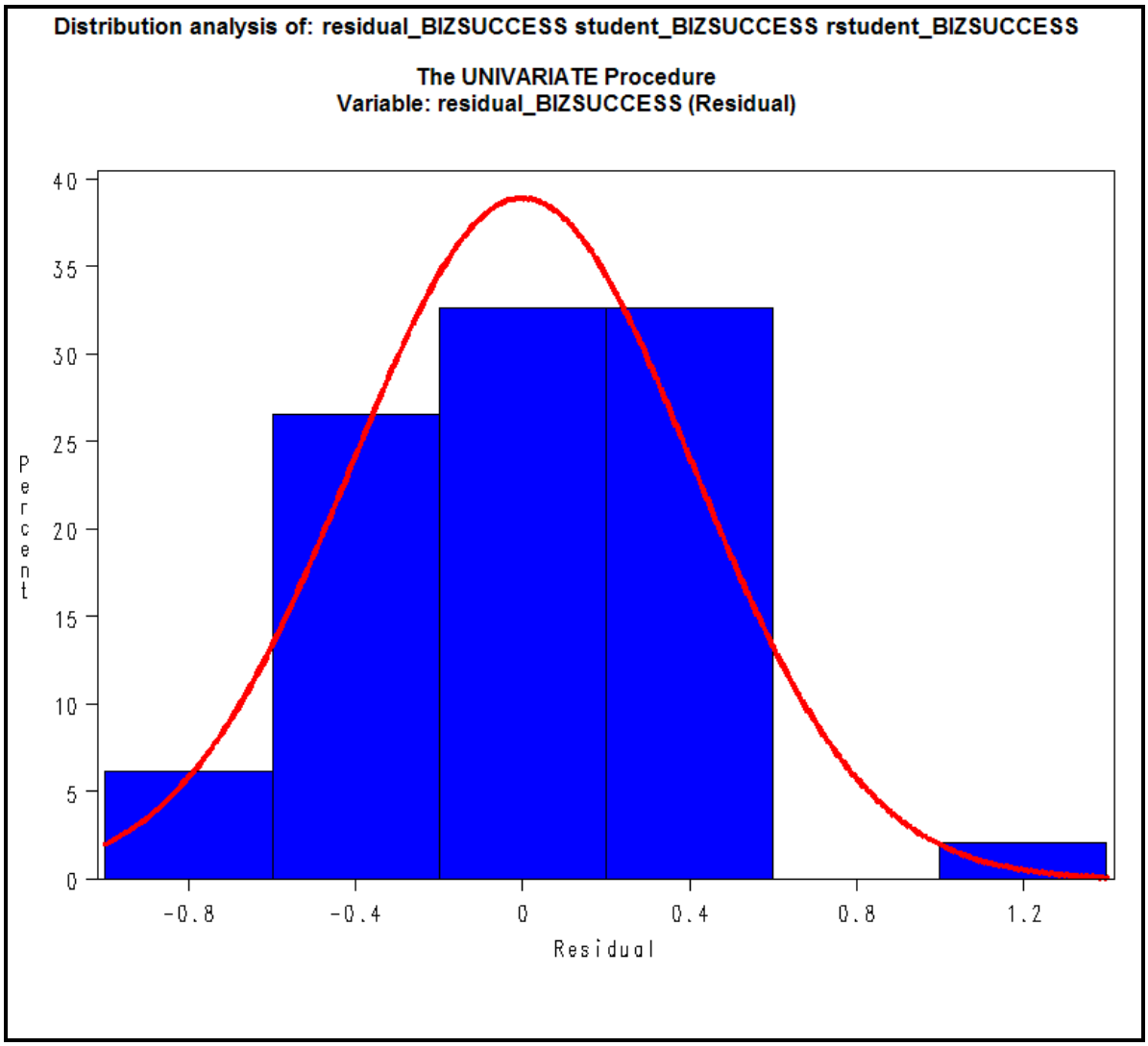

Distribution analysis of: residual_SATISFACTION student_SATISFACTION rstudent_SATISFACTION
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
Residual
1
5
10
25
50
75
90
95
99
Normal Percentiles

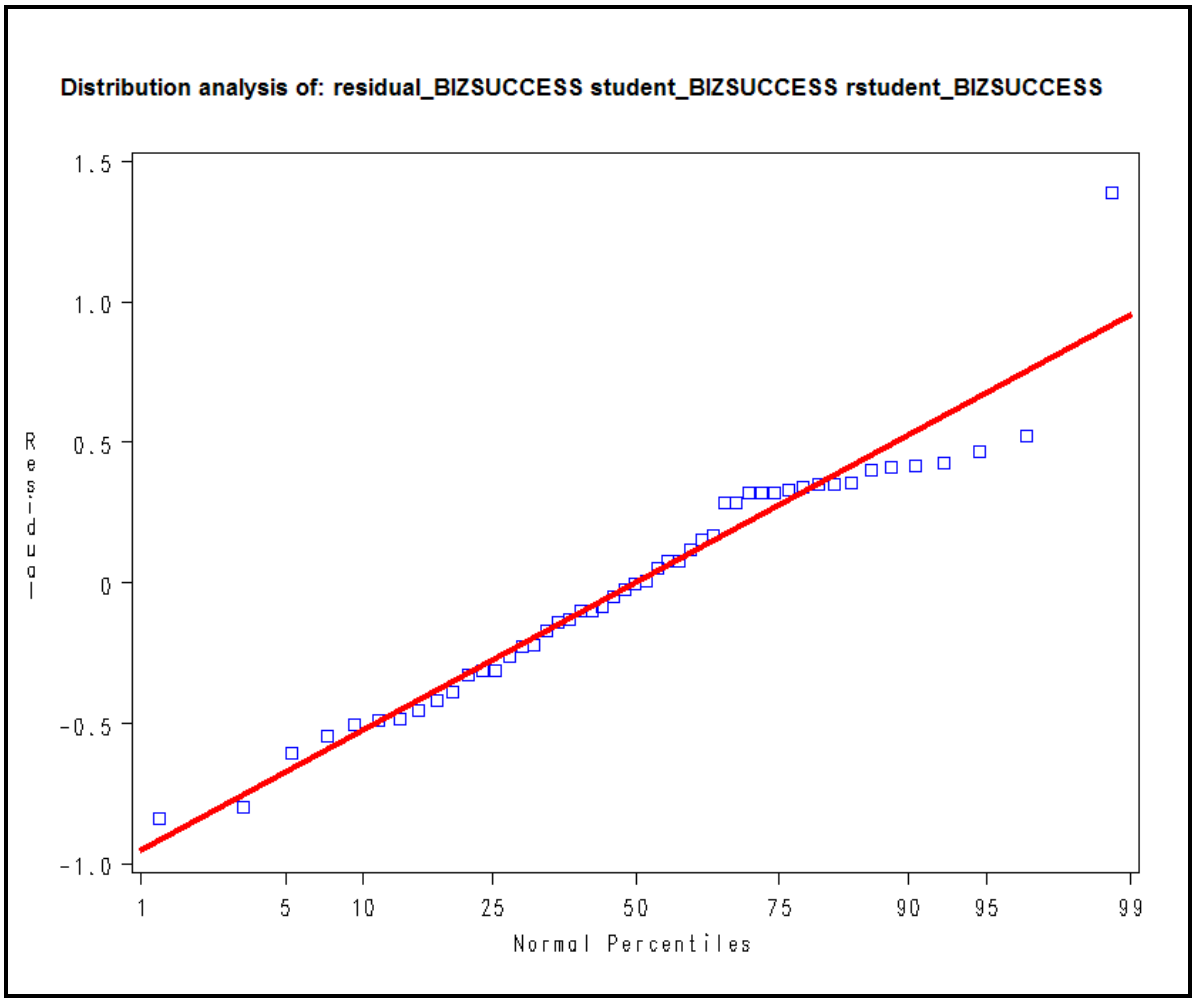
ANALYSIS OF STEP 2 (Dependant on Independents)




Distribution analysis of: residual_BIZSUCCESS student_BIZSUCCESS rstudent_BIZSUCCESS
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
Residual
1
5
10
25
50
75
90
95
99
Normal Percentiles

ANALYSIS OF STEP 3 (Dependant on Independents and Mediator)




Distribution analysis of: residual_BIZSUCCESS student_BIZSUCCESS rstudent_BIZSUCCESS
1.5
1.0
0.5
0
-0.5
-1.0
Residual
1
5
10
25
50
75
90
95
99
Normal Percentiles

Kolmogorov-Smirnov Test.

Table 33 summarizes the output of the Kolmogorov-Smirnov Test.

Table 33 – Kolmogorov – Smirnov Test.

ANALYSIS OF STEP 1 (Mediator on Independents)

Distribution analysis of: residual_SATISFACTION student_SATISFACTION rstudent_SATISFACTION

The UNIVARIATE Procedure
Fitted Distribution for residual_SATISFACTION

Parameters for Normal Distribution

Parameter	Symbol	Estimate
Mean	Mu	0
Std Dev	Sigma	0.57318

Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.09310080	Pr > D	>0.150
Cramer-von Mises	W-Sq	0.11223056	Pr > W-Sq	0.079
Anderson-Darling	A-Sq	0.74080673	Pr > A-Sq	0.050

Quantiles for Normal Distribution

	Quantile	
Percent	Observed	Estimated
1.0	-1.44731	-1.333417
5.0	-1.33490	-0.942798
10.0	-0.78867	-0.734560
25.0	-0.31920	-0.386604
50.0	0.08148	-0.000000
75.0	0.30307	0.386604
90.0	0.73444	0.734560
95.0	0.86919	0.942798
99.0	1.16820	1.333417

ANALYSIS OF STEP 2 (Dependant on Independents)

Distribution analysis of: residual_BIZSUCCESS student_BIZSUCCESS rstudent_BIZSUCCESS

The UNIVARIATE Procedure
Fitted Distribution for residual_BIZSUCCESS

Parameters for Normal Distribution

Parameter	Symbol	Estimate
Mean	Mu	0
Std Dev	Sigma	0.571545

Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.09385937	Pr > D	>0.150
Cramer-von Mises	W-Sq	0.08142613	Pr > W-Sq	0.201
Anderson-Darling	A-Sq	0.60096642	Pr > A-Sq	0.114

Quantiles for Normal Distribution

	Quantile	
Percent	Observed	Estimated
1.0	-1.51131	-1.329612
5.0	-1.08894	-0.940107
10.0	-0.95542	-0.732464
25.0	-0.30828	-0.385501
50.0	-0.02231	-0.000000
75.0	0.41415	0.385501
90.0	0.58255	0.732464
95.0	0.71002	0.940107
99.0	1.51239	1.329612

ANALYSIS OF STEP 3 (Dependant on Independents and Mediator)

Distribution analysis of: residual_BIZSUCCESS student_BIZSUCCESS rstudent_BIZSUCCESS

The UNIVARIATE Procedure
Fitted Distribution for residual_BIZSUCCESS

Parameters for Normal Distribution

Parameter	Symbol	Estimate
Mean	Mu	0
Std Dev	Sigma	0.41009

Goodness-of-Fit Tests for Normal Distribution

Test		Statistic		p Value
Kolmogorov-Smirnov	D	0.10269749	Pr > D	>0.150
Cramer-von Mises	W-Sq	0.06001728	Pr > W-Sq	>0.250
Anderson-Darling	A-Sq	0.52674149	Pr > A-Sq	0.178

Quantiles for Normal Distribution

	Quantile	
Percent	Observed	Estimated
1.0	-0.83845	-0.954011
5.0	-0.60312	-0.674537
10.0	-0.50260	-0.525551
25.0	-0.31133	-0.276601
50.0	-0.00043	-0.000000
75.0	0.32221	0.276601
90.0	0.41481	0.525551
95.0	0.46527	0.674537
99.0	1.38903	0.954011

Table 34 resumes underlying analysis of assumptions considering the Regression Model obtained based in current sample.

The following analysis is applicable individually by each individual regression as follows:

- **STEP 1 (Mediator on Independents)**
- **STEP 2 (Dependant on Independents)**
- **STEP 3 (Dependant on Independents and Mediator)**

Table 34 – Regression Assumptions: Summary

Assumption	Verification
No Perfect Multicollinearity	Multicollinearity exists when there is a strong correlation between two or more predictors in a regression model. Perfect collinearity exists when at least one predictor is a perfect linear combination of the others. One alternative of identifying multicollinearity is to scan the correlation matrix of all of the variables and check if there are correlations of above .80. Based on the results obtained from current data, summarized in Table 30, there is not an evident course of multicollinearity. Another alternative consists in scanning 2 additional coefficients from the Regression Model: "Tolerance" (Tol) and "Variance Inflation" (VIF), and verify that the following conditions are met: (d) The largest value of VIF is less than 10. (e) The average VIF is substantially lesser than 1 (f) Tolerance values ought to be above 0.2. Based on the analysis displayed in Table 31, the three required conditions are fully met. Both ways suggest that there are no reasons to contradict the assumption of "No Perfect Multicollinearity".
Independent Errors	For any two observations the residual terms should be uncorrelated. This assumption can be tested with the Durbin-Watson test, which monitors for serial correlations between errors. The statistic can vary between 0 and 4 with a value of 2 meaning that the residuals are uncorrelated. A value greater than 2 indicates a negative correlation between residuals, whereas a value below 2 indicates a positive correlation. Values less than 1 or greater than 3 are definitely cause for concern. Results obtained from current data, summarized in Table 32, suggest that there are no reasons to contradict the assumption of "Independent Errors".
Normally Distributed Errors	It is assumed that the residuals in the model are random, normally distributed variables with mean of 0. This assumption simply means that the differences between the model and the observed data are most frequently zero or very close to zero. There are two ways to test this assumption: First one is to work with a normal probability plot to analyze deviations from normality. In this plot the straight line represents a normal distribution and the points represent the observed residuals. In a perfectly normally case, all points will lie on the line. The other alternative is to apply a Kolmogorov-Smirnov test on the standardized residuals, to check whether they deviate significantly from normality. Results obtained from current data, summarized in Figure 11 and Table 33, suggest that there are no reasons to contradict the assumption of "Normally Distributed Errors".
Homocedasticity.	It is assumed that at each level of the variables, the variance of the residuals terms should be constant. This assumption is validated by analyzing the "Regression Standardized Residual" vs. "Regression Standardized Predicted Value" graph. This graph should look like a random array of dots evenly dispersed around zero. If this graph funnels out, then it suggests a potential heterocedascity trend in the data. Results obtained from current data, summarized in Figure 10, suggest that there are no reasons to contradict the assumption of "Homocedasticity". As an additional test, it is also suggested to work with partial plots. These plots are scatterplots of the residuals of the outcome variable and each of the predictors when both variables are regressed separately. These graphs can also detect any heterocedascity trend in the data.

Based on previous results, it could be summarized that the model seems, it most senses, to be accurate for the sample and generalizable to the population.

Appendix F: List of Additional Articles Included.

Even though the present dissertation is focused in a more ambitious and singular model, former ERP research conducted by the author introducing other models are also attached with the only purpose of additional reference: Those models followed the germinal motivation for the present work.

- Maldonado, M., Santana, M. El Impacto del Adiestramiento, Habilidades en Tecnología de la Información y Gerencia de Proyectos en el Éxito de Implementaciones de Sistemas Integrados ERP. Revista Latinoamericana Y Del Caribe De La Asociación De Sistemas De Información, 2 (1), Artículo 3.

  Disponible también en http://aisel.aisnet.org/relcasi/vol2/iss1/3.

- Maldonado, M. (2008). El impacto de los factores críticos de éxito en la implementación de sistemas integrados de ERP. ESAN: Cuadernos de Difusión, 13(25), 77-118.

- Maldonado, M., Santana, M., Lorenzo, O. (2008). El Impacto del Adiestramiento, Habilidades en Tecnología de la Información y Gerencia de Proyectos en el Éxito de Implementaciones de Sistemas Integrados de Planificación de Recursos Empresariales (ERP) en la Pequeña y Mediana Empresa: Una Investigación Empírica en América Latina" (2008). *AMCIS 2008 Proceedings.* Paper 285. (Note: This paper was honored as Best Paper in Track).

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R E L C A S I

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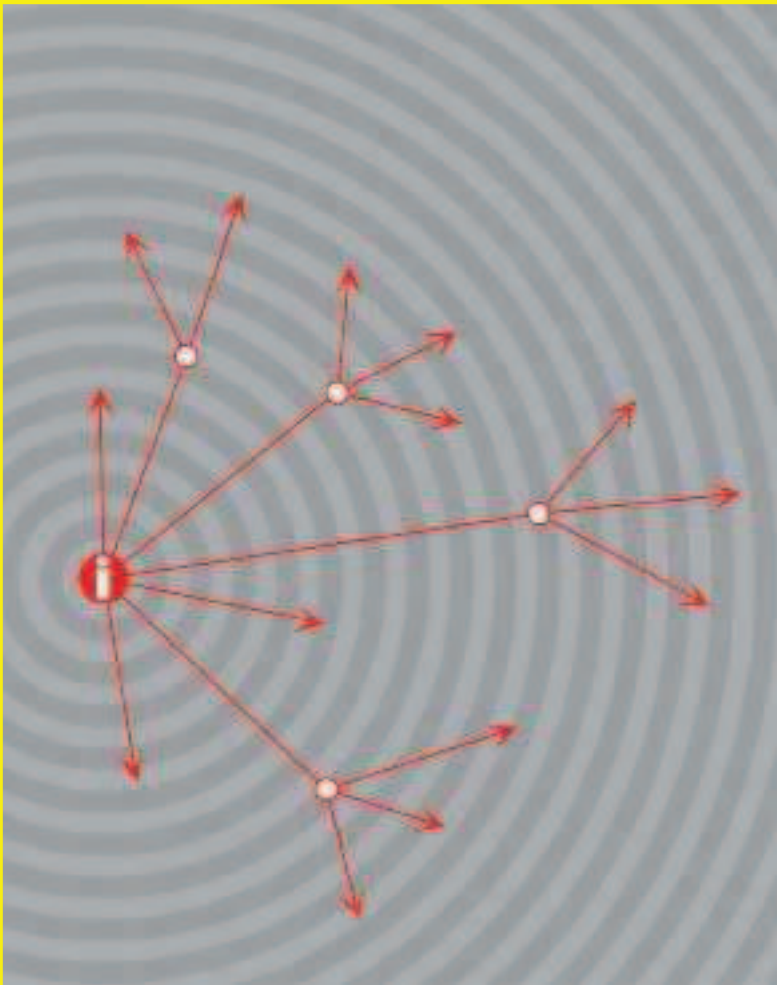
REVISTA LATINOAMERICANA Y DEL CARIBE DE LA ASOCIACIÓN DE SISTEMAS DE INFORMACIÓN

CONTENIDO



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Impacto del Adiestramiento, Habilidades en Tecnología de la Información y Gerencia de Proyectos en el Éxito de Implementaciones de Sistemas Integrados ERP

The Impact of Training, IT Skills and Project Management on ERP Systems Implementations Success

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Martín Santana
Universidad ESAN, MSantana@esan.edu.pe

RESUMEN

El análisis del éxito de las implementaciones de sistemas integrados de Planificación de Recursos Empresariales (ERP, por sus siglas en inglés) es un tema de creciente interés en la comunidad de tecnología de información. La investigación existente se concentra primariamente en metodologías cualitativas aplicadas a las grandes empresas. En el presente estudio cuantitativo, en cambio, se presenta un modelo que pretende revelar factores determinantes del éxito en las implementaciones de sistemas ERP en la pequeña y mediana empresa (pyme en adelante). La validación empírica de este modelo, aplicado en 15 empresas, permitió verificar relaciones significativas entre el "adiestramiento", las "habilidades en tecnología de información" y el "éxito", medido en la dimensión del "tiempo de implementación empleado". Se verificó también el impacto del "tiempo de implementación" en la percepción de la "satisfacción global" con dicha implementación. La investigación concluye con recomendaciones a la gerencia y sugiere también áreas potenciales de investigación inspiradas en un sorprendente resultado colateral obtenido.

Palabras Claves: ERP, Enterprise Resource Planning, factores críticos de éxito, pequeñas y medianas empresas, PYMES, Latinoamérica.

ABSTRACT

The widespread adoption of Enterprise Resource Planning systems (ERP) has been a particular area of importance in the Information Technology field. Current research has been mostly focused on qualitative studies

designed to analyze ERP implementations in corporations and large enterprises. This quantitative study introduces a model aimed to reveal some critical success factors that affect ERP implementations but focused in the small and medium enterprises niche. An empirical confirmation of this model, based on data gathered from 15 companies, confirmed significant relationships among Training, IT Skills and ERP Implementation Success. The relationship between Implementation Time and ERP Implementation Satisfaction was also evaluated. The article finishes with relevant recommendations to practitioners, suggesting also additional research themes stimulated by an unexpected result observed.

Keywords: *Enterprise Resource Planning Systems, ERP, critical success factors, small and medium enterprises, SME, Latin America.*

ANTECEDENTES DEL ESTUDIO

Los sistemas integrados de Planificación de los Recursos Empresariales (ERP, por sus siglas en inglés) conforman una tipología de tecnología de información que pretende integrar y automatizar los procesos medulares de las organizaciones, incluyendo finanzas, logística, ventas, procesamiento de órdenes, producción y planificación de materiales. Algunos estudios estimaron la inversión de las empresas en las implementaciones de sistemas ERP en, aproximadamente, 300 billones de dólares americanos en la década de los noventa, y sólo para el 2004 se estimó que este valor estaría en alrededor de 79 billones de dólares americanos (Carlino et ál., 2000), lo cual suministra un punto de referencia acerca de la relevancia actual del tema.

¿Por qué ha surgido, tanto entre los académicos como en la gerencia, creciente interés en el análisis de las implementaciones de sistemas ERP? Esencialmente por la presencia de experiencias contrapuestas: éxitos y fracasos. Cuando se implementan y asimilan exitosamente, los sistemas ERP pueden generar beneficios muy relevantes y repercutir tanto en las operaciones como en los aspectos estratégicos del negocio (Shang et ál., 2000). Hitt et ál. (2002) encontraron empíricamente que las organizaciones que han invertido en sistemas ERP tienden a exhibir mejores desempeños financieros y mayor valoración de mercado en comparación con las que no han invertido en este tipo de tecnología de información.

Si bien en muchos casos los sistemas ERP han potenciado la ventaja competitiva de las organizaciones, en otros su implementación ha ocasionado grandes fracasos con deterioros irreversibles. Davenport (1998) presentó el fracaso de la compañía FoxMeyer Drugs, que atribuyó a la implementación de un sistema ERP su posterior bancarrota. Gargeya et ál. (2005) ofrecen una aproximación a la tasa de fracasos y señalan que el 70% de los proyectos de ERP fallan en ser completamente implementados, aun después de transcurridos tres años. Ante tales

resultados contradictorios, son múltiples las inquietudes y confusiones que experimentan las empresas que evalúan la adopción de este tipo de tecnología en sus procesos de negocio (Davenport, 1998).

MOTIVACIÓN Y PROPÓSITO DE LA INVESTIGACIÓN

Aun cuando los sistemas ERP fueron inicialmente destinados a abordar las necesidades de las grandes organizaciones, a partir del año 2000 se ha notado un sólido y sostenido crecimiento de su implementación en el sector de las pequeñas y medianas empresas (pymes en lo sucesivo) (Van Everdingen et ál., 2000). Justamente, la presente investigación empírica pretende contribuir al limitado conocimiento existente sobre esta materia en el caso de las pymes, mediante el análisis de los factores que influyen en el proceso de implementación exitoso de sistemas ERP en estas empresas.

Para trabajar sobre un ámbito más preciso, se utilizó una técnica similar a la empleada por Parr et ál. (1999), que solicitaron la participación de cinco expertos en el área de implementación de sistemas ERP en América Latina. En el presente estudio se recurrió a especialistas con más de quince años de experiencia en este campo y que en los últimos ocho años se han dedicado específicamente a la asesoría en procesos de adopción de ERP en pymes. A ellos se les pidió que identificaran los diez factores que a su juicio consideraran los determinantes del éxito en las implementaciones de sistemas ERP en las pymes de América Latina y que los ordenaran de acuerdo con su importancia. De este modo se obtuvieron los siguientes tres factores como los más relevantes:

Nivel de gerencia de proyecto empleado durante la implementación del sistema ERP: incluye los recursos, las actividades y el conocimiento necesario en la coordinación de las acciones y tareas que permitan garantizar el logro de los objetivos que motivaron la implementación del sistema ERP.

Nivel de adiestramiento durante la implementación del sistema ERP: comprende las actividades relacionadas con la transferencia de conocimiento acerca de las características y funcionalidades del nuevo sistema ERP en los grupos de usuarios, con la finalidad de incrementar el nivel de pericia y conocimiento asociado. Contempla también el adiestramiento del equipo de implementación sobre prácticas de cómo administrar el proyecto.

Nivel de habilidades en tecnología de información presentes en la empresa: se refiere a las destrezas para configurar y mantener técnicamente el sistema ERP, de tal manera que cumpla con los requerimientos del negocio.

Los expertos coincidieron en que estos factores impactan en el éxito de las implementaciones. Se puso énfasis en el tiempo empleado como uno de los criterios con los cuales las pymes pueden percibir el éxito de tales implementaciones.

El análisis del impacto de los tres factores anteriormente mencionados en las implementaciones de los sistemas ERP en las pymes de América Latina motiva la presente investigación.

Preguntas de investigación

El presente estudio pretende abordar las siguientes preguntas de investigación:

¿Existe relación entre la gerencia de proyecto, el adiestramiento y las capacidades en tecnología de información de la empresa, por un lado, y el tiempo de implementación exitoso, por el otro, en los proyectos de adopción de sistemas ERP en las pymes?

¿Existe relación entre el tiempo de implementación ejecutado y la satisfacción con el proceso de implementación de los sistemas ERP en las pymes?

MARCO TEÓRICO

Tiempo de Implementación ejecutado del sistema ERP

Bajwa et ál. (2004) afirman que el proceso de implementación de sistemas ERP compromete las operaciones normales del negocio así como los recursos disponibles. Por tanto, el tiempo de implementación es un factor crítico que debe considerarse. Los resultados en este sentido son muy variados y, en algunos casos, desalentadores. Bajwa et ál. (2004) mencionan que un estudio ha reportado que el 35% de las implementaciones de sistemas ERP ha sido cancelado, el 55% ha incurrido en excesos de tiempo y solo el 10% ha sido completado en el plazo previsto.

Hitt et ál. (2002) afirman que las implementaciones de los sistemas ERP son conocidas por ser muy complejas y difíciles. Algunos estudios referidos a grandes empresas han estimado que la implementación puede tomar entre uno y tres años, con beneficios tangibles percibidos, en promedio, a los 31 meses posteriores a la implementación (McAfee, 1999). Parte de la dificultad radica en los cambios asociados con el sistema ERP, en la necesidad de revaluar los procesos de las organizaciones, y en el grado en que deban adaptarse los procesos a la capacidad del sistema. Esta complejidad induce diversos riesgos que potencialmente atentan contra el plazo de implementación originalmente planificado. El mayor tiempo de implementación causa, a su vez, mayores costos asociados y, por ende, afecta directa y negativamente el nivel de

satisfacción con el proceso de implementación. Dadas las limitaciones mencionadas anteriormente, este impacto debe repercutir con mayor intensidad en las pymes.

De estos argumentos surge la siguiente hipótesis:

H1: En la implementación de sistemas ERP en pymes, el tiempo de implementación empleado y el nivel de satisfacción con dicha implementación están negativamente relacionados.

Gerencia de proyecto durante la implementación del ERP

Según Ahituv et ál. (2002), la definición del ámbito del proyecto, una clara determinación de los recursos necesarios en el equipo de proyecto y un plan detallado son actividades fundamentales que se deben considerar en la fase de preparación de la gerencia de proyecto en la implementación de un sistema ERP. Holland et ál. (1999) sostienen que la definición precisa del alcance del proyecto plasmado en un plan claro de implementación debe establecerse como pilar de la gerencia de proyecto. Boehm (1991) había anticipado también la importancia de contar con planes realistas dentro de la gerencia de proyecto como factor de éxito en cualquier proyecto de implementación de tecnología de información.

Con respecto al líder del proyecto, Nah et ál. (2003) señalan que el rol de este directivo es aun más importante en las implementaciones de sistemas ERP que en cualquier otra tecnología de información, porque estos sistemas requieren de gran compromiso organizacional. Jiang et ál. (1996) sostienen que la designación de un gerente de proyecto competente es el segundo factor más importante para toda implementación de tecnología de información. Jiang et ál. (2002) han recopilado evidencia empírica que ratifica el desempeño del gerente de proyecto como factor crítico en las implementaciones de proyectos de tecnología de información.

Nah et ál. (2003) afirman que la gerencia de proyecto es esencial en las implementaciones de los sistemas ERP, pues es un factor que permitirá el logro de los objetivos en términos de tiempo y presupuesto.

De estos argumentos surge la siguiente hipótesis:

H2: En la implementación de sistemas ERP en pymes, el nivel de gerencia de proyecto aplicado y el tiempo de implementación empleado están negativamente relacionados.

Adiestramiento durante la implementación de sistemas ERP

Diversos investigadores han coincidido en la importancia de suministrar adiestramiento formal a los usuarios finales como parte del proyecto de implementación de sistemas ERP (Bingi et ál., 1999; Holland et ál., 1999; Roberts et ál., 1992; Shanks et ál., 2000). Este adiestramiento ayudará a

los usuarios a entender el sistema y también a vislumbrar cómo deben adaptar sus tareas y llevarlas a cabo en lo sucesivo.

Sumner (1999) manifiesta que, además del entrenamiento de los usuarios finales, es fundamental la capacitación en los temas técnicos propios de la tecnología de los sistemas ERP, así como el adiestramiento del equipo de implementación en temas de metodología y gerencia de proyectos.

Roberts et ál. (1992) y Mainwaring (1999) sostienen que el adiestramiento debería ser una actividad que se ejecute desde el mismo inicio del proyecto de implementación, pues a través de esta vía los involucrados podrán contribuir de forma más efectiva y eficiente en la adaptación de los procesos de negocio al sistema y acelerar así el proceso de implementación.

De estos argumentos surge la siguiente hipótesis:

H3: En la implementación de sistemas ERP en pymes, el nivel de adiestramiento ejecutado y el tiempo de implementación empleado están negativamente relacionados.

Habilidades en tecnología de información presentes en la empresa

Bajwa et ál. (2004) señalan que las capacidades y habilidades técnicas del equipo que lidera la implementación de sistemas ERP constituyen un factor fundamental para el éxito.

Nah et ál. (2003) afirman que las empresas deberían estar dispuestas a aceptar las mejores prácticas que vienen incluidas con el *software* y modelar sus procesos de negocio de acuerdo con estas prácticas, con la finalidad de hacer más eficiente el proceso de implementación del sistema ERP. Autores como Bingi et ál. (1999), Holland et ál. (1999), Murray et ál. (2001) y Shanks et ál. (2000) señalan que el sistema ERP debería ser instalado rápidamente y modificado de forma eficiente y que las empresas deberían estar dispuestas a adaptar sus procesos de negocio a las prácticas incorporadas en este sistema para explotar todas sus ventajas y ejecutar el proceso de implementación en el menor tiempo posible.

Markus et ál. (2000) destacan, entre los temas propios de tecnología de información involucrados en la implementación de sistemas ERP, la importancia de la depuración de datos y la migración ordenada de los datos existentes al nuevo sistema. Estas tareas relacionadas con la calidad de los datos existentes pueden ser subestimadas y merecen una atención especial con la finalidad de evitar retrasos graves en el proceso de implementación.

De estos argumentos surge la siguiente hipótesis:

H4: En la implementación de sistemas ERP en pymes, el nivel de habilidades en tecnología de información presentes en la empresa

y el tiempo de implementación empleado están negativamente relacionados.

Modelo de investigación

El modelo de investigación propuesto en la presente investigación se resume en la figura 1.

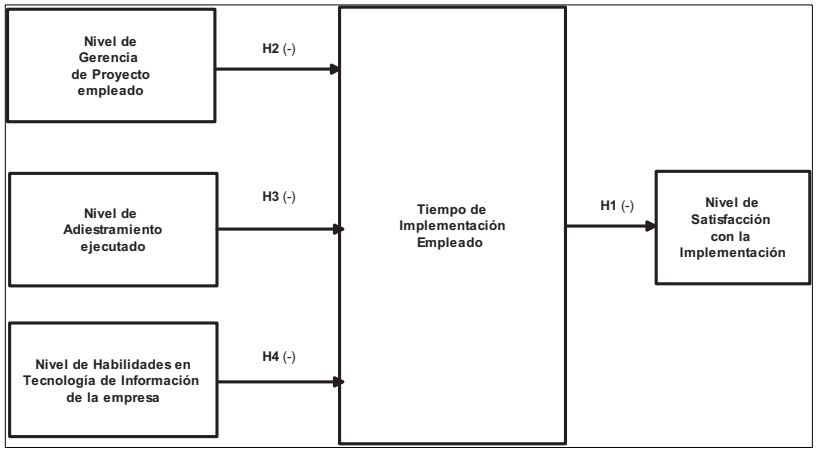

Figura 1

METODOLOGÍA

La presente investigación adoptó una perspectiva empírica y cuantitativa orientada a verificar hipótesis y, por ende, relaciones propuestas entre variables. Se siguió una estrategia de investigación tipo encuesta (*survey*). La investigación recopiló los datos en un instante particular del tiempo en una muestra de pymes (estudio *cross-sectional*). Para facilitar la recolección de información de la muestra seleccionada se diseñó un cuestionario. La unidad de análisis en esta investigación fue la empresa.

Descripción de la muestra

El universo seleccionado pertenece al conjunto de pymes que han implementado un sistema ERP perteneciente a un proveedor líder en América Latina. Vale destacar que la definición de pymes del mencionado proveedor coincide con las especificadas tanto por Zevallos (2003) como por Boggs et ál. (2007), que califican como pymes a las empresas que constan de hasta 500 empleados.

El universo contaba con 52 empresas que habían implementado dicho sistema ERP y se mantenían en estado productivo por más de un año. Estas empresas estaban ubicadas en diferentes países de América Latina, incluyendo México, Guatemala, Costa Rica, Perú y el Caribe. Se seleccionó, de forma aleatoria, una muestra de 40 empresas. Con las

restantes 12 empresas se procedió a hacer una prueba piloto del cuestionario para asegurar su correcta interpretación. La prueba piloto se realizó telefónicamente y las 5 empresas que participaron propusieron mejoras que fueron incluidas en el instrumento.

La invitación a participar en el estudio fue enviada al dueño o director general de la organización a través de correo electrónico, era una comunicación que explicaba también la naturaleza voluntaria, el objetivo y los beneficios del estudio, así como el compromiso de confidencialidad de la información. La encuesta formaba parte de la comunicación. Se hizo un recordatorio de la invitación y el período de recolección duró dos meses.

La muestra final abarcó 15 empresas, con lo que se obtuvo una tasa final de participación de 38%.

El no-sesgo de las empresas que no respondieron se verificó de la siguiente manera: después de la recolección de la última encuesta en el tiempo fijado de dos meses, se separaron los registros de las empresas que respondieron de las que no respondieron. No se encontraron diferencias significativas entre el grupo que respondieron y el grupo que no respondieron al aplicar pruebas t que comparaban tres variables demográficas: número de empleados de la empresa ($t = -1.42$, $p = 0.16$), años de la empresa en el mercado ($t = 1.43$, $p = 0.16$), facturación anual de la empresa ($t = 0.30$, $p = 0.76$). De esta forma se asumió que el sesgo de las empresas que no respondieron no era evidente.

Operacionalización de las variables

Tiempo de Implementación empleado en el sistema ERP

Inicialmente se planteó utilizar como métrica de este constructo la duración en semanas del tiempo de implementación. Pero considerando que las implementaciones del sistema ERP pueden variar según las empresas de acuerdo con los objetivos establecidos, se decidió que esta medición podría originar confusiones en la interpretación y que no necesariamente permitiría establecer comparaciones equivalentes entre organizaciones (no todas las empresas deciden implementar todos y los mismos procesos de negocio en el sistema ERP). Se decidió entonces utilizar un ítem, con una escala tipo semántica diferencial (Babbie, 1990), en el que se preguntaba sobre el resultado en tiempo de implementación empleado con respecto a las expectativas iniciales. Los participantes respondieron de acuerdo con una escala que iba de 1 (“El tiempo de implementación estuvo muy por debajo de lo esperado”) a 5 (“El tiempo de implementación excedió mucho a lo esperado)”. Esta alternativa coincide con lo utilizado por Reinartz et ál. (2004) bajo el entendimiento del uso de una medida perceptual del constructo.

Nivel de satisfacción con la implementación del sistema ERP

Se utilizó un ítem, con una escala tipo semántica diferencial (Babbie, 1990), en el que se preguntaba sobre el nivel de satisfacción general con la implementación del sistema ERP en la empresa. Los participantes respondieron de acuerdo con una escala que iba de 1 ("Nada satisfecho con la implementación del ERP") a 5 ("Muy satisfecho con la implementación del ERP"). Esta alternativa coincide con lo utilizado por Reinartz et ál. (2004) bajo el entendimiento del uso de una medida perceptual del constructo.

Nivel de gerencia de proyecto durante la implementación del sistema ERP

Se utilizó una medida de 3 ítems basada en Nah et ál. (2003) con una escala tipo semántica diferencial (Babbie, 1990). Para cada ítem se consultaba su nivel de presencia en la implementación subyacente. Los participantes respondieron de acuerdo con una escala que iba de 1 ("Totalmente en desacuerdo") a 5 ("Totalmente de acuerdo").

Ítems empleados para el nivel de gerencia de proyecto
Claro establecimiento de los recursos necesarios para la implementación
Definición de un plan de trabajo realista
Establecimiento del líder de proyecto

Los ítems mostraron una buena confiabilidad ($\alpha = 0.92$) y se promediaron luego para generar el factor correspondiente.

Nivel de adiestramiento durante la implementación del sistema ERP

Se utilizó una medida de 2 ítems basada en Nah et ál. (2003) y Holland et ál. (1999) con una escala tipo semántica diferencial (Babbie, 1990). Para cada ítem se consultaba su nivel de presencia en la implementación subyacente. Los participantes respondieron de acuerdo con una escala que iba de 1 ("Totalmente en desacuerdo") a 5 ("Totalmente de acuerdo").

Ítems empleados para el nivel de adiestramiento
Adecuada y suficiente capacitación en la administración del proyecto
Adecuada y suficiente capacitación en la utilización del *software* ERP

Los ítems mostraron una buena confiabilidad ($\alpha = 0.70$) y se promediaron luego para generar el factor correspondiente.

Habilidades en tecnología de información presentes en la empresa

Se utilizó una medida de 3 ítems basada en Nah et ál. (2003) y Markus et ál. (2000) con una escala tipo semántica diferencial (Babbie, 1990). Para cada ítem se consultaba su nivel de presencia en la implementación subyacente. Los participantes respondieron de acuerdo con una escala que iba de 1 ("Totalmente en desacuerdo") a 5 ("Totalmente de acuerdo").

Ítems empleados para el nivel de habilidades en tecnología de información
Rápida y eficiente instalación e inicialización del *software* ERP
Migración de datos al *software* ERP de manera ordenada
Integración de procesos del negocio al *software* ERP realizada eficientemente

Los ítems mostraron un nivel de confiabilidad por debajo de los límites estándares sugeridos ($\alpha = 0.52$) y se promediaron luego para generar el factor correspondiente.

Vale destacar que la operacionalización de las variables fue revisada con expertos en implementación de sistemas ERP en América Latina, antes de la verificación estadística correspondiente.

RESULTADOS

Con respecto a las características demográficas de las empresas entrevistadas, el perfil es el siguiente:

El 62% de las empresas entrevistadas cuenta con menos de 100 empleados, mientras el 31% cuenta con menos de 50 empleados. La empresa entrevistada con menos empleados tiene 12 empleados. En cuanto a las ventas anuales, el promedio es de US$ 9.000.000. La empresa con menos ingresos vende alrededor de US$ 130.000. En cuanto a los años en el mercado, el promedio de las empresas opera 15 años. La empresa con menor tiempo en el mercado opera 3 años y la que más tiempo tiene cuenta con 58 años. Respecto a los sectores a los cuales pertenecen las empresas, el 37% corresponde al sector de manufactura; el 25%, al sector servicios; y el 38%, al sector de *retail*.

El análisis de la correlación entre las variables "Nivel de gerencia de proyecto empleado" (FACPROMGM), "Nivel de adiestramiento ejecutado (FACTRAINING), "Habilidades en tecnología de información de la empresa" (FACIT), "Tiempo de implementación empleado" (RESULTADOTIEMPO) y "Nivel de satisfacción con la implementación del ERP" (SATISFIMPLEMENT) se presenta en la Tabla 1.

Pearson Correlation Coefficients, N = 15
Prob > |r| under H0: Rho=0

	FACPROMGM	FACTRAINING	FACIT	RESULTADOTIEMPO	SATISFIMPLEMENT
FACPROMGM	1.00000	0.70655	0.57207	-0.17500	0.34426
FACPROMGM		0.0032	0.0259	0.5327	0.2089
FACTRAINING	0.70655	1.00000	0.42366	-0.49030	0.28870
FACTRAINING	0.0032		0.1156	0.0635	0.2967
FACIT	0.57207	0.42366	1.00000	-0.48999	0.73311
FACIT	0.0259	0.1156		0.0637	0.0019
RESULTADOTIEMPO	-0.17500	-0.49030	-0.48999	1.00000	-0.52329
RESULTADOTIEMPO	0.5327	0.0635	0.0637		0.0453
SATISFIMPLEMENT	0.34426	0.28870	0.73311	-0.52329	1.00000
SATISFIMPLEMENT	0.2089	0.2967	0.0019	0.0453	

Tabla 1

La verificación de las hipótesis se realizó mediante el análisis de regresión lineal múltiple.

La Tabla 2 reporta los resultados del análisis de regresión cuando la variable dependiente es "Tiempo de implementación empleado" y las variables independientes son "Nivel de gerencia de proyecto empleado" (FACPROMGM), "Nivel de adiestramiento ejecutado" (FACTRAINING) y "Nivel de habilidades en tecnología de información de la empresa" (FACIT). Los supuestos estadísticos subyacentes fueron validados y se corroboró que no se puede rechazar el supuesto de normalidad de los residuos mediante el análisis del gráfico de probabilidad normal y el test Kolmogorov-Smirnov (D = 0.165, p-Valor = > 0.15). Tampoco se pudo rechazar el supuesto de independencia de errores mediante la aplicación del test Durbin-Watson (D = 2.47).

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Tolerance	Variance Inflation
Intercept	Intercept	1	5.62287	1.00799	5.58	0.0002	.	0
FACPROMGM	FACPROMGM	1	0.65645	0.33484	1.96	0.0758	0.41013	2.43827
FACTRAINING	FACTRAINING	1	-0.64135	0.26966	-2.38	0.0366	0.50022	1.99912
FACIT	FACIT	1	-0.67126	0.30948	-2.17	0.0529	0.67198	1.48814

Nota: $R^2 = 0.50$ $p < 0.05$. Tabla 2

Con respecto al "Nivel de adiestramiento ejecutado", los resultados corroboran la hipótesis H3, pues se verifica una relación negativa con el "Tiempo de implementación empleado" ($\beta = -0.64135$, $p < 0.05$).

En cuanto al "Nivel de habilidades en tecnología de información de la empresa", los resultados corroboran la hipótesis H4, pues se verifica una relación negativa con el "Tiempo de implementación empleado" ($\beta = -0.67126$, $p < 0.10$).

Con relación al "Nivel de gerencia de proyecto empleado", sorprendentemente y de modo contrario al establecido originalmente en la hipótesis H2, se verifica una relación positiva con el "Tiempo de implementación empleado" ($\beta = 0.65645$, $p < 0.10$). En tal sentido, la hipótesis H2 no se corrobora.

Si se observa en la Tabla 1 la correlación entre "Nivel de satisfacción con la implementación del ERP" (SATISFIMPLEMENT) y "Tiempo de implementación empleado" (RESULTADOTIEMPO), se deriva que los resultados obtenidos corroboran la hipótesis H1, pues se verifica la relación negativa entre estas variables ($\beta = -0.52329$, $p < 0.05$).

Análisis

La presente investigación contribuye con el conocimiento de los factores que pueden determinar el éxito en las implementaciones de sistemas ERP en las pymes. El interés se concentró en estudiar variables que pueden incidir directamente en el tiempo de implementación empleado, lo cual conforma una dimensión fundamental que todas las empresas, pero en especial las pymes por sus estrechas limitaciones, precisan entender y controlar (Shehab et ál., 2004).

Los resultados obtenidos corroboran la importancia de que las pymes cuenten con sólidas habilidades en materia de tecnología de información a la hora de emprender un proyecto de implementación de sistemas ERP. Si bien este tipo de proyectos requieren capacidades estratégicas y de negocios, no deben descuidarse las capacidades en materia de tecnología de información, que pueden marcar la diferencia (Holland et ál., 1999; Markus et ál., 2000). Si las pymes no cuentan con el conocimiento técnico requerido, será necesario emplear un tiempo adicional en reclutamiento, adiestramiento y puesta en marcha para disponer de estas habilidades, lo que inevitablemente determinará un mayor tiempo necesario para activar el ERP.

Con respecto al nivel de adiestramiento, se verifica la importancia de ejecutar una transferencia de conocimientos desde el mismo inicio de la implementación, tanto al equipo del proyecto como a los usuarios involucrados. Esto facilita la asimilación eficaz no solo de las capacidades y limitaciones del sistema ERP, sino también de alternativas eficientes para adaptar los procesos de negocio a la nueva plataforma. El temprano conocimiento de las características y funcionalidades del sistema permitirá crear alternativas ágiles cuando surjan obstáculos en el proceso de implementación, de modo que se podría acortar los tiempos involucrados.

En cuanto al nivel de gerencia de proyecto empleado, resultó sorpresiva la relación positiva y significativa obtenida con el tiempo de implementación empleado, en sentido contrario al establecido en la hipótesis. Frente a este resultado caben dos vías de análisis. Una posible explicación para este hallazgo puede relacionarse con lo señalado por Yen et ál. (2002), quienes indican que, por lo general, las pymes no están acostumbradas a enfrentar estos proyectos de gran envergadura. La mayoría de ellas no están adiestradas en el uso de metodologías y revisiones minuciosas de procesos de negocio; es usual que tampoco cuenten con documentación de tales procesos. En estos casos, para cumplir con la metodología estricta que puede requerir la gerencia de estos proyectos, puede incurrirse en mucho trabajo adicional para analizar y documentar los procesos de negocio que deben implementarse. Esto indefectiblemente impacta en el tiempo requerido para alcanzar la implementación. Por otra parte, la gerencia de proyecto disciplinada debe garantizar que el equipo del proyecto esté

siempre enfocado en el proceso. Dadas las limitaciones de recursos que experimentan las pymes, es frecuente que un mismo trabajador desempeñe varios roles. Por lo general, los empleados comparten sus labores tradicionales con el proceso de implementación. Es muy probable que en muchos casos las labores diarias absorban el tiempo que los empleados tienen disponible para el proyecto y, en consecuencia, una gerencia de proyecto disciplinada no culminará las tareas correspondientes hasta contar con el apoyo y la validación de los recursos respectivos. Esto ocasionará retrasos en el tiempo de implementación. Marsh (2000) resume esta perspectiva y argumenta que la poca experiencia de la empresa en afrontar proyectos de escala similar en tecnología de información puede impactar el proceso de implementación del sistema ERP.

La segunda vía de análisis puede conducirnos a la manera restringida como se operacionalizó la variable "Nivel de gerencia de proyecto empleado". Vale destacar que Soja (2006) sostiene, mediante su estudio cuantitativo, que mientras mayor es la duración de los proyectos y mayor el tamaño de la empresa, mayor es el impacto de factores inmersos en la gerencia de proyectos, tales como la definición de un cronograma detallado y la clara especificación de los objetivos del proyecto. Soja (2006) afirma también que hay factores que pueden ser sobreestimados por los expertos y destaca explícitamente el factor "Líder de proyecto", considerado uno de los criterios más importantes por los expertos, pero que en sus resultados empíricos encontró que no tiene influencia significativa en el éxito de la implementación. Los resultados de la presente investigación parecen inclinarse más hacia los hallazgos similares obtenidos por Soja (2006) y, por ende, con la primera vía de análisis anteriormente presentada.

Finalmente, se verifica también que en las pymes el tiempo de implementación empleado incide en la satisfacción general con el proceso, hecho consistente con lo introducido por Zviran et ál. (2005), quienes resaltaron la importancia de la dimensión "tiempo" como un determinante de la "satisfacción". Considerando las limitaciones que enfrentan las pymes, presentadas por Yen et ál. (2002), se desprende entonces que las implementaciones de sistemas ERP que involucren menores tiempos que los esperados exhibirán, definitivamente, un mayor nivel de satisfacción.

Limitaciones de la investigación

Hay razones para ser cautelosos con la generalización de los resultados de la presente investigación. Primero, las empresas analizadas se ubican en el contexto latinoamericano. Los hallazgos aquí encontrados podrían no ser aplicables a otras latitudes. Segundo, la muestra de empresas que respondieron el cuestionario todavía es limitada y la generalización y potencia estadística subyacente podrían verse cuestionadas, según lo

acotado por Baroudi et ál. (1989). Esta muestra limitada quizás es la causa también de la frágil confiabilidad obtenida del factor "Nivel de habilidades en tecnología de información". Tercero, el éxito de la implementación del sistema ERP se midió comparando el tiempo de implementación empleado con las expectativas iniciales. Otras dimensiones importantes del éxito quedaron fuera del alcance de la presente investigación. Cuarto, la muestra se focalizó en pymes que habían implementado el sistema ERP de un proveedor en particular. Aun cuando las implementaciones fueron realizadas por empresas consultoras diferentes, no se consideraron empresas que habían implementado el software ERP de otros proveedores. En todo caso, el hecho de analizar el mismo software ERP ayudó a controlar el contexto y establecer comparaciones.

Una limitación adicional de la presente investigación está relacionada con los constructos y mediciones involucrados. No se encontraron prácticamente referencias de trabajos empíricos previos, muy en línea con lo mencionado por autores como Kumar et ál. (2002), quienes manifiestan que existe poca investigación empírica conducida referente a los obstáculos en la adopción de sistemas ERP en las organizaciones. En tal sentido, las mediciones propuestas en la presente investigación están sujetas a mejoras y ampliaciones. Un candidato directo para esta mejora lo constituye la operacionalización de la variable "Nivel de satisfacción con la implementación del ERP". Por otra parte, Dorantes et ál. (2006) proveen un marco conceptual que puede enriquecer, en futuras investigaciones, la operacionalización de la variable "Habilidades en tecnología de la información presentes en la empresa".

CONCLUSIONES

La presente investigación aborda una brecha importante en la literatura revisada y aporta hallazgos significativos al limitado conocimiento existente relacionado con las implementaciones de los Sistemas ERP en las pymes. De acuerdo a la literatura revisada, esta investigación conforma uno de los primeros estudios empíricos realizados bajo el contexto de América Latina, lo cual estimula importantes análisis bajo el entorno de naciones en desarrollo. Se derivan de los resultados obtenidos implicaciones muy relevantes tanto para la gerencia como para los investigadores interesados en el tema, así como líneas futuras de investigación que definitivamente contribuirán notoriamente al entendimiento de los procesos de implementación de ERP en las pymes.

IMPLICACIONES PARA LA GERENCIA

A pesar de sus limitaciones, la presente investigación muestra importantes lecciones que deben tener en cuenta las pymes que están evaluando la posibilidad de implementar un sistema ERP. Debe darse especial prioridad al adiestramiento de los miembros del equipo del proyecto, tanto en los temas concernientes a la gerencia de proyecto como en los temas propios

de conocimiento del sistema ERP, desde el mismo comienzo. Dadas las restricciones de las pymes, siempre habrá motivo para minimizar el presupuesto y, por lo general, el adiestramiento constituye una de las líneas candidatas para cualquier reducción. El presente estudio contribuye a reforzar la importancia del adiestramiento y a prever el riesgo que puede ocasionar, tanto en el tiempo de la implementación como en la posterior satisfacción, cualquier reducción en esta materia. ¡No escatime en el adiestramiento!

También es muy importante que las pymes reflexionen sobre las habilidades existentes, "puertas adentro", en materia de tecnología de información. Debe haber la certeza de contar con el inventario de las habilidades que facilitarán el proceso de implementación. De no disponer de tales habilidades, los hallazgos del presente estudio sugieren que la pyme evalúe prudentemente la postergación del proceso de implementación.

CONTRIBUCIONES DEL ESTUDIO Y FUTURAS ÁREAS DE INVESTIGACIÓN

Tal como señalan Hitt et ál. (2002), la mayor parte de la investigación sobre los sistemas ERP ha sido llevada a cabo principalmente a través de casos de estudio y encuestas a nivel de industrias. La investigación existente ha sido mayormente dirigida al segmento de las grandes empresas y corporaciones (Shehab et ál., 2004).

El presente estudio pretende aportar nuevas luces considerando tales brechas y, por tanto, se ha concentrado en el análisis de las pymes a partir de una investigación empírica realizada a través de encuestas a empresas de diversas industrias ubicadas en diferentes puntos geográficos. Este aspecto cobra mayor relevancia si se tiene en cuenta que en muchos países las pymes constituyen el motor de la economía (Shehab et ál., 2004). América Latina no escapa a esta realidad y, en consecuencia, el presente estudio también contribuye en esa dirección, porque a la fecha no se han encontrado investigaciones que aborden el contexto latinoamericano. Sería muy valioso conducir investigaciones similares en otras geografías al exterior de América Latina, que permitan contrastar los resultados obtenidos. Estudios cualitativos como el de Brown et ál. (2007) sugieren, a manera de ejemplo, que las comparaciones de implementaciones de sistemas ERP entre Occidente y China pueden ser no relevantes y deben ser tomadas con extrema cautela. Este hallazgo sugiere la profundización de esta línea de investigación poco documentada en la actualidad.

Shehab et ál. (2004) sostienen que puede haber diferencias en las implementaciones de sistemas ERP entre las pymes y las grandes empresas. Incluso motiva a investigar en esta dirección. El hallazgo encontrado en el presente estudio con relación a la gerencia de proyecto puede ser un ejemplo de estas diferencias y, en este sentido, se reitera la

invitación de Shehab et ál. (2004) de seguir investigando con profundidad en el segmento de las pymes para consolidar el mayor entendimiento acerca de ellas y establecer comparaciones pertinentes con las grandes empresas.

La presente investigación se concentró principalmente en el análisis del tiempo de implementación empleado en comparación con las expectativas iniciales como una de las dimensiones del éxito del proyecto. Definitivamente, existen otras dimensiones que contribuyen al éxito y cuyo estudio debe profundizarse en investigaciones posteriores. Establecer constructos subyacentes de tales dimensiones sería ya un aporte fundamental para el desarrollo de investigaciones futuras.

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Política Editorial

RELCASI está principalmente dirigida a investigadores de habla hispana en el área de Administración de Sistemas de Información (MIS por sus siglas en Inglés). Los artículos son académicamente rigurosos sin sacrificar la claridad, estilo, simplicidad y contribución práctica que los hace atractivos a profesionales de la disciplina. En consecuencia, la audiencia de esta revista está compuesta no sólo por investigadores de MIS, sino también por profesionales y administradores en el área de tecnologías de información.

Todos los artículos son escritos, revisados y publicados en español; sin embargo, estos contendrán título, resumen y palabras claves en español y en inglés.

RELCASI es una publicación arbitrada que se presenta en formato impreso y en línea. La versión impresa de RELCASI está disponible a pedido (y próximamente bajo subscripción). La versión en línea se provee a través de la Asociación de Sistemas de Información. El proceso de evaluación se realizará con al menos dos examinadores. La identidad del editor asociado y de los examinadores no será del conocimiento del autor, y ni los examinadores ni el editor asociado conocerán la identidad del autor. Una ronda del proceso de evaluación tomará alrededor de 90 días.

La revista incluye principalmente artículos de investigación desarrollados con un marco teórico robusto y que incluyan una adecuada revisión de literatura. Los artículos podrán ser de investigación empírica (cualitativa o cuantitativa), conceptuales, encuestas de corrientes de investigación, o encuestas de la industria de TI en países en desarrollo. Los artículos de investigación empírica, deben proveer una amplia justificación y descripción de la colección de datos, metodología y técnicas analíticas. Estudios de caso, artículos pedagógicos, revisión de libros, y debates y ensayos de opinión serán considerados pero no formarán el grueso de la publicación. Artículos con un alto contenido técnico y bajo contenido gerencial/administrativo no son recomendados y sólo serán aceptados cuando sean altamente relevantes o innovadores. Los artículos deberán tener una extensión no mayor a las 8.000 palabras.

Editorial Policy

RELCASI is primarily directed to Spanish speaking researchers in the area of Management Information Systems (MIS). Articles will have academic rigor without sacrificing clarity, style, simplicity, and a practical contribution that will also make them attractive to practitioners. Therefore, its audience includes both academics and practitioners of MIS and IT.

Articles are written, reviewed, and published in Spanish; however, their title, abstract, and keywords will also be published in English.

RELCASI is a double-blind peer-reviewed journal that is both in-print and on-line. The print version is currently provided on-demand and we will soon have a subscription service. The on-line version is available through the Association for Information Systems. The double-blind peer-review process will involve an associate editor and a minimum of two academic peers. We aim to have a round of the review process take no more than 90 days.

The journal will primarily comprise of research articles developed with a robust theoretical framework that include an appropriate literature review. The articles could be qualitative or quantitative, conceptual, research stream surveys, or surveys that relate to IT/MIS in developing countries. Empirical research articles must include a clear, comprehensive, and concise description of the methodology, data collection, and analytical techniques used. Case studies, pedagogical articles, book reviews, debates, and opinion papers will be considered but will not make the bulk of the journal. Articles with a high technical and low managerial content are not encouraged but may be accepted if highly relevant or innovative. Articles may not include more than 8,000 words.

Solicitud de Artículos

Call for Articles

RELCASI está permanentemente en la búsqueda de artículos en español en el área de sistemas de información (MIS), la cual incluye tópicos relacionados a la adopción, administración, uso, e impactos de la tecnología de información (TI). Tópicos populares incluyen (pero no están limitados a) los siguientes:

- Estudios inter-culturales (dentro de países latinoamericanos o comparaciones con países desarrollados) que comparen antecedentes e impactos de la TI en organizaciones
- Modelos de bases de datos y estructuras de sistemas de información a nivel empresarial o global
- Factores culturales que influyen en el desarrollo efectivo de sistemas de información a gran escala
- Costos y Retornos de Inversión esperados en la implementación de tecnologías de información
- Impacto de TI emergente en pequeñas y medianas empresas (PYMEs)
- El rol de TI en mejorar la ventaja competitiva de las PYMEs
- Infraestructura de sistemas de información
- Recursos humanos en sistemas de información
- Impacto de la TI en la productividad individual
- Programas personalizados vs encapsulados
- Efectos de obligar el uso de TI específicas en subsidiarias locales
- Tercerización ("outsourcing") / Offshoring / Nearshoring
- Debates acerca de implementaciones globales
- Procura de TI en países en vías de desarrollo
- Uso, difusión y legislación de programas de código abierto en Latinoamérica
- Costo total: programas, adaptación, consultoría y entrenamiento
- Como programas de código abierto pueden contribuir al desarrollo
- Uso, venta, e implementación de paquetes globales en economías locales
- Impacto de estilos gerenciales en el uso y desarrollo de TI
- Ejecución de contratos de TI en una economía global
- La paradoja de la productividad de la TI en Latinoamérica
- Implementación y adaptación de paquetes de programas
- Implementaciones globales
- Transferencia de tecnología
- Aspectos económicos y financieros de la compra, desarrollo e implementación de TI

- Debates en sistemas de entrenamiento de TI (para expertos y usuarios)
- El valor del negocio de la TI
- Soporte local vs soporte a larga distancia

Los artículos pueden utilizar cualquiera de las siguientes modalidades de acuerdo al contexto y metodología.

1. Investigación empírica
    a. Cualitativa (perspectivas positivistas o interpretativas): desarrollo o comprobación de teorías: estudios de caso, estudios de casos múltiples, investigación-acción
    b. Cuantitativa: comprobación de teorías: experimentos, encuestas, estudios de caso, archivos
2. Encuestas de corrientes de investigación: revisión de literatura usando narrativa o meta-análisis
3. Encuestas de la industria de TI en países en desarrollo. Debido a la falta de difusión del conocimiento de TI en países en desarrollo es importante publicar artículos que provean una visión general de la situación de la industria de TI en estos países. Los artículos pueden ser reportes académicos que provean una clara representación de la industria de TI y/o su relación con otras industrias y el gobierno.
4. Conceptual: desarrollo de nuevas teorías/modelos desde literatura existente, observación de hechos y argumentos lógicos
5. Diseño de la investigación: desarrollo de artefactos para resolver problemas relevantes que profesionales de la TI enfrentan en países en desarrollo. Algunos ejemplos pueden incluir: desarrollo de herramientas y aplicaciones innovadoras de TI, nuevos métodos para gerenciar TI en países en desarrollo, etc.

Artículos con un alto contenido técnico y bajo contenido gerencial/administrativo no son recomendados y solo serán aceptados cuando sean altamente relevantes o innovadores. La revista incluirá principalmente artículos teóricos y de investigación que han sido desarrollados en un marco teorético robusto, incluyen una adecuada revisión de literatura y proveen una amplia justificación y descripción de la metodología y técnicas analíticas. Estudios de caso, artículos pedagógicos, revisión de libros, y debates y ensayos de opinión serán considerados pero no formarán parte del grueso de la publicación.

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La revista está principalmente dirigida a investigadores de MIS de habla hispana. Los artículos serán académicamente rigurosos sin sacrificar la claridad, estilo y simplicidad que hace que estos artículos sean atractivos a profesionales de la disciplina En consecuencia, la revista será atractiva no solo para investigadores de MIS y sino también para profesionales.

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Todos los artículos serán escritos, revisados y publicados en español; sin embargo, el título, palabras claves y resumen deberán ser incluidos en inglés y español

FORMATO

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El proceso de evaluación se realizara con al menos dos árbitros. La identidad del editor asociado y de los examinadores no será del conocimiento del autor y estos tampoco conocerán la identidad del autor. Una ronda del proceso de evaluación deberá tomar alrededor de 90 días.

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EL IMPACTO DE LOS FACTORES CRÍTICOS DE ÉXITO EN LA IMPLEMENTACIÓN DE SISTEMAS INTEGRADOS DE ERP

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Resumen

El análisis del éxito de la implementación de los sistemas integrados de planificación de los recursos empresariales (ERP por sus siglas en inglés) es un tema que, aunque reciente, tiene mucha relevancia para la comunidad de tecnología de la información (TI). Sin embargo, y como resultado de esta novedad, la mayor parte de la investigación existente se circunscribe a metodologías cualitativas o estudios descriptivos orientados, sobre todo, a grandes empresas o corporaciones. En esta investigación se presenta un modelo que pretende revelar los factores determinantes del éxito de la implementación de ERP en la pequeña y la mediana empresa latinoamericana. La validación empírica de este modelo permitió verificar relaciones significativas entre adiestramiento y habilidades en TI en la empresa y el éxito de la implementación, medido por el tiempo requerido para esta. Se verificó también el impacto de este tiempo sobre la percepción de la satisfacción global de las empresas con la implementación del ERP. La investigación concluye con recomendaciones para su aplicación y sugiere también potenciales áreas de investigación adicionales inspiradas en un sorprendente resultado colateral obtenido.

Palabras clave: Sistemas ERP, sistemas integrados, *enterprise resource planning*, factores críticos de éxito, éxito de los ERP en las pyme.

Abstract

Although is a recent topic, the analysis of the success of the integrated systems implementation of the enterprise resource planning (ERP) is a topic that has a lot of relevance for the information technology (IT) community. However, as a result of this novelty, most of the existent investigation is limited to qualitative methodologies or descriptive studies oriented to big companies or corporations mainly. This investigation presents a model that seeks to reveal the determining factors of the success of ERP implementation in a small and medium Latin American company. The validation of this empiric model allowed to verify significant relationships between training and IT abilities in the company and the success of the implementation, measured by the time required for this one. It was also verified the impact of this time over the perception of the companies global satisfaction with the ERP implementation. The investigation concludes with recommendations for its application and also suggests additional potential areas of investigation inspired by an amazing collateral result obtained.

Key words: *ERP systems, integrated systems, enterprise resource planning, critical factors of success, success of the ERP in the small and medium company.*

Introducción

Los sistemas integrados de planificación de los recursos empresariales (ERP por sus siglas en inglés: *enterprise resource planning*) forman una tipología de TI que pretende integrar y automatizar los procesos medulares de las organizaciones, incluyendo finanzas, logística, ventas, procesamiento de órdenes, producción y planificación de materiales. Algunos estudios han estimado la inversión de las empresas en implementar los ERP en aproximadamente 300 billones de dólares estadounidenses en la década de 1990, y solo para el año 2004 se estimó que este valor estaría alrededor de los 79 billones de dólares (Carlino et ál., 2000), lo cual demuestra la relevancia actual del tema.

¿Por qué ha surgido, tanto en los académicos como en los empresarios, este creciente interés en analizar la implementación de los ERP? En lo esencial, por la presencia de experiencias contrapuestas: éxitos y fracasos. Cuando son implementados y asimilados *con éxito*, los beneficios generados por los ERP pueden ser muy relevantes, pues repercuten tanto en las operaciones como en los aspectos estratégicos del negocio (Shang y Seddon, 2000).

Algunos casos de estudio han revelado que la implementación exitosa de los ERP puede contribuir con ahorros en costos realmente notables gracias a la integración de procesos y la habilitación de formas innovadoras de conducir el negocio que impactan positivamente en la rentabilidad. También se ha documentado la repercusión directa de las mejoras debidas a los ERP sobre áreas medulares que inciden en la fuente de ingresos, como servicio al cliente, análisis de patrones de ventas y toma de decisiones en tiempo real (Davenport, 2000). Hitt et ál. (2000) demostraron empíricamente que aquellas organizaciones que han invertido en ERP tienden a exhibir mejores desempeños financieros y mayor valoración en el mercado, en comparación con aquellas que no lo han hecho.

Si bien es cierto que en muchos casos los ERP potencian la ventaja competitiva de las organizaciones, en otros, su implementación ha generado *fracasos* dramáticos con deterioros irreversibles. Davenport (1998) presentó el caso de la compañía FoxMeyer Drugs que atribuyó a la implementación del ERP su posterior bancarrota. Ante estos resultados contradictorios, son múltiples las inquietudes que experimentan las empresas que evalúan la adopción de este tipo de tecnología en sus procesos de negocio (Davenport, 1998). Loh y Koh (2004) sostienen que la alta tasa de fracasos en la implementación de los ERP ofrece una oportunidad única a los investigadores para obtener un mejor entendimiento de aquellos elementos críticos que pueden determinar su éxito. Gargeya y Brady (2005) dan una aproximación a esta tasa de fracasos y sostienen que 70% de los proyectos ERP fallan en ser completamente implementados, inclusive después de 3 años invertidos en el intento.

Además, y aun cuando la implementación del ERP sea exitosa, no debe pasarse por alto que las empresas también enfrentan retos, obstáculos y riesgos previos al disfrute de sus beneficios. En términos de inversión, para las grandes empresas la adopción de un ERP puede requerir miles o incluso millones de dólares (Robey et ál., 2002). Otro factor, tan importante como la inversión, lo representa el *tiempo de implementación* del ERP, pues este compromete directamente tanto las operaciones del negocio como sus recursos. Los resultados

obtenidos en este aspecto son también muy variados y, en algunos casos, profundamente desalentadores (Bajwa et ál., 2004).

1. Propósito de la investigación

Aun cuando los sistemas ERP fueron inicialmente destinados a abordar las necesidades de las grandes organizaciones, a partir del año 2000 se ha notado un sólido y sostenido crecimiento de su empleo en el sector de las pequeñas y las medianas empresas (pymes) (Van Everdingen et ál., 2000). Los riesgos y los obstáculos que enfrenta la implementación del ERP pueden parecer más impactantes si se considera el entorno de estas empresas, caracterizadas por estrictas limitaciones de conocimientos y recursos (Loh y Koh, 2004). Mabert et ál. (2000) sostienen que la inversión en ERP puede ser incluso más desafiante para este tipo de empresas, pues en algunos casos puede comprometer hasta la mitad de sus ingresos anuales, lo cual introduce un grado de vulnerabilidad superior para este tipo de organizaciones.

Si bien es cierto que la mayor parte de la investigación existente sobre ERP ha sido conducida para las grandes empresas (Loh y Koh, 2004), Mabert et ál. (2003) consideran que empresas de diversos tamaños pueden abordar los procesos de implementación del ERP de forma diferente pues les es posible establecer prioridades particulares.

La presente investigación empírica pretende contribuir al limitado conocimiento existente en materia de implementación de ERP en las pymes mediante el análisis de los factores que influyen en un resultado exitoso en estas empresas. En este sentido, se analizará el *tiempo de implementación* como una dimensión específica de su éxito. Se tomará como punto de referencia los factores que impactan sobre ese tiempo de implementación como: a) gerencia de proyecto, b) adiestramiento y c) habilidades en tecnología de la información (TI), los cuales ya han sido estudiados para el caso de las grandes empresas.

Estas son las preguntas que se intenta responder:

- ¿Existe relación entre la gerencia de proyecto, el adiestramiento y las capacidades de TI de la empresa con un tiempo de implementación exitoso en los proyectos de adopción de ERP en las pymes?
- ¿Existe relación entre el tiempo de implementación para la ejecución del ERP y la satisfacción con el proceso de implementación de este en las pymes?

En las siguientes secciones se abordarán la revisión de la literatura, la metodología de investigación aplicada, los resultados, la discusión relacionada, las limitaciones encontradas y las oportunidades de investigación adicionales que se derivan de estas.

2. Revisión de la literatura

2.1. Los sistemas de planificación de los recursos empresariales (ERP)

Los ERP son una *suite* de aplicaciones administrativas integradas que contempla soluciones de TI para los procesos de finanzas, contabilidad, recursos humanos, manufactura, logística, servicios y relaciones con los clientes. Su objetivo consiste en unir, bajo una plataforma única de información, todos los procesos del negocio de una empresa.

La creciente y sostenida demanda de los ERP en el mercado empresarial resulta notable. Kalakota y Robinson (1999) precisan algunas necesidades fundamentales de las empresas como justificación de este interés:

- La necesidad de contar con una plataforma tecnológica que mejore el procesamiento de las órdenes de los clientes.
- La necesidad de consolidar y unificar las funciones del negocio, como manufactura, finanzas, distribución-logística y recursos humanos.
- La necesidad de integrar diversas tecnologías de información, junto con los procesos subyacentes que soportan, en una única «columna vertebral de información», en un «denominador común» informático que mejore la eficiencia.
- La necesidad de contar con una infraestructura informática que permita a las empresas adaptarse rápidamente al entorno actual de los negocios: disponer de capacidades como multiidiomas, multimonedas, multicompañías, etcétera.

Rowe (1999) describe la implementación de los sistemas ERP como la materialización del sueño de la gerencia empresarial de unificar y centralizar toda la infraestructura de sistemas de TI en un único sistema común. Los ERP proveen a los actores organizacionales de un lenguaje y un repositorio común de datos. En un nivel práctico, estos sistemas generan beneficios tangibles, por ejemplo:

- Unifican la infraestructura de tecnología de información.
- Estandarizan los procedimientos y los reportes operativos.
- Optimizan los procesos claves de la organización.

Además, ofrecen altos niveles de portabilidad y flexibilidad para adaptarse al entorno y los requerimientos específicos de las organizaciones (Rowe, 1999).

Compañías como Microsoft, Coca Cola, Cisco, Hershey Foods y Colgate y, en América Latina, Telmex, PDVSA, Petrobras, Quilmes, Lan Chile, Wong y Federación de Cafeteros de Colombia han adoptado la tecnología ERP y han obtenido beneficios tangibles como reducción de inventario, disminución de costos operativos y mejora de la eficiencia en los procesos logísticos.

2.2. Barreras en la implementación de los sistemas ERP

La percepción de la alta inversión requerida, en términos de tiempo y costo, constituye una de las mayores preocupaciones de las organizaciones a la hora de emprender un proyecto de esta naturaleza. Inclusive, los sistemas ERP se ven como aptos para las grandes organizaciones que pueden permitirse invertir en el rediseño de los procesos medulares del negocio. Besson (1999) reportó cuán rápido los gerentes culpan a los sistemas ERP y su complejidad como la causa de proyectos fallidos.

Parece que cualquier subestimación por parte de la gerencia involucrada en estos casos sobre la escala del cambio organizacional requerido puede convertirse en una gran fuente de riesgo, muchas veces irreversible.

2.3. La experiencia de los sistemas ERP en las pymes

Aun cuando los sistemas ERP fueron inicialmente destinados para las grandes organizaciones, es indudable que su implementación comienza a generar beneficios en organizaciones más pequeñas y con menos recursos financieros (Adam y O'Doherty, 2000). Fuerzas motoras como la globalización han puesto a las pymes en una nueva base de competencia y colaboración, por lo que resulta imperativo que incorporen tecnología de información que les permita abordar tales retos (Lebre La Rovere, 1996). Es evidente el impacto que los sistemas ERP pueden tener en este entorno.

Desde el punto de vista tecnológico, los motivos para la adopción de un sistema ERP en las pymes no son distintos de los de la gran empresa. Sus objetivos son similares: al adoptar un sistema ERP, las pymes buscan optimizar su desempeño organizacional mediante una mejor y más oportuna información, mayor control de la organización y el reemplazo de sistemas anticuados (Adam y O'Doherty, 2000; Thong, 1999).

2.4. Tiempo de implementación en la ejecución del ERP

Bajwa et ál. (2004) sostienen que el proceso de implementación del ERP compromete las operaciones normales del negocio y los recursos disponibles, por tanto, el tiempo de implementación es un factor crítico a considerar. En este sentido, los resultados son muy variados y en algunos casos desalentadores. Estos autores citan un estudio que reportó que 35% de las implementaciones de los ERP han sido canceladas, 55% han incurrido en excesos de tiempo y solo 10% han sido completadas dentro del tiempo previsto.

Hitt et ál. (2002) afirman que la implementación de los ERP es considerada como muy compleja y difícil. Para las grandes empresas, algunos estudios han estimado que percibir los beneficios tangibles puede tomar entre 1 y 3 años, en promedio, a partir de los 31 meses de efectuada (McAfee, 1999). Parte de las dificultades radica en los cambios asociados con el ERP, la necesidad de revaluar los procesos de las organizaciones y el nivel en el cual deben adaptarse los procesos a la capacidad del sistema. Esta complejidad induce diversos riesgos que potencialmente atentan contra el tiempo de implementación originalmente planificado. A su vez, el mayor tiempo en la implementación impacta sobre mayores costos asociados y, por ende, atenta directamente contra el nivel de satisfacción con el proceso. Este impacto debe repercutir, dadas las limitaciones mencionadas, con mayor intensidad en las pymes. De estos argumentos surge la siguiente hipótesis:

> **H1**: En la implementación de los ERP en las pymes, el tiempo de implementación empleado y el nivel de satisfacción con dicha implementación se relacionan de manera negativa.

2.5. Gerencia del proyecto durante la implementación del ERP

Ahituv et ál. (2002) sostienen que la definición del ámbito del proyecto, una clara determinación de los recursos necesarios para el equipo que participa en este y un plan detallado son los aspectos fundamentales que se deben considerar en la fase de preparación de la gerencia del proyecto de implementación de un ERP. Holland et ál. (1999) y Shanks et ál. (2000) postulan que una definición precisa del alcance del

proyecto plasmado en un plan de implementación claro debe ser el pilar de la gerencia de este y destacan la necesidad de trabajar sobre planes realistas. Boehm (1991) había anticipado también la importancia de contar con planes realistas dentro de la gerencia del proyecto como factor de éxito en cualquier intento de implementación de TI.

Bajwa et ál. (2004) sostienen que la implementación del ERP es extremadamente riesgosa debido a la amplitud de su ámbito, la naturaleza poco estructurada de sus tareas y la complejidad de la tecnología involucrada; como consecuencia, el empleo de herramientas de gerencia de proyecto apropiadas es absolutamente esencial para el éxito. Las herramientas de integración interna son críticas para coordinar las tareas del equipo de implementación y resolver los problemas técnicos que puedan surgir. Las herramientas de integración externa también son decisivas para facilitar la colaboración y asegurar que se tengan en cuenta los requerimientos de los usuarios finales. Las herramientas de planeación y control quizá puedan resultar menos útiles debido a la naturaleza propia y poco estructurada del proceso de implementación del ERP. Sin embargo, pueden ser necesarias para validar todas las especificaciones y todos los productos considerados, lo que permitirá evaluar el progreso del proyecto más adelante.

La implementación del ERP abarca todos los departamentos funcionales de la empresa, por lo que la cooperación entre técnicos y expertos de negocios es fundamental. Bingi et ál. (1999), Buckhout et ál. (1999) y Shanks et ál. (2000) sostienen inclusive que la mejor gente de la organización debería ser reclutada para el proyecto de implementación del ERP.

Acerca del líder del proyecto, Nah et ál. (2003) afirman que este papel es aún más importante, en comparación con el caso de cualquier otra tecnología de información, porque requiere de gran compromiso organizacional. Jiang et ál. (1996) indican que la designación de un gerente de proyecto competente es el segundo factor más importante para cualquier implementación de una TI. Estos autores han recopilado evidencia empírica que ratifica el papel del gerente del proyecto como factor crítico en la implementación de los proyectos de TI. También Nah et ál. (2003) señalan que la gerencia del proyecto es esencial en la implementación de los ERP pues es un factor que permitirá el logro de los objetivos en términos de *tiempo* y presupuesto.

Todos los argumentos anteriormente citados con referencia a la relación entre el nivel de gerencia del proyecto y el tiempo de implementación del ERP ejecutado se evidencian como especialmente relevantes para las pymes, por lo que se desprende la siguiente hipótesis:

> **H2**: En la implementación del ERP en las pymes, el nivel de gerencia del proyecto aplicado y el tiempo de implementación empleado se relacionan en forma negativa.

2.6. Adiestramiento durante la implementación del ERP

Bingi et ál. (1999), Holland et ál. (1999), Roberts y Barrar (1992), Shanks et ál. (2000) y Stratman y Roth (2002) han destacado la importancia de suministrar adiestramiento formal a los usuarios finales como parte del proyecto de implementación del ERP. Este adiestramiento los ayudará a entender el sistema y también

a comprender cómo sus tareas deben ser adaptadas y llevadas a cabo en lo sucesivo. Estos autores también indican que, por lo general, el adiestramiento es uno de los primeros rubros que se recorta cuando el proyecto comienza a exceder el presupuesto planificado, pero destacan que las empresas no debieran tomar esta acción que repercutirá frontalmente en los resultados posteriores de la implementación.

Sumner (1999) sostiene que, además del entrenamiento de los usuarios finales, es fundamental la capacitación en los temas técnicos propios de la tecnología del ERP y el adiestramiento para el equipo de implementación en temas de metodología y gerencia del proyecto.

Roberts y Barrar (1992) y Mainwaring (1999) afirman que el adiestramiento debería ser una actividad que se ejecute desde el inicio mismo del proyecto de implementación, pues a través de esta vía los involucrados podrán contribuir de forma más efectiva y eficiente a la adaptación de los procesos de negocios al sistema, *acelerando* así el proceso de implementación.

Todos estos argumentos sobre la relación entre el nivel de adiestramiento y el tiempo de implementación del ERP ejecutado parecen ser muy pertinentes para su aplicación en las pymes, por lo que se desprende la siguiente hipótesis:

> **H3**: En la implementación del ERP en las pymes, el nivel de adiestramiento ejecutado y el tiempo de implementación empleado se relacionan negativamente.

2.7. Habilidades de tecnología de información presentes en la empresa

Bajwa et ál. (2004) sostienen que el grado de adaptación técnica que se haga al ERP durante su implementación tiene un efecto directo sobre su éxito. Una adaptación excesiva puede ser muy costosa y al mismo tiempo destruir la integridad del *software* e inclusive reducir los beneficios asociados. Estos autores también indican que las capacidades y las habilidades técnicas del equipo que lidera la implementación constituyen un factor fundamental. Asimismo, argumentan que, a diferencia de otras aplicaciones de TI, el ERP requiere de un equipo dedicado de soporte en la organización que permita controlar los aspectos de eficiencia técnica del sistema y atienda también a las inquietudes de los usuarios finales.

Nah et ál. (2003) afirman que las empresas deberían estar dispuestas a aceptar las mejores prácticas que vienen incluidas con el *software* y modelar sus procesos de negocio de acuerdo con estas prácticas para hacer más eficiente el proceso de implementación del ERP. Autores como Bingi et ál. (1999), Holland et ál. (1999), Murray y Coffin (2001) y Shanks et ál. (2000) sostienen que el ERP debería ser instalado con rapidez y modificado eficientemente, pues las empresas deberían estar dispuestas a adaptar sus procesos de negocio a las prácticas incorporadas en el ERP para explotar todas sus ventajas y ejecutar el proceso en el menor tiempo posible.

Markus et ál. (2000) destacan, dentro de los temas propios de TI involucrados en la implementación del ERP, la importancia de la depuración de los datos y de una migración ordenada de estos al nuevo sistema. Estas tareas relacionadas con la calidad de

los datos existentes pueden ser subestimadas y merecen una atención especial con la finalidad de *evitar retrasos* dramáticos en el proceso de implementación.

Los argumentos anteriores sobre la relación entre el nivel de habilidades en materia de TI existente en la empresa y el tiempo de implementación del ERP son especialmente aplicables para el caso de las pymes, por lo que se desprende la siguiente hipótesis:

> **H4**: En la implementación del ERP en las pymes, el nivel de habilidades de tecnología de la información presentes en la empresa y el tiempo de implementación empleado están negativamente relacionados.

El modelo de investigación propuesto en la presente investigación se resume en el *gráfico 1*.

El *cuadro 1* presenta un resumen de las variables involucradas y su relevancia en la literatura.

3. Metodología

La presente investigación adoptó una perspectiva empírica y cuantitativa orientada a verificar hipótesis y, por ende, las relaciones propuestas entre variables. Se siguió una estrategia de investigación tipo *encuesta* (*survey*). Los datos se recopilaron mediante una muestra de pymes a la que se aplicó una encuesta en un lapso de tiempo determinado (estudio *cross-sectional*). Se diseñó un cuestionario para facilitar la recolección de información de la muestra seleccionada.

La unidad de análisis de esta investigación es la empresa.

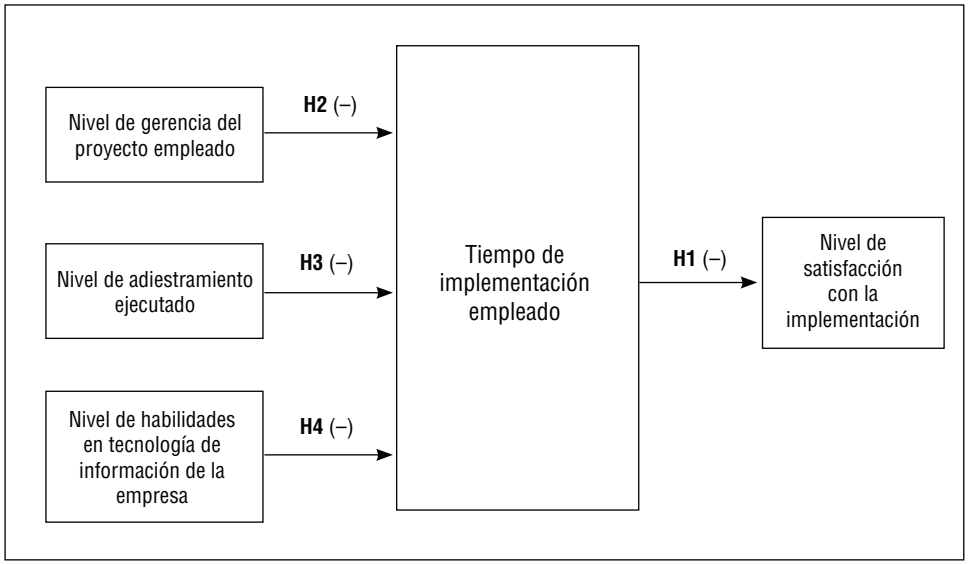

Gráfico 1
Modelo de investigación

Cuadro 1. Variables y literatura sobre ERP

Variables	Autores
1. Tiempo de implementación del ERP ejecutado	Bajwa et ál. (2004) Hitt et ál. (2000)
2. Gerencia del proyecto	Nah et ál. (2003) Bajwa et ál. (2004)
2.1. Recursos necesarios	Ahituv et ál. (2002) Bingi et ál. (1999) Buckhout et ál. (1999) Shanks et ál. (2000)
2.2. Plan de Trabajo realista	Boehm (1991) Holland et ál. (1999) Shanks et ál. (2000)
2.3. Rol del gerente del proyecto	Nah et ál. (2003) Jiang et ál. (1996, 2002)
3. Adiestramiento durante la implementación del ERP	Roberts y Barrar (1992) Mainwaring (1999)
3.1. Adiestramiento en la gestión del proyecto	Sumner (1999)
3.2. Adiestramiento en la utilización del sistema	Bingi et ál. (1999) Holland et ál.(1999) Roberts y Barrar (1992) Shanks et ál. (2000) Stratman y Roth (2002)
4. Habilidades en tecnologías de la información de la empresa	Bajwa et ál. (2004)
4.1. Habilidades en instalación rápida y eficiente	Bingi et ál. (1999) Holland et ál. (1999) Murray y Coffin (2001)
4.2. Habilidades en migración y calidad de los datos	Markus et ál. (2000)
4.3. Habilidades en integrar procesos de negocio al *software*	Nah et ál. (2003) Shanks et ál. (2000)

3.1. Descripción de la muestra

El universo seleccionado pertenece al conjunto de pymes que han implementado un ERP de un determinado proveedor líder en América Latina. Se debe destacar que la definición de pymes de este proveedor coincide con las características especificadas por Zevallos (2003) y Boggs et ál. (2007), quienes las definen como empresas que constan de hasta 500 empleados.

Esta lista original tenía 52 empresas que habían implementado ese determinado ERP y estaban ubicadas en diferentes países de América Latina, incluyendo México, Brasil, Guatemala, Costa Rica, Perú y algunos del Caribe. Se seleccionó de forma aleatoria una muestra de 40 empresas. Para hacerlo, se asignó un número de identificación a cada una de las empresas (comprendido entre 1 y 40) y se generaron 40 números al azar, mediante el uso de una rutina computarizada. Los números generados indicaron la identificación de las empresas que fueron invitadas a participar.

La invitación a participar en el estudio fue enviada al dueño o director general de la organización a través de un correo electrónico en el cual se destacaba la naturaleza voluntaria, el objetivo del estudio, sus beneficios y el compromiso de confidencialidad de la información. De las 40 empresas, 34 accedieron a participar en el estudio y respondieron el cuestionario enviado. Debido a la existencia de cuestionarios con información incompleta en algunos tópicos, la muestra final abarcó 15 empresas, con lo que se obtuvo una tasa final de participación de 38%.

Las organizaciones que no participaron no diferían en número de empleados respecto de las que sí lo hicieron.

3.2. Operacionalización de las variables

Las variables consideradas fueron: tiempo de implementación del ERP, nivel de satisfacción con su implementación, nivel de gerencia durante esta, nivel de adiestramiento en el proceso y habilidades de tecnología de la información presentes en la empresa.

Tiempo de implementación empleado en el ERP

Inicialmente se planteó utilizar como medida de esta variable la duración en semanas del tiempo de implementación; pero, ya que las implementaciones de un ERP pueden variar en las diferentes empresas de acuerdo con los objetivos establecidos (procesos de negocio que deben contemplarse en la implementación), se decidió que esta medición podría originar confusiones en la interpretación y no necesariamente permitiría establecer comparaciones equivalentes entre organizaciones, pues no todas las empresas deciden implementar todos y los mismos procesos de negocio en el ERP.

Se optó entonces por utilizar una variable con una escala tipo semántica diferencial (Babbie, 1990), donde se preguntaba sobre el resultado en «tiempo de implementación» empleado con respecto de las expectativas iniciales. Los participantes respondieron según una escala que iba de 1 («El tiempo de implementación fue muy por debajo a lo esperado») a 5 («El tiempo de implementación fue muy excedido a lo esperado»). Esta alternativa coincide con la utilizada por Reinartz et ál. (2004) desde la perspectiva del uso de una medida perceptual del constructo.

Nivel de satisfacción con la implementación del ERP

También en este caso se empleó una variable con una escala tipo semántica diferencial (Babbie, 1990), en la cual se preguntaba sobre el nivel de «satisfacción general» con la implementación del ERP en la empresa. Los participantes respondieron de acuerdo con una escala que iba de 1 («Nada satisfecho con la implementación del ERP») a 5 («Muy satisfecho con la implementación del ERP»). Esta alternativa coincide con la usada por Reinartz et ál. (2004) en la perspectiva de una medida perceptual del constructo.

Nivel de gerencia del proyecto durante la implementación del ERP

Se utilizó una medida de tres variables basada en Nah et ál. (2003) con una escala tipo semántica diferencial (Babbie, 1990) que va de 1 («Nada satisfecho») a 5 («Muy satisfecho»):

- Claro establecimiento de los recursos necesarios para la implementación
- Definición de un Plan de Trabajo realista
- Establecimiento del líder del proyecto

Estos tres elementos mostraron una buena confiabilidad: $\alpha = 0{,}92$ (ver reporte estadístico detallado en el anexo 1); luego se promediaron para generar el factor correspondiente.

Nivel de adiestramiento durante la implementación del ERP

Se utilizó una medida de dos variables basada en Nah et ál. (2003) y Holland et ál. (1999) con una escala tipo semántica diferencial (Babbie, 1990) que iba desde 1 («Nada satisfecho») hasta 5 («Muy satisfecho»):

- Capacitación adecuada y suficiente durante la administración del proyecto
- Capacitación adecuada y suficiente en la utilización del *software* ERP

Estos dos aspectos presentaron una buena confiabilidad: $\alpha = 0{,}70$ (ver reporte estadístico detallado en el anexo 1); luego se promediaron para generar el factor correspondiente.

Habilidades de tecnología de la información presentes en la empresa

Se utilizó una medida de variables basada en Nah et ál. (2003) y Markus et ál. (2000) con una escala tipo semántica diferencial (Babbie, 1990) que iba desde 1 («Nada satisfecho») hasta 5 («Muy satisfecho»):

- Instalación e inicio rápido y eficiente del *software* ERP
- Migración ordenada de los datos al *software* ERP
- Integración eficiente de los procesos de negocio al *software* ERP

Estos aspectos mostraron una relativa confiabilidad: $\alpha = 0{,}52$ (ver reporte estadístico detallado en el anexo 1); luego se promediaron para generar el factor correspondiente.

Se debe destacar que se verificó la «validez discriminante» de las variables y las medidas anteriores mediante la ejecución de un análisis factorial con el empleo específico de la técnica de «Extracción de análisis de componentes principales» con el método de rotación Varimax y normalización Kaiser (ver reporte estadístico detallado en el anexo 1).

El cuestionario final empleado, basado en las definiciones descritas anteriormente y diseñado considerando las guías metodológicas suministradas por Roberts (1999) se presenta en el anexo 4.

4. Resultados

A continuación se presenta el perfil demográfico de las empresas entrevistadas. Así, 62% de las empresas entrevistadas cuenta con menos de 100 empleados y 31% tiene menos de 50 empleados. La empresa entrevistada con menos empleados tiene únicamente 12. En cuanto a las ventas anuales, el promedio es de 9 millones de dólares anuales. La empresa con menores ingresos vende alrededor de 130 mil dólares anuales. Respecto de los años en el mercado, el promedio de estos es 15 años. La empresa con menos tiempo en el mercado tiene 3 años y la más antigua, 58 años.

En cuanto a los sectores a los cuales pertenecen las empresas, 37% se ubica en el sector manufactura; 25%, en el sector servicios; y 38%, en el sector de ventas minoristas (*cuadro 2*).

El *cuadro 3* muestra un análisis de la correlación de las variables utilizadas.

Se utilizará el análisis de regresión lineal múltiple para verificar las hipótesis. Hair et ál. (2005) sostienen que el análisis de regresión múltiple es la técnica estadística apropiada cuando el problema de investigación pretende analizar una presunta relación entre una variable dependiente y varias variables independientes.

El *cuadro 4* presenta los resultados del análisis de regresión cuando la variable dependiente es *tiempo de implementación empleado* y las variables independientes son *nivel de gerencia del proyecto*, *nivel de adiestramiento ejecutado* y *nivel de habilidades en TI de la empresa* (el anexo 2 presenta en forma exhaustiva los resultados de la regresión y el cumplimiento de las hipótesis subyacentes).

Cuadro 2. Análisis descriptivo de las variables utilizadas

Variable	Significado	Promedio	Desviación estándar	Mínimo	Máximo
FACPROMGM	Nivel de gerencia del proyecto	3,8888889	0,8967903	2,0000000	5,0000000
FACTRAINING	Adiestramiento	3,3666667	1,0082989	1,0000000	4,5000000
FACIT	Habilidades de tecnología de la información	3,6000000	0,7580258	1,6666667	5,0000000
SATISFIMPLEMENT	Nivel de satisfacción con la implementación	3,2500000	0,9309493	1,0000000	4,0000000
RESULTADOTIEMPO	Tiempo de implementación empleado	3,6875000	0,9464847	3,0000000	5,0000000

Cuadro 3. Análisis de la correlación de las variables

	Pearson correlation coefficients Prob > |r| under H0: Rho = 0 Number of observations			
	FACPROMGM	**FACTRAINING**	**FACIT**	**RESULTADOTIEMPO**
FACPROMGM	1,00000	0,70655	0,57207	–0,17500
FACPROMGM		0,0032	0,0259	0,5327
	15	15	15	15
FACTRAINING	0,70655	1,00000	0,42366	–0,49030
FACTRAINING	0,0032		0,1156	0,0635
	15	15	15	15
FACIT	0,57207	0,42366	1,00000	–0,48999
FACIT	0,0259	0,1156		0,0637
	15	15	15	15
RESULTADOTIEMPO	–0,17500	–0,49030	–0,48999	1,00000
RESULTADOTIEMPO	0,5327	0,0635	0,0637	
	15	15	15	16

Cuadro 4. Resultados del análisis de regresión de la variable dependiente *tiempo de implementación empleado* y de las variables independientes *gerencia*, *adiestramiento* y *habilidades en TI*

Parameter estimates								
Variable	**Label**	**DF**	**Parameter estimate**	**Standard error**	**t value**	**Pr > |t|**	**Tolerance**	**Variance inflation**
Intercept	Intercept	1	5,62287	1,00799	5,58	0,0002		0
FACTPROMGM	FACTPROMGM	1	0,65645	0,33484	1,96	0,0758	0,41013	2,43827
FACTRAINING	FACTRAINING	1	–0,64135	0,26966	–2,38	0,0366	0,50022	1,99912
FACIT	FACIT	1	–0,67126	0,30948	–2,17	0,0529	0,67198	1,48814

Nota: $R^2 = 0,50$, $p < 0,05$

Con respecto de *nivel de adiestramiento ejecutado*, los resultados corroboran la hipótesis 3, pues se verifica su relación negativa con el *tiempo de implementación empleado*: $\beta = –0,64135$, $p < 0,05$.

En cuanto a *nivel de habilidades en tecnología de la información de la empresa*, los resultados corroboran la hipótesis 4, pues se verifica una relación negativa con el *tiempo de implementación empleado*: $\beta = –0,67126$, $p < 0,10$.

Finalmente, respecto de *nivel de gerencia de proyecto empleado*, sorprendentemente, y en contra a lo que se planteó en la hipótesis 2, se verificó una relación positiva con el *tiempo de implementación empleado*: $\beta = 0,65645$, $p < 0,10$. En este sentido, la hipótesis no fue corroborada.

El *cuadro 5* reporta los resultados del análisis de regresión cuando la variable dependiente es *nivel de satisfacción con la implementación del ERP* y la variable independiente es *tiempo de implementación empleado*. Los resultados obtenidos corroboran la hipótesis 1, pues se verifica la relación negativa entre estas variables: $\beta = -0{,}51724$, $p < 0{,}05$) (el anexo 3 presenta en detalle los resultados de la regresión y el cumplimiento de las hipótesis subyacentes).

El *cuadro 6* resume las hipótesis involucradas y los resultados obtenidos.

5. Resultados, limitaciones y perspectivas

En este acápite final se presentan los resultados, las limitaciones, sus implicancias para las empresas y las contribuciones y las perspectivas de esta investigación.

5.1. Resultados

La presente investigación contribuye con el conocimiento de los factores que pueden determinar el éxito en la implementación del ERP, especialmente en el área

Cuadro 5. Análisis de regresión de *nivel de satisfacción con la implementación del ERP* como variable dependiente y *tiempo de implementación empleado* como variable independiente

Parameter estimates

Variable	Label	DF	Parameter estimate	Standard error	t value	Pr > |t|	Tolerance	Variance inflation
Intercept	Intercept	1	5,19540	0,86573	6,00	<,0001		0
RESULTADOTIEMPO	RESULTADOTIEMPO	1	0,51724	0,23361	–2,21	0,0453	1,00000	1,00000

Nota: $R^2 = 0{,}27$, $p < 0{,}05$

Cuadro 6. Hipótesis involucradas y sus resultados

Hipótesis	Variable dependiente	Variable independiente	Sentido de la relación	¿Corroborada?
H1	Nivel de satisfacción con la implementación del ERP	Tiempo de implementación empleado	Negativo	SÍ
H2	Tiempo de implementación empleado	Nivel de gerencia del proyecto empleado	Negativo	NO Resulta significativa una relación en sentido contrario (positivo)
H3	Tiempo de implementación empleado	Nivel de adiestramiento ejecutado	Negativo	SÍ
H4	Tiempo de implementación empleado	Nivel de habilidades en TI de la empresa	Negativo	SÍ

de las pymes. Se concentró el interés en estudiar las variables que pueden incidir directamente en el tiempo de implementación empleado[1], el cual es una dimensión fundamental que todas las empresas, en especial las pymes, por sus especiales limitaciones, deben comprender y controlar (Shehab et ál., 2004).

Los resultados obtenidos corroboran la importancia de que las pymes cuenten con *sólidas habilidades en materia de tecnología de la información* a la hora de emprender un proyecto de implementación de ERP. Si bien es cierto que este tipo de proyectos requiere de capacidades estratégicas y de negocios, no deben descuidarse las capacidades en materia de TI que pueden marcar la diferencia (Holland et ál., 1999; Markus et ál., 2000). De no contar una pyme con el conocimiento técnico requerido, será necesario emplear un tiempo adicional en el reclutamiento, el adiestramiento y la puesta en marcha para disponer de estas habilidades, lo que inevitablemente requerirá de un mayor tiempo para activar el ERP.

Con respecto del *nivel de adiestramiento*, se confirma la importancia de ejecutar un proceso de transferencia de conocimientos desde el inicio mismo de la implementación, tanto al equipo del proyecto como a los usuarios involucrados. Esto facilita la asimilación eficaz no solo de las capacidades y las limitaciones del sistema ERP, sino también de alternativas eficientes para adaptar los procesos de negocio a la nueva plataforma. Un conocimiento temprano de las características y las funciones del sistema permitirá crear alternativas ágiles cuando surjan obstáculos en el proceso de implementación, lo que puede permitir acortar el tiempo necesario para todo el proceso.

1. Siempre tomando como referencia las expectativas iniciales.

En cuanto al *nivel de gerencia del proyecto*, resultó sorpresiva la relación positiva y significativa obtenida con el *tiempo de implementación empleado*, en contra del sentido de la hipótesis propuesta. Una posible explicación para este hallazgo puede estar relacionada con lo señalado por Yen et ál. (2002), quienes indican que, por lo general, las pymes no están acostumbradas a enfrentar proyectos de gran envergadura. En la mayor parte de los casos no están adiestradas en el uso metodologías y revisiones minuciosas de los procesos de negocio. Tampoco es usual que cuenten con documentación sobre tales procesos. En estos casos, para cumplir con la metodología estricta que puede requerir la gerencia del proyecto, puede ser necesario mucho trabajo adicional para analizar y documentar los procesos de negocio que deben implementarse. Esto indefectiblemente impacta en el tiempo requerido para la implementación.

Por otra parte, una gerencia de proyectos disciplinada debe garantizar que el equipo del proyecto siempre esté enfocado en el proceso. Dadas las limitaciones de recursos que experimentan las pymes, es usual que un mismo empleado desempeñe varios roles pues los empleados suelen compartir sus labores tradicionales con el proceso de implementación del ERP. Es muy probable que en muchos casos el día a día absorba el tiempo que los empleados deberían disponer para el proyecto y, en este sentido, una gerencia de proyecto disciplinada no culminará las tareas correspondientes hasta contar con el apoyo y la validación de los recursos respectivos; lo que ocasionará retrasos en el tiempo de implementación. Marsh (2000) resume esta perspectiva y argumenta que la poca experiencia de la empresa en afrontar proyectos de escala similar en TI puede impactar sobre su proceso de implementación.

Finalmente, se verifica también que, para las pymes, el tiempo de implementación empleado[2] incide en la satisfacción general con el proceso, tal como fue indicado por Zviran et ál. (2005). Considerando las limitaciones que enfrentan las pymes, de acuerdo con Yen et ál. (2002), se desprende que una implementación de ERP que involucre menores tiempos a los esperados definitivamente supondrá un mayor nivel de satisfacción.

5.2. Limitaciones

Existen razones para ser cautelosos con la generalización de los resultados de la presente investigación. Primero, porque las empresas analizadas se ubican en el contexto latinoamericano. Los hallazgos aquí encontrados pudieran no ser aplicables a otras latitudes. Segundo, la muestra de las empresas que respondieron el cuestionario es limitada y la generalización y la potencia estadística subyacente pudieran verse cuestionadas, según lo señalado por Baroudi y Orlikowski (1989). Tercero, el éxito de la implementación del ERP se midió principalmente considerando el *tiempo de implementación* con respecto a las expectativas iniciales; sin embargo, otras dimensiones importantes del éxito quedaron fuera del alcance de esta investigación. Cuarto, la muestra se focalizó en pymes que habían implementado el ERP de un proveedor en particular, pues no se consideraron empresas que habían utilizado otros proveedores.

Una limitación adicional que se detectó es aquella relacionada con los constructos y las mediciones involucradas. No se encontraron prácticamente referencias de trabajos empíricos previos, en línea con lo mencionado por autores como Kumar et ál. (2002), quienes sostienen que existe poca investigación *empírica* relacionada con los principales obstáculos para la adopción de los ERP en las organizaciones. En este sentido, las mediciones propuestas están sujetas a mejoras y ampliaciones.

5.3. Implicancias para las empresas

A pesar de las limitaciones indicadas, el estudio ofrece importantes lecciones que deben ser consideradas por las pymes que están evaluando la posibilidad de implementar un ERP. En primer lugar, debe darse total prioridad desde el inicio al *adiestramiento de los miembros del equipo del proyecto*, tanto en los temas de gerencia del proyecto, como en aquellos propios del conocimiento del sistema de ERP. Dadas las restricciones de las pymes, existe la tendencia a minimizar el presupuesto y, por lo general, el adiestramiento es una de las líneas susceptibles de reducción. El presente estudio contribuye a reforzar la importancia del adiestramiento y el riesgo que puede ocasionar, tanto en tiempo requerido como en posterior satisfacción, cualquier reducción en esta materia. ¡No escatime en adiestramiento!

También es muy importante que las pymes reflexionen sobre las capacidades existentes, «puertas adentro», en materia de TI. Debe existir la certeza de que se cuenta con un inventario de estas habilidades, lo que facilitará el proceso de implementación. De no disponer de tales habilidades, los hallazgos del presente estudio sugieren que la pyme evalúe con prudencia la postergación del proceso de implementación.

2. Siempre tomando como referencia las expectativas iniciales.

5.4. Contribuciones y futuras áreas de investigación

Tal como afirma Hitt (2002), la mayor parte de la investigación sobre los ERP ha sido llevada a cabo principalmente a través de estudios de caso y encuestas en industrias y, además, la investigación existente ha estado orientada al segmento de grandes empresas y corporaciones (Shehab et ál., 2004).

El presente estudio pretende aportar nuevas luces considerando tales brechas y por eso se concentró en el análisis de las *pymes*, con una investigación *empírica* a través de encuestas a empresas pertenecientes a diversas industrias e inclusive en diferentes países; este hecho tiene mayor relevancia si se considera que en muchos de ellos las pymes constituyen el motor de la economía (Shehab et ál., 2004). América Latina no escapa a esta realidad y, en ese sentido, este estudio también contribuye en esa dirección, dado que no se encontraron investigaciones que abordaran la realidad latinoamericana.

Shehab et ál. (2004) sostienen que pueden existir diferencias en la implementación del ERP por parte de las pymes frente a las grandes empresas. Inclusive este hecho motiva los estudios en esta dirección. El hallazgo encontrado en esta investigación relacionado con el tópico *gerencia del proyecto* puede ser un ejemplo de estas diferencias y, en este sentido, apoya la invitación de Shehab et ál. (2004) de seguir profundizando en el segmento de las pymes para consolidar un mejor entendimiento y poder establecer comparaciones pertinentes con las grandes empresas.

Este estudio se concentró en el análisis del tiempo de implementación ejecutado en comparación con las expectativas iniciales como una de las dimensiones del éxito del proyecto. Definitivamente, existen otras dimensiones que contribuyen al éxito, cuya investigación debe ser profundizada en el futuro. Establecer los constructos subyacentes de tales dimensiones sería un aporte fundamental para el desarrollo de investigaciones sucesivas.

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Anexo 1
Validez discriminante y confiabilidad de variables-constructos

1. Validez discriminante

Tres de las variables utilizadas fueron medidas mediante constructos del tipo multiítem. En este sentido, el análisis discriminante fue empleado para corroborar la unidimensionalidad de cada uno de ellos. La validez discriminante se verificó empleando la técnica del análisis factorial. Para este caso se utilizó el método de extracción de *análisis de componentes principales*, mediante rotación Varimax y normalización Kaiser.

A continuación se presenta el reporte estadístico detallado obtenido mediante el uso del paquete estadístico SAS (Enterprise Guide). El cuadro siguiente confirma un valor para el test de Kaiser de 0,71. De acuerdo con Field (2005), un valor mayor que 0,5 ratifica que el análisis factorial es apropiado para la muestra de datos utilizada.

También se verifica que son tres los factores resultantes del análisis, siguiendo la convención referida por Jolliffe (Field, 2005) de mantener aquellos factores cuyos *eigenvalores* (o valores propios) sean mayores que 0,7.

Finalmente, se corrobora que todas las variables se adhieren específicamente a uno de los tres factores de acuerdo con la propuesta inicial planteada. Solo surge inconsistencia frente a la clasificación inicialmente propuesta en *capacitación en administración del proyecto* y *rápida instalación del software*. Field (2005) argumenta que estas variaciones pueden darse en una muestra limitada y, por tanto, recomienda aumentar el tamaño de la muestra para tener mayor certeza al respecto.

Cuadro 5A
Factor analysis results

The FACTOR procedure
Initial factor method: principal components

PARTIAL CORRELATIONS CONTROLLING ALL OTHER VARIABLES

	Label	Recursos NecesariosImp	Líderde Proyecto	PlandeTrabajo Realista	Capacitación AdmProyecto	Capacitación UsoSWERP	Rápida Instalación delERP	Migración DatosalERP	Integración Procesos alERP
RecursosNecesariosImp	RecursosNecesariosImp	1,00000	0,20055	0,79293	0,21383	–0,35658	–0,37840	0,01251	0,08116
LíderdeProyecto	LíderdeProyecto	0,20055	1,00000	0,05275	0,31810	–0,26127	0,06668	0,18523	0,09383
PlandeTrabajoRealista	PlandeTrabajoRealista	0,79293	0,05275	1,00000	0,05737	0,52274	0,16666	0,04237	0,04029
CapacitaciónAdmProyecto	CapacitaciónAdmProyecto	0,21383	0,31810	0,05737	1,00000	0,11393	0,67973	–0,58546	0,21774
CapacitaciónUsoSWERP	CapacitaciónUsoSWERP	–0,35658	–0,26127	0,52274	0,11393	1,00000	0,09224	–0,08538	0,14094
RápidaInstalaciónERP	RápidaInstalaciónERP	–0,37840	0,06668	0,16666	0,67973	0,09224	1,00000	0,37309	–0,18813
MigraciónDatosalERP	MigraciónDatosalERP	0,01251	0,18523	0,04237	–0,58546	–0,08538	0,37309	1,00000	0,67525
IntegraciónProcesosalERP	IntegraciónProcesosalERP	0,08116	0,09383	0,04029	0,21774	0,14094	–0,18813	0,67525	1,00000

Kaiser's measure of sampling adequacy: Overall MSA = 0,71271267

Recursos NecesariosImp	Líderde Proyecto	Plande TrabajoRealista	Capacitación AdmProyecto	Capacitación UsoSWERP	Rápida InstalaciónERP	Migración DatosalERP	Integración ProcesosalERP
0,71430437	0,89877530	0,75557498	0,71842790	0,69711711	0,65770136	0,33977195	0,73316789

→

Prior communality estimates: ONE

Eigenvalues of the correlation matrix: Total = 8 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	4,40032716	2,76374807	0,5500	0,5500
2	1,63657909	0,84369034	0,2046	0,7546
3	0,79288875	0,19123091	0,0991	0,8537
4	0,60165784	0,37106074	0,0752	0,9289
5	0,23059711	0,02521235	0,0288	0,9578
6	0,20538476	0,12207934	0,0257	0,9834
7	0,08330543	0,03404558	0,0104	0,9938
8	0,04925985	—	0,0062	1,0000

Factor analysis results

The FACTOR procedure rotation method: Varimax

	Orthogonal Transformation Matrix		
	1	**2**	**3**
1	0,80665	0,55118	0,21333
2	0,06170	–0,43751	0,89709
3	–0,58779	0,71048	0,38693

Rotated factor pattern

	Label	Factor 1	Factor 2	Factor 3
RecursosNecesariosImp	RecursosNecesariosImp	0,92341	0,16376	0,15305
LíderdeProyecto	LíderdeProyecto	0,86301	0,19761	0,19338
PlandeTrabajoRealista	PlandeTrabajoRealista	0,82460	0,43104	0,15558
CapacitacióAdmProyecto	CapacitaciónAdmProyecto	0,71220	0,60513	–0,18362
CapacitaciónUsoSWERP	CapacitaciónUsoSWERP	0,14675	0,87742	0,05633
RápidaInstalaciónERP	RápidaInstalaciónERP	0,32959	0,78884	–0,01769
MigraciónDatosalERP	MigraciónDatosalERP	–0,01236	–0,10104	0,95443
IntegraciónProcesosalERP	IntegraciónProcesosalERP	0,47796	0,17358	0,77646

2. Confiabilidad de variables-constructos

La consistencia interna de las variables se verificó a través del cálculo del Alpha de Cronbach (α) sobre los ítem que forman las variables. Se presenta a continuación el reporte estadístico detallado obtenido mediante el uso del paquete estadístico SAS (Enterprise Guide).

Constructo: nivel de gerencia del proyecto durante la implementación del ERP

Cuadro 5
Correlation analysis
The CORR procedure

3 variables	RecursosNecesariosImp	PlandeTrabajoRealista	LíderdeProyecto

Simple Statistics

Variable	N	Mean	Std. dev.	Sum	Minimum	Maximum	Label
RecursosNecesariosImp	15	3,80000	0,94112	57,00000	2,00000	5,00000	RecursosNecesariosImp
PlandeTrabajoRealista	15	3,73333	1,09978	56,00000	2,00000	5,00000	PlandeTrabajoRealista
LíderdeProyecto	15	4,13333	0,83381	62,00000	2,00000	5,00000	LíderdeProyecto

Cronbach coefficient Alpha

Variables	Alpha
Raw	0,921711
Standarized	0,925746

Cronbach coefficient Alpha with deleted variable

Deleted variable	Raw variables		Standarized variables		
	Correlation with total	Alpha	Correlation with total	Alpha	Label
RecursosNecesariosImp	0,907040	0,833819	0,897524	0,852276	RecursosNecesariosImp
PlandeTrabajoRealista	0,885383	0,863014	0,880180	0,866602	PlandeTrabajoRealista
LíderdeProyecto	0,769968	0,947368	0,770952	0,953397	LíderdeProyecto

Pearson correlation coefficients, N = 15
Prob > |r| under HO: Rho = 0

	RecursosNecesariosImp	PlandeTrabajoRealista	LíderdeProyecto
RecursosNecesariosImp RecusosNecesariosImp	1,00000	0,91094 <,0001	0,76461 0,0009
PlandeTrabajoRealista PlandeTrabajoRealista	0,91094 <,0001	1,00000	0,74258 0,0015
LíderdeProyecto LíderdeProyecto	0,76461 0,0009	0,74258 0,0015	1,00000

Constructo: nivel de adiestramiento durante la implementación del ERP

Cuadro 6
Correlation analysis
The CORR procedure

2 variables	CapacitaciónAdmProyecto	CapacitaciónUsoSWERP

Simple statistics

Variable	N	Mean	Std. dev.	Sum	Minimum	Maximum	Label
CapacitaciónAdmProyecto	15	3,40000	1,24212	51,00000	1,00000	5,00000	CapacitaciónAdmProyecto
CapacitaciónUsosSWERP	15	3,33333	1,04654	50,00000	1,00000	5,00000	CapacitaciónUsosSWERP

Cronbach coefficient Alpha

Variables	Alpha
Raw	0,702576
Standarized	0,709247

Cronbach coefficient Alpha with deleted variable

	Raw variables		Standarized variables		
Deleted variable	**Correlation with total**	**Alpha**	**Correlation with total**	**Alpha**	**Label**
CapacitaciónAdmProyecto	0,549484	—	0,549484	—	CapacitaciónAdmProyecto
CapacitaciónUsosSWERP	0,549484	—	0,549484	—	CapacitaciónUsosSWERP

Pearson correlation coefficients, N = 15
Prob > |r| under HO: Rho = 0

	CapacitaciónAdmProyecto	**CapacitaciónUsosSWERP**
CapacitaciónAdmProyecto CapacitaciónAdmProyecto	1,00000	0,54948 0,0339
CapacitaciónUsosSWERP CapacitaciónUsosSWERP	0,54948 0,0339	1,00000

Cuadro 7
Correlation analysis
The CORR procedure

3 variables	RápidaInstalaciónERP	MigraciónDatosalERP	IntegraciónProcesalERP

Simple statistics

Variable	N	Mean	Std. dev.	Sum	Minimum	Maximum	Label
RápidaInstalaciónERP	15	3,73333	1,09978	56,00000	1,00000	5,00000	RápidaInstalaciónERP
MigraciónDatosalERP	15	3,86667	1,06010	58,00000	1,00000	5,00000	MigraciónDatosalERP
IntegraciónProcesalERP	15	3,20000	1,01419	48,00000	1,00000	5,00000	IntegraciónProcesalERP

Cronbach coefficient Alpha

Variables	Alpha
Raw	0,524862
Standarized	0,536477

Cronbach coefficient Alpha with deleted variable

	Raw variables		Standarized variables		
Deleted variable	**Correlation with total**	**Alpha**	**Correlation with total**	**Alpha**	**Label**
RápidaInstalaciónERP	0,113483	0,768392	0,116879	0,768856	RápidaInstalaciónERP
MigraciónDatosalERP	0,358252	0,390411	0,375306	0,391442	MigraciónDatosalERP
IntegraciónProcesalERP	0,618798	–0,067511	0,623945	–0,067558	IntegraciónProcesalERP

Pearson correlation coefficients, N = 15
Prob > |r| under HO: Rho = 0

	RecursosNecesariosImp	**PlandeTrabajoRealista**	**LíderdeProyecto**
RápidaInstalaciónERP RápidaInstalaciónERP	1,00000	–0,03268 0,9080	0,24335 0,3821
MigraciónDatosalERP Migración DatosalERP	–0,03268 0,9080	1,00000	0,62451 0,0128
IntegraciónProcesalERP IntegraciónProcesalERP	0,24335 0,3821	0,62451 0,0128	1,00000

Anexo 2
Análisis de regresión I

En este acápite se presenta el reporte estadístico detallado obtenido mediante el uso del paquete estadístico SAS (Enterprise Guide), cuando la variable dependiente es *tiempo de implementación empleado* y las variables independientes son *nivel de gerencia de proyecto empleado*, *nivel de adiestramiento ejecutado* y *nivel de habilidades en tecnología de la información de la empresa*.

Cuadro 8
Linear regression results

The REG procedure
Model: Linear_Regression_Model
Dependent variable: RESULTADOTIEMPO RESULTADOTIEMPO

Number of observations read	34
Number of observations used	15
Number of observations with missing values	19

Analysis of variance

Source	DF	Sum of squares	Mean squares	F value	Pr > F
Model	3	5,90489	1,96830	3,80	0,0431
Error	11	5,69511	0,51774		
Corrected total	14	11,60000			

Root MSE	0,71954	**R-Square**	0,5090
Dependent mean	3,60000	**Adj. R-Sq.**	0,3751
Coeff. var.	19,98722		

Parameter estimates

Variable	Label	DF	Parameter estimate	Standard error	t value	Pr > |t|	Tolerance	Variance inflation
Intercept	Intercept	1	5,62287	1,00799	5,58	0,0002	—	0
FACPROMGM	FACPROMGM	1	0,65645	0,33484	1,96	0,0758	0,41013	2,43827
FACTRAINING	FACTRAINING	1	–0,64135	0,26966	–2,38	0,0366	0,50022	1,99912
FACIT	FACIT	1	–0,67126	0,30948	–2,17	0,0529	0,67198	1,48814

Collinearity diagnostics

				Proportion of variation		
Number	**Eigenvalue**	**Condition index**	**Intercept**	**FACPROMGM**	**FACTRAINING**	**FACIT**
1	3,92153	1,00000	0,00216	0,00125	0,00244	0,00171
2	0,04432	9,40617	0,21780	0,01140	0,48211	0,08240
3	0,02031	13,89396	0,77997	0,05259	0,08651	0,56917
4	0,01383	16,83684	0,00007067	0,93476	0,42894	0,34672

Collinearity diagnostics (intercept adjusted)

			Proportion of variation		
Number	**Eigenvalue**	**Condition index**	**FACPROMGM**	**FACTRAINING**	**FACIT**
1	2,14267	1,00000	0,07405	0,07846	0,08688
2	0,59207	1,90236	0,01788	0,26819	0,74540
3	0,26526	2,84210	0,90807	0,65335	0,16771

→

Cuadro 9
Linear regression results

The REG procedure
Model: Linear_Regression_Model
Dependent variable: RESULTADOTIEMPO RESULTADOTIEMPO

Consistent covariance of estimates

Variable	Label	Intercept	FACPROMGM	FACTRAINING	FACIT
Intercept	Intercept	0,7020257643	–0,122247273	0,0050075691	–0,068170261
FACPROMGM	FACPROMGM	–0,122247273	0,0694754865	–0,010041976	–0,026584518
FACTRAINING	FACTRAINING	0,0050075691	–0,010041976	0,015025187	–0,005539843
FACIT	FACIT	–0,068170261	–0,026584518	–0,005539843	0,0502930458

Test of first and second moment specification

DF	Chi-Square	Pr > ChiSq
9	8,95	0,4418

Durbin-Watson D	2,475
Number of observations	15
1st. order autocorrelation	–0,273

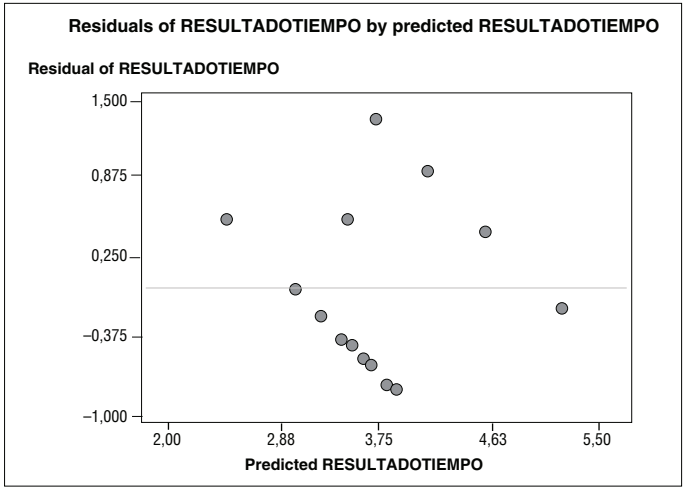


Figura 2
Regression analysis plots

Cuadro 10
Distribution analysis of: student_RESULTADOTIEMPO
The UNIVARIATE procedure
Fitted distribution for student_RESULTADOTIEMPO

Parameters for normal distribution

Parameter	Symbol	Estimate
Mean	Mu	–0,00017
Std. dev.	Sigma	1,021361

Quantiles for normal distribution

	Quantile	
Percent	**Observed**	**Estimated**
1,0	–1,30463	–2,37621
5,0	–1,30463	–1,68016
10,0	–1,11488	–1,30910
25,0	–0,78774	–0,68907
50,0	–0,32085	–0,00017
75,0	0,95555	0,68873
90,0	1,45377	1,30875
95,0	2,07506	1,67982
99,0	2,07506	2,37587

Goodness-of-Fit tests for normal distribution

Test	Statistic		p value	
Kolmogorov-Smirnov	**D**	0,16557997	**Pr > D**	>0,150
Cramer-Von Mises	**W-Sq**	0,08765978	**Pr > W-Sq**	0,152
Anderson-Darling	**A-Sq**	0,49541313	**Pr > A-Sq**	0,189

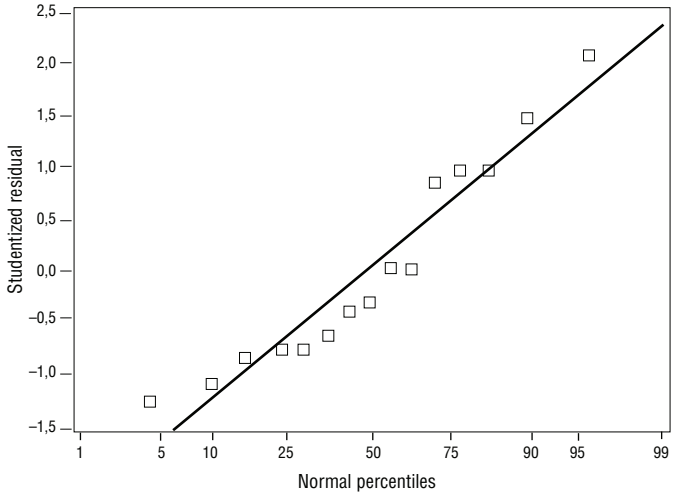


Figura 3
Distribution analysis of: student_RESULTADOTIEMPO

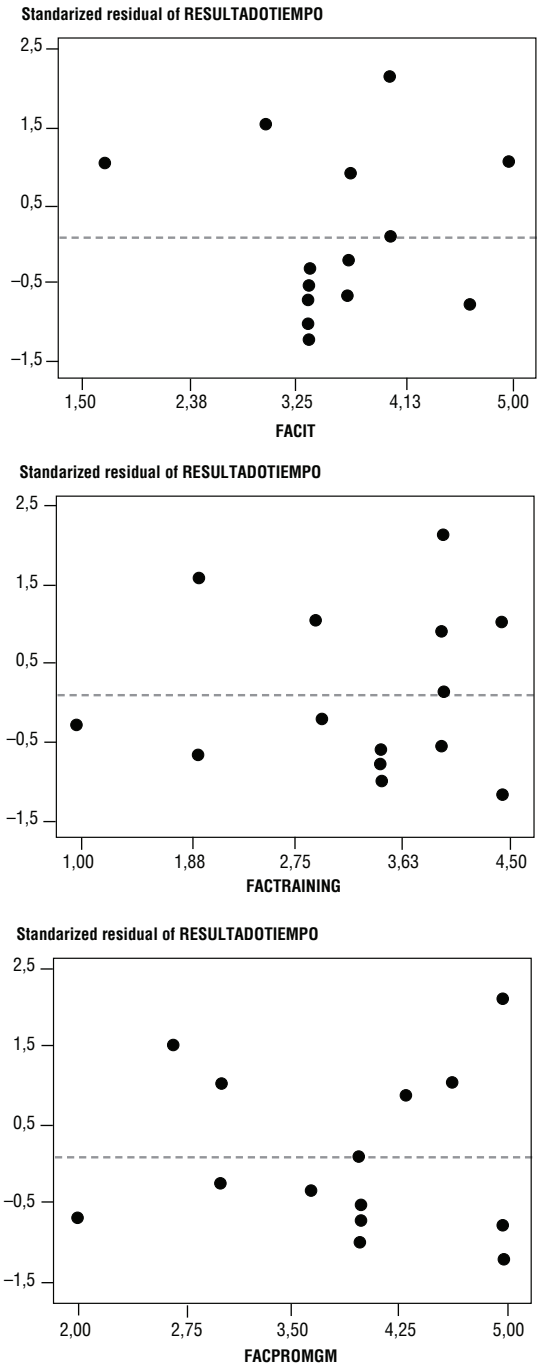


Figura 4
Standarized residual of RESULTADOTIEMPO

Anexo 3
Análisis de regresión II

Se presenta a continuación el reporte estadístico detallado obtenido mediante el uso del paquete estadístico SAS (Enterprise Guide) cuando la variable dependiente es *nivel de satisfacción con la implementación del ERP* y la variable independiente es *tiempo de implementación empleado.*

Cuadro 11
Linear regression results

The REG procedure
Model: Linear_Regression_Model
Dependent variable: SATISFIMPLEMENT SATISFIMPLEMENT

Number of observations read	16
Number of observations used	15
Number of observations with missing values	1

Analysis of variance

Source	DF	Sum of squares	Mean squares	F value	Pr > F
Model	1	3,10345	3,10345	4,90	0,0453
Error	13	8,22989	0,63307		
Corrected total	14	11,33333			

Root MSE	0,79566	**R-Square**	0,2738
Dependent mean	3,33333	**Adj. R-Sq**	0,2180
Coeff. var.	23,86967		

Parameter estimates

Variable	Label	DF	Parameter estimate	Standard error	t value	Pr = |t|	Tolerance	Variance inflation
Intercept	Intercept	1	5,19540	0,86573	6,00	<,0001	—	0
RESULTADOTIEMPO	RESULTADOTIEMPO	1	–0,51724	0,23361	–2,21	0,0453	1,00000	1,00000

Collinearity diagnostics

			Proportion of variation	
Number	**Eigenvalue**	**Condition index**	**Intercept**	**RESULTADOTIEMPO**
1	1,97144	1,00000	0,01428	0,01428
2	0,02856	8,30783	0,98572	0,98572

Cuadro 12
Linear regression results

The REG procedure
Model: Linear_Regression_Model
Dependent variable: SATISFIMPLEMENT SATISFIMPLEMENT

Consistent covariance of estimates

Variable	Label	Intercept	RESULTADOTIEMPO
Intercept	Intercept	0,793854106	–0,2447773
RESULTADOTIEMPO	RESULTADOTIEMPO	–0,2447773	0,0775555339

Test of first and second moment specification

DF	Chi-Square	Pr > ChiSq
2	4,37	0,1125

Durbin-Watson D	1,897
Number of observations	15
1st. order autocorrelation	–0,113

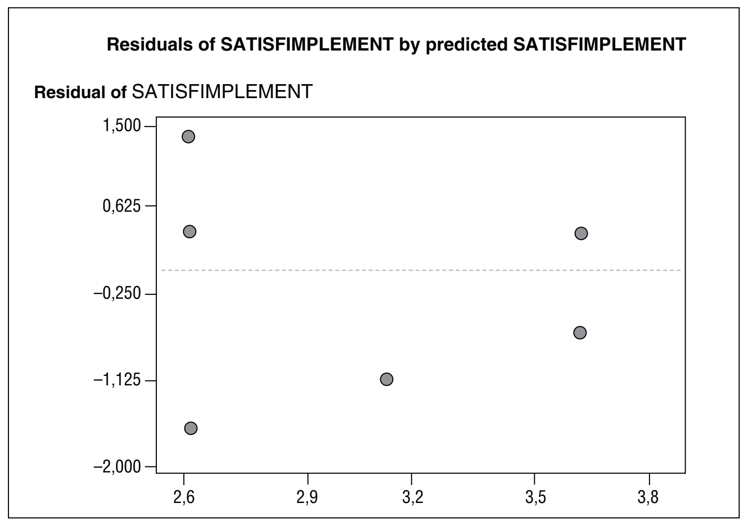


Figura 5
Residual of SATISFIMPLEMENT

Cuadro 13
Distribution analysis of: student_SATISFIMPLEMENT
The UNIVARIATE Procedure

Fitted distribution for student_SATISFIMPLEMENT

Parameters for normal distribution

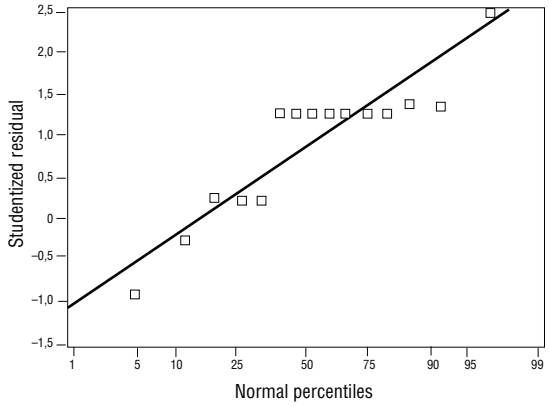
Parameter	Symbol	Estimate
Mean	Mu	0,005233
Std. dev.	Sigma	1,065404

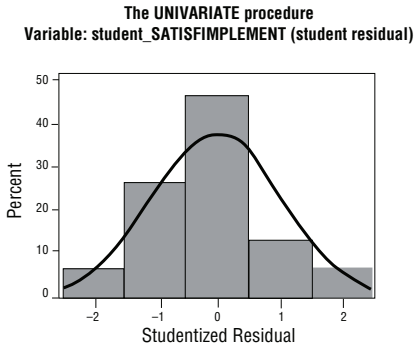
Goodness-of-Fit tests for normal distribution

Test	Statistic		p value	
Kolmogorov-Smirnov	**D**	0,33582979	**Pr > D**	<0,010
Cramer-Von Mises	**W-Sq**	0,27288823	**Pr > W-Sq**	<0,005
Anderson-Darling	**A-Sq**	0,30352070	**Pr > A-Sq**	<0,005

Quantiles for normal distribution

	Quantile	
Percent	**Observed**	**Estimated**
1,0	–2,31330	–2,47327
5,0	–2,31330	–1,74720
10,0	–1,47637	–1,36014
25,0	–0,85166	–0,71337
50,0	0,47146	0,00523
75,0	0,47146	0,72384
90,0	0,56180	1,37060
95,0	1,99935	1,75767
99,0	1,99935	2,48373





Anexo 4
Cuestionario utilizado

ESTE ES EL CUESTIONARIO UTILIZADO PARA RECOPILAR LOS DATOS DE LAS EMPRESAS.

Todas las respuestas serán tratadas con absoluta confidencialidad. Es de suma importancia para este estudio que las respuestas a las preguntas reflejen la situación REAL en la empresa y NO lo que hubiese deseado.

Si usted tiene cualquier pregunta con relación a este estudio y la encuesta por favor comuníquese con Miguel Maldonado al correo electrónico: <miguel.maldonadob@gmail.com>.

Una vez contestado el cuestionario favor enviarlo al fax: +1 419 844 8957 o al e-mail: <miguel.maldonadob@gmail.com>.

¡Muchas gracias por su colaboración!

Con el fin de hacerle llegar una copia del informe final con los resultados del estudio, le rogamos nos proporcione los datos siguientes:

Empresa: _____

Cargo: _____

País: _____

SECCIÓN A. INFORMACIÓN DE LA EMPRESA

Las siguientes preguntas pretenden obtener información general de su empresa. Por favor complete en los espacios con la respuesta que considere más apropiada para cada pregunta.

1. Por favor indique la naturaleza de su empresa

a. ¿A qué se dedica su empresa? Manufactura ____ Servicios ____ Comercio ____

Giro / Actividad: _____

_____

b. ¿Cuántas sucursales tiene la empresa? N.º: _____

c. ¿Cuál es el tamaño de su empresa?
Número de empleados: _____ Facturación: $_____

d. ¿Cuándo se fundó la empresa? Año: _____

e. ¿Cuántas razones sociales (registro fiscal) tiene la empresa? N.º: _____

SECCIÓN B. PROCESO DE PREIMPLEMENTACIÓN

Las siguientes preguntas pretenden obtener información sobre las razones que motivaron a su empresa a adquirir un ERP.

De los siguientes motivos para la implantación del ERP ¿cuáles considera usted fueron muy importantes y cuáles no fueron importantes según el entorno de su empresa? (Por favor encierre en un círculo el valor que represente su respuesta según los valores propuestos).

	Sin importancia	Neutro			Muy importante
Presión de los clientes	1	2	3	4	5
Reemplazar los sistemas de información anteriores	1	2	3	4	5
Mantenerse a la vanguardia tecnológica	1	2	3	4	5
Simplificar y estandarizar los sistemas	1	2	3	4	5
Mejorar la comunicación y la interacción con proveedores (presión de proveedores)	1	2	3	4	5
Mejorar la comunicación y la interacción con clientes (presión de clientes)	1	2	3	4	5
Apoyar una nueva estrategia empresarial (crecimiento, nuevas líneas de negocio)	1	2	3	4	5
Ligarse y vincularse a actividades/negocios globales	1	2	3	4	5
Presión de otros competidores en la industria y el mercado	1	2	3	4	5
Facilidad para actualizar los sistemas de información en la empresa	1	2	3	4	5
Reestructurar la organización de la empresa	1	2	3	4	5
Falta de control	1	2	3	4	5
Necesidad de mejor información	1	2	3	4	5
Otro _____	1	2	3	4	5
Otro _____	1	2	3	4	5

SECCIÓN C. PROCESO DE IMPLEMENTACIÓN

La presente sección pretende investigar algunos factores relevantes en el proceso de implementación del ERP.

A continuación se le presentan algunas acciones y actividades conducidas comúnmente en los proyectos de implementación de ERP en las empresas. Queremos conocer el nivel de satisfacción que usted experimentó con dichas actividades durante la implementación del ERP en su empresa. (Por favor encierre en un círculo el valor que represente su respuesta según los valores propuestos).

	Nada satisfecho	Neutro			Muy satisfecho
Establecimiento del líder de proyecto de implementación	1	2	3	4	5
Adecuada y suficiente capacitación del *software* ERP	1	2	3	4	5
Rápida y eficiente instalación del *software* ERP en la empresa	1	2	3	4	5
Definición de un Plan de Trabajo realista	1	2	3	4	5
Migración de los datos existentes en la empresa a la nueva plataforma ERP	1	2	3	4	5
Integración eficiente de los procesos de negocio al *software* ERP	1	2	3	4	5
Adecuada y suficiente capacitación sobre gerencia de proyectos ERP	1	2	3	4	5
Claro establecimiento de los recursos necesarios durante la implementación	1	2	3	4	5

SECCIÓN D. SATISFACCIÓN CON EL PROCESO DE IMPLEMENTACIÓN DEL ERP

Las siguientes preguntas pretenden conocer su satisfacción con la implementación del ERP en su empresa.

Por favor encierre en un círculo el valor que represente su respuesta según los valores propuestos.

Con respecto al tiempo real que se tomó la implementación del ERP en su empresa y las expectativas inicialmente planteadas, por favor indique el valor que más se aproxime a su criterio encerrando en un círculo el valor elegido.

El tiempo de implementación resultó muy por debajo de lo esperado		El tiempo de implementación se ajustó a lo esperado		El tiempo de implementación fue muy excedido a lo esperado
1	2	3	4	5

Con respecto al nivel de satisfacción general de su empresa con el proceso de implementación del ERP ¿cómo lo calificaría de acuerdo a la escala que se le presenta? Favor indique el valor que más se aproxime a su criterio encerrando en un círculo el valor elegido.

Nada satisfecho con el proceso de implementación del ERP en la empresa		Ni satisfecho ni insatisfecho con el proceso de implementación del ERP en la empresa		Muy satisfecho con el proceso de implementación del ERP en la empresa
1	2	3	4	5

ESPACIO PARA COMENTARIOS ADICIONALES

Por favor, formule aquí cualesquiera comentarios juzgue pertinentes, ya sea sobre aspectos no cubiertos en este cuestionario, como sobre este cuestionario mismo y/o sobre aspectos de importancia para su sector/segmento.

Muchas gracias por completar este cuestionario. Toda la información proporcionada será manejada de forma estrictamente confidencial.

Americas Conference on Information Systems (AMCIS)

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El Impacto del Adiestramiento, Habilidades en Tecnologia de la Informacion y Gerencia de Proyectos en el Exito de Implementaciones de Sistemas Integrados de Planificacion de Recuersos Empresariales (ERP) en la Pequena ya Mediana Empresa: Una Investigacion Empirica en America Latina

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Oswaldo Lorenzo‡

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†Universidad ESAN

‡Instituto de Empresa Business School

El Impacto del Adiestramiento, Habilidades en Tecnología de la Información y Gerencia de Proyectos en el Éxito de Implementaciones de Sistemas Integrados de Planificación de Recursos Empresariales (ERP) en la Pequeña y Mediana Empresa: Una investigación empírica en América Latina.

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RESUMEN

El análisis del éxito de implementaciones de Sistemas Integrados de Planificación de Recursos Empresariales (ERP por siglas en inglés) es un tópico de creciente interés en la comunidad de Tecnología de Información. La investigación existente se concentra primariamente en metodologías cualitativas aplicadas a las grandes empresas. En esta investigación cuantitativa se presenta un modelo que pretende revelar factores determinantes del éxito en las implementaciones del ERP en la Pequeña y Mediana Empresa. La validación empírica de este modelo aplicado en 15 empresas permitió verificar relaciones significativas entre el Adiestramiento, las Habilidades en Tecnología de la Información existentes y el Éxito, medido en la dimensión del Tiempo de implementación empleado. Se verificó también el impacto del Tiempo de Implementación en la percepción de la Satisfacción Global con dicha implementación. La investigación concluye con recomendaciones a los practicantes, sugiriendo áreas potenciales de investigación inspiradas en un sorprendente resultado colateral obtenido.

Palabras Claves.

Sistemas ERP, Enterprise Resource Planning, Factores Críticos de Éxito, Éxito de los ERP en las Pequeñas y Medianas Empresas, Pymes.

ANTECEDENTES DEL ESTUDIO.

Los Sistemas Integrados de Planificación de los Recursos Empresariales (ERP por sus siglas en inglés) conforman una tipología de Tecnología de la Información que pretende integrar y automatizar los procesos medulares de las organizaciones, incluyendo finanzas, logística, ventas, procesamiento de órdenes, producción y planificación de materiales. Algunos estudios estimaron la inversión de las empresas en las implementaciones del ERP en aproximadamente 300 billones de dólares americanos en la década de los noventa y sólo para el 2004, se estimó que este valor estaría alrededor de 79 billones de dólares americanos (Carlino, Nelson y Smith, 2000), lo cual suministra un punto de referencia acerca de la relevancia actual del tema.

¿Por qué ha surgido, tanto en los académicos como en los practicantes, creciente interés en el análisis de las implementaciones de los ERP? Esencialmente por la presencia de experiencias contrapuestas: éxitos y fracasos. Cuando son implementados y asimilados exitosamente, los beneficios generados por los ERP pueden ser muy relevantes, repercutiendo tanto en las operaciones como en los aspectos estratégicos del negocio (Shang y Seddon, 2000). Hitt, Wu y Zhou (2002) revelaron empíricamente que aquellas organizaciones que han invertido en ERP tienden a exhibir mejores desempeños financieros y mayor valoración de mercado, en comparación a aquellas que no han invertido en este tipo de tecnología de información.

Si bien es cierto que en muchos casos el ERP ha potenciado la ventaja competitiva de las organizaciones, en otros, su implementación ha generado fracasos dramáticos con deterioros irreversibles. Davenport (1998) presentó el fracaso de la compañía FoxMeyer Drugs que atribuyó a la implementación del ERP su posterior bancarrota. Gargeya y Brady (2005) dan una aproximación a la tasa de fracasos y sostienen que el 70% de los proyectos ERP fallan en ser completamente implementados, aún después de 3 años invertidos en su Implementación. Ante tales resultados contradictorios, son múltiples las inquietudes y confusiones que experimentan las empresas que evalúan la adopción de este tipo de tecnología en sus procesos de negocio (Davenport, 1998).

MOTIVACIÓN. PROPÓSITO DE LA INVESTIGACIÓN.

Aún cuando los sistemas ERP fueron inicialmente destinados para abordar las necesidades de las grandes organizaciones, a partir del año 2000 se ha notado un sólido y sostenido crecimiento en las implementaciones de los ERP en el sector de las Pequeñas y Medianas Empresas (Pymes en lo sucesivo) (Van Everdingen,Van Hillegersberg, y Waarts, 2000).

La presente investigación empírica pretende contribuir al limitado conocimiento existente en materia de las implementaciones del ERP en las Pequeñas y Medianas Empresas, mediante el análisis de factores que influyen en un proceso de implementación exitoso del ERP en estas empresas.

Para trabajar sobre un ámbito más preciso, se utilizó una técnica similar a la empleada por Parr, Shanks y Darke (1999), con la cual se solicitó la participación de cinco expertos en el área de implementación de sistemas ERP en América Latina. Se les consultó que identificaran los diez factores que ellos consideraran como los determinantes del éxito en las implementaciones de los sistemas ERP en las Pymes de América Latina. Se les solicitó que los ordenaran de acuerdo a su importancia y se obtuvieron los siguientes tres factores como los más relevantes:

Nivel de Gerencia de Proyecto empleado durante la implementación del ERP: Incluye los recursos, actividades y conocimiento necesario en la coordinación de las acciones y tareas que permitan garantizar el logro de los objetivos que motivaron la implementación del ERP.

Nivel de Adiestramiento durante la implementación del ERP: Incluye las actividades relacionadas con la transferencia de conocimiento acerca las características y funcionalidades del nuevo Sistema ERP en los grupos de usuarios, con la finalidad de incrementar el nivel de pericia y conocimiento asociado. Contempla también el adiestramiento del equipo de implementación sobre prácticas en como administrar el proyecto.

Nivel de Habilidades en Tecnología de la Información presentes en la empresa: Incluye las capacidades para configurar y mantener técnicamente el Sistema ERP de tal manera que cumpla con los requerimientos del negocio.

Los expertos coincidieron en que estos factores impactan en el éxito de las implementaciones. Se hizo énfasis en el tiempo de implementación empleado como uno de los criterios como las Pymes pueden percibir el éxito de tales implementaciones.

El análisis del impacto de los tres factores anteriormente mencionados en las implementaciones del los sistemas ERP en las Pymes de América Latina, forjaron la motivación de la presente investigación.

Preguntas de Investigación.

La presente investigación pretende abordar las siguientes preguntas de investigación:

¿Existe relación entre la gerencia de proyecto, el adiestramiento y las capacidades de tecnología de información de la empresa con un tiempo de implementación exitoso en los proyectos de adopción de ERP en las Pymes?

¿Existe relación entre el tiempo de implementación ejecutado del ERP y la satisfacción con el proceso de implementación del ERP en las Pymes?

MARCO TEÓRICO. HIPÓTESIS.

Tiempo de Implementación ejecutado del ERP.

Bajwa, Garcia, y Mooney (2004) sostienen que el proceso de implementación del ERP comprometen las operaciones normales del negocio así como los recursos disponibles. Por lo tanto, el tiempo de implementación es un factor crítico a considerar. Los resultados en este sentido son muy variados y en algunos casos desalentadores. Bajwa et al. (2004) mencionan que un estudio ha reportado que el 35% de las implementaciones de los ERP ha sido cancelada, el 55% de las implementaciones de los ERP ha incurrido en excesos de tiempo y sólo el 10% ha sido completada en el tiempo previsto.

Hitt et al. (2002) sostienen que las implementaciones de los ERP son conocidas por ser muy complejas y difíciles. Para grandes empresas, algunos estudios han estimado que la implementación puede tomar entre 1 a 3 años, con beneficios tangibles percibidos, en promedio, a los 31 meses posterior a la implementación (McAfee, 1999). Parte de la dificultad radica en los cambios asociados con el ERP, en la necesidad de revaluar los procesos de las organizaciones, y el nivel en que deban adaptarse los procesos a la capacidad del sistema. Esta complejidad induce diversos riesgos que potencialmente atentan contra el tiempo de implementación originalmente planificado. Mayor tiempo en implementación a su vez impacta en mayores costos asociados y por ende, esto atenta directamente en el nivel de satisfacción con el proceso de implementación del ERP. Dicho impacto debe repercutir, dadas las limitaciones mencionadas anteriormente, con mayor intensidad en las Pymes.

De estos argumentos surge la siguiente hipótesis:

H1:	En una implementación de ERP en la Pyme, el tiempo de implementación empleado y el nivel de satisfacción con dicha implementación, están negativamente relacionados.

Gerencia de Proyecto durante la implementación del ERP.

Ahituv, Neumann, y Zviran (2002) sostienen que la definición del ámbito del proyecto, una clara determinación de los recursos necesarios en el equipo de proyecto y un plan detallado son actividades fundamentales que se deben considerar en una fase de preparación de la gerencia de proyecto en una implementación de un ERP. Holland, Light, y Gibson (1999) sostienen que una definición precisa del alcance de proyecto plasmado en un plan de implementación claro debe ser establecido como pilar de la gerencia del proyecto. Boehm (1991) había anticipado también la importancia de contar con planes realistas dentro de la gerencia de proyecto como factor de éxito en cualquier proyecto de implementación de tecnología de información.

Con respecto al líder del proyecto, Nah, Zuckweiler y Lau (2003) sostienen que este rol es aún más importante en las implementaciones de ERP en comparación con cualquier otra tecnología de información, porque el ERP requiere de gran compromiso organizacional. Jiang, Klein y Balloun (1996) sostienen que la designación de un gerente de proyecto competente es el segundo factor más importante para cualquier implementación de tecnología de información. Jiang, Klien y Discenza (2002) han recopilado evidencia empírica que ratifica el desempeño del gerente de proyecto como factor crítico en las implementaciones de proyectos de Tecnología de Información.

Nah et al. (2003) sostienen que la gerencia de proyecto es esencial en las implementaciones de los ERP, pues es un factor que permitirá el logro de los objetivos en términos de tiempo y presupuesto.

De estos argumentos surge la siguiente hipótesis:

H2:	En una implementación de ERP en la Pyme, el nivel de Gerencia del Proyecto aplicado y el tiempo de implementación empleado, están negativamente relacionados.

Adiestramiento durante la implementación del ERP.

Diversos investigadores han coincidido en la importancia de suministrar adiestramiento formal a los usuarios finales como parte del proyecto de implementación del ERP (Bingi, Sharma y Godla, 1999; Holland et al., 1999; Roberts y Barrar, 1992; Shanks, Parr, Hu, Corbitt, Thanasankit, y Seddon, 2000). Este adiestramiento ayudará a los usuarios a entender el sistema y también a vislumbrar como sus tareas deben ser adaptadas y llevabas a cabo en lo sucesivo.

Sumner (1999) sostiene que, adicional al entrenamiento de los usuarios finales, es fundamental la capacitación en los temas técnicos propios de la tecnología del ERP, así como el adiestramiento para el equipo de implementación en temas de metodología y de gerencia de proyecto.

Roberts et al. (1992) y Mainwaring (1999) sostienen que el adiestramiento debería ser una actividad que se ejecute desde el mismo inicio del proyecto de implementación, pues a través de esta vía los involucrados podrán contribuir de forma más efectiva y eficiente en la adaptación de los procesos de negocio al sistema, acelerando así el proceso de implementación.

De estos argumentos surge la siguiente hipótesis:

H3:	En una implementación de ERP en la Pyme, el nivel de Adiestramiento ejecutado y el tiempo de implementación empleado, están negativamente relacionados.

Habilidades de Tecnología de la Información presentes en la empresa.

Bajwa et al. (2004) sostienen que las capacidades y habilidades técnicas del equipo que lidera la implementación constituyen un factor fundamental.

Nah et al. (2003) sostienen que las empresas deberían estar dispuestas a aceptar las mejores prácticas que vienen incluidas con el software, y modelar sus procesos de negocio acorde a estas prácticas, con la finalidad de hacer más eficiente el proceso de implementación del ERP. Autores como Bingi et al. (1999), Holland et al. (1999), Murray y Coffin (2001), y Shanks et al. (2000) sostienen que el ERP debería ser instalado rápidamente y eficientemente modificado y que las empresas deberían estar dispuestas a adaptar sus procesos de negocio a las prácticas incorporadas en el ERP para explotar todas sus ventajas y ejecutar el proceso de implementación en el menor tiempo posible.

Markus, Axline, Petrie y Tanis (2000) destacan, dentro de los temas propios de tecnología de la información involucrados en una implementación del ERP, la importancia de la depuración de datos y de una migración ordenada de los datos existentes al nuevo sistema. Estas tareas relacionadas con la calidad de los datos existentes pueden ser subestimadas y merecen una atención especial con la finalidad de evitar retrasos dramáticos en el proceso de implementación.

De estos argumentos surge la siguiente hipótesis:

H4:	En una implementación de ERP en la Pyme, el nivel de habilidades de tecnología de información presentes en la empresa, y el tiempo de implementación empleado están negativamente relacionados.

Modelo de Investigación.

El modelo de investigación propuesto en la presente investigación se resume en la Figura 1.

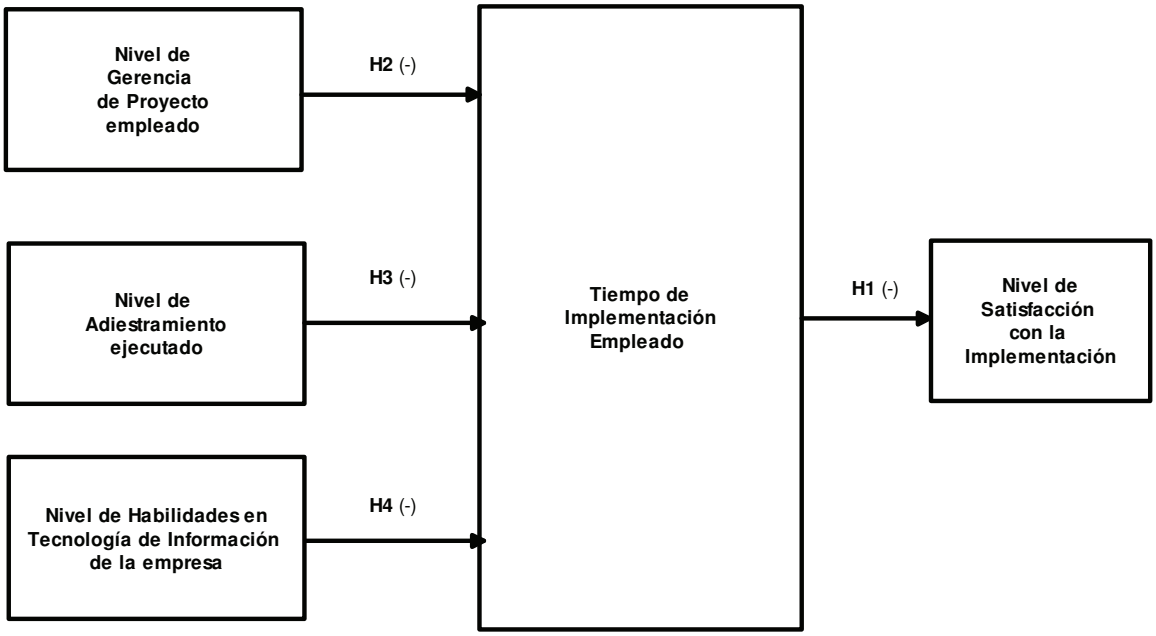

Figura 1.

METODOLOGÍA.

La presente investigación adoptó una perspectiva empírica y cuantitativa orientada a verificar hipótesis y por ende, relaciones propuestas entre variables. Se siguió una estrategia de investigación tipo Encuesta (Survey). La investigación recopiló los datos en un instante particular de tiempo en una muestra de Pymes (estudio "cross-sectional"). Un cuestionario se diseñó para facilitar la recolección de información de la muestra seleccionada. La unidad de análisis en esta investigación fue la empresa.

Descripción de la muestra.

El universo seleccionado pertenece al conjunto de Pymes que han implementado un ERP perteneciente a un proveedor líder en América Latina. Vale destacar que la definición de empresas Pymes de tal proveedor coincide con las especificadas tanto por Zevallos (2003) como por Boggs, Converso, Koch, Gibin, Lee y Sandler (2007), donde se definen estas como las empresas que constan de hasta 500 empleados.

Este universo contaba con 52 empresas que habían implementado dicho ERP y estaban en estado productivo por más de un año. Estas empresas estaban ubicadas en diferentes países de América Latina, incluyendo México, Guatemala, Costa Rica, Perú y el Caribe. Se seleccionó, de forma aleatoria, una muestra de 40 empresas. Con las restantes 12 empresas que no fueron seleccionadas aleatoriamente, se procedió a hacer una prueba piloto del cuestionario para asegurar la correcta interpretación del mismo. Este piloto se realizó telefónicamente y las 5 empresas que participaron propusieron mejoras que fueron incluidas en el instrumento.

La invitación a participar en el estudio fue enviada al dueño/director general de la organización a través de correo electrónico, mediante una comunicación que clarificaba también la naturaleza voluntaria, el objetivo del estudio, los beneficios del mismo, y el compromiso de confidencialidad de la información. La encuesta formaba parte de la comunicación. Se hizo un recordatorio de la invitación y el período de colección de las mismas tardó dos meses.

La muestra final abarcó 15 empresas, con lo que se obtuvo una tasa final de participación del 38%.

El no-sesgo de las empresas que no respondieron se verificó de la siguiente manera: Después de la recolección de la última encuesta en el tiempo fijado de los dos meses, se separaron los registros de las empresas que respondieron de las que no respondieron. Aplicando pruebas t que comparaban tres variables demográficas entre el grupo que respondieron y los que no respondieron, no se encontraron diferencias significativas entre ellos: Número de Empleados de la Empresa (t=-1.42, p=0.16), Años de la Empresa en el Mercado (t=1.43, p=0.16), Facturación Anual de la Empresa (t=0.30, p=0.76). Se asumió de está forma que el sesgo de las empresas que no respondieron no era evidente.

Operacionalización de las Variables.

Tiempo de Implementación empleado en el ERP.

Inicialmente se planteó utilizar como métrica de este constructo la duración en semanas del tiempo de implementación. Pero dado que las implementaciones de ERP pueden variar por empresas de acuerdo a los objetivos establecidos, se decidió que esta medición podría originar confusiones en la interpretación y que no necesariamente permitiría establecer comparaciones equivalentes entre organizaciones (no todas las empresas deciden implementar todos y los mismos procesos de negocio en el ERP). Se decidió entonces utilizar un ítem con una escala tipo Semántica Diferencial (Babbie, 1990), donde se preguntaba sobre el resultado en Tiempo de Implementación empleado con respecto a las expectativas iniciales. Los participantes respondieron de acuerdo a la escala que iba de 1 ("El Tiempo de Implementación fue muy por debajo a lo esperado") a 5 ("El Tiempo de Implementación fue muy excedido a lo esperado)". Esta alternativa coincide con lo utilizado por Reinartz, Krafft y Hoyer (2004) bajo el entendimiento del uso de una medida perceptual del constructo.

Nivel de Satisfacción con la Implementación del ERP.

Se utilizó un ítem con una escala tipo Semántica Diferencial (Babbie, 1990), donde se preguntaba sobre el nivel de Satisfacción General con la implementación del ERP en la empresa. Los participantes respondieron de acuerdo a la escala que iba de 1 ("Nada Satisfecho con la Implementación del ERP") a 5 ("Muy Satisfecho con la Implementación del ERP"). Esta alternativa coincide con lo utilizado por Reinartz et al. (2004) bajo el entendimiento del uso de una medida perceptual del constructo.

Nivel de Gerencia de Proyecto durante la implementación del ERP.

Se utilizó una medida de 3-items basada en Nah et al. (2003) con una escala tipo Semántica Diferencial (Babbie, 1990):

Ítems empleados para el Nivel de Gerencia de Proyecto.
Claro establecimiento de los recursos necesarios para la implementación
Definición de un Plan de Trabajo Realista
Establecimiento del Líder de Proyecto.

Los ítems mostraron una buena confiabilidad (α = 0.92). Estos ítems luego se promediaron para generar el factor correspondiente.

Nivel de Adiestramiento durante la implementación del ERP.

Se utilizó una medida de 2-items basada en Nah et al. (2003) y Holland et al. (1999) con una escala tipo Semántica Diferencial (Babbie, 1990):

Ítems empleados para el Nivel de Adiestramiento
Adecuada y Suficiente capacitación en la administración del proyecto.
Adecuada y Suficiente capacitación en la utilización del Software ERP.

Los ítems mostraron una buena confiabilidad (α = 0.70). Estos ítems luego se promediaron para generar el factor correspondiente.

Habilidades de Tecnología de la Información presentes en la empresa.

Se utilizó una medida de 3-items basada en Nah et al. (2003) y Markus et al. (2000) con una escala tipo Semántica Diferencial (Babbie, 1990):

Ítems empleados para el Nivel de Habilidades de Tecnología de la Información.
Rápida y Eficiente Instalación e Inicialización del Software ERP
Migración de Datos al Software ERP de manera ordenada
Integración de Procesos del Negocio al Software ERP realizada eficientemente

Los ítems mostraron un nivel de confiabilidad por debajo de los límites estándares sugeridos (α = 0.52). Estos ítems luego se promediaron para generar el factor correspondiente.

Vale destacar que la operacionalización de las variables fue revisada con expertos de implementación de sistemas ERP en América Latina previo a la verificación estadística correspondiente.

RESULTADOS.

Con respecto a las características demográficas de las empresas entrevistadas, el perfil es el siguiente:

El 62% de las empresas entrevistadas cuenta con menos de 100 empleados. El 31% de las empresas entrevistadas cuenta con menos de 50 empleados. La empresa entrevistada con menos empleados tiene 12 empleados. En cuanto a las ventas anuales, el promedio es de US$ 9.000.000,oo. La empresa con menos ingresos vende alrededor de US$ 130.000,oo. En cuanto a los años en el mercado, el promedio de las empresas es de 15 años. La empresa con menos tiempo en el mercado tiene 3 años y la que más tiempo tiene cuenta con 58 años. En cuanto a los sectores a las cuales pertenecen las empresas, el 37% pertenece al sector de manufactura, el 25% al sector servicios y el 38% al sector de retail.

El análisis de la correlación entre las variables Nivel de Gerencia de Proyecto (FACPROMGM), Nivel de Adiestramiento (FACTRAINING), Habilidades de Tecnología de Información (FACIT), Tiempo de Implementación (RESULTADOTIEMPO) y Nivel de Satisfacción con la Implementación del ERP (SATISFIMPLEMENT) se presenta en la Tabla 1.

Pearson Correlation Coefficients, N = 15 Prob > |r| under H0: Rho=0					
	FACPROMGM	FACTRAINING	FACIT	RESULTADOTIEMPO	SATISFIMPLEMENT
FACPROMGM	1.00000	0.70655	0.57207	-0.17500	0.34426
FACPROMGM		0.0032	0.0259	0.5327	0.2089
FACTRAINING	0.70655	1.00000	0.42366	-0.49030	0.28870
FACTRAINING	0.0032		0.1156	0.0635	0.2967
FACIT	0.57207	0.42366	1.00000	-0.48999	0.73311
FACIT	0.0259	0.1156		0.0637	0.0019
RESULTADOTIEMPO	-0.17500	-0.49030	-0.48999	1.00000	-0.52329
RESULTADOTIEMPO	0.5327	0.0635	0.0637		0.0453
SATISFIMPLEMENT	0.34426	0.28870	0.73311	-0.52329	1.00000
SATISFIMPLEMENT	0.2089	0.2967	0.0019	0.0453	

Tabla 1.

La verificación de las hipótesis se realizó mediante el análisis de regresión lineal múltiple.

La Tabla 2 reporta los resultados del análisis de regresión cuando la variable dependiente es "Tiempo de Implementación empleado" y las variables independientes son "Nivel de Gerencia de Proyecto Empleado" (FACPROMGM), "Nivel de Adiestramiento Ejecutado" (FACTRAINING) y "Nivel de Habilidades en Tecnología de la Información de la empresa" (FACIT). Los supuestos estadísticos subyacentes fueron validados y se corroboró que no se puede rechazar el supuesto de normalidad de los residuos mediante el análisis del gráfico de probabilidad normal y test Kolmogorov-Smirnov (D = 0.165, p-Valor = > 0.15). Tampoco se pudo rechazar el supuesto de independencia de errores mediante la aplicación del test Durbin-Watson (D = 2.47).

Parameter Estimates								
Variable	**Label**	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Tolerance**	**Variance Inflation**
Intercept	Intercept	1	5.62287	1.00799	5.58	0.0002	.	0
FACPROMGM	FACPROMGM	1	0.65645	0.33484	1.96	0.0758	0.41013	2.43827
FACTRAINING	FACTRAINING	1	-0.64135	0.26966	-2.38	0.0366	0.50022	1.99912
FACIT	FACIT	1	-0.67126	0.30948	-2.17	0.0529	0.67198	1.48814

Nota: $R^2 = 0.50$ $p < 0.05$.

Tabla 2.

Con respecto al "Nivel de Adiestramiento Ejecutado", **los resultados corroboran la hipótesis H3**, donde se verifica una relación negativa con el "Tiempo de Implementación empleado" ($\beta = -0.64135$, $p < 0.05$).

Con respecto al "Nivel de Habilidades en Tecnología de la Información de la empresa", **los resultados corroboran la hipótesis H4**, donde se verifica una relación negativa con el "Tiempo de Implementación empleado" ($\beta = -0.67126$, $p < 0.10$).

Con respecto al "Nivel de Gerencia de Proyecto Empleado", sorprendentemente, y contrario a como fue establecido originalmente con la hipótesis H2, se verifica una relación positiva con el "Tiempo de Implementación empleado" ($\beta = 0.65645$, $p < 0.10$). En tal sentido, **la hipótesis H2 no se corrobora**.

Observando en la Tabla 1, la correlación entre "Nivel de Satisfacción con la Implementación del ERP" (SATISFIMPLEMENT) y "Tiempo de Implementación empleado" (RESULTADOTIEMPO) se deriva que **los resultados obtenidos corroboran la hipótesis H1**, donde se verifica la relación negativa entre estas variables ($\beta = -0.52329$, $p < 0.05$).

Análisis.

La presente investigación contribuye con el conocimiento de los factores que pueden determinar el éxito en las implementaciones del ERP en el área de las Pymes. Se concentró el interés en estudiar variables que pueden incidir directamente en el tiempo de implementación empleado, lo cual conforma una dimensión fundamental que todas las empresas, pero en especial las Pymes por sus estrechas limitaciones, precisan entender y controlar (Shehab, Sharp, Supramaniam, y Spedding, 2004).

Los resultados obtenidos corroboran la importancia de que las Pymes cuenten con sólidas habilidades en materia de Tecnología de Información a la hora de emprender un proyecto de implementación de ERP. Si bien es cierto que este tipo de proyectos requieren capacidades estratégicas y de negocios, no deben descuidarse las capacidades en materia de tecnología de información que pueden marcar la diferencia (Holland et al, 1999; Markus et al., 2000). De no contar la Pyme con el conocimiento técnico requerido, será necesario emplear un tiempo adicional en reclutamiento, adiestramiento y puesta en marcha para disponer de estas habilidades, lo que inevitablemente incurrirá en un mayor tiempo necesario para activar el ERP.

Con respecto al Nivel de Adiestramiento, se verifica la importancia de ejecutar una transferencia de conocimiento desde el mismo inicio de la implementación, tanto al equipo de proyecto, como a los usuarios involucrados. Esto facilita la asimilación eficaz de, no sólo las capacidades y limitaciones del sistema ERP, sino también de alternativas eficientes para adaptar los procesos de negocio a la nueva plataforma. El temprano conocimiento de las características y funcionalidades del sistema permitirá crear ágiles alternativas cuando surjan obstáculos en el proceso de implementación, pudiendo acortar así los tiempos involucrados.

Con respecto al Nivel de Gerencia de Proyecto Empleado, resultó sorpresiva la relación positiva y significativa obtenida con el "Tiempo de Implementación empleado", contrario al sentido que se había establecido en la hipótesis. Este resultado podría tener dos análisis: Una posible explicación para este hallazgo puede estar relacionado con lo acotado por Yen, Chou y Chang (2002) quienes indican que las Pymes por lo general, no están acostumbradas a enfrentar estos proyectos de gran envergadura. En la mayoría de los casos, no están adiestradas en el uso metodologías y revisiones minuciosas de procesos de negocio. Es usual que tampoco cuenten con documentación de tales procesos. En estos casos, para cumplir con la metodología estricta que puede requerir la gerencia de estos proyectos, puede incurrirse en mucho trabajo adicional en analizar y documentar los procesos de negocio que deben implementarse. Esto indefectiblemente impacta en el tiempo requerido para alcanzar la implementación. Por otra parte, la gerencia de proyectos disciplinada, debe garantizar que el equipo del proyecto siempre esté enfocado en el proceso. Dadas las limitaciones de recursos que experimentan las Pymes, es usual que un mismo empleado desempeñe varios roles. Por lo general, los empleados también comparten sus labores tradicionales con el proceso de implementación. Es muy probable que en muchos casos el día a día absorba el tiempo que los empleados tienen disponible para el proyecto, y en este sentido, una gerencia de proyecto disciplinada, no culminará las tareas correspondientes hasta contar con el apoyo y validación de los recursos respectivos. Esto ocasionará retrasos en el tiempo de implementación. Marsh (2000) resume esta perspectiva y argumenta que la poca experiencia de la empresa en afrontar proyectos de escala similar en tecnología de información puede impactar el proceso de implementación del ERP. Otro posible vía de análisis puede conducirnos a la manera restringida como se operacionalizó la variable "Nivel de Gerencia de Proyecto Empleado".

Vale destacar que Soja (2006) sostiene, mediante su estudio cuantitativo, que mientras mayor es la duración de los proyectos y mayor el tamaño de la empresa, mayor es el impacto de factores inmersos en la gerencia de proyectos tales como la definición de un cronograma detallado y clara especificación de los objetivos del proyecto. Soja (2006) sostiene también que hay factores que pueden ser sobreestimados por los expertos y destaca explícitamente el factor de "Líder de Proyecto", el cual es considerado como uno de los criterios más importantes por los expertos, pero, en sus resultados empíricos, obtuvo que este factor no tiene influencia significativa en el éxito de la implementación. Los resultados de la presente investigación

parecen inclinarse más con los hallazgos similares obtenidos por Soja (2006) y por ende con la primera vía de análisis anteriormente presentada.

Finalmente, se verifica también que para las Pymes el tiempo de implementación empleado incide en la satisfacción general con el proceso, consistente con lo introducido por Zviran, Pliskin y Levin (2005), quienes resaltaron la importancia de la dimensión Tiempo como un determinante de la Satisfacción. Considerando limitaciones que enfrentan las Pymes presentadas por Yen et al. (2002), se desprende entonces que implementaciones de ERP que involucren menores tiempos a los esperados definitivamente exhibirán un mayor nivel de satisfacción.

Limitaciones de la Investigación.

Existen razones para ser cautelosos con la generalización de los resultados de la presente investigación. Primero, las empresas analizadas se ubican en el contexto latinoamericano. Los hallazgos aquí encontrados pudieran no ser aplicables a otras latitudes. Segundo, la muestra de empresas que respondieron el cuestionario todavía es limitada y la generalización y potencia estadística subyacente pudieran verse cuestionadas, según lo acotado por Baroudi y Orlikowski (1989). Esta muestra limitada quizás es la causa también de la frágil confiabilidad obtenida del factor "Nivel de Habilidades de Tecnología de la Información". Tercero, el éxito de la implementación del ERP se midió considerando el "Tiempo de Implementación" con respecto a las expectativas iniciales. Otras dimensiones importantes del éxito quedaron fuera del alcance de la presente investigación. Cuarto, la muestra se focalizó en Pymes que habían implementado el ERP de un proveedor en particular. Aún cuando las implementaciones fueron realizadas por empresas consultores diferentes, no se consideraron empresas que habían implementado el software ERP de otros proveedores. En todo caso, el hecho de analizar el mismo software ERP ayudó a controlar el contexto y establecer comparaciones homogéneas.

Una limitación adicional en la presente investigación estuvo relacionada con los constructos y mediciones involucradas. No se encontraron prácticamente referencias de trabajos empíricos previos, muy en línea con lo mencionado por autores como Kumar, Maheshwari y Kumar (2002), quienes sostienen que existe poca investigación empírica conducida referente a los obstáculos en la adopción de los ERP en las organizaciones. En tal sentido, las mediciones propuestas en la presente investigación están sujetas a mejoras y ampliaciones. Un candidato directo para esta mejora lo constituye la operacionalización de la variable "Nivel de Satisfacción con la implementación del ERP". Por otra parte, Dorantes y Rao (2006) proveen un marco conceptual que puede enriquecer, en futuras investigaciones, la operacionalización de la variable "Habilidades de Tecnología de la Información presentes en la empresa".

CONCLUSIONES.

Implicaciones para los practicantes.

A pesar de las limitaciones que la presente investigación afronta, el estudio demuestra importantes lecciones que deben ser consideradas por las Pymes que están evaluando la posibilidad de implementar un ERP. Debe darse una prioridad sobresaliente al tema de **Adiestramiento** a los miembros del equipo de proyecto, tanto en los temas de Gerencia de Proyecto, como en los temas propios de conocimiento del sistema de ERP, desde el mismo comienzo. Dadas las restricciones de las Pymes, existe el motivador de minimizar el presupuesto y por lo general, el adiestramiento, constituye una de las líneas candidatas para cualquier reducción. El presente estudio contribuye a reforzar la importancia del adiestramiento y el riesgo que puede ocasionar, tanto en el tiempo como en la posterior satisfacción, cualquier reducción en esta materia. ¡No escatime en el Adiestramiento!

También es muy importante que las Pymes reflexionen sobre las **capacidades** existentes, "puertas adentro", **en materia de tecnología de información**. Debe existir certeza de contar con el inventario de estas habilidades que facilitarán el proceso de implementación. De no disponer de tales habilidades, los hallazgos del presente estudio sugieren que la Pyme evalúe prudentemente la postergación del proceso de implementación.

Contribuciones del estudio y futuras áreas de investigación.

Tal como fue acotado por Hitt et al. (2002), la mayor parte de la investigación de los ERP ha sido llevada a cabo principalmente a través de casos de estudio, y encuestas a nivel de industrias. La investigación existente ha sido mayormente dirigida al segmento de las grandes empresas y corporaciones (Shehab et al., 2004).

El presente estudio pretende aportar nuevas luces considerando tales brechas y en tal sentido se concentró en el análisis de las Pymes, con una investigación empírica a través de encuestas de empresas pertenecientes a diversas industrias e incluso múltiples geografías. Esto toma mayor relevancia si se considera que en muchos países las Pymes constituyen el motor de la economía (Shehab et al., 2004). América Latina no escapa a esta realidad y en ese sentido, el presente estudio también contribuye en esa dirección, dado que a la fecha no se encontraron investigaciones abordando el contexto latinoamericano.

Shehab et al. (2004) sostienen que pueden existir diferencias en las implementaciones de ERP por parte de las Pymes en comparación con las grandes empresas. Incluso motiva a investigar en esta dirección. El hallazgo encontrado en la presente investigación relacionado con el tópico de "Gerencia de Proyecto" puede ser un ejemplo de estas diferencias y en este sentido se reitera la invitación de Shehab et al. (2004) de seguir investigando con profundidad en el segmento de las Pymes para consolidar mayor entendimiento y poder establecer comparaciones pertinentes con las grandes empresas.

La presente investigación se concentró principalmente en el análisis del tiempo de implementación ejecutado en comparación a las expectativas iniciales como una de las dimensiones del éxito del proyecto. Definitivamente existen otras dimensiones que contribuyen al éxito y que deben profundizarse en investigaciones posteriores. Establecer constructos subyacentes de tales dimensiones ya generaría un aporte fundamental para el desarrollo de investigaciones sucesivas.

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