

COMPLEX INFORMATION TECHNOLOGY USAGE: TOWARD HIGHER LEVELS  
THROUGH EXPLORATORY USE –THE ERP SYSTEMS CASE

by

RUI MANUEL DINIS DE SOUSA

(Under the Direction of Dale Louis Goodhue)

ABSTRACT

Complex information technology often remains under-utilized following implementation. As a result, potentially powerful tools may deliver only limited benefits. These limited benefits may not compensate for what is usually a costly and difficult implementation process. One way for organizations to move from superficial to more comprehensive usage is to get users to go beyond the basic capabilities of the system and uncover new ways of using it, either on their own or helped by others, i.e., through exploratory use.

This study focuses on ERP systems as an example of complex IT. Building from the Theory of Planned Behavior (TPB), sets of salient behavioral, normative, and control beliefs are identified as determinants of the intention to explore. To engage in the exploratory use of complex technologies, users will likely need to overcome significant knowledge and motivational barriers. Thus, key knowledge and motivational factors are hypothesized to impact

intention to explore and exploratory use through the previous identified sets of beliefs. Hypothesis testing is performed with structural equation modeling, using data collected through a cross-sectional field survey of ERP users.

Based on the empirical findings, users intend to engage in exploratory use because they recognize first the potential benefits (perceived usefulness of exploratory use), they feel the pressure (subjective norm), and have confidence on their abilities (specific computer self-efficacy for exploratory use) to do it. These abilities come from knowing how to use the system (procedural knowledge) and how the different parts of the system work together to accomplish organizational tasks (application conceptual knowledge). Among the different types of knowledge, application conceptual knowledge is the major contributor to better understanding of the usefulness in exploring the system, which emerged as the strongest direct determinant of intention to explore. Perceived risk of exploratory use, perceived ease of exploratory use, resource facilitating conditions, business context knowledge and psychological ownership are the constructs that did not operate as expected and call for further research. Management attention is called particularly to the development of application conceptual knowledge so users can be on their own while exploring complex IT to get the most benefits out of it.

**INDEX WORDS:** Complex Information Technology Usage, Exploratory Use, Theory of Planned Behavior, Perceived Risk of Exploratory Use, Business Context Knowledge, Application Conceptual Knowledge, Procedural Knowledge, Motivation, Psychological Ownership, ERP Systems

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DEDICATION

To my family

Fátima, my lovely wife

Diogo Fernando and Afonso Guilherme, my adorable kids

and

Adão and Donzília, my beloved parents

Celeste, my dear sister

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## CHAPTER

### 1 INTRODUCTION

Information technology is becoming more pervasive and complex at the workplace. The access to Information Technology and Communications is now relatively easy. In addition, for the same amount invested before, organizations are getting now more powerful IT equipment and software applications. However, many years of growing IT investments have resulted in the proliferation of many IT islands that can prevent organizations from remaining competitive.

To survive in a highly competitive environment, organizations need to integrate different areas in the organization to get the right information to quickly answer changes in demand. To deal with the high diversity and huge amounts of data and strong interdependences among processes and data, software applications are now more complex. Supply Chain Management (SCM), Customer Relationship Management (CRM), or Enterprise Resource Planning (ERP) systems are good examples of that complexity.

Given the proliferation, complexity, and high rate of change in IT investments, it is not surprising that much of that IT could remain under-utilized and organizations still struggle to prove the value of their massive investments in IT. That is the case of ERP systems.

Now that most large companies have ERP implemented, they are trying to realize benefits and organizing to expand them in the future (Swanton 2004).

## 1.1 Complex Information Technology

Complex is an adjective that is hard to define given its several uses both formally and informally in our everyday life. A commonsense definition would associate something being complex with being difficult to understand. Since individuals differ in the abilities and skills they use to understand the world, one may expect that an information technology classified as complex may intuitively be seen as simple by one individual and complex by another. This suggests the following questions: Does complexity exist only in the observer's eyes? Is complexity subjective?

Besides considering how differently individuals may perceive complexity, one should also consider what type of phenomenon is under observation. Depending on the phenomenon, object or system observed, a different definition for complexity may be formulated –a vague definition may be useless, a restricted definition may only be applicable to a particular domain. At least 31 definitions of complexity have already been proposed (Horgan 1995) making it even more difficult to achieve a well-defined concept for complexity. The efforts in achieving a “unified theory” of complexity have been so far unsuccessful (Yates 1978; Horgan 1995). However, despite the many different concepts for complexity, is there anything fundamental to all those concepts? Is there an “objective” core to the many concepts of complexity?

The term complex comes from the word *complexus* meaning in Latin “embrace”, “entwined” or “twisted together”. The Longman Dictionary of American English defines complex as 1) consisting of many closely connected parts or processes, and 2) full of small details, and therefore difficult to understand or explore. This commonsense definition from the dictionary calls to consideration both subjective and objective components for the concept of complexity.

The first meaning for complexity in the dictionary leads to the identification of two “objective” properties of complexity: distinction and connection. On one hand, there are parts, and thus there is distinction; on the other hand, the parts are closely connected, and thus there is connection. Distinction leads to variety, heterogeneity, different behaviors, or “disorder”. Connection leads to constraint, interdependence, or “order”. Complexity exists when distinction and connection, both the properties, are present –a midpoint between disorder and order (Horgan 1995; Heylighen 1996; McElroy 2003). Consequently, the more distinct (more parts) and more connected (more interdependence) are the parts, the more complex is the system. As defined by the philosopher (Bunge 1963), “An object belongs to a degree of complexity higher than another, if and only the number of its constituents, and consequently the number of its interrelations is larger than both the number of elements and mutual relations of the objects belonging to a lower degree”. Given this shared understanding, the core, objective properties of complexity are the number of parts and the number and strength of the interrelations among the parts. To these two properties, Yates (1978) adds nonlinearity (unstable models), broken symmetry (no part can provide sufficient information to predict the properties of other parts), and nonholonomic constraint (transient anarchy in a system), considering that complexity exists when one or more of the five properties is present.

The second meaning for complexity in the dictionary relates to the number of details in the system that makes the system difficult to understand. Since the number of details perceived in a system differs from individual to individual, the higher the number of details (parts) an individual can distinguish in a system, the more complex will be the system perceived. Although there is a subjective component to what parts of the system are perceived by an individual, there

is also an underlying objective complexity determined by the degree of interdependence among the parts.

Reflecting this objective and subjective components for complexity, Flood and Carson (1988) decompose complexity in two components, a systems component and a people component. The systems component refers to the number of parts as well as the number of relations between the parts that was further expanded to address the remaining three properties from Yates (1978). The people component refers to interests, capabilities and notions/perceptions.

On another perspective, Cramer (1993) decomposes complexity into a static and a dynamic components. The static complexity is intrinsic to the structure while the dynamic complexity is imposed on the static complexity through changes in time and space. Drawing upon this perspective, Schneberger (1995) adds rate of change to the previous systems component definition (Flood and Carson 1988). Thus, Schneberger (1995) characterizes computing complexity by “the number and variety of components and their interactions, and their rate of change (p.28)”. Since the dynamic of changes in information technology is high, it seems reasonable to incorporate that property of complexity when addressing information technology as the object of interest.

Taking into consideration both objective and subjective components of complexity, a psychological construct (Yates 1978), and departing from Schneberger (1995)’s definition of complexity in the IT domain, information technology complexity is defined in this study *by characteristics of the system itself (the number and variety of components, the number and strength of interactions, their combined rate of change) and by individuals’ perceptions of the system (difficulty in understanding the technology).*

Among many systems in the IT domain, ERP systems emerge as a good candidate to be defined as complex information technology. ERP systems are made of a large and diverse numbers of parts tightly interconnected and have been pointed out as difficult to understand. Thus, this research will look into ERP systems as an instance of complex information technology.

## **1.2 ERP Systems**

An Enterprise Resource Planning (ERP) system is defined as “a packaged software solution that seeks to integrate the complete range of a business’ processes and functions in order to present a holistic view of the business from a single information and IT architecture” (Klaus, Rosemann et al. 2000).

An ERP system is commercial package software entirely developed by a single vendor to be implemented in multiple industries in various countries. It is a standard solution with an organization-wide scope that offers a highly comprehensive functionality. Before it can be used, the package software has to be tailored to the specific requirements of each organization. In many cases, this generic application software has already been configured to a specific industry such as automotive, banking or chemicals and then offered as a pre-configured template by the ERP vendor. Standard processes and data definitions are embedded in the ERP system as “best practices” in the business.

At the core of the ERP system is the concept of integration of data and business processes across all organizational functions especially between the accounting (e.g., financial, controlling functions) and logistics (e.g., materials management, production, sales and distribution functions) areas. This integration is accomplished by a set of application modules that work tightly together using a common underlying database. This IT architecture accessed through a

uniform graphical interface across all areas gives the impression of a single application that provides a holistic view of the business.

Although this integration might be achieved by developing an enterprise system in-house, the task would seem infeasible for most organizations. The complexity and time to accomplish such a project turn the acquisition of a ready to implement package a more attractive alternative, even when some customization is required. Furthermore, the organization may benefit from the best practices in the business already embedded in the package by incorporating them into its work systems.

### ***1.2.1 ERP: an evolving concept***

The ERP label derives from MRPII (Manufacturing Resource Planning) software, an evolution of the MRP (Material Requirements Planning) software. MRPII adds to the efficient determination of the needed materials in MRP new functionalities such as sales planning, purchasing, capacity scheduling and adjustment. The expansion of MRPII to other functions beyond the manufacturing such as finance, sales and distribution and human resources leads to a broad concept of a system to support a totally integrated organization, now called ERP. However, it would be incorrect to assume that the actual ERPs evolved from MRP systems, since many different evolution paths may be identified.

ERP should not be interpreted as enterprise-wide planning of resources. Klaus, Rosemann et al. (2000) point out three ways in what the label is misleading to understand the concept. First, “planning” is certainly not the only functionality and perhaps not the strongest ERP provides. Second, the process view is as important as the “resource” view. Third, the term “enterprise” indicates a narrower focus than the packages are now aiming to provide with the integration extending beyond organizational boundaries to customers and business partners. The

same Gartner Group that coined the “ERP” term more than a decade ago designates this new phase as ERP II. AMR Research labels this new phase as ECM (Enterprise Commerce Management), but both are seen as transitory designations (Mello 2001). Earlier attempts to change the label to Enterprise Wide Systems<sup>1</sup> or just Enterprise Systems have not had significant impact. Business press and academics working in the area still refer to these systems by the term “ERP”.

It follows that any packaged software provided by a vendor—therefore not developed in-house—that provides integration of the business processes across organizational boundaries either internal or external is a potential candidate to be an object of this study.

### ***1.2.2 ERP systems importance***

ERP systems are expected to deliver many benefits by integrating data and business processes across functions and organizational groups. The “best practice” business processes and integrated data embedded in ERP systems are expected to bring substantial cost and time reductions in key business processes. In a survey by Networking Computing (2001), the reduction of the cycle time is reported as the most important factor (28 percent of the respondents) in developing and implementing ERP systems followed by the capture of analytical data (20 percent) as the second most important. An integrated infrastructure facilitates a better coordination and collaboration among the organizational functions and allows management to get a global view of the organization’s operations and performance.

Among many IT initiatives, ERP systems were pointed out as the most important in achieving overall business goals in 2003, according to 30 percent of respondents to the AMR

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<sup>1</sup> e.g., the now standing AMCIS mini-track dedicated to these systems has changed its designation from Enterprise Resource Planning in 2000 to Integrated Enterprise-Wide Systems in 2001

Research E-Business Initiatives survey<sup>2</sup>. This was the biggest percentage for any IT initiative followed by Supply Chain Management (SCM) and Customer Relationship Management (CRM) at 20 percent and 19 percent respectively (iSourceOnline 2002).

In 2002, ERP systems accounted for the largest part of the IT applications budget reaching a \$16 billion market (Yahoo! Finance 2002). Despite the economic slowdown, ERP systems achieved a 2% growth rate in that year. In 2003, the ERP market reached nearly \$25 billion in license and maintenance revenue achieving a 5% growth rate (Pang 2004). Many organizations were just waiting for the economy to turn around so they could have the resources to implement ERP systems (Scott and Shepherd 2002). By the end of 2008, the ERP market is expected to reach \$38 billion in revenues.

All this ERP spending has been justified by the huge benefits that come from the integration that ERP systems allow. However, there are many problems that prevent organizations from achieving benefits at a level that will justify what has been invested.

### **1.3 Problems in Achieving Benefits**

To get the ERP system implemented, the organization has usually to endure a costly and longtime process: 60 percent of the ERP implementations have been reported costing more than \$1 million and about 40 percent having an actual or estimated duration of 1 to 3 years—only 20 percent of the implementations are reported to have taken less than a year (Networking Computing 2001).

Under the pressure of a notoriously difficult implementation process, organizations often lower their sights, seeking only to get a minimally functional system in place and assure the continued operation of critical business processes. A large part of the high functionality offered

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<sup>2</sup> 100 interviews conducted with business decision makers in representative American companies from the manufacturing and service industries with total employees of a thousand or more

in the package may not even be considered. Many organizations do not take advantage of the capabilities contained within the advanced software tools they are purchasing (Schenker 2002). ERP systems are no different. But if an organization remains at the “minimal” level of exploitation of the ERP, it will not see the full possible benefits. Without full benefits the organization is also unlikely to get the return on the high investment made and meet the usually high expectancies created at the beginning of the ERP implementation.

The trade press has been providing mixed results about ERP success. For each story of success one may find a story of failure. However, despite the problems, there is no doubt that many organizations succeeded with their implementation, turning the ERP system in the backbone of the informational infrastructure of the organization (Gaughan 2004). Although there are plenty of ERP initiatives that one may consider successful, ERP systems often fail to deliver the expected level of benefits. One possible explanation is that organizations may not be using ERP systems to their fullest potential. Even in the cases where expected benefits are delivered, if the organization is not using the ERP system to its fullest potential, it may be missing substantial benefits. Thus, this dissertation considers that the difference in the level and type of use in implemented ERP systems is an important factor in ERP success.

To reinforce the previous perceptions, after several years of ever-growing IT spending and the economic slowdown asking for judicious IT spending, organizations start to ask questions such as “why are IT resources so under-utilized?” (Lewis 2004)

After stabilizing the ERP implementation, the key work is to get individuals to take advantage of the functionalities they already have available (Swanton 2004). Recently, AMR Research has identified three critical elements in realizing ERP benefits: a clear corporate vision emphasizing consistency and cooperation among business units, a dedicated group harmonizing

and improving business processes, and a central financial analyst presenting a credible and transparent accounting of the costs and the business value realized. Looking at exploratory use, this study aims to contribute to the identification of factors that may be determinant of producing a dedicated group of people that “harmonize” and improve the business processes. This group of people may get the most out of the system by turning on or reconfiguring already owned functionality (Swanton 2004).

#### **1.4 The Research Question**

Getting to the fullest potential of the ERP system it is not an easy endeavor. The so-called best business practices that the ERP embeds, the broad organizational scope, the variety of functionalities provided, the tight integration among the several system components, all the features that make the package attractive for management to achieve business goals, make it a complex one for users, given the increased difficulty in understanding the system (Attewell 1992; Maney 1999; Boudreau 2001; Robey, Ross et al. 2002). Without being fully aware of the consequences in using the system, users may work under the fear of making mistakes. Therefore, they tend to stick to what they have initially been taught, which may be just a pre-defined set of commands, without trying to find better ways or explore other functionalities to improve their job performance. This may explain why ERP systems may be kept at a superficial level of usage, the most likely level of usage achieved immediately after implementation. In many cases ERP systems are used just at the basic transaction level (Maney 1999; Ross and Vitale 2000) despite the rich functionality offered at other levels such as tracking, planning and reporting.

Organizations have to move from a superficial to a more comprehensive usage of the ERP systems to achieve the full benefits of a costly and longtime implementation. ERP systems should be used not only at the basic transaction level but also at other levels that are important

for decision-making. Since the potential of these systems remains to be explored in many organizations, the identification of the factors upon which management may act to facilitate the exploratory use of the system and in that way extend its use to get to its fullest potential assumes relevance. In this research “exploratory use” is defined as the discovery of new information or new functionalities through a different set of actions from the ones users typically perform as they go about their routine use.

ERP systems are complex. By focusing on ERP systems as a prominent case of complex information technology, this study seeks to answer the following general research question:

*What factors are likely to promote the exploratory use of complex information technology?*

## **1.5 Overview of the Research Design**

A cross-sectional field study using a survey for data collection was used to empirically assess the research model. The research model has been developed looking at specific bodies of literature in the social psychology, management information systems and management that provide support for testable hypotheses regarding the exploratory use of complex technologies. As a good example of complex technologies, ERP systems have been selected as the research setting for this study. Among the ERP systems, SAP is the leader. Thus, SAP Portugal was contacted and agreed to participate in the study.

An e-mail letter explaining the research purpose was sent to the Portuguese SAP Users Group that comprises around five hundred key user contacts in a bit more than a hundred organizations. From this group, almost a hundred responses were collected. Through personal contacts, the researcher got some more responses including other ERP systems such as Oracle, Baan and Navision. In all, 118 usable responses were collected over a period of half a year.

This is a study at the individual level of analysis having the ERP user as the unit of analysis. Analysis was performed using structural equation modeling. Since this study is to some extent both exploratory and confirmatory, a two-step approach was adopted as the strategy for data analysis. An exploratory approach was taken when assessing the measurement model. The measurement model was refined till an acceptable fit to the data was achieved. Then a confirmatory approach took place using both the measurement and structural model to assess the research model. Given the difficulty in getting more responses, the same data was used for both steps in the analysis what has the potential to capitalize on chance. However, it must be stressed that capitalization on chance was lessened by having the measurement model assessed first without considering simultaneously the structural part.

## **1.6 Importance of Research**

Three reasons justify the importance of this research. First, this research answers the call for a more comprehensive look into usage of complex technologies, given the predominance so far in studying the usage of simple, personal, and voluntary technologies (Zmud 2000; Gallivan 2001). By looking at the usage of a complex technology such as the ERP system, this research will contribute for the IT adoption and innovation literature in general.

Second, this research seeks to contribute to a better understanding of the ERP usage, very little investigated in the ERP literature so far (Holland and Light 2001). Esteves and Pastor (2001)'s review of the ERP literature in IS events and IS journals between 1997 and 2000 identifies 189 publications, the majority (78) focused on implementation issues, followed by 38 in general issues and 26 in education. There is a considerable lack of research in the post-implementation stages when the organization is supposed to collect the benefits of a costly and longtime IT implementation.

Third, the empirical approach to be followed in this study breaks with the predominantly qualitative approach in the ERP area. There is a considerable lack of theory-driven approaches (Klaus, Rosemann et al. 2000; Dong, Neufeld et al. 2002). The exploratory studies that constitute the bulk of the ERP research carried out so far were necessary to understand the nature of the emergent phenomenon. The results of studying the ERP implementation through anecdotal evidence and multiple case studies may now be incorporated in an empirical approach what will constitute a departure from the descriptive type of research undertaken so far. The ERP technology has now reached some maturity in terms of the functionalities offered. Enough organizations have implemented ERP and enough time has passed after the initial deployment that is now possible to assess how these systems are being used.

This research provides a conceptual development that will result in a model to empirically assess factors predicting more comprehensive or exploratory use of ERP systems.

### **1.7 Importance to Practice**

This study is of great importance for practice so managers know on what crucial factors they should focus their attention to get to the full potential of complex IT relying on its exploratory use by the users during its post-implementation stage. During the previous stage, the implementation stage, it may not be possible to anticipate all the organizational needs and to know in depth all the capabilities that complex IT provides to support them. On one hand, the organization or its environment keep creating new needs. On other hand, the organization is subject to time and budget constraints during the implementation process.

Although the organization may have been warned for a costly and lengthy implementation process, easy promises from vendors coupled with time and budget constraints as well as the organization desire for quickly getting benefits tend to shortcut the implementation

process. The result may be an under-utilized complex IT. Nothing would be wrong with that for a starting point except that in many cases complex IT remains under-utilized long time after it is deployed. Expected benefits may never be achieved.

The implementation process of complex IT is usually disruptive and costly; it is not an easy one for the organizations. The implementation of ERP systems is a good example. As many complex Information Technologies, ERP systems are hardly implemented without requiring the services of consultants. Organizations may pay three to four times in consulting services what they have paid for the software to get it into production (Burlison 2001). Thus organizations tend to overlook or underestimate some costs during the budgeting process. Training is pointed out almost unanimously as the most underestimated item on the budget. However, training is already a significant expense (Mabert, Soni et al. 2000; Koch 2002). The question may not be to increase the training but to re-conceptualize it and make it more appropriate and effective (Sein, Bostrom et al. 1998).

This study calls management attention to exploratory use as a way of going further in the usage level of complex IT to reap considerable benefits. In addition, planning for exploratory use may be a way of planning for user's disengagement from consultants. Consultants are not always available and they certainly can take the opportunity to present high fees anytime they are called for any improvement. Knowing which factors will be determinant for the users to explore the system may help management to better define the interaction and set up a contract with the consultants. That contract can target a specific set of competencies and ways of evaluating it so that some users may take later the place of the consultants, train other users and foster the use of the complex IT system.

In summary, planning for and having some users exploring complex IT is a way of building internal capabilities that in the long run may allow considerable savings and may more easily uncover the IT potential to better achieve the organizational goals.

## **1.8 Outline of the Dissertation**

This dissertation is presented over six chapters. The second chapter presents a review of the literature relevant for the phenomenon under study, complex IT usage. Different types of use are identified and described and exploratory use emerges as the type of usage under focus. Drawing upon the Theory of Planned Behavior, a conceptual framework is developed and the scope for this study is then presented.

The third chapter develops the research model according to the scope previously set up. The Theory of Planned Behavior is decomposed into sets of behavioral, normative and control beliefs that act as primary determinants of intention to explore and exploratory use. Key factors that act upon the previously primary determinants as well as control variables are identified. A set of thirteen hypotheses is then proposed to test.

The fourth chapter describes the methodology adopted to investigate the relationships proposed in the research model. The research instrument is developed, pre-tested and the procedures for its administration are explained. Survey response and sample characteristics are discussed.

The fifth chapter provides a cross-sectional data analysis following a two-step strategy. First, the measurement model is developed and validated; second, an overall model evaluation takes places to assess the structural relationships in the research model.

The sixth and last chapter discusses the results, acknowledges the limitations, highlights the contributions to academia and practice, develops the conclusions and sets up the guidelines for future research.

## CHAPTER

### 2 COMPLEX INFORMATION TECHNOLOGY USAGE

In order to develop the research model, the research on usage of what is referred to as complex technologies like ERP systems is first described. Then, by looking at how different types of use interconnect to deliver full benefits from the implementation of the ERP system, exploratory use is elicited as the dependent variable for this study. Next, building from the theoretical framework of the Theory of Planned Behavior, the research model is developed.

#### 2.1 Information Technology Usage

Usage has been one of the most researched constructs in IS, a construct usually regarded as a surrogate for IS success (DeLone and McLean 1992). However, that research has been mainly carried out for simple technologies such as graphics (Davis 1989), voice-mail, word processors and spreadsheets (Adams, Nelson et al. 1992), and e-mail (Gefen and Straub 1997) to name a few. Besides their simplicity, those technologies have been studied in personal and volunteer contexts.

In the previous chapter, information technology complexity has been defined by characteristics of the system itself (the number and variety of components, the number and strength of interactions, their combined rate of change) and by individual's perceptions of the system (difficulty in understanding the technology). Unlike simple technologies, a complex technology presents usually many and much different functionalities that require training to be specific for each type of user. Everyone is not engaged in the same functionalities, but all these

functionalities fit together and cannot be left to voluntary use. Unless each one plays its role in using the technology, hardly benefits will be obtained given the network and ripple effects that complex technologies are built on. That makes this type of technologies difficult to understand requiring not only a specific but also a lengthy training. Enterprise Resource Planning (ERP), Supply Chain Management (SCM) or Customer Relationship Management (CRM) systems are good examples of complex information technology.

Since the benefits of using complex technologies as the ones just mentioned usually require the contribution of many and different types of users on an organization-wide scope, a complex information technology is rarely left to the discretionary will of users to be adopted. Past research has essentially looked at usage behavior in a volunteer context, apart from a few exceptions (Hartwick and Barki 1994; Venkatesh and Davis 2000). In a volunteer context, given the choice of not using the technology, just the simple fact of using it means acceptance. On the contrary, in a mandated context, as is usually the case for technologies such as ERP systems, acceptance is often imposed. Depending on the organizational level, there may be or not room for discretionary behavior. For example, transactional users will not have any alternative to using the system since there is no other way they can do their job. Other types of users, those that may need a report, may be slowly forced to use the system. More than acceptance, the question is now at what level that “acceptance” is translated into different usage levels. So far, researchers have been looking at usage indiscriminately, as Zmud (2000) points out.

When looking for research on the usage of complex information technologies, in particular, empirical research on ERP usage, taking the ERP system as an example, there is not much found in the literature. Even when ERP usage is studied, for example, looking at the impact on ERP use of users’ trust in the ERP vendor (Gefen 2000), ERP use has been still

conceptualized and operationalized in the same way as simple technologies were in past research. The operationalization has been essentially based on frequency and amount of use as illustrated by the following questionnaire items in the ERP study: “My company is a heavy user of the software provided by [ERP vendor]”; “We use [ERP vendor] software on a daily basis”; “We use [ERP vendor] software very often”; and “My company uses the software provided by [ERP vendor] very frequently” (p.29). Getting at frequency, but not at the nature of the use may be too simplistic to assess the usage of complex information technology.

Using an IT heavily and using it often does not necessarily imply proper use is taking place to achieve maximal benefits. While it may be relatively easy to get to the full potential in simple technologies characterized by a small number of functionalities and limited interactions among them, that is not the case for complex technologies: even if intensively using some functionalities, given the larger number and the increased potential for interactions, users may be still missing other important functionalities to improve performance.

Frequency and time may be meaningful indicators of how successfully accepted an IT is when the context is volunteer. In a mixed scenario, with at least certain kinds of use mandated, frequency of use may not be as relevant as the type of use one makes of the complex information technology, how deep and broad one goes in using their functionalities.

Usage research has to move from the acceptance stage to the infusion stage when looking at complex information technologies. So far, the primary concern in IS research has been to find the antecedents of use, not to discriminate among types of use. Furthermore, despite its widespread adoption, little or no validation of the construct has been provided (Burton-Jones and Straub 2002). Researchers are starting to call now for the rethinking of the “use” construct (Zmud 2000; Chin and Marcolin 2001; Burton-Jones and Straub 2002). The conceptualization of

“use” should take into account the diversity of types of use that may occur, given the complexity of the technology. In addition, that conceptualization may differ according to the implementation stage one might be looking at.

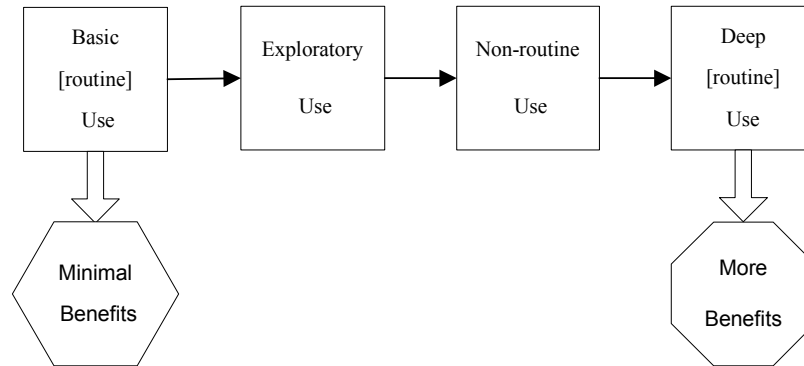
Zmud (2000) and colleagues (Kwon and Zmud 1987; Cooper and Zmud 1990; Saga 1994; Massetti and Zmud 1996) emphasize the need for looking into the depth of usage when addressing, particularly, the use of complex technologies in organizational and mandatory settings. That is the case of ERP systems. Chin and Marcolini (2001) point out that “research into deep usage can begin by examining and integrating different forms of usage” (p.9) adding “we are still in the early stages of understanding the IT usage in its myriad of forms and conceptualizations” (p.10). Measures of depth of usage have been pointed out as nonexistent at the individual level of analysis (Burton-Jones and Straub 2002).

## **2.2 Types of Use**

Without dismissing the importance of extent of use, this study emphasizes the focus on use in terms of depth of usage. Following Chin and Marcolin’s suggestion to look into different types of use, this research proposes four types to be considered: basic use, exploratory use, non-routine use, and deep use. Figure 2.1 illustrates the sequence in types of use to achieve more benefits from using a complex information technology like an ERP system.

### **2.2.1 Basic [Routine] Use**

Basic routine use may be defined as a *low level of usage maintained by performing just straightforward input and retrieval tasks as a matter of habit*. This is the type of use exhibited in basic tasks in the ERP system such as taking orders without considering the relationship history with the customer or the impact on the production plans.



**Figure 2.1: Types of use in achieving more benefits**

Basic routine use consists in using just the minimal set of functionalities to keep the business running in transactional terms without getting insights to anticipate problems or pursue additional goals based on the data that has been captured. For example, basic routine use might mean using only the basic input and retrieval transactions but not the planning and reporting capabilities in an extensive way. With only basic use, the organization can only expect minimal benefits from the implementation of the ERP.

### **2.2.2 Exploratory Use**

“Exploratory use” is defined as the search for new information or new functionalities through a different set of actions from the ones users usually perform as they go about their routine use. This is different from what will be called non-routine use: although it involves a use that is not routine, exploratory use relates to the search for useful functionalities, while non-routine use relates to the use of already recognized useful functionalities during an institutionalization process.

Exploratory use is based on Nambisan, Agarwal et al. (1999)‘s “intention to explore”, defined as the user’s willingness and purpose to find new ways of applying IT to work tasks.

“Intention to explore” has been introduced as a key antecedent of user innovation in IT when arguing that users remain a largely untapped source for getting the most out of technology use.

Exploratory use becomes more important when moving from a personal to an organizational setting. Unlike previous studies on IT use where the setting has been mainly personal, ERP use happens in an organizational setting. Tasks are tightly interconnected throughout the organization on the ERP system. Thus, something useful found by one user is likely to benefit the whole organization without requiring that everyone engage in exploratory use.

### ***2.2.3 Non-routine Use***

“Non-routine use” is defined as “using more of the technology’s features that are still perceived as new in order to accommodate a more comprehensive set of work tasks”. Non-routine use is a transitional period that takes place while users get used to the new ways uncovered through exploratory use. Once found useful, the newly discovered ways of using the system are institutionalized becoming part of the well-established procedures.

While the users perceive what they are using as different from what they used to do, requiring perhaps some extra effort or the help of others, they are engaged in non-routine use. After this transition period, what was perceived as different and new becomes perceived as normal and becomes routine use, a deeper one.

After exploratory use, it will not be true that all newly discovered information or new ways of performing will be accepted as beneficial enough to be integrated in the work practices. Those that are chosen as worthy by the work group or individual make their way to institutionalization through non-routine use. The user involved in non-routine use does not have to be necessarily the user that has engaged in exploratory use. The user engaged in exploratory

use is the first one in the organization to try out the new ways of using the ERP system on his/her own not excluding any help he/she can get from external sources such as consultants or users in other organizations. The users in the organization that adopt the new ways will be engaging in non-routine use.

#### **2.2.4 Deep [Routine] Use**

Deep use is defined as *a high level of usage achieved through the comprehensive integration of IT functionalities in the work system*. This high level of usage characterizes what is called the infusion stage for any IT implementation.

Maximal benefits are expected when an IT implementation reaches the infusion stage (Saga and Zmud 1994; Agarwal 2000). This stage, the last one to be achieved as shown in the well-known Cooper and Zmud (1990)'s six-stage model (initiation, adoption, adaptation, acceptance, routinization, and infusion), is defined as a process that takes place when “increased organizational effectiveness is obtained by using the IT application in a more comprehensive and integrated manner to support higher level aspects of organizational work” (p. 125).

Saga and Zmud (1994) identify extended, integrative and emergent use as different types of use to achieve infusion, i.e., deep use. “Extended use” is defined as “using more of the technology’s features in order to accommodate a more comprehensive set of work tasks” (p.3). Users developing their own reports in the ERP system using the reporting tools may be an illustration of “extended use”.

“Integrative use” is defined as “using the technology to establish or enhance flow linkages among a set of work tasks (p.3)”. By its own nature, an ERP system enforces this type of use among many tasks. Recording a sale in the Sales and Distribution area will have as immediate repercussions in the Materials Management area decreasing the correspondent stock

and in the Financial Accounting area opening an accounts receivable entry. Nevertheless, users may define their own workflows *ad hoc* besides the ones already set up in the ERP system and in this way increase the integrative use.

The last type of use that Saga and Zmud propose, “emergent use”, is defined as “using the technology in order to accomplish tasks that were not feasible or recognized prior to the application of the technology to the work system” (p.3). The production of a group-wide plan to improve the management process by recording and evaluating aggregated data at a high level may be an illustration of “emergent use” in the ERP system.

The above extended, integrative and emergent uses illustrate some of the types of use that occur at the infusion stage of a complex technology such as an ERP system and through which users may achieve “deep use”. Though it may be fairly easy to achieve “deep use” in a simple technology it will be hardly the case in a complex one.

The training before the ERP system goes live will hardly leave the users with sufficient knowledge to take advantage of the myriad of possibilities the system offers. The organization may have to rely on the users to uncover the potential of the ERP system while they use it post implementation. By discovering and learning by using the system, users will get eventually to a “deep use” of the ERP system. This means having at least some users engaged in the exploratory use of the ERP system either on their own or helped by others.

### **2.2.5 *Getting more benefits***

In summary, exploratory use leads to deep [routine] use that delivers more benefits (Figure 2.1). This is because some of the new functionalities or new ways of getting to the information uncovered through exploratory use may be in time integrated in the work practices. During the time they are perceived as “new”, these ways of using the system will be considered

non-routine. Once completely integrated, the functionalities become part of the well-established work practices on the system, i.e., “routine use”. This routine use will become more and more sophisticated each time new functionalities are embedded deeply and comprehensively in the work practices, leading to a “deep [routine] use” and, hopefully, to more benefits.

### **2.3 Conceptual Framework**

Extensive research on the individual use of IT has drawn on theories from social psychology such as the Theory of Reasoned Action (Fishbein and Ajzen 1975), the Theory of Planned Behavior (Ajzen 1985), Diffusion of Innovations Theory (Rogers 1983), and Social Cognitive Theory (Bandura 1986). This research will draw on the Theory of Planned Behavior, an extension of the more general explanation provided by the Theory of Reasoned Action.

The Theory of Reasoned Action (TRA) shows that actual behavior is determined by the intention to perform the behavior; intention, in turn, is determined by the individual’s attitude towards the behavior and the subjective norm concerning the behavior.

Attitude is the sum product of the beliefs about consequences of the behavior (behavioral beliefs) by the evaluation of the consequences: if an individual believes major consequences come from performing the behavior, and those consequences are good, then the individual will feel a more positive feeling about performing the behavior.

Subjective norm is the sum of the products of perceived expectations of others (normative beliefs), multiplied by the motivation to comply with those expectations: if an individual feels that others have expectations about the behavior that s/he should or should not perform it, and s/he cares about those expectations, then subjective norm will impact the intention to perform the behavior. Both for attitude and subjective norm, the impact on the actual behavior is fully mediated through behavioral intention.

Across many behaviors in many domains (social psychology, marketing, and information technology), TRA has been empirically supported. However, “the successful performance of an intended behavior is contingent on the presence of required information, skills and abilities” (Ajzen 1985).

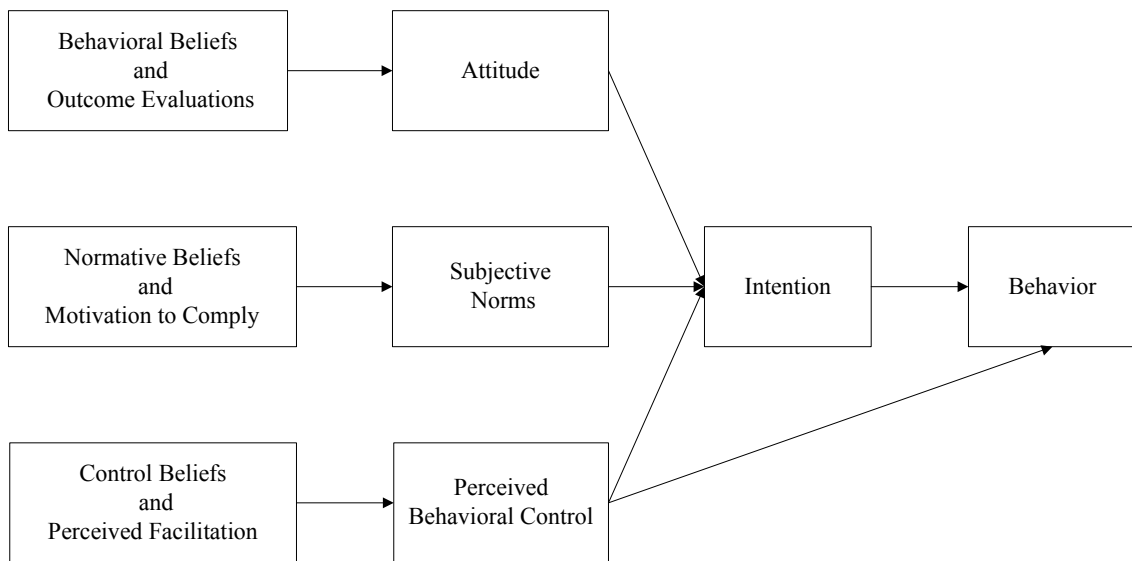
Taking this perspective and making the point that TRA does not assume significant barriers to the performance of behavior, Ajzen developed the Theory of Planned Behavior (TPB).

### ***2.3.1 The Theory of Planned Behavior***

TPB expands the more general explanation for behavior that TRA provides by including Perceived Behavioral Control (PBC). PBC refers to the individual’s perceptions of the presence or absence of requisite resources and opportunities necessary to perform the behavior (Ajzen and Madden 1986).

PBC is determined by the sum of the products of the individual beliefs concerning the presence or absence of resources and opportunities to perform the behavior (control beliefs), multiplied by the power of each control factor in either inhibiting or facilitating the behavior, the perceived facilitation. Unlike attitude and subjective norm, intention does not fully mediate the impact of PBC on actual behavior:

TPB proposes that behavior is determined not only by the intention to engage in the behavior, but also directly determined by perceptions of control over the behavior. TPB (Figure 2.2) provides the foundations used to develop the research framework for this study.



**Figure 2.2: The Theory of Planned Behavior**

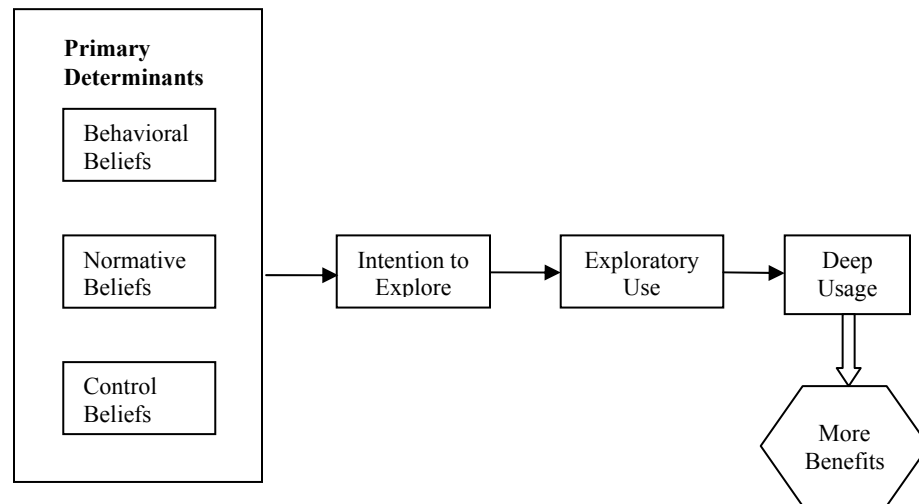
## 2.4 Predicting Exploratory Use

To predict exploratory use, a simplification of the basic framework is made by placing direct links from beliefs to intention. Although this simplification runs counter to TPB, there is empirical evidence to support this approach.

For example, showing that attitude did not fully mediate the effect of beliefs on intention, Davis, Bagozzi et al. Davis et al.(1989) have found a direct link from a belief (perceived usefulness) to behavioral intention. This was a strong direct link while the link between perceived usefulness and attitude was weak. Since there is already empirical evidence of direct belief-intention links, this study takes that approach and goes straight to the sets of salient

beliefs, leaving out the mediators in TPB. The result is a more parsimonious model as presented in Figure 2.3.

Before moving on identifying the sets of salient beliefs, the research framework is expanded looking for key factors that may change these types of beliefs.



**Figure 2.3: Initial Research Framework**

#### **2.4.1 Key factors affecting beliefs**

The question now is how to impact and thus change the sets of beliefs in order to promote exploratory use of complex technologies such as ERP systems. Among the possible key factors that may act upon the primary determinants of exploratory use, knowledge and motivation emerge as the most promising.

#### **Knowledge**

Complex technologies raise considerable barriers to their usage. Complex IT is difficult to learn and even more difficult to explore. Without understanding the “big picture” of the

relationships among the several parts of the IT system and under the fear of making mistakes that quickly may have bad consequences in other parts of the system, users may avoid anything beyond the routine usage that they were usually taught. One of the ways of lowering these barriers is to provide the required knowledge so users can understand better the consequences of their usage of the system, namely, of new usage. Having the right knowledge, users may recognize the usefulness of engaging in exploratory use by recognizing areas with new functionalities that may bring considerable improvements to the business.

### **Motivation**

Besides knowledge, another key factor may be the motivation to engage in exploratory use. Exploratory use is a challenging behavior that requires extra effort. It is something the user does not do by habit. The extra energy that is required for this behavior may come from motivation, either intrinsic or extrinsic. In combination, knowledge and motivation are proposed as the key factors that may impact positively the primary determinants of intention to explore and exploratory use.

The issue now is how to leverage users' knowledge of the system and how to foster their motivation to go beyond the routine usage of the system and uncover new ways of using it so that benefits can be brought to the business. Management would like to know how to increase users' knowledge and the motivation to engage in exploratory use.

#### ***2.4.2 Managerially Leverageable Factors***

Some factors under managerial influence may be leveraged to positively impact the variables and sets of beliefs already identified as key factors and primary determinants of

exploratory use. Training, situated learning, and user participation are the managerially leverageable factors proposed.

### **Training**

Training has been pointed out as the responsible for the 10% to 15% of ERP implementations that had a smooth implementation delivering the expected benefits (Wheatley 2000). Particularly with an integrated package such as an ERP, training should be more “conceptual” than “skill-focused” to engage in exploratory use, but both types of training are needed as suggested by the training strategy framework proposed by Sein, Bostrom et al. (1999). Through different types of training, different levels of knowledge may be leveraged.

Moreover, through training, users may develop feelings of efficacy and competence. They should feel more prepared after training to deal with the situations they were trained for. Feelings of efficacy and competence propel the individuals to explore and manipulate the environment and feel in control of it (Pierce, Kostova et al. 2003). Thus, training may increase the motivation to engage in exploratory use and get the most out of the system.

### **Situated Learning**

Situated learning is defined as *learning through hands-on experience and knowledge sharing in a community of practice*. A community of practice is defined as “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (Wenger, McDermott et al. 2002). To compensate for the limitations of the initial formal training in ERP implementations, case study research has shown that users may engage in the practice of situated learning (Boudreau 2000).

Transaction processing activities are easily codified and passed on as explicit knowledge. However, tacit knowledge related to previous experiences, such as how to work around or suppress errors in an ERP, cannot so easily be transferred. The development of a community of practice where situated learning takes place may constitute an important vehicle to share and disseminate critical tacit knowledge about the ERP.

Users improve their knowledge by sharing how they recover from errors, how they make sense of the system messages, how they navigate the menus and combine commands to support a task. Users get a clearer global picture of the ERP system and raise their awareness of its potential when they share experiences and convey explicit and tacit knowledge across functional boundaries. Users are more likely to better understand the interdependences among tasks and solve possible conflicts when they belong to a community of practice where interaction and knowledge sharing is facilitated. By sharing their concerns and experiences in using the system, users are more likely to develop a sense of possession toward the system that comes from a community that cares about the use the organization makes of the system. The better knowledge that comes from a community where users can rely on to find help in using the system also makes that feeling of possession stronger and increases their motivation to perform a challenging behavior (Pierce, Kostova et al. 2001).

### **User Participation**

There is empirical support for the link between system use and user participation. Overall responsibility defined as *user activities and assignments reflecting leadership or accountability* has emerged as a key dimension of user participation (Hartwick and Barki 1994). User perception of control over a newly developed information system, argued as similar to overall responsibility, has been also empirically correlated to user performance (Hunton and Beeler

1997) suggesting that a participation strategy that develops a sense of overall responsibility and system ownership is a key IS success factor. These findings point to a relationship between user participation and motivational factors such as psychological ownership.

In addition, when the users participate in extensive process analysis to get the best fit between the ERP system and the business processes, they get a better understanding of the business context increasing their knowledge about the business processes and their interdependencies.

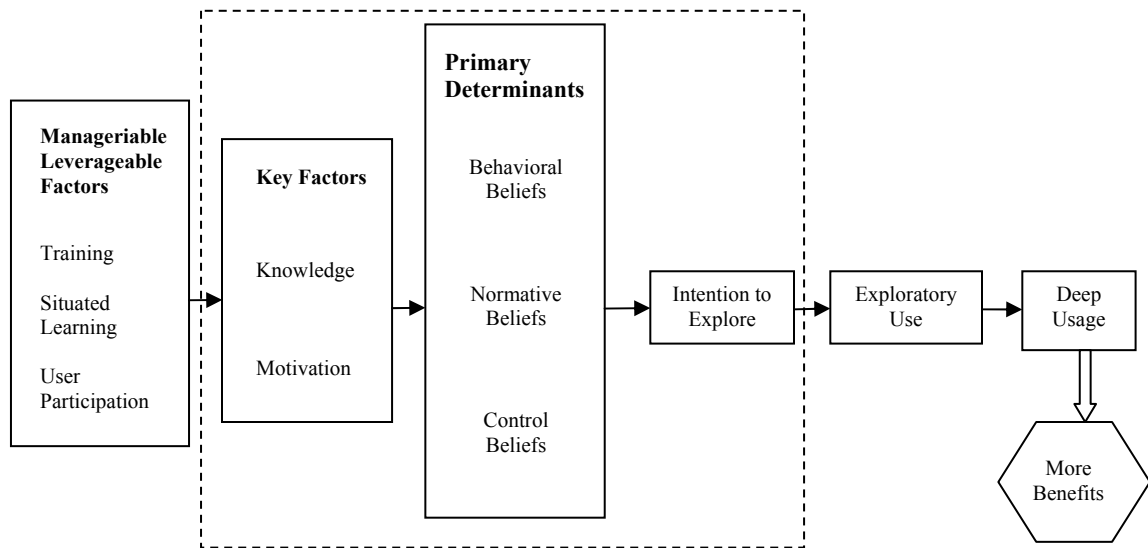
### **2.4.3 Research Scope**

Assessing how deep is the complex information technology usage and what benefits come from that level of use is not under the scope of this research. This study assumes that exploratory use leads to deep use, something still to prove. Moreover, the actual behavior is left out in this study as a variable to be directly assessed, because it would be something infeasible at this point. Unless exploratory use was observed and actually measured, Intention to Explore as a self-reported measure, may work as well to fulfill the goals of this study.

To keep this study at a small enough scope that it is feasible under the time of a dissertation and to avoid having a big model difficult to assess, the scope for this study is the one presented within dotted lines in Figure 2.4. Therefore, to answer the research question “What factors are more likely to promote the exploratory use of complex information technology?” two other questions were answered:

- a) What are the **primary belief determinants of exploratory use** of complex information technology such as ERP systems?
- b) What **key factors** have an impact on the previous primary belief determinants?

The goal was first to identify the primary belief determinants of intention to explore of complex information technologies such as ERP systems drawing upon the Theory of Planned Behavior. Second, once those primary belief determinants are identified the study will take one further step back to identify those knowledge and motivation factors that are most likely to have a positive impact on the belief determinants.



**Figure 2.4: Research Framework and Scope**

## CHAPTER

### 3 RESEARCH MODEL

According to the Theory of Planned Behavior, different empirical settings may elicit different sets of salient beliefs. In addition, belief sets that are combined into one-dimensional construct (such as attitude) may also not consistently relate to behavioral intention. Thus one has to go deeper to identify the sets of beliefs components that lead to an overall attitude, subjective norm and perceived behavioral control and get a decomposed TPB (Taylor and Todd 1995).

As already mentioned in the previous chapter while developing the scope for the research model, since empirical evidence has been found to support direct beliefs-intention links (Davis, Bagozzi et al. 1989), the focus is placed on the sets of beliefs and the mediators are left out. Davis, Bagozzi et al. (1989) found that attitude was only a partial mediator for a belief (usefulness). In addition, Venkatesh, Morris et al. (2003) found that attitudinal constructs are significant only when specific cognitions are not included in the model. Other model tests have shown that attitude is non-significant when the right set of key beliefs is present (Thompson, Higgins et al. 1991; Taylor and Todd 1995)

By focusing on a specific, stable set of salient beliefs that might be generalizable across different settings, it should be possible to identify components that can be manipulated to impact the behavior; the Technology Acceptance Model (TAM) (Davis 1989) is a good example. Therefore, within the scope selected for this research (behavioral, normative and control beliefs), the specific salient beliefs that are the primary determinants of intention to explore are identified.

### 3.1 Behavioral Beliefs

Behavioral beliefs refer to the individual's beliefs about the consequences of performing the behavior. TAM provides a good starting point to find a specific, stable set of behavioral beliefs. As a specialization of the general explanation provided by TRA and one of the most researched and accepted models for explaining individual IT use, TAM identifies two salient beliefs in predicting information technology use: perceived usefulness (the belief that using an application will increase one's performance) and perceived ease of use (the belief that one's use of an application will be free of effort). The result is a parsimonious model whose two beliefs have been empirically validated as key determinants of the user's attitude toward using a particular IT system.

TAM has been used primarily to explain usage of simple technologies in voluntary and personal contexts (Gefen and Straub 2000; Lederer, Maupin et al. 2000; Zmud 2000) such as e-mail, voice-mail, word processing and spreadsheets. Although some doubts may be cast on its adequacy to explain the usage of complex technologies such as ERP systems, TAM has already been empirically supported in predicting ERP use in terms of frequency and duration of use in a study looking at users' trust in the ERP vendor as an antecedent (Gefen 2000).

In this study, the focus is not indiscriminant use, but on a particular type of use—exploratory use. Given the saliency of the beliefs elicited by TAM for use in general, it seems reasonable to expect that those two key beliefs appropriately adjusted to a slightly different context will still be important when a particular type of use is under consideration.

#### 3.1.1 *Perceived Usefulness of Exploratory Use*

Perceived usefulness of exploratory use is defined as *the belief that looking for new ways of using an application has a good potential to lead to greater effectiveness in one's work*

*system*. Past research has shown perceived usefulness as the strongest predictor of intention to use among the constructs in the tested models (Taylor and Todd 1995; Agarwal and Prasad 1998; Venkatesh 2000). On some other studies, empirical evidence for a strong effect of extremely similar constructs to usefulness has been provided: job-fit on utilization of PCs (Thompson, Higgins et al. 1991), outcome expectations on usage (Compeau and Higgins 1995), and relative advantage on intention to adopt (Plouffe, Hulland et al. 2001) to name a few.

Perceived usefulness of exploratory use is based upon perceived usefulness - the degree to which a person believes that using a particular system would enhance his or her job performance (Davis 1989)) but its definition was modified to reflect a different usage context, exploratory usage. In addition, emphasis was placed on the probability (“has a good potential”) since it is a more challenging behavior with results that cannot be guaranteed.

Given the roots of the construct and drawing upon all the previous findings on perceived usefulness, something similar is hypothesized for perceived usefulness of exploratory use. Perceived usefulness of exploratory use, a salient, behavioral belief concerning exploratory use, is expected to link exploratory use with a positive outcome, i.e., a greater effectiveness in one’s work system coming from uncovering new information and new functionalities. Thus, contributing to the user’s positive evaluation of performing exploratory use, perceived usefulness of exploratory use is expected to lead to the intention to explore. Thus,

H1: *Perceived Usefulness of Exploratory Use has a positive effect on Intention to Explore.*

### **3.1.2 Perceived Ease of Exploratory Use**

Perceived ease of exploratory use is defined as *the belief that looking for new ways of using the system is possible without having great difficulty*. Drawing upon (Davis 1989;

Venkatesh and Davis 1996)' findings on the impact of perceived ease of use on intention to use, it seems reasonable to assume that the easier exploratory use is perceived, the more likely the individual will formulate a positive intention in performing the exploratory use. Therefore,

*H2: Perceived Ease of Exploratory Use has a positive effect on Intention to Explore.*

To the set of behavioral beliefs just proposed, Perceived Usefulness of Exploratory Use and Perceived Ease of Exploratory Use, this study adds Perceived Risk of Exploratory Use.

### ***3.1.3 Perceived Risk of Exploratory Use***

Perceived Risk of Exploratory Use is defined as the chance of inadvertently changing something in the system with negative consequences for the organization while looking for new functionalities or new information." Since Bauer (1960) first defined the concept of perceived risk while studying consumer behavior, considerable work on risk-taking theory has been done and can be found in the marketing literature, in particular, in the consumer behavior literature. In the MIS literature, the concept of risk has made its way when looking at software project management (Keil, Tan et al. 2000) or linked to another concept, trust, when looking at electronic markets (Jarvenpaa, Tractinsky et al. 1999; Ba and Pavlou 2002).

While summarizing past research on the risk-taking theory, Sitkin and Pablo (1992) identified three determinants of risk behavior: risk preferences, risk perceptions, and risk propensity. In this study, we will be looking at risk perceptions of exploratory use, one of the determinants of a risk behavior such as exploratory use. The concept of perceived risk most often used by consumer researchers defines risk in terms of uncertainty about the outcome and adverse consequences of making a mistake (Derbaix 1983; Dowling and Staelin 1994). Thus these two dimensions have been used to define Perceived Risk of Exploratory Use.

The larger the number of parts and the more diverse and more interdependent the parts are, the more complex is the IT. If each one of the parts is frequently updated, complexity increases even more. The more complex the IT, the more likely it is that a change in one of the parts might have a ripple effect on the IT system, given the interdependence among many parts. The likelihood of unintentionally changing something in the IT with bad consequences increases with complexity. Therefore, exploring a complex IT system may lead the user to unfamiliar areas where one local change may create other more remote changes in the system. If users believe they are not aware of the full consequences of changing something and perceive a high risk in doing something wrong while exploring the system, users are less likely to engage in exploratory use. Therefore, it is hypothesized that

*H3: Perceived Risk of Exploratory Use has a negative effect on Intention to Explore.*

### **3.2 Normative Beliefs**

Normative beliefs refer to the individual's perceptions about other's expectations that a behavior should or should not be performed. Some normative beliefs create a social pressure to perform or not perform the behavior. As Fishbein and Ajzen (1975) define it, subjective norm is "a person's perception that most people who are important to him think he should or should not perform the behavior in question" Exploratory use may or may not be approved by others in the organization whose opinion an individual values; thus, the individual may feel pressured to perform or not perform the behavior regardless of other beliefs about the consequences of the behavior.

However, subjective norm, as a direct determinant of behavioral intention in TRA and TPB, has provided mixed results (Davis 1989; Mathieson 1991; Taylor and Todd 1995). Based on Hartwick and Barki (1994)'s different findings in mandatory and voluntary settings,

Venkatesh and Davis (2000) suggested voluntariness as a moderating variable to distinguish between those settings while developing TAM2, an extension for TAM. These researchers provide empirical support for the idea that Voluntariness, defined as “the extent to which potential adopters perceive the adoption decision to be non-mandatory”, moderates the impact of subjective norm on intention to use. Later studies show that subjective norm do matter but it is more likely to be significant in mandatory usage settings (Venkatesh, Morris et al. 2003).

If voluntariness is defined in this study context as “*the extent to which potential exploratory users perceive the exploratory use to be voluntary*”, subjective norm is more likely to have a positive impact on intention to explore when exploratory use is perceived to be mandatory; otherwise, a weak or non-significant impact would be expected according to Venkatesh and Davis (2000), and Venkatesh, Morris et al. (2003). Other researchers have also incorporated voluntariness in their models not as a moderator but as a direct effect on intention (Moore and Benbasat 1991; Agarwal and Prasad 1998; Karahanna, Straub et al. 1999).

Although having exploratory use as something mandated for complex technologies seems unlikely for the generality of the users, it is not out of the question that some users may be required to do it. In particular, a certain type of users, the technical users, may be expected to do it as part of the job of keeping the system running for the generality of the users. Anyway, to keep the scope of the research within reasonable bounds while keeping voluntariness of a control variable, only the positive effect of subjective norm on intention to explore is hypothesized:

*H4: Subjective Norm has a positive effect on Intention to Explore.*

Regardless of the context, mandatory or voluntary, TAM2 suggests that subjective norm has an indirect effect through perceived usefulness. Similarly, instead of a direct effect on intention to explore from subjective norm, e.g., because of user compliance to a management

request or pressure, an indirect effect may be observed through perceived usefulness of exploratory use. Either by suggestion of superiors, peers or subordinates, users may come to internalize that exploratory use is something useful to do. However, since this relationship is not central to answer the research question and to avoid a complex model, the relationship between subjective norm and perceived usefulness of exploratory use is left out.

### **3.3 Control Beliefs**

Control beliefs refer to the individual beliefs concerning the presence or absence of resources and opportunities to perform the behavior. TPB extends TRA by adding the control beliefs set through the Perceived Behavioral Control (PBC) construct to the existing behavioral and normative sets of beliefs in TRA. The PBC construct that Ajzen developed based on self-efficacy research (Bandura 1986) has been used sometimes as synonymous for self-efficacy. However, as acknowledged by Ajzen and empirically supported (Povey and Conner 2000; Trafimow, Sheeran et al. 2002), self-efficacy and PBC are distinct constructs. In fact, that empirical evidence suggests that PBC is a multidimensional construct, composed by two distinct constructs, “perceived difficulty” and “perceived control”. Perceived difficulty reflects internal factors corresponding to self-efficacy beliefs while perceived control reflects external control factors.

#### ***3.3.1 Perceived Difficulty: Specific Computer Self-Efficacy for Exploratory Use***

“Perceived difficulty” refers to whether people consider a behavior to be easy or difficult to perform according to their capabilities—i.e., perceived self-efficacy. In Social Cognitive Theory (SCT), “perceived self-efficacy is defined as people’s judgments of their capabilities to

organize and execute courses of action required to attain designated types of performances” (Bandura 1986).

Unless users have the required capabilities to engage in exploratory use, they will perceive that behavior as difficult, i.e., they will hold lower self-efficacy beliefs. “People tend to avoid tasks they believe exceed their capabilities, but they undertake and perform assuredly activities they judge themselves capable of handling” (Bandura 1986). Exploratory use of complex IT may be a challenging task: complex information technologies are difficult to understand because they present high knowledge barriers to overcome. Routine use may be already complex—the way some usual tasks are supported by the complex IT may still remain hard to understand. Users just know they have to do it that particular way. When leaving routine use to engage in exploratory use, users may face even greater difficulties in understanding the complex IT.

As a predictor of IS use, the self-efficacy construct, designated computer self-efficacy (CSE) for the IT domain, has received considerable empirical support (Compeau and Higgins 1995; Compeau, Higgins et al. 1999). CSE can be conceptualized at both the general computing behavior level and at the specific computer application level, as distinguished in a thorough computer self-efficacy literature review (Marakas, Yi et al. 1998): general computer self-efficacy (GCSE) is defined as “an individual’s judgment of efficacy across multiple computer application domains” (p.129), whereas specific computer self-efficacy (SCSE) is defined as “an individual’s perception of efficacy in performing specific computer-related tasks in the domain of general computing” (p.128).

CSE literature already empirically supports the impact of CSE on IT usage (Compeau and Higgins 1995; Compeau, Higgins et al. 1999). Relevance has to be given to individuals’

confidence in their abilities in the IT domain for such challenging task as exploratory use. Empirical support can be found for the impact of self-efficacy beliefs not only on the behavior, but also on the intention to perform it (Hill, Smith et al. 1987). Thus, it is hypothesized

*H5: Specific Computer Self-efficacy for Exploratory Use has a positive effect on Intention to Explore.*

The impact of computer self-efficacy has also been consistently shown as a key antecedent of ease of use of information technology (Igbaria and Iivary 1995; Venkatesh and Davis 1996). The higher one's computer self-efficacy the easier to use information technology will seem. Presumably this is also true for exploratory use. However, since this relationship is not essential to answer the research question, the hypothesis that Specific Computer Self-efficacy has a positive effect on Perceived Ease of Exploratory Use is left out.

Having addressed self-efficacy as the internal component in the set of control beliefs, perceived control as the external component is now addressed.

### ***3.3.2 Perceived Control: Resource Facilitating Conditions***

Perceived control reflects external control factors to the behavior. Perceived control refers to the extent to which people consider the performance of a behavior to be under their voluntary control (Ajzen and Madden 1986; Trafimow, Sheeran et al. 2002). These control beliefs refer to the perception of opportunity to perform the behavior and are more in line with the facilitating conditions construct, as defined by Triandis (1980): "objective factors "out there" in the environment, that several judges or observers can agree make an act easy to do" (p. 205). Thus, it is hypothesized

*H6: Resource Facilitating Conditions have a positive effect on Intention to Explore.*

Among the many resources that may constraint or facilitate the exploratory use of a complex technology, it would be interesting to know which specific ones would make a difference. Assistance emerges as a good candidate. If users know that someone may be contacted in case they face obstacles when looking for new ways of using the system, users will more easily engage in exploratory use. Thus, the previous hypothesis turns into the following one

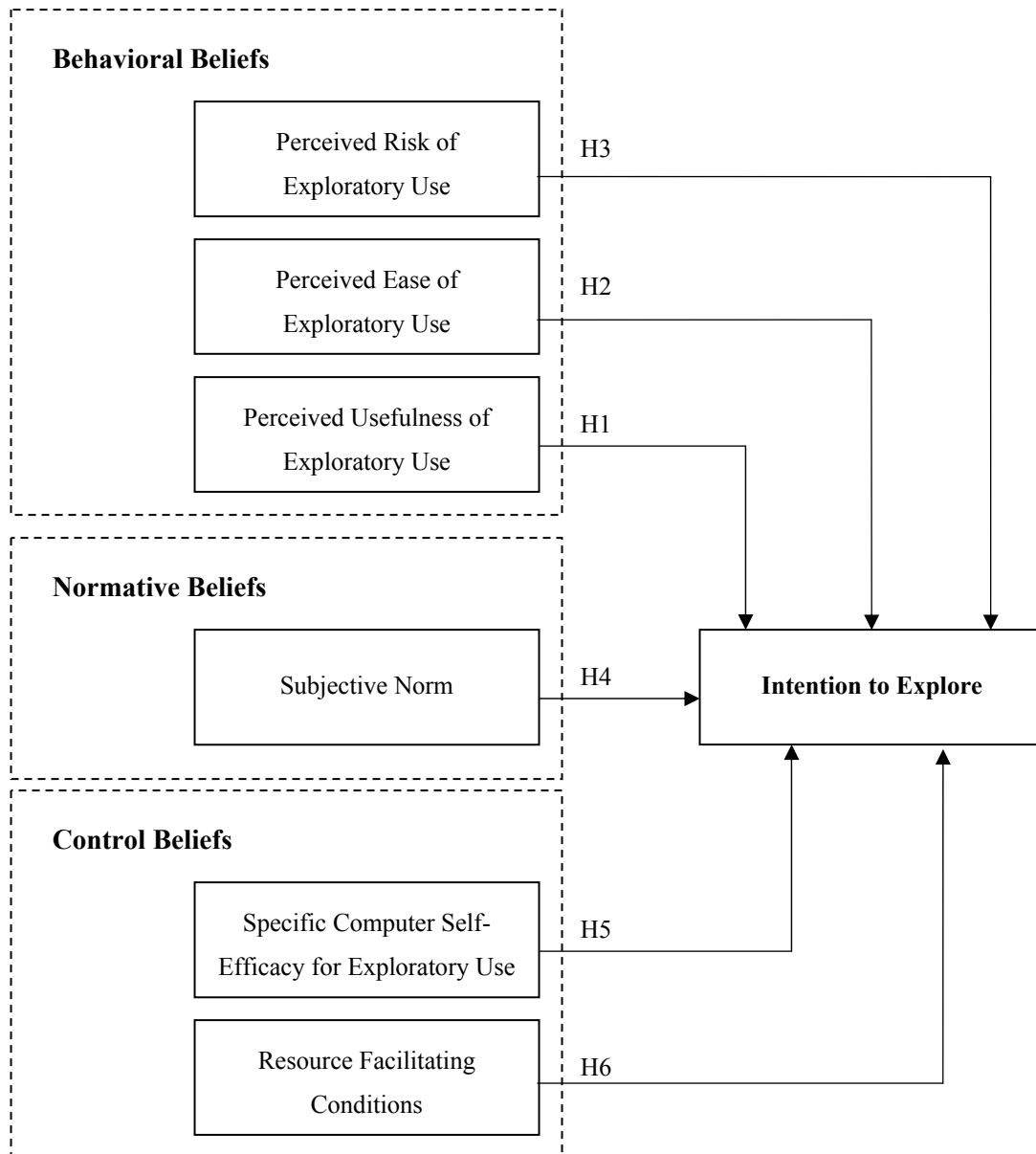
*H6a: Assistance has a positive effect on Intention to Explore.*

Before users look around and search for new information or new functionalities in a complex information technology, they may have to make sure that they have enough time to do it. Exploratory use of a complex information technology is something that may require considerable time. Thus, available time may also be an important facilitating condition to formulate the intention of exploring the system. Therefore, the hypothesis regarding facilitating conditions in general turns into a more specific one,

*H6b: Available Time have a positive effect on Intention to Explore.*

These resource facilitating conditions such as assistance and available time may also allow the individual to move from the intention to explore to the actual exploration of the complex information technology and thus impact directly exploratory use, but those hypotheses are left out in this study since the dependent variable is “intention to explore”.

Figure 3.1 presents the decomposed Theory of Planned Behavior for the behavioral, normative, and control beliefs identified so far as the salient beliefs to determine the intention to explore and consequently the exploratory use of a complex information technology.



**Figure 3.1: Decomposed Theory of Planned Behavior for intention to explore**

### **3.4 Key factors that act upon primary determinants of exploratory use**

Going one level further, this study will look for the key factors that are more likely to impact the sets of beliefs so far identified, as present in Figure 2.4.

#### **3.4.1 Knowledge**

Since the setting for this research is complex information technology with a focus on exploratory use as the usage behavior, it is reasonable to assume that knowledge will play an important role making the complex IT not only more easily understandable but also more amenable to exploratory use. Past research suggests that a user willing to explore a new IT may need different knowledge types (Tornatzky and Fleischer 1990).

There are several conceptualizations for knowledge types (e.g., dictionary, episodic, endorsed, procedural, axiomatic, augmented, deuteron (Sinkula 1994); context free IT knowledge, industry specific IT knowledge, firm specific IT knowledge (Nambisan, Agarwal et al. 1999). Among many possible conceptualizations, the one proposed by Sein, Bostrom et al. (1999) seems particularly adequate in the context of this study because it has been developed while looking at training strategies. Although not under the scope of research for this study, training is part of the research framework and will be addressed in future research.

While addressing end-user training strategy, Sein, Bostrom et al. (1999) developed a User Knowledge Level Framework. This six-level knowledge framework, ranging from syntactical to meta-cognition, presents what may be appropriate levels of knowledge to master in order to engage in exploratory use (Table 3.1).

**Table 3.1: User Level Knowledge Framework**

(from Sein, Bostrom et al. 1999)

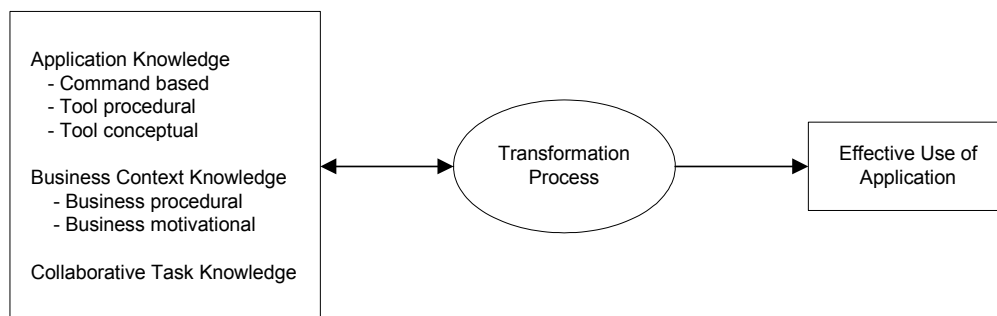
<b>Software Example</b> <b>Knowledge Level</b>	<b>Individual Productivity</b> <b>Software Example</b>	<b>Integrative Application</b> <b>Software Example</b>
<b>Command-Based</b> Syntax and semantics	Mouse click on button to delete a sentence	Mouse click on a button to enter a transaction
<b>Tool Procedural</b> Combining commands to do generic tasks	Create a document	Create a transaction
<b>Business Procedural</b> Application of tool procedures to a task	Do a mail merge (produce letters for a group of people)	Query the database for other functional transactions
<b>Tool Conceptual</b> The big picture of what to do with the tool	Productivity tool	Workflow tool
<b>Business Motivational</b> What can the tool do for the trainee and the organization	Raises my skill level, I can do more in my job, my company can raise productivity	Enables consistent transactions across organizational functions
<b>Meta-Cognition</b> Learning to learn	Teach learners to recognize and use a visual-kinesthetic pattern	Teach learners to use the learning cycle in exercises

The same framework has already been used in an experiment by Coulson (2002) to develop more effective ERP training strategies. A total of 77 senior undergraduate business students that were divided into two groups participated in the study. One group, covering the first three knowledge levels in the framework, received procedurally oriented training; the other group, in addition to similar procedural training, received a tool conceptual advanced organizer covering the fourth knowledge level in the framework through the introduction to ERP workflow concepts. Empirical results indicated that by adding a conceptual organizer to the training the end users developed more accurate mental models of the system.

Building upon this framework to develop a model of collaborative application training for commercial software packages, such as Lotus Notes and Microsoft Exchange, Kang and Santhanam (2002) presented a different user knowledge level framework composed of three types of use required for an effective application use: Application Knowledge, Business Context Knowledge and Collaborative Task Knowledge. The first two types of use are adapted from Sein, Bostrom et al. (1999)'s framework by encompassing several levels of knowledge as shown in Figure 3.2. The last one, Collaborative Task Knowledge, is motivated by specific findings of their study and refers to the knowledge that "should enable users to assess the collective consequences of their individual ways of using a collaborative application in the context of a business process" (p.24).

Following a similar approach, this study elects three types of knowledge as important in building required capabilities to engage in exploratory use. However, a different distribution for the original knowledge levels is considered to get a better understanding of their impact on exploratory use while preserving a parsimonious set of constructs. It can be argued that the meta-cognition level is covered by the construct of general computer self-efficacy. The remaining

levels of knowledge are distributed into the following proposed constructs: Procedural Knowledge, Application Conceptual Knowledge, and Business Context Knowledge. An explanation of each one follows.



(from Kang and Santhanam 2002)

**Figure 3.2: Model of Collaborative Application Training**

### **Procedural Knowledge**

Procedural Knowledge encompasses Command-based, Tool Procedural, and Business Procedural Knowledge from Sein, Bostrom et al. (1999)'s framework. It is defined as *the understanding of the syntax and semantics of the application commands, how to combine them, and how to use them to support a task*. This is the basic type of knowledge that is conveyed to users and usually the focus of training. Without this level of knowledge, users would be mimicking keystrokes and would stop at the first error encountered. Proficiency on procedural knowledge is likely to make easier the navigation through the system when looking for new functionalities or new information given the similarities in the way commands are executed and menus are structured across the several modules that comprise an ERP system. Thus,

*H7: Procedural Knowledge has a positive effect on Perceived Ease of Exploratory Use.*

This same type of knowledge is expected to increase the confidence user will have on his capabilities to engage in exploratory use of IT since there is usually many similarities in the way commands are used across different tools. Thus, it is hypothesized

*H8: Procedural Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.*

### **Application Conceptual Knowledge**

Application Conceptual Knowledge corresponds to the Tool Conceptual Knowledge from Sein, Bostrom et al. (1999)'s framework. Therefore, it is defined as *the understanding of the business processes mapped in the system to know the big picture of what to do with the application*. Contrasting with Kang and Santhanam (2002) that consider together command-based knowledge, tool procedural knowledge and tool conceptual knowledge under Application Knowledge, this study considers it relevant to distinguish between the conceptual and procedural components of the application knowledge as supported by Coulson (2002)'s findings. In general, training focuses on procedural knowledge leaving out the conceptual one. However, training should “give users a good conceptual understanding of the system they are using” (Kalen and Allwood 1991) in (Venkatesh 1999). Even though procedural knowledge may be enough for transactional user training in routine use, it is not likely to be enough for exploratory use.

ERP Systems are well known by the “best-practices” they provide. Based on the ERP vendor's analysis of key business processes of successful organizations in a particular sector, logic of work is embedded in the tool for that sector of the business. Understanding these “best practices”, understanding the workflows suggested in the ERP system, having a clear picture of how to take advantage and how to suggest modifications to them comes from mastering the

conceptual knowledge of the ERP system. By providing a big picture of the business processes embedded in the tool, application conceptual knowledge makes it easier to know where to look for and how to take advantage of the myriad of functionalities, therefore increasing the usefulness of engaging in exploratory use. Accordingly, it is expected that

*H9: Application Conceptual Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.*

In understanding the big picture, knowing where to look to find new functionalities or new information is likely to become easier, reducing the perceived difficulty when engaging in exploratory use. Therefore,

*H10: Application Conceptual Knowledge has a positive effect on Perceived Ease of Exploratory Use.*

In addition, understanding conceptually how different parts of the system connect and depend upon each other leads users to better understand the complexity and increase their capabilities in dealing with it. Thus,

*H11: Application Conceptual Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.*

### **Business Context Knowledge**

Business Context Knowledge is defined as *the understanding of the business processes and their interdependencies*. Although recognizing that Task Collaborative Knowledge is crucial in ERP systems, given the task interdependencies, there is no need to create a new knowledge level: Business Context Knowledge definition covers also the Task Collaborative Knowledge. Users get a global and thorough view of the business processes through Business Context Knowledge. This understanding leaves them aware of how changes in their activities may impact

other's activities, how to avoid conflicts, how to identify opportunities to increase performance, and ultimately how to recognize which system functionalities should be embedded in the work practices. Since Business Context Knowledge is the knowledge about the business processes that makes clear what tasks may benefit from which IT functionalities and why, an increase in perceived usefulness of exploratory use is likely to be experienced. That perceived usefulness comes from the recognition that engaging in exploratory use is potential beneficial for the user, the work group, and the organization, because it can lead to embedding new IT functionalities into work practices or uncovering new types of information.

*H12: Business Context Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.*

### **3.4.2 Motivation**

It may not be easy or even desirable having all users explore the system by making that activity part of their usual duties on the job. It is enough that a few users explore and disseminate the findings to the others. Having the managers mandating these elected users to perform that behavior requires first knowing what to ask and second, who to ask. It would be more desirable to see the users step forward to engage in exploratory use, on a voluntary basis, seeking to improve their own performance or their work group's performance. This means looking at exploratory use as an extra-role behavior, a discretionary behavior, something that is not required or expected as part of user's habitual duties, but that is desirable. This behavior requires motivation.

Besides the knowledge levels already identified as important capabilities to engage in exploratory use what other constructs are more likely to express an innate motivation to explore

the system? To answer this question, a survey of candidate constructs in the management literature yields psychological ownership as worthy of consideration.

### **Psychological Ownership**

Psychological ownership differs from formal ownership: whereas formal ownership refers to a legal, financial possession of something, psychological ownership refers to a state of mind. “Psychological ownership” is defined as *the state of mind in which individuals feel as if a material or immaterial target of ownership or part of it is theirs* (Pierce, Rubenfeld et al. 1991).

The exploratory use of an ERP system may be regarded as “extra-role behavior”. In-role behavior is defined as “behavior, which is required or expected as part of performing the duties and responsibilities of the assigned role” (Van Dyne, Cummings et al. 1995). Extra-role behavior is defined as “behavior which benefits the organization and/or is intended to benefit the organization, which is discretionary and which goes beyond existing role expectations” (Van Dyne, Cummings et al. 1995). Thus, exploratory use can be seen as extra-role behavior because the users make constructive work efforts to go beyond what is required and expected without any kind of formal incentives.

Psychological ownership has been associated with high levels of motivation including the performance of extra-role behaviors (Pierce, Rubenfeld et al. 1991; Pierce, Kostova et al. 2001). The link has been empirically confirmed in a study involving university housing cooperatives that shows a higher impact of psychological ownership than satisfaction on extra-role behaviors (Vandewalle, Dyne et al. 1995). By the same token, a positive impact of psychological ownership on exploratory use, regarded as extra-role behavior, is posited.

Psychological ownership is a state of mind that increases the motivation of users to engage in constructive proactive acts like the exploration of the ERP system. Giving a sense of

control, of shared responsibility, psychological ownership leads users to a self-investment of their time and skills for the benefit of their group or organization. The more the individual identifies with the system, the more the individual will be willing to explore the system.

Therefore

*H13: Psychological Ownership has a positive effect on Intention to Explore.*

According to TRA, external variables impact behavior through the mediation of individual's cognitive beliefs. Psychological ownership as an intrinsically motivating state may be understood as an external variable that leads to exploratory use through perceived usefulness of exploratory use.

Users who develop psychological ownership of a complex information technology like an ERP will be willing "to go the extra mile" and invest the self into the ERP system by exploring its potential. The higher discretion that the complexity of ERP systems allows makes it more likely for individuals to invest more of their own ideas (Pierce, Kostova et al. 2001) by exploring the system. Users are more likely to search for and find reasons to see the exploration of the system as useful. Accordingly,

*H14: Psychological Ownership has a positive effect on Perceived Usefulness of Exploratory Use.*

### **3.5 Control variables**

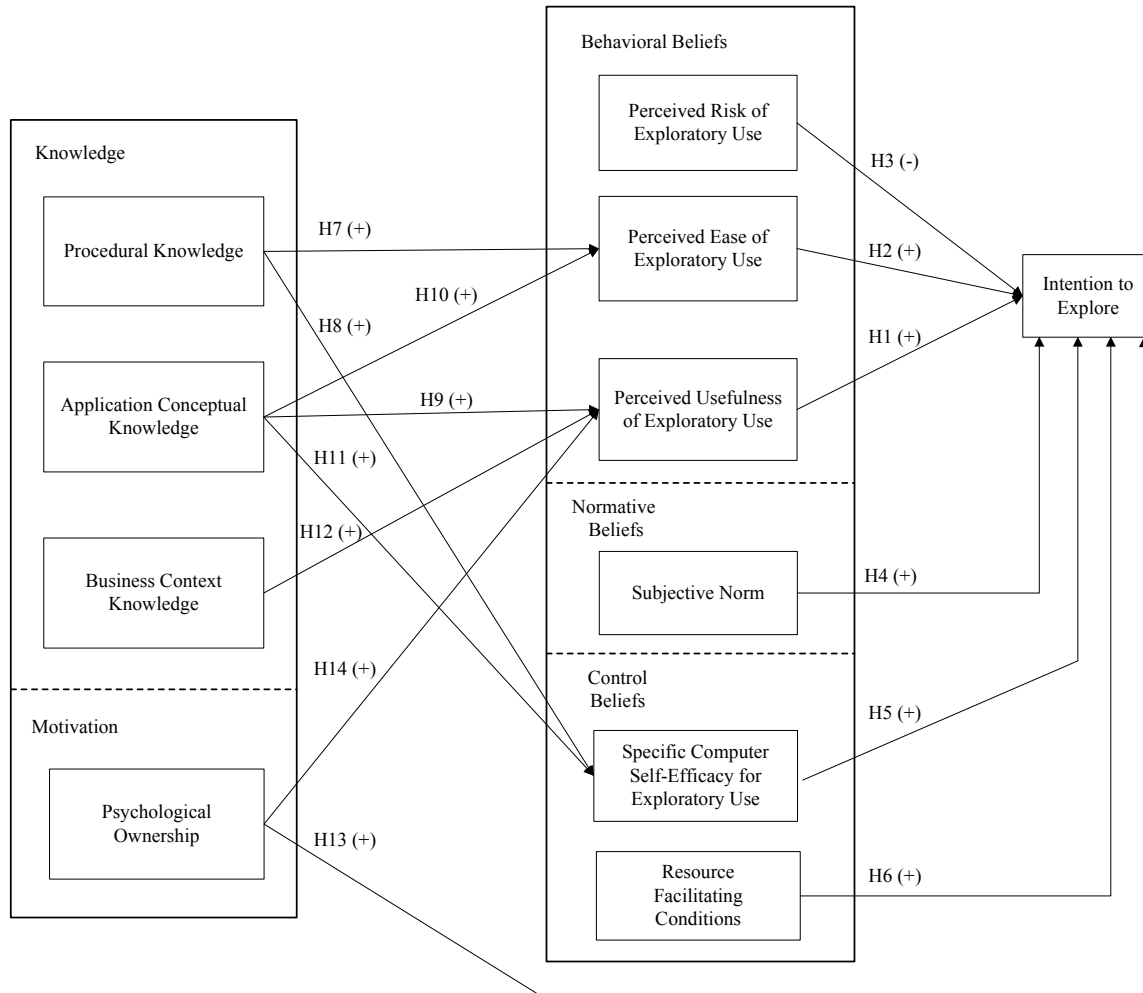
#### **3.5.1 Voluntariness**

Voluntariness as already been mentioned as a variable worth to control for to account for the perceived non-voluntary exploratory use. Past studies suggest that the effect of subjective norm on intention to explore is more likely to occur in mandatory settings. To control for the type of setting, voluntariness is introduced.

### **3.5.2 *Personal Innovativeness in the IT domain***

Personal innovativeness in the domain of information technology (PIIT) is defined as “*the willingness to try out any new information technology*” (Agarwal and Prasad 1998). Developed and validated in the context of the innovation represented by World-Wide Web, PIIT is regarded as an individual trait. It is expected to be stable across different types of information technology. PIIT has been linked to cognitive absorption with an information technology (Agarwal and Karahanna 2000) and to general computer self-efficacy beliefs. Individuals with higher personal innovativeness in IT are more prone to take risks such as exploring a complex technology. They are more willing to experiment with any new information technology.

The resulting research model is presented in Figure 3.3.



**Figure 3.3: Research Model**

## CHAPTER

### 4 RESEARCH DESIGN

#### 4.1 Method

The research model described in the previous chapter has been developed looking at specific bodies of literature in the social psychology, management information systems, marketing and management that provide support for testable hypotheses regarding the exploratory use of complex technologies. The researcher's experience in the educational environment with SAP (the ERP market leader) software package helps to confirm to the face validity of the research model. In addition, the researcher has interviewed some users to increase that face validity. However, the key test of the model was a cross-sectional field study using a survey for data collection.

#### 4.2 Unit of Analysis

This is a study at the individual level of analysis –the ERP user. An ERP user may refer to several types of users as defined by SAP (Sein, Bostrom et al. 1999): a transactional user (a user who will use the system to carry out specific transactions), a casual user (a user who will use the system to retrieve information) and a power user (a user who has strong knowledge of the system and can act as an interface between the project team and the users). Although exploratory use is more likely to happen with power users, there is no reason at this point to exclude the other types of users. In fact, power users may emerge from the other user types.

### 4.3 Research Setting

The target population comprised any individual that interacted with an ERP system in a regular or casual basis after the system had been implemented. To get to potential respondents, the following sources have been used:

- Portuguese SAP users group;
- Personal contacts the researcher had, in particular, with Portuguese organizations that have implemented ERP systems;

### 4.4 Instrument Development

To the extent possible, the constructs have been operationalized with measurement items that were drawn from validated instruments in the literature and worded according to the specific context of this study. For the constructs without instruments in the literature, measurement items were developed based on the conceptual definitions introduced during the research model development.

Table 4.1 presents the distribution for the instruments that have been used without any modification, the instruments that have adapted from other contexts, and the instruments that have been developed from scratch as well as the sources.

#### 4.4.1 *Instruments used*

Personal Innovativeness in IT (PIIT) was the only instrument used without any modification. PIIT was defined as “the willingness to try out new information technology”. Since it is a personal characteristic regardless of the information technology under study, there was no need for changes (Table 4.2).

**Table 4.1: Construct Roots and Instrument Development**

<b>Construct</b>	<b>Root Construct</b>	<b>U</b>	<b>A</b>	<b>D</b>
<b>Dependent Variable</b>				
Intention to Explore	(Nambisan, Agarwal et al. 1999)		X	
<b>Behavioral Beliefs</b>				
Perceived Risk of Exploratory Use	(Dowling and Staelin 1994)			X
Perceived Ease of Exploratory Use	(Davis 1989)		X	
Perceived Usefulness of Exploratory Use	(Davis 1989)		X	
<b>Normative Beliefs</b>				
Subjective Norm	(Venkatesh and Davis 2000)		X	
<b>Control Beliefs</b>				
Specific Computer Self-Efficacy	(Compeau and Higgins 1995, 1999)		X	
Resource Facilitating Conditions	(Ajzen and Madden 1986)			X
<b>Knowledge Types</b>	(Sein, Bostrom et al. 1999)			
Procedural Knowledge				X
Application Conceptual Knowledge				X
Business Context Knowledge				X
<b>Motivation</b>				
Psychological Ownership	(Dyne and Pierce 2002)		X	
<b>Control Variables</b>				
Voluntariness	(Moore and Benbasat 1991)		X	
Personal Innovativeness in IT	(Agarwal and Prasad 1998)	X		
	<b>U – Instruments Used</b>	<b>1</b>		
	<b>A – Instruments Adapted</b>		<b>7</b>	
	<b>D – Instruments Developed</b>			<b>5</b>

**Table 4.2: Items for Personal Innovativeness in Information Technology**

Original Items Used (Agarwal and Prasad 1998)
If I heard about a new information technology, I would look for ways to experiment with it.
Among my peers, I am usually the first to try out new information technologies.
In general, I am hesitant to try out new information technologies.
I like to experiment with new information technologies.

#### **4.4.2 Instruments adapted**

The following tables present the modifications made to original items whenever validated instruments were found that could be adapted to for this study. That was the case for more than half of the constructs: Intention to Explore, Perceived Ease of Exploratory Use, Perceived Usefulness of Exploratory Use, Subjective Norm, Specific Computer Self-Efficacy for Exploratory Use, Psychological Ownership, and Voluntariness. As recommended by the Theory of Reasoned Action, studies need to be specific as possible as the target behavior of interest. Therefore, all the measurement items were adapted having that recommendation in mind.

#### **Intention to Explore**

Intention to explore, the dependent variable, is defined as “willingness and purpose to explore a new technology”. When contextualized for ERP systems, intention to explore becomes “user’s willingness and purpose to find new ways of applying the ERP system to work tasks”.

The items for the dependent variable have been slightly changed to fit into the context. Explicit references to the technology (ERP systems) were made, time frames (six months and

couple of months) added and the word “explore” has been removed in the first and second items following Ajzen and Madden (1986) recommendations to be specific. In the second original item, “enhancing the effectiveness of my work” was left out since it is something that Perceived Usefulness already covers. In the first and second item, the word “explore” was replaced by something that could better explain what “exploring” means (Table 4.3).

**Table 4.3: Items for Intention to Explore**

<b>Original Items (Nambisan, Agarwal et al. 1999)</b>	<b>Items Used</b>
I intend to explore new IT for potential application in my work context.	Over the next six months, I intend to search for new ways to use the system in my work context.
I intend to explore new IT for enhancing the effectiveness of my work.	Over the next six months, I intend to look for new functionalities and/or new information in the ERP.
I intend to spend considerable time and effort this year in exploring new IT for potential applications.	I intend to spend considerable time and effort in the next couple of months exploring the ERP for potential applications.

### **Perceived Ease of Exploratory Use**

Perceived Ease of Exploratory Use was defined as “the belief that looking for new ways of using the system is possible without having great difficulty”. Drawing upon Davis (Davis 1989)’s instrument for perceived ease of use, modifications were made having in mind the technology (ERP systems) and the behavior (exploring, looking for new ways) (Table 4.4).

**Table 4.4: Items for Perceived Ease of Exploratory Use**

<b>Original Items (Davis 1989)</b>	<b>Items Used</b>
My interaction with CHART-MASTER would be clear and understandable.	The ERP system is clear and understandable enough to facilitate my looking for new ways to use it.
Learning to operate CHART-MASTER would be easy for me.	Finding new ways to use the ERP system does not require much of my mental effort.
I would find CHART-MASTER easy to use.	I find the ERP system easy to explore when I am looking for new ways of using it.
I would find CHART-MASTER easy to use.	I find it easy to look for new ways to use the ERP system.

### **Perceived Usefulness of Exploratory Use**

Perceived Usefulness of Exploratory Use was defined as “the belief that looking for new ways of using an application has a good potential to lead to greater effectiveness in one’s work system”. Instead of the words “would find, would increase, would enhance”, “has the potential for” has been used. Exploring the system is getting in unknown territory. There is less guarantee of usefulness when exploring the system than when using the system. Therefore, “has the potential” expresses better that likelihood (Table 4.5).

### **Subjective Norm**

Subjective Norm was defined as “a person’s perception that most people who are important to him think he should or should not perform the behavior in question.” The original instrument by Venkatesh and Davis (2000) was slightly modified to accommodate exploratory use instead of just use. Instead of just two items, another item under the same conceptual

underpinnings was added to prevent future problems when using structural equation modeling for data analysis (Table 4.6).

**Table 4.5: Items for Perceived Usefulness of Exploratory Use**

<b>Original Items (Davis 1989)</b>	<b>Items Used</b>
I would find CHART-MASTER useful in my job.	My looking for new ways of using the ERP has the potential to uncover something useful for the organization.
Using CHART-MASTER in my job would increase my productivity.	My exploration of ERP functionalities has the potential to increase the productivity of the organization.
Using CHART-MASTER would enhance my effectiveness on the job.	My searching for different ways of using the ERP system has the potential to enhance the effectiveness in my organization.
I would find CHART-MASTER useful in my job.	My exploration of the ERP system for new information or new functionality is potentially useful for the organization.

### **Specific Computer Self-Efficacy for Exploratory Use**

Specific Computer Self-Efficacy was defined as “an individual’s judgment of efficacy in a specific computer application domain (e.g., ERP systems) to perform exploratory use.” From the ten-item instrument proposed by Compeau and Higgins (1995) and used again by Compeau, Higgins et al. (1999), two items were only selected (Table 4.7).

The criteria were to reduce a rather lengthy instrument while stressing the confidence of the user to perform the behavior without any help. Any reference to help or to available time as

happened in other items of the instrument was to be covered by another construct in this study, Resource Facilitating Conditions (Table 4.11).

**Table 4.6: Items for Subjective Norm**

<b>Original Items (Venkatesh and Davis 2000)</b>	<b>Items Used</b>
People who influence my behavior think I should use the system	People who influence my behavior in the organization encourage me to explore new ways of using the ERP system.
	People whose opinion I value think I should look for new ways of using the ERP system.
People who are important to me think that I should use the system.	People who are important to me are supportive of my looking for new ways of using the ERP system.

**Table 4.7: Items for Specific Computer Self-Efficacy for Exploratory Use**

<b>Original Items (Compeau and Higgins 1995; Compeau, Higgins et al. 1999)</b>	<b>Items Used</b>
I could complete the job using the software package if I had never used a package like it before.	I feel capable of exploring areas of the system I hadn't used before.
I could complete the job using the software package if there was no one around to tell me what to do as I go.	<p>If I wanted to, I could easily figure out how to use new functionalities on my own, at least in certain areas of the ERP system.</p> <p>For those parts of the system I know the best, I have confidence I would be able to figure out new ways of using the system, even if there was no one around to show me how to do it.</p>

### **Psychological Ownership**

Psychological Ownership was defined as “the state of mind in which individuals feel as if a material or immaterial target of ownership or part of it is theirs”. Three criteria were taken in account for adapting the original items to the specific context. First, given the high number of measurement items in the whole study, unless necessary, a reduced number of items is targeted for each measure that is adapted from a validated instrument. Thus the original seven-item instrument (Dyne and Pierce 2002; Dyne and Pierce 2004) was reduced to a five-item instrument. Second, Portugal was identified as a collectivistic country where the levels of psychological ownership were significantly higher when captured by words such as “we” and “our” (Pierce, Kostova et al. 2003). Thus emphasis was given to such set of words instead of using “I” and “mine” when adapting the items (Table 4.8).

### **Voluntariness of Exploratory Use**

Voluntariness of Exploratory Use was defined as “the extent to which users perceive the search for new ways of using the system to be voluntary”. Drawing upon Moore and Benbasat (1991)’s instrument for voluntariness on adoption of Personal Work Stations (PWS) by individuals, a new instrument was developed. Their suggestion for inclusion in any “short” scale of two among the four original items was followed (the last two items in Table 4.9). In addition, a third item was considered to have at least a minimum of three items for the scale in case measurement problems happen. Once again, the items had to be reworded having in mind a different context.

**Table 4.8: Items for Psychological Ownership**

<b>Original Items</b> <b>(Dyne and Pierce 2002; Dyne and Pierce 2004)</b>	<b>Items used</b>
This is MY organization.	I identify myself with this ERP system.
I sense that this organization is OUR company.	I sense that this ERP system is OUR system.
I feel a very high degree of personal ownership for this organization.	
I sense that this is MY company.	
This is OUR company.	This is OUR system.
Most of the people that work for this organization feel as though they own the company.	Most of the people that work with this ERP system feel that this is our system.
It is hard for me to think about this organization as MINE.	It is hard for me to think about this ERP system as OURS.

**Table 4.9: Items for Voluntariness of Exploratory Use**

<b>Original Items</b> <b>(Moore and Benbasat 1991)</b>	<b>Items used</b>
My superiors expect me to use a PWS.	
My use of a PWS is voluntary (as opposed to required by my superiors or job description).	I am not required to search for new ways of using the system as a part of my job.
My boss does not require me to use a PWS.	My supervisor/manager does not require me to look for new ways of using the system.
Although it might be helpful, using a PWS is certainly not compulsory in my job.	Although it might be helpful, searching for new ways to use the system is certainly not compulsory in my job.

### 4.4.3 *Instruments developed*

Items for the other half of the constructs were developed from scratch but under the conceptual underpinnings provided by the literature: Perceived Risk of Exploratory Use, Resource Facilitating Conditions (Assistance and Time), Procedural Knowledge, Application Conceptual Knowledge and Business Context Knowledge.

#### **Perceived Risk of Exploratory Use**

Perceived Risk of Exploratory Use was defined as “the chance of inadvertently changing something in the system with negative consequences for the organization while looking for new functionalities or new information.” Since no adequate and validated measure was found in the literature for this specific context of study, an instrument was developed based on conceptual underpinnings (Bauer 1960; Derbaix 1983; Dowling and Staelin 1994) that make salient two dimensions in the concept of perceived risk: uncertainty of the outcome and adverse consequences of making a mistake (Table 4.10).

**Table 4.10: Items for Perceived Risk of Exploratory Use**

<b>Developed items (conceptual underpinnings from Bauer 1960; Derbaix 1983; Dowling and Staelin 1994)</b>
I have to worry about negative consequences while exploring new functionalities or new information in the ERP system even when I am careful not to change anything important.
It is risky to look into new ways of using the ERP system because I might inadvertently change something important, with possible unpleasant consequences.
It is dangerous to look for new functionalities or new information since my unintentional changes may lead to negative outcomes.

## Resource Facilitating Conditions

Resource Facilitating Conditions was defined as *objective factors “out there” in the environment that make easy to perform a behavior*. Available time and assistance have been identified as facilitating conditions that are likely to be significant to engage in exploratory use (Table 4.11).

**Table 4.11: Items for Resource Facilitating Conditions**

Resource	Developed Items (conceptual underpinnings from Azjen and Madden 1986)
Assistance	I have the technical support that I need to look for new functionalities or new information in the ERP system.
	When looking for new ways of using the system, I have someone whom I can ask for assistance.
	I can rely on someone when facing problems while exploring the ERP system.
Available Time	I have the time I need to look for new ways of using the ERP system.
	I am too busy to explore new ways of using the ERP system.

## Knowledge types

Three types of knowledge have been identified as significant key factors that may impact the primary belief determinants of exploratory use. Since no validated measures have been found in the literature, drawing upon Sein, Bostrom et al. (1999)’s framework, measurement items were developed for each of the three types of knowledge.

Procedural Knowledge was defined as “the understanding of the application commands, menus and screens, how to combine them, and how to use them to complete a job task.”

Table 4.12 presents the developed measurement items. According to the area to which the respondent belongs.

**Table 4.12: Items for Procedural Knowledge**

<b>Developed items (conceptual underpinnings from Sein, Bostrom et al. 1999)</b>
I understand how to use the commands and menus that are available to me in the ERP system (for example, in Materials Management).
I understand how to combine the ERP commands, menus and screens (for example, in Materials Management) to accomplish a job task.
I understand how to access the ERP data (for example, in Materials Management) needed to perform the necessary work.
I know how to use the functionalities in the ERP system (for example, in Materials Management) to complete the necessary job tasks.

Application Conceptual Knowledge was defined as “understanding the workflow of the business processes mapped in the ERP system to know the big picture of what to do with the system”. Table 4.13 presents the developed measurement items for Application Conceptual Knowledge.

Business Context Knowledge was defined as “the understanding of the business processes and their interdependencies across the organizational functions.” Table 4.14 presents the developed measurement items for Business Context Knowledge.

#### **4.4.4 Additional variables**

Additional variables were included in the survey to account for characteristics of the ERP system, types of usage and demographic details among other things:

- a) ERP system (what system, modules in use);
- b) User's role on ERP implementation (part of the team, interaction with implementation team);
- c) User's ERP experience (years of use, weekly average usage);
- d) User's ERP types of usage (routine, non-routine, taught vs. not taught, requested vs. voluntary);
- e) User's organization (industry, size, revenues);
- f) User's job (position, reporting relationships);
- g) User's personal data (age, gender, education level).

**Table 4.13: Items for Application Conceptual Knowledge**

Developed Items (conceptual underpinnings from Sein, Bostrom et al. 1999)
I understand how the way in which I use an ERP module affect others' work that use the same module.
I understand how my use of an ERP module affects people's work in other ERP modules.
I understand how work processes in the ERP modules I use flow through the ERP system and how they may affect other modules.
I understand how things I do with the ERP system can affect the work in other parts of the business.

#### 4.5 Pre-testing

To validate the developed instrument, a pre-test was conducted. Before submitting the instrument to a formal pre-testing, other researchers were asked to critically review it. The resulting version was then administered through the Web to selected ERP users while

interviewing them on the phone. Users were asked to “think aloud” during the telephone interview while they were going over the survey.

**Table 4.14: Items for Business Context Knowledge**

<b>Developed Items</b> (conceptual underpinnings from Sein, Bostrom et al. 1999)
I understand how our work in Purchasing contributes to important processes in the organization.
I understand how the work we do in Purchasing relates to tasks in other parts of the business.
I have a good understanding of the big picture of what is important in this business.
I understand how work in my area contributes to the overall success of my organization.

The research evolved from the pre-testing to the data collection without going through a pilot survey. A pilot survey would have wasted subjects in a population where was already hard to find enough respondents to fill the survey. To counterbalance the absence of a pilot test and avoid hurting the construct validity and the reliability, extra effort was put on the pre-testing. Although data collection procedures could not be checked in a pilot survey, proper tests were developed to assure that the right procedures were in place for the data collection.

To pre-test the instrument, a sort-card methodology was adopted (Moore and Benbasat 1991). The goal is to minimize the potential for interpretational confounding by assuring the face validity of the measures. The judges are presented with randomly shuffled items and asked to sort them into categories according to the definitions provided (Appendix A).

This is an iterative process requiring as many rounds as necessary to reach acceptable reliabilities. Each round requires a new set of judges. Items may be refined, dropped or added

according to the assessed reliabilities after each round. After each round, the reliability of the sorting is assessed through the following measures:

- a) Kappa scores (Cohen 1960): level of agreement between pairs of judges
- b) Overall frequency with which all judges placed items within the intended theoretical construct

An initial set of 55 measures to assess 13 constructs was under analysis (Table 4.15).

**Table 4.15: Items per construct**

<b>Research Model Area</b>	<b>Construct</b>	<b>Number Of Items</b>
Dependent Variable	Intention to Explore	3
Behavioral Beliefs	Perceived Risk of Exploratory Use	3
	Perceived Ease of Exploratory Use	4
	Perceived Usefulness of Exploratory Use	4
Normative Beliefs	Subjective Norm	3
Control Beliefs	Specific Computer Self-Efficacy	3
	Resource Facilitating Conditions	5
Knowledge Types	Procedural Knowledge	6
	Application Conceptual Knowledge	6
	Business Context Knowledge	6
Motivation	Psychological Ownership	5
Control Variables	Voluntariness	3
	Personal Innovativeness in IT	4
	<b>13 constructs</b>	<b>55</b>

For a first round, only the six measures that had some potential for confounding interpretations given the closeness of the concepts are considered: first, the set of three knowledge constructs that have been developed from scratch (Procedural, Application Conceptual and Business Knowledge); second, the Perceived Ease of Exploratory Use and the Specific Computer Self-Efficacy for Exploratory Use since they are linked concepts; third, Perceived Usefulness of Exploratory Use, since this construct usually appears in studies where Perceived Ease of Use is present as well.

Three judges, with a Management of Information Systems educational background, two at the undergraduate level and one at the graduate level, participated in this first round. The average level of agreement (kappa score) of the sorting process was 0.66 (Table 4.16).

**Table 4.16: Kappa scores for the first sorting round**

First Judge	Second Judge	Kappa
A	B	0.71
A	C	0.67
B	C	0.59
<b>Average</b>		<b>0.66</b>

Landis and Koch (1977) have proposed a scale for interpreting the level of agreement: 0.21-0.40, “Fair”; 0.41-0.60, “Moderate”; 0.61-0.80, “Substantial”; 0.81-1.00, “Almost perfect”. According to this scale, a moderate agreement among judges was achieved.

The other measure used to assess the reliability, the overall item placement ratio, reaches 80%. Looking at the individual constructs, two of them (Business Context Knowledge and Perceived Usefulness of Exploratory Use) had all items placed by all judges as intended

(Table 4.17). Perceived Ease of Exploratory Use and Procedural Knowledge had the worst overall hit ratio (67%).

For the remaining four constructs (Application Conceptual Knowledge, Procedural Knowledge, Perceived Ease of Exploratory Use, and Specific Computer Self-Efficacy for Exploratory Use) that did not reach 100% agreement (Table 4.17), the items at the root of the disagreement were carefully examined and a total of 13 items were reworded for better interpretation (Appendix B).

**Table 4.17: Item placement ratios for the first sorting round**

**(Total Item Placements: 87; Hits: 70; Overall Hit Ratio: 80%)**

Actual Construct		PK	ACK	BCK	SCSE	PEEU	PUEU		
Target Construct								Tot.	%
Procedural Knowledge	PK	12	2		2	2		18	67%
Application Conceptual Knowledge	ACK	1	13	2	2			18	72%
Business Context Knowledge	BCK			18				18	100%
Specific Computer Self-Efficacy	SCSE				7	2		9	78%
Perceived Ease of Exploratory Use	PEEU	2			2	8		12	67%
Perceived Usefulness of Exploratory Use	PUEU						12	12	100%

For the second round, a new set of four judges was selected: one MIS undergrad, one MIS PhD student, one Finance PhD student and one MIS faculty. This time all the thirteen constructs were subjected to the sorting process, but in two sets. The first set is the same as the one used in the first round except that Perceived Usefulness of Exploratory Use has been replaced by Resource Facilitating Conditions, a construct also close to Perceived Ease of

Exploratory Use. The second set comprises the remaining seven constructs. The reliability results expressed in Kappa scores are presented in Table 4.18. Tables 4.19 and 4.20 present the item placement ratios for both sets in the second sorting round.

**Table 4.18: Kappa scores for the second sorting round**

First Judge	Second Judge	Kappa 1st set	Kappa 2nd set
A	B	0.72	1.00
A	C	0.80	1.00
A	D	0.60	0.96
B	C	0.80	1.00
B	D	0.80	0.96
C	D	0.72	0.96
<b>Average</b>		<b>0.74</b>	<b>0.98</b>

**Table 4.19: Item placement ratios for the first set in the second sorting round**

**(Total Item Placements: 120; Hits: 103; Overall Hit Ratio: 86%)**

Actual Construct									
Target Construct		PK	ACK	BCK	SCSE	PEEU	RFC	Tot.	%
Procedural Knowledge	PK	21	1		2			24	88%
Application Conceptual Knowledge	ACK	2	19		1	2		24	79%
Business Context Knowledge	BCK		2	22				24	92%
Specific Computer Self-Efficacy	SCSE				10	2		12	83%
Perceived Ease of Exploratory Use	PEEU				2	14		16	88%
Resource Facilitating Conditions	RFC				1	2	17	20	85%

**Table 4.20: Item placement ratios for the second set in the second sorting round****(Total Item Placements: 99; Hits: 98; Overall Hit Ratio: 99%)**

Actual Construct		PUEU	PO	SN	VEU	PREU	PIIT	IE	Tot.	%
Target Construct										
Perceived Usefulness of Explorat. Use	PUEU	16							16	100%
Psychological Ownership	PO		20						20	100%
Social Norms	SN			12					12	100%
Voluntariness of Exploratory Use	VEU				12				12	100%
Perceived Risk of Exploratory Use	PREU					12			12	100%
Personal Innovativeness in IT	PIIT	1					15		16	94%
Intention to Explore	IE							12	12	100%

Assessed for the first time for the second set, the average kappa score is 0.98, an “almost perfect” score. The overall hit ratio is 99%. However, for the first set, the average kappa score is at a substantial degree of concordance: the score has improved from 0.66 to 0.74. “Almost perfect” was the target. Although there was an improvement for all constructs that had items reworded, we wanted even better. Thus items were examined again and reworded to be submitted to a new sorting round.

This time since Application Conceptual Knowledge and Procedural Knowledge had both six measurement items each there was room to remove the worst items. Each of the constructs had two items removed. Rewording took place for six items. Perceived Ease of Exploratory Use and Specific Computer Self-Efficacy had just some items reworded.

For the third sorting round, a new set of four judges was selected: three MIS PhD students and one MIS faculty. Despite the good results for the second set in the previous round, both sets were again submitted to this third sorting round.

Excellent results were obtained in the third sorting round (Tables 4.21, 4.22 and 4.23). The very good results obtained for the second set in the previous round were confirmed. The average kappa score was confirmed at 0.98 (Table 4.21) and the overall hit ratio at 99% (Table 4.23).

Very good results were also obtained for the first set this time. The average kappa score for the first set improved from 0.74 to 0.88, placing the degree of concordance at an “almost perfect” level (Table 4.21). The overall hit ratio increased from 86% to 95% (Table 4.22). The worst hit ratio was now 88%.

**Table 4.21: Kappa scores for the third sorting round**

First Judge	Second Judge	Kappa 1st set	Kappa 2nd set
A	B	0.90	1.00
A	C	0.96	1.00
A	D	0.85	0.95
B	C	0.88	1.00
B	D	0.79	0.95
C	D	0.90	0.95
<b>Average</b>		<b>0.88</b>	<b>0.98</b>

In summary, considerable improvement in reliability as assessed by kappa scores and overall placement ratios (Table 4.24) resulted from these three rounds. “Almost perfect” concordance has been achieved among the judges for both sets with overall hit ratios near 100%.

The level of agreement and overall hit ratios achieved provided the necessary confidence to proceed to the administration of the instrument without going through a pilot test.

**Table 4.22: Item Placement Ratios for the first set in the third sorting round****(Total Item Placements: 96; Hits: 91; Overall Hit Ratio: 95%)**

Actual Construct		PK	ACK	BCK	SCSE	PEEU	RFC		
Target Construct								Tot.	%
Procedural Knowledge	PK	15	1					16	94%
Application Conceptual Knowledge	ACK	1	14	1				16	88%
Business Context Knowledge	BCK			16				16	100%
Specific Computer Self-Efficacy	SCSE				11	1		12	92%
Perceived Ease of Exploratory Use	PEEU				1	15		16	94%
Resource Facilitating Conditions	RFC						20	20	100%

**Table 4.23: Item Placement Ratios for the second set in the third sorting round****(Total Item Placements: 99; Hits: 98; Overall Hit Ratio: 99%)**

Actual Construct		PUEU	PO	SN	VEU	PREU	PIIT	IE		
Target Construct									Tot.	%
Perceived Usefulness of Explorat. Use	PUEU	16							16	100%
Psychological Ownership	PO		20						20	100%
Social Norms	SN			12					12	100%
Voluntariness of Exploratory Use	VEU			1	11				12	92%
Perceived Risk of Exploratory Use	PREU					12			12	100%
Personal Innovativeness in IT	PIIT						16		16	100%
Intention to Explore	IE							12	12	100%

**Table 4.24: Kappa scores and item placement ratios summary**

		1st round	2nd round	3rd round
Kappa score	1st set	0.66	0.74	0.88
Kappa score	2nd set	---	0.98	0.98
Item Placement Ratio	1st set	80%	86%	95%
Item Placement Ratio	2nd set	---	99%	99%

#### 4.6 Instrument Administration

The researcher used his personal contacts in Portugal to get the key contact list for the SAP users in Portugal. More than a hundred organizations using SAP were identified in Portugal as well as their main contact for the ERP implementation. Some other personal contacts resulted in the participation of users from other ERP systems such as Oracle, Baan and Navision.

The survey instrument consisted of ninety-four questions divided into five sections that were expected to be answered in 20 minutes. The first section contained fourteen questions asking about the ERP system: four questions about the system itself to be considered in this study and ten additional questions about the participation in the system implementation, the training provided before and after the implementation and a global evaluation of the system to be analyzed in further studies. The second section consisted of thirty questions related to the constructs and hypothesized relationships in the research model by ticking a Lickert-type scale. The third section consisted of a maximum of five questions depending on the answers provided to assess types of usage. The fourth section consisted of another set of thirty questions related to the constructs in the research model. The fifth and last section consisted of fifteen questions

asking for demographic details about the organization, the job and personal data. Given the absence of experience with this type of surveys in the Portuguese organizations and anticipating a difficult task in getting respondents, this last section was not mandatory to be filled in. In fact, about only 20% of the respondents provided demographic data even when they were reassured that all individual data would be kept confidential and results would be presented in the aggregate form.

Data collection was performed using the Internet. Potential respondents were contacted mainly through email and asked to access the survey via Web (Appendix D).

#### ***4.6.1 Instrument Translation***

The instrument was developed in English but had to be translated into Portuguese. To assure that the instrument was conceptually equivalent in both languages, proposed guidelines were followed (Brislin 1986). From the original version in English, a Portuguese version was obtained. The rule is to get the translation in the target language done by a native speaker that understands the original language. Since the researcher is Portuguese, he translated from English into Portuguese. Then a native English speaker that writes and speaks Portuguese was asked to translate the Portuguese version back into English. The original and translated versions were compared and modified through an iterative process until the two versions were in agreement. The survey in both languages is presented in Appendix E.

#### ***4.6.2 Survey Response***

The data collection took place during six months to get 118 valid responses. The first e-mail letter (Appendix D) was sent by the end of July to the group of SAP Users in Portugal. Among the initial 477 e-mails sent to key users representing around hundred organizations, 51

were returned in error. Thus, the invitation reached 426 potential respondents asking them to participate and forward the invitation to two other users.

July may have not been the best of the times to ask for cooperation since the vast majority of people in Portugal take their family vacation in August. However, there were still a few days before the end of July and 23 responses were received by then. Only 6 responses came in August. As soon as September started, a new e-mail letter was sent thanking those respondents who have already participated and renewing the invitation to the remaining. A renewal of the invitation was sent again in the early days of November and again in January. Between the e-mail invitations to all the SAP key contacts, some personal contacts were made with some of them to reinforce the importance of participating in this study.

By the end of the data collection, 99 answers were received from users working with the SAP system. Personal contacts managed to get more 19 answers from other ERP systems' users. Table 4.25 presents the frequency distribution by ERP system.

#### **4.7 Sample Characteristics**

Since only 20% of the sample provided data on demographic details such as age, gender, education level, etc. there is no use in reporting them. However, some other demographic details that were mandatory to fill in may be reported for the whole sample such as organizational function, being part of the implementation team, experience with ERP systems, and types of usage the users engaged.

##### **Organizational Function**

The sample splits basically in two halves, one on the IT side and the other on the business side. 42% of the respondents came from the Information Technology function while the

remaining 58% came from other non-IT functions according to the frequency breakdown presented in Table 4.26.

**Table 4.25: Frequency Distribution by ERP system**

ERP System	Frequency	Percent
SAP	99	84%
4GS	6	5%
BAAN	4	3%
ORACLE	3	3%
NAVISION	1	1%
OTHER	5	4%
<b>Total</b>	<b>118</b>	<b>100%</b>

### **Part of the Implementation Team**

The majority of the respondents (75%) were on the ERP implementation team (Table 4.27). That was something expected since the invitation for participation was sent directly to the key contacts registered in the SAP Users group. It is understandable that those key contacts may have been selected from the implementation team given the knowledge and the relationships developed during the implementation process. The remaining 25% are probably the result of forwarding the invitation to other users by the key contacts.

### Experience with ERP Systems

In terms of number of years of experience with ERP systems, about half of the respondents (54%) have four or more years (Table 4.28). On average, the weekly usage of the ERP system by the respondents was 20 hours with a standard deviation of 15.

**Table 4.26: Frequency distribution by organizational function**

Activity Area	Frequency	Percent
Information Technology	50	42%
Human Resources	13	11%
Accounting	6	5%
Purchasing	6	5%
Sales	4	3%
Marketing	3	3%
Production	3	3%
Other	33	28%
<b>Total</b>	<b>118</b>	<b>100%</b>

**Table 4.27: Part of the implementation team**

Part of the Implementation Team	Frequency	Percent
No	29	25%
Yes	89	75%
<b>Total</b>	<b>118</b>	<b>100%</b>

**Table 4.28: Years of experience with ERP systems**

Years	Frequency	Percent
Less than 1	3	2%
1	6	5%
2	26	22%
3	20	17%
4	20	17%
5	22	19%
More than 5	21	18%
<b>Total</b>	<b>118</b>	<b>100%</b>

### Types of usage

To better know to what extent the users engage in different types of usage, they were first asked about the percent of time they used the ERP system in about the same way as always, i.e., using the same functionalities and the same type of information they typically used (routine usage). On average, routine usage was about three quarters (74%) of the usage time. That meant that about a quarter of the time (26%) was dedicated on average by this sample of respondents to non-routine usage (using the ERP system in a somehow different way, i.e., using either new functionalities or new types of information).

For the respondents that were involved in non-routine usage, on average, almost three quarters of that usage (70%) had not been taught. This is what may be considered exploratory usage. However, this exploratory usage may be requested or voluntary. For this percentage of time dedicated to not taught non-routine usage (exploratory usage), almost half had been requested (40%) leaving more than half of the percent of time (60%) for voluntary exploratory use. Table 4.29 presents descriptive statistics for the different types of usage.

**Table 4.29: Percentage of time by types of usage**

Type of Usage	N	Min	Max	Mean	S. D.
Non-routine usage	118	0	90	26	21
Not taught non-routine usage	118	0	100	70	34
Requested not taught non-routine usage	118	0	100	40	34

If 20 hours is the weekly average time spent on the ERP system, 5.2 hours (26%) are for non-routine usage per week. From the 5.2 hours using either new information or new functionalities, 3.6 hours (70%) are used for tasks that have not been taught (exploratory use). In summary, on average, the respondents spent 18% of the weekly usage time on exploratory use of the system, a bit more than half by their own initiative.

## CHAPTER

### 5 DATA ANALYSIS

Classical regression types of analysis are not the most appropriate to assess the relationships in the research model. These types of analysis require the separate assessment of one single relationship between each single dependent and its independent variables. However, the research model has multiple interrelated dependence relationships: a dependent variable in one relationship is an independent variable in another relationship. Regression would require sequential and repeated assessment of independent models, combined with previous and separated application of factor analysis to get the coefficients, while ignoring measurement errors. Multiple interrelated dependence relationships require a more complex approach that may take into consideration all the relationships in one comprehensive model. Structural Equation Modeling (SEM) provides us with such ability.

SEM provides a direct way of simultaneously estimating two models. The first model is a measurement model that expresses the response/observed variables as indicators of latent variables (factors). The second model is a structural model that expresses the latent variables as linear functions of one another.

Structural Equation Modeling (SEM) covers an entire family of techniques that “are distinguished by two characteristics: (1) estimation of multiple and interrelated dependence relationships, and (2) the ability to represent unobserved concepts in these relationships and account for measurement error in the estimation process (Hair, Anderson et al. 1998)”.

## 5.1 Assumptions

Like other multivariate techniques, SEM requires independence of observations, random sampling of respondents, and linearity of all relationships. As opposed to regression models that implicitly assume zero measurement error, SEM assumes that the constructs are measured with error making it part of the model. When present, the measurement error for a given indicator should be uncorrelated with the latent variable the indicator is associated with. Multivariate normality may be also a requirement, depending on the estimation procedure selected.

### 5.1.1 *Multivariate normality*

In SEM, the estimation procedure takes place through an iterative process such that some function of differences between the input and the model covariance matrices is minimized. Maximum Likelihood (ML) is the most frequently used estimation procedure in SEM. ML assumes that the variables in the model are multivariate normal, i.e., each variable under consideration is normally distributed with respect to each other variable.

Since univariate normality is a necessary condition for multivariate normality, the first step is to examine univariate distributions, skew and kurtosis, for each variable. A common rule-of-thumb test for normality is computing statistic values ( $z$ ) for skewness and kurtosis and comparing them to a critical value based on the desired significance level (Hair, Anderson et al. 1998). Appendix F presents the calculated  $z$ -values for skewness and kurtosis having divided the skewness and kurtosis by their standard errors for each observed variable. These values can be compared to a critical value such as  $\pm 1.96$  for a 0.05 significance level or  $\pm 2.58$  for a 0.01 significance level. The  $z$ -values (skewness and kurtosis) for the great majority of the variables exceed the critical value of  $\pm 2.58$ . Thus the data has to be considered non-normal. Variables such as ACK4, BCK4, PK1 or PUEU1 have  $z$ -values exceeding considerably the critical value

and thus present severe levels of non-normality. Common statistical tests of normality like the Saphiro-Wilks test and the Kolmogorov-Smirnov confirm the data non-normality by showing zero level of significance for the differences from a normal distribution.

If the univariate distributions are non-normal, then the multivariate distribution will be non-normal. In fact, testing for multivariate normality using the Mardia's test as provided by PRELIS, yields a 1.047 relative multivariate kurtosis. When the variables are multivariate normal, a zero relative multivariate kurtosis is expected. Therefore, based on tests of both univariate and multivariate normality, a significant departure from normality exists in the data for this study.

### ***5.1.2 Dealing with non-normality***

Non-normal data in this study is no reason to completely dismiss the use of the predominant estimation procedure in SEM. Despite its multivariate normality assumption, ML is recognized as robust against violations of that assumption. Even under conditions of severe non-normality, parameter estimates are still reliable. However, chi-square values tend to be inflated and standard errors tend to be deflated (Bollen 1989; Hoogland and Boomsma 1998; Boomsma and Hoogland 2001). If a proper solution can be found using ML, results will have to be interpreted having in mind chi-squares inflated and standard errors deflated. As a response to inflated chi-square values, Satorra-Bentler chi-square, which penalizes chi-square for the amount of kurtosis in the data adjusting it for non-normality can be used. In addition, there are other indicators of model fit that should be considered. Deflated standard errors can result in the relationship been found significant when in reality it is not. As a response to this problem, a more demanding test of significance may be used.

Other estimation procedures such as Unweighted Least Squares (ULS) or Asymptotically Distribution-Free (ADF) do not assume multivariate normality, but their superiority over the normal theory estimation procedures have not received strong support (Anderson and Gerbing 1988). For large models and under non-normal conditions, robust ML estimators when compared to other estimators such as Generalized Least Squares, Elliptical Reweighted Least Squares, Asymptotically Distribution-Free or Weighted Least Squares, have relatively good statistical properties (Boomsma and Hoogland 2001). Thus, ML will be used as the estimation procedure and results will be interpreted having in mind the non-normality conditions.

### **5.1.3 *Sample size***

Sample size, as the basis for estimating sample error, clearly influences the way results may be interpreted. There is no single criterion for how large the sample size should be in SEM, but there is no doubt sample size is important and has many impacts. (Hair, Anderson et al. 1998) identifies the following four factors that impact the sample size requirements: (1) model misspecification, (2) model size, (3) departures from normality, and (4) estimation procedure. First, the ability to detect the absence of a relevant construct increases when sample size increases. Second, the larger the model the larger the sample size should be. Third, the more the data deviates from normality the larger should be the sample size to reduce the impact of sampling error. Four, some estimation procedures are more demanding in terms of sample size. Although the estimation procedures work better for larger sample sizes, other problems may result from large sample sizes. For example, increasing sample size increases ML sensitivity to any difference between the data and the model, which may result in an indication of poor fit when the model is actually a good representation of reality. SEM is generally not used for sample sizes below 100. This value is usually accepted as a lower bound minimum.

Recommendations are for a sample size between 100 and 200, but again sample size is dependent on many factors.

The sample size in this study is 118. There are no missing values for the 49 observed variables that are under consideration to assess the model; a Web survey has been used preventing the respondents from leaving any question unanswered. There are also no outliers since all 49 variables were measured by selection of only allowed levels on Likert scales. 118 is certainly not the sample size we would like to perform the data analysis given the number of constructs in the model and the non-normality in the data. However, it may be still adequate depending on the way analysis is performed and results are interpreted.

## **5.2 Strategy**

SEM is essentially a confirmatory method guided more by theory than by empirical results. The ultimate goal is to assess the relationships presented in a research model that should be strongly supported by theory. However, there is no single way to achieve that goal.

One way is a single-step analysis with the simultaneous estimation of both structural and measurement models. This is the best way when the research model has both strong theoretical rationale and highly reliable measures. However, having some measures been developed from scratch, the measurement model was assessed first to make sure that it possesses highly reliable measures. In this way, the interpretability of both measurement and structural models was maximized decreasing the probability of confounding interpretations that could come from the interaction of both models, in particular, when one of the models is not strong (Anderson and Gerbing 1988).

To some extent this study was both exploratory and confirmatory, since the measurement properties for many variables have not yet been established in the literature. A mix of both

established and new measures leads almost invariably to unacceptable fit if a strictly confirmatory approach is followed. Since a re-specification and re-estimation of the measurement model took place before the structural analysis, this study was not exclusively confirmatory. However, after acceptable fit was achieved for the measurement model, a confirmatory approach was followed using both the measurement and the structural sub-models simultaneously.

For this type of two-step process, it would have been preferable to use two different samples for the measurement model and the confirmatory overall model. This cross-validation approach could have been accomplished either by getting a new and independent sample for validation purposes from the population to which the results were to be generalized or splitting the sample in two, one for calibration and the other for validation purposes. Following a cross-validation strategy would have increased the generalizability of the findings by diminishing the capitalization on chance.

Unfortunately, neither approach was feasible. The present sample was not big enough to split in two and another sample would have been very difficult to get given the willingness of the population to participate in these studies. However, the impact of capitalizing on chance was lessened by assessing the measurement model without looking simultaneously at the structural model (Anderson and Gerbing 1988). While it is true that some capitalization on chance may have occurred while developing the measurement model, there was no model-trimming at the structural level. Anyway, the results interpretation will have to be kept under reserve till a cross-validation may be performed for the overall model using an independent validation sample in future work.

### 5.3 Model Evaluation Criteria

The acceptability of the proposed model is based on the extent to which the model fits the data. SEM literature provides many goodness-of-fit measures. Since no single measure is sufficient in itself to determine the acceptability of the model, researchers typically report multiple measures that reflect somewhat different facets of the model. The question is to know which measures to choose from each type. Looking at the measures usually reported, some measures seem to gain a consensus and are recommended to constitute a minimal set.

The most basic measure is a chi-square statistic with degrees of freedom that are equal to the difference between the number of observations and model parameters. It is usually reported but it is not a very good measure in practice because it is very sensitive to sample size, model size and departures from multivariate normality.

Among absolute fit measures that indicate the fit between the model and the data, the Standardized Root Mean Squared Residual (SRMR) is one of the most recommended to be included in a basic set (Kline 1998; Vandenberg and Lance 2000). SRMR is a standardized summary of the average of covariance residuals –the differences between the observed and the model covariances. SRMR equals zero when the fit of the model is perfect. Although 0.08 has been recently recommended as the cutoff value before we can conclude that there is a good fit between the proposed model and the observed data (Hu and Bentler 1999), the traditional 0.10 is still regarded as an upper limit while 0.08 is suggested as indicative of excellent fit (Vandenberg and Lance 2000).

The Root Mean Square Error of Approximation (RMSEA) is another absolute fit index that is fairly used. A study suggests that RMSEA is best suited when sample size is big (Ridgdon 1996). Our sample size does not qualify as a big one, but RMSEA is a fairly used fit index and

recommended as part of a minimal set of fit indices (Vandenberg and Lance 2000). The RMSEA is representative of the goodness-of-fit that could be expected if the model were estimated in the population, not just the sample drawn for the estimation (Hair, Anderson et al. 1998). Values less than 0.08 represent reasonable errors of approximation to the population, although a critical value of 0.06 was also suggested (Hu and Bentler 1999).

Incremental fit indices are another type of measures that compare the proposed model to some baseline model or null model. Among the incremental measures, Vandenberg and Lance (2000) recommend especially the Nonnormed Fit Index (NNFI) and the Comparative Fit Index (CFI). NNFI, also known as Tucker-Lewis Index (TLI), unlike other fit indices, it is not systematically related to sample size. NNFI indicates appropriately when a model is inconsistent with the data (sensitive to model misspecifications), it is relatively insensitive to violations of multivariate normality and relatively insensitive to estimation method (Lance and Vandenberg 2001). This is an index that adjusts the proportion of explained variance for model complexity. Values of .90 or above have been interpreted as indicating acceptable model fit. However, Hu and Bentler (1999) presented evidence suggesting .95 as the minimal criterion to infer good fit. Since this evidence comes from a study that it is one of the first of its kind, more studies are required before adopting 0.95 as the cutoff criteria. Meanwhile, .90 may be considered a lower bound of good fit with a high confidence emerging when NNFI meets or exceeds .95 (Vandenberg and Lance 2000).

The Comparative Fit Index (CFI) is another incremental fit index that is also recommended to be part of a basic set of fit indices (Kline 1998). As a modified version of another incremental fit index (Normed Fit Index) but less affected by sample size, the CFI

describes the overall proportion of explained variance. Values range from 0 to 1 with values above .90 indicating an acceptable model (Hu and Bentler 1999).

Based on the above recommendations, SRMR, RMSEA, NNFI and RMSEA are selected as the combination of fit indices to take in account to evaluate both the measurement model and the overall model during the analysis process described in this chapter.

#### **5.4 Measurement Model Development**

The measurement model models the way that the observed variables are related to the latent variables. SEM Confirmatory Factor Analysis (CFA) is used to examine the estimated loadings and to assess the statistical significance of each observed variable on its construct. However, SEM CFA does not assume cross-loadings.

Unless the observed variables (indicators) actually do measure their intended latent variables (the constructs) the testing of the structural relationships linking the constructs will be pointless. Thus before using SEM CFA, it makes sense to identify any cross-loadings using first Exploratory Factor Analysis (EFA). According to some researchers, EFA provides important diagnostics that should be considered along with the results of CFA in judging a scale and its items (Hurley, Scandura et al. 1997).

EFA allowed the identification of the worst offender by examining the indicator that showed strong cross-loadings across multiple constructs. This analysis was repeated as many times as needed. In each EFA, the worst offender was taken out having also in consideration content validity issues till a measurement model that discriminated among constructs was achieved. This was a good approach for the analysis since we had multiple measures for each construct and we could afford to remove the poor indicators. And it was not done blindly

empirically. As an indicator was dropped, a content validity analysis took place to evaluate the removal impact on the definition of the underlying construct.

Following this iterative process, internal consistency was evaluated. Using the surviving indicators from the whole previous EFA iterative process, internal consistency was evaluated by looking at each and every construct separately to see if indicators hanged together in one construct.

Once discriminant validity and internal consistency rested ensured, the overall measurement model was evaluated. The measurement model comprised 49 observed variables and 14 underlying latent variables. According to the nature of the variables, the measurement model was split in two sub-models. One sub-model was composed by ten exogenous latent variables reflected in 35 indicators while the other was composed by four endogenous variables reflected in 14 indicators; the two measurement models were assessed separately.

#### ***5.4.1 Ensuring discriminant validity***

To ensure discriminant validity, any observed variable that cross-loads strongly across multiple constructs is a good candidate for elimination. An Exploratory Factor Analysis (EFA) was conducted to detect those variables. Using SPSS, the number of factors to extract was fixed according to the number of latent variables theoretically supported and expected. Principal Component Analysis was the extraction method used. Since correlation among factors is a more realistic situation and one cannot dismiss that possibility, the latent variables (factors) were allowed to correlate using an oblique rotation.

### **Exogenous variables**

The first EFA is performed for the 10 exogenous latent variables reflected in 35 indicators (Table 5.1). According to some common rules of thumb (e.g., a minimum sample size of 5:1 subject-item ratio), the sample size in this study (118 valid responses) is not enough for an EFA with 35 items; the results may be lack of generalizability and inflated error rates when sample size is too small.

Literature provides basically two types of rules of thumb: minimum absolute sample size and ratio of subjects to items (Osborne and Costello 2004). If one were to take the subject-to-item ratio rule of thumb, past studies range in their recommendations from a minimum of 5:1 to 10:1 ratios. If one were to take the minimum absolute sample size, recommendations range from a minimum of 50 to 400. An inexperienced researcher in these techniques is left between two camps each one arguing that one type of guidelines is more relevant than the other while suggesting different levels.

Recent studies have shown the limited value of traditional rules of thumb concerning sample size in factor analysis (Velicer and Fava 1998; MacCallum, Widaman et al. 1999; MacCallum, Widaman et al. 2001). For example, regardless of sample size, the recovery of population factors in sample data is normally very good when communalities are high (MacCallum, Widaman et al. 2001). Although larger samples are usually desirable, samples somewhat smaller than suggested by common rules of thumb may still be sufficient. Thus, the adoption of hard and fast rules is questionable.

The EFA under discussion provided initial moderate to high communalities for the major part of the 35 items (Table 5.1).

**Table 5.1: Communalities**

Item	Extraction	Item	Extraction	Item	Extraction
ACK1	0,78	PK1	0,80	RFCA1	0,70
ACK2	0,74	PK2	0,79	RFCA2	0,86
ACK3	0,62	PK3	0,82	RFCA3	0,87
ACK4	0,64	PK4	0,88	RFCT1	0,68
BCK1	0,72	PO1	0,70	RFCT2	0,70
BCK2	0,64	PO2	0,89	SN1	0,79
BCK3	0,42	PO3	0,83	SN2	0,67
BCK4	0,74	PO4	0,68	SN3	0,75
PIIT1	0,57	PO5	0,64	VEU1	0,72
PIIT2	0,72	PREU1	0,60	VEU2	0,76
PIIT3	0,59	PREU2	0,84	VEU3	0,61
PIIT4	0,76	PREU3	0,84		

When the requisite factors are obtained through EFA and support the restrictions underlying CFA, a small sample size, although less than ideal, is a minimal issue. Sample size becomes an issue when the majority of the items do not load as expected leading to an ambiguous situation. Either bad measurement or not enough sample size to get the standard errors down to a reasonable level may be at the root of the problem. That is not the case in this analysis.

When the EFA for the exogenous variables is examined (Table 5.2), the majority of the items load as expected. There are, however, some cross-loadings involving the Business Context Knowledge (BCK) and Application Conceptual Knowledge (ACK) items that raise some concern. Now the question is whether eliminating them is reasonable. It is always dangerous to eliminate items based on purely empirical grounds. Thus content validity issues are addressed as the same time as the cross loading item is considered for elimination.

Having kept these 35 items together without following a common rule of thumb like a minimum 5:1 subject-to-item ratio was in fact a much more conservative approach. If the rule had been followed, the set of exogenous would have been split into two. Having kept all the

exogenous factors together permitted maximum pulling of items among factors. The fact that the majority of items still held together is indicative of their validity.

The Exploratory Factor Analyses that led to the elimination of six items that exhibited problematic cross loadings are now presented and discussed along with content validity issues. To simplify the tables reading, only loadings above 0.20 are presented and the strongest loading for each item (indicator) is bold-faced. However, only items with loadings above 0.30 will be considered significant cross-loaders especially when the two strongest loadings for the item are too close thus preventing enough discriminant power.

When an oblique rotation is used, the statistical tool (SPSS) provides two factor matrices: the factor structure matrix and the factor pattern matrix. The loadings in the factor structure matrix have both the unique variance between items and factors and the correlation among factors. The loadings in the factor pattern matrix have the unique contribution of the variable to the factor. It is more difficult to distinguish which items load uniquely on each factor in the factor structure matrix as the correlation among factors increases. Thus only the pattern matrix is reported in these factor analyses as most researchers do (Hair, Anderson et al. 1998).

Examining the first EFA pattern matrix for the ten exogenous presented in Table 5.2, BCK3 is the indicator that exhibits the most serious discriminant problem, loading about the same in two factors, 0.34 (its strongest loading) on factor 3 and 0.32 on factor 9.

The higher loadings on factor 3 are from ACK items (ACK1, ACK2 and ACK3) while the higher loadings on factor 9 are from BCK items (BCK1 and BCK4). Interpreting these factors, factor 3 seems to represent the Application Conceptual Knowledge while factor 9 seems to represent the Business Context Knowledge. However, confounding the interpretation, BCK items (BCK2 and BCK3) load onto factor 3 while ACK items (ACK4) load onto factor 9.

**Table 5.2: Pattern matrix for the 10 exogenous variables**

	1	2	3	4	5	6	7	8	9	10
ACK1			<b>-0,88</b>							
ACK2			<b>-0,76</b>				0,20			
ACK3		0,20	<b>-0,47</b>	0,27						0,30
ACK4		-0,28	-0,26						<b>-0,48</b>	
BCK1									<b>-0,80</b>	
BCK2			<b>-0,44</b>						-0,34	0,36
<b>BCK3</b>			<b>-0,34</b>						-0,32	
BCK4			-0,31						<b>-0,69</b>	
PIIT1	-0,23			0,29		0,40	<b>0,42</b>			
PIIT2							<b>0,80</b>			
PIIT3						-0,28	0,24	-0,24	0,24	<b>0,47</b>
PIIT4					0,19		<b>0,70</b>			0,35
PK1				<b>0,88</b>						
PK2				<b>0,82</b>						
PK3				<b>0,91</b>						
PK4				<b>0,91</b>						
PO1	<b>0,64</b>						0,20			-0,28
PO2	<b>0,85</b>									
PO3	<b>0,79</b>									
PO4	<b>0,58</b>		0,28		0,27				-0,30	
PO5	<b>0,76</b>									0,27
PREU1		<b>-0,64</b>					0,26			
PREU2						<b>0,88</b>				
PREU3						<b>0,88</b>				
RFCA1					<b>0,74</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,93</b>					
RFCT1				0,22				-0,33		<b>-0,58</b>
RFCT2		0,21				-0,22	0,21	<b>-0,65</b>		-0,26
SN1		<b>-0,73</b>			0,20					
SN2		<b>-0,74</b>								
SN3		<b>-0,53</b>			0,37		0,23			
VEU1		0,32	0,24					<b>0,52</b>	-0,35	-0,29
VEU2		0,22					0,31	<b>0,72</b>		
VEU3								<b>0,73</b>		

Examining the wording for BCK3, it is not difficult to admit that “I have a good understanding of the big picture of what is important in this business” may result from “understanding the workflow of the business processes mapped in the system to know the big

picture of what to do with the system”, i.e., Application Conceptual Knowledge, or may result from “the understanding of the business processes and their interdependencies across organizational functions”, i.e., Business Context Knowledge. While one type of knowledge focuses on the tool, the other focuses on the business. Despite the efforts placed in the instrument pre-test that resulted in Business Context Knowledge showing 100% item placement ratio, BCK3 does not have a clear loading on the expected factor. In fact, the BCK3 item splits almost equally across the two factors. BCK3 is then removed and a new analysis is performed for the remaining indicators (Table 5.3).

The interpretation of factors 3 and 9 is still confounded. BCK2 keeps its strongest loading (0.43) on factor 3 (to be interpreted as Application Conceptual Knowledge) followed by a loading of 0.35 on factor 9 (to be interpreted as Business Context Knowledge). It seems that BCK2 “I understand how the work we do in <respondent’s selected area in the web survey> relates to tasks in other parts of the business” was understood in the same way as ACK items were (e.g., ACK1, “I understand how the way in which I use an ERP module affect others’ work that use the same module”.)

One possible explanation is that probably many respondents were basically thinking about the impact on other’s work having the module they work with and not the functional area they work in as the reference when they read BCK2. Some users might be thinking on how well they understand the way in which they use an ERP module affect others’ work. Some other users might be thinking on how well they understand the work in their functional area contributes to the organization success. This is even more understandable when the module has the same name as the functional area and BCK2 becomes unclear on what it refers to.

**Table 5.3: Pattern matrix for the exogenous variables (BCK3 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1			<b>-0,87</b>							
ACK2			<b>-0,75</b>				0,22		-0,16	
ACK3		0,21	<b>-0,47</b>	0,28	0,19				-0,18	0,30
ACK4		-0,26	-0,26						<b>-0,51</b>	
BCK1									<b>-0,80</b>	
<b>BCK2</b>			<b>-0,43</b>						-0,35	0,37
BCK4	0,14		-0,30						<b>-0,70</b>	
PIIT1	-0,23			0,29		<b>0,40</b>	0,43			
PIIT2							<b>0,81</b>			
PIIT3						-0,28	0,20	-0,20	0,22	<b>0,52</b>
PIIT4							<b>0,66</b>			0,41
PK1				<b>0,88</b>						
PK2				<b>0,81</b>						
PK3				<b>0,92</b>						
PK4				<b>0,91</b>						
PO1	<b>0,65</b>						0,21			-0,26
PO2	<b>0,85</b>									
PO3	<b>0,79</b>									
PO4	<b>0,58</b>		0,27		0,27				-0,30	
PO5	<b>0,76</b>									0,28
PREU1		<b>-0,64</b>					0,25	0,21		
PREU2						<b>0,88</b>				
PREU3						<b>0,88</b>				
RFCA1					<b>0,73</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,93</b>					
RFCT1				0,22				-0,39		<b>-0,55</b>
RFCT2		0,20				-0,22	0,21	-0,68		
SN1		<b>-0,74</b>			0,20					
SN2		<b>-0,75</b>								
SN3		<b>-0,54</b>			0,37		0,22			
VEU1		0,34	0,23					<b>0,49</b>	-0,35	-0,33
VEU2		0,24					0,32	<b>0,71</b>		
VEU3								<b>0,71</b>		

At the operationalization of the Business Context Knowledge construct, three basic dimensions may be identified: first, the understanding of one's work area's contribution to organizational success (items BCK1, BCK4); second, a global understanding of the business (item BCK3); third, the interdependence among business tasks (item BCK2). Only the first dimension survived.

The understanding of the interdependencies among tasks is essentially covered through Application Conceptual Knowledge. Thus Business Context Knowledge would be more correctly defined as “the understanding of one’s functional area work contribution to the overall success of the organization”. Given the ambiguous interpretation for BCK2, the item is removed and a new analysis is performed (Table 5.4).

Still in the realm of the knowledge types, ACK4 presents its highest loading (0.54) on factor 9 that is underlying the BCK items. It seems that ACK4, “I understand how things I do with the ERP system can affect the work in other parts of the business”, may have been interpreted more in terms of contribution to the business success than in terms of interdependence among tasks, a dimension covered through Application Conceptual Knowledge. The problem may have been caused by the word “business” at the end of item wording. Such word may have called the respondent’s attention to the business context in general. Instead of the word “business”, the word “system” would have been more effective. Where the ERP system is not present in the organization, it is certainly more difficult to know what are the impacts, because they are indirect and may not be clearly identified as are the ones still in the domain of the system.

Although ACK4 clearly loads onto factor 9 and could provide the interdependence dimension that was lost in the Business Context Knowledge by BCK2 removal, that loading was not theoretically intended. In addition, Application Conceptual Knowledge is better defined by the remaining three ACK items. Thus, ACK4 is removed and a new analysis is performed (Table 5.5).

At this point we still see that PIIT1 has the two strongest loadings about the same, 0.41 on factor 6 and 0.37 on factor 7, a cross loading already visible since the first EFA.

**Table 5.4: Pattern matrix for exogenous variables (BCK3 and BCK2 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1				<b>-0,87</b>						
ACK2				<b>-0,75</b>			0,23			
ACK3	0,27		-0,20	<b>-0,48</b>						-0,25
<b>ACK4</b>			0,25	-0,27					<b>-0,54</b>	
BCK1									<b>-0,81</b>	
BCK4				-0,28					<b>-0,72</b>	
PIIT1	0,28	-0,22				0,40	<b>0,41</b>			
PIIT2							<b>0,81</b>			
PIIT3						-0,28	0,25			<b>-0,56</b>
PIIT4							<b>0,68</b>			-0,30
PK1	<b>0,88</b>									
PK2	<b>0,81</b>									
PK3	<b>0,91</b>									
PK4	<b>0,91</b>									
PO1		<b>0,66</b>								0,26
PO2		<b>0,86</b>								
PO3		<b>0,80</b>								
PO4		<b>0,57</b>		0,26	0,27				-0,29	
PO5		<b>0,75</b>								-0,32
PREU1			<b>0,61</b>				0,28	0,23		
PREU2						<b>0,88</b>				
PREU3						<b>0,88</b>				
RFCA1					<b>0,73</b>					
RFCA2					<b>0,96</b>					
RFCA3					<b>0,93</b>					
RFCT1	0,21							-0,40		<b>0,58</b>
RFCT2						-0,21		<b>-0,69</b>		
SN1			<b>0,76</b>							
SN2			<b>0,77</b>							
SN3			<b>0,56</b>		0,35		0,22			
VEU1			-0,34	0,23				<b>0,46</b>	-0,30	0,41
VEU2			-0,28				0,32	<b>0,70</b>		
VEU3								<b>0,69</b>	0,22	0,21

Interpreting the factors by looking at the items which load the highest on the factor, factor 6 is basically defined by Perceived Risk of Exploratory Use (PREU) items while factor 7 is basically defined by Personal Innovativeness in Information Technology (PIIT) items. PIIT1 as

well as PIIT3 do not load together with the remaining PIIT items (PIIT2 and PIIT4) that exhibit the strongest loadings among PIIT items (Table 5.5).

**Table 5.5: Pattern matrix for exogenous variables (BCK3, BCK2, and ACK4 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1				<b>0,89</b>						
ACK2				<b>0,76</b>			0,22			
ACK3	0,27	0,21		<b>0,50</b>						-0,22
BCK1									<b>-0,82</b>	
BCK4				0,31					<b>-0,72</b>	
<b>PIIT1</b>	0,28		-0,25			<b>0,41</b>	0,37	-0,26		
PIIT2							<b>0,79</b>			
PIIT3						-0,32	0,31	0,23	0,21	<b>-0,48</b>
PIIT4					0,20		<b>0,71</b>			-0,29
PK1	<b>0,88</b>									
PK2	<b>0,80</b>									
PK3	<b>0,91</b>									
PK4	<b>0,91</b>									
PO1			<b>0,60</b>					-0,27		0,22
PO2			<b>0,84</b>							
PO3			<b>0,78</b>							
PO4			<b>0,60</b>	-0,23	0,28				-0,26	
PO5			<b>0,78</b>							-0,23
PREU1		<b>-0,57</b>					0,30	0,31		
PREU2						<b>0,88</b>				
PREU3						<b>0,89</b>				
RFCA1					<b>0,71</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,92</b>					
RFCT1								<b>-0,74</b>		
RFCT2						-0,21		<b>-0,65</b>		-0,35
SN1		<b>-0,75</b>								
SN2		<b>-0,77</b>								
SN3		<b>-0,56</b>			0,34		0,21			
VEU1		0,31							-0,27	<b>0,67</b>
VEU2		0,30					0,34	0,37		<b>0,55</b>
VEU3									0,27	<b>0,70</b>

PIIT is a scale borrowed without any modification from Agarwal and Prasad (1998) that reported it with a high internal consistency (0.84). However, it is possible to find an explanation for the reason why PIIT1 does not go necessary along with the set PIIT2/PIIT4.

PIIT1 expresses a clear and personal intention of looking for new information technology: “If I heard about a new information technology, I would look for ways to experiment with it”. On the contrary, PIIT2 only states that someone is usually the first without necessarily looking for it: “Among my peers, I am usually the first to try out new information technologies”. It may be just the case that the organizational circumstances are favorable to the experimentation, even without someone making an extra effort looking for it. For example, the respondents that work in the Information Technology area are more likely to be the first ones to experiment with new IT.

In addition, just the mere fact of hearing about a new technology does not imply that the new IT is available in the organization for experimentation. Some respondents may have assumed the new IT was at least available in the organization while others assumed a broad context when interpreting PIIT1.

For the above reasons, both theoretical and empirical, PIIT1 is removed and a new analysis is performed for the remaining items (Table 5.6).

Having removed PIIT1, PIIT3 still remains a cross loader presenting significant loadings (above 0.30) really close to each other: 0.37 on factor 2 (to be interpreted as Voluntariness of Exploratory Use), 0.31 on factor 3 (to be interpreted as Perceived Risk of Exploratory Use) and 0.33 on factor 7 (to be interpreted as Personal Innovativeness in Information Technology, the right factor for this item).

**Table 5.6: Pattern matrix for exogenous variables (BCK3, BCK2, ACK4, and PIIT1 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1				<b>0,88</b>						
ACK2				<b>0,76</b>			0,22			
ACK3	0,30			<b>0,52</b>	0,20			0,23		
BCK1									<b>-0,81</b>	
BCK4				0,33					<b>-0,71</b>	
PIIT2							<b>0,81</b>			0,23
<b>PIIT3</b>		<b>-0,37</b>	-0,31				0,33		0,24	-0,28
PIIT4		-0,21			0,21		<b>0,73</b>			
PK1	<b>0,87</b>									
PK2	<b>0,81</b>									
PK3	<b>0,91</b>									
PK4	<b>0,91</b>									
PO1						-0,63				0,26
PO2						-0,87				
PO3						-0,80				
PO4				-0,23	0,26	-0,62			-0,25	
PO5						-0,78				-0,20
PREU1			0,21				0,32	<b>-0,56</b>		-0,22
PREU2			<b>0,93</b>							
PREU3			<b>0,96</b>							
RFCA1					<b>0,72</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,92</b>					
RFCT1	0,22									<b>0,78</b>
RFCT2		-0,42					0,20	0,21		<b>0,59</b>
SN1								<b>-0,73</b>		
SN2								<b>-0,77</b>		
SN3					0,34		0,22	<b>-0,54</b>		
VEU1		<b>0,64</b>						0,29	-0,30	
VEU2		<b>0,65</b>					0,30	0,26		-0,28
VEU3		<b>0,73</b>							0,24	

PIIT3, “In general, I am hesitant to try out new information technologies”, is the only item negatively worded item among PIIT items. Negative items require extra mental effort to be interpreted. That may be a reason why this item did not work out. Removing PIIT3, Personal Innovativeness in IT is still well represented by the remaining two items, PIIT2 (“Among my peers, I am usually the first to try out new information technologies”) and PIIT4 (“I like to

experiment with new information technologies”). Thus, PIIT3 is removed and a new analysis is performed (Table 5.7).

**Table 5.7: Pattern matrix for exogenous variables (BCK3, BCK2, ACK4, PIIT1 and PIIT3 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1				<b>-0,87</b>						
ACK2				<b>-0,75</b>			0,24			
ACK3	0,29	0,22		<b>-0,53</b>						
BCK1									<b>0,84</b>	
BCK4				-0,29					<b>0,75</b>	
PIIT2							<b>0,80</b>			0,21
PIIT4					0,21		<b>0,73</b>	0,27		
PK1	<b>0,87</b>									
PK2	<b>0,80</b>									
PK3	<b>0,91</b>									
PK4	<b>0,90</b>									
PO1						<b>-0,64</b>				0,22
PO2						<b>-0,87</b>				
PO3						<b>-0,80</b>				
PO4				0,24	0,26	<b>-0,61</b>			0,26	
PO5						<b>-0,77</b>		0,21		
<b>PREU1</b>		<b>-0,58</b>	0,20				0,31			
PREU2			<b>0,93</b>							
PREU3			<b>0,95</b>							
RFCA1					<b>0,71</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,92</b>					
RFCT1										<b>0,84</b>
RFCT2								0,34		<b>0,68</b>
SN1		<b>-0,72</b>								
SN2		<b>-0,79</b>					-0,22			
SN3		<b>-0,52</b>			0,35		0,23			
VEU1		0,28		0,23				<b>-0,66</b>	0,31	
VEU2		0,24					0,29	<b>-0,62</b>		-0,30
VEU3								<b>-0,76</b>		

At this point only PREU1 calls up the attention as a significant cross loader. PREU1 presents a loading of 0.58 on factor 2 (to be interpreted as Subjective Norm) and only 0.20 on

factor 3 (to be interpreted as Perceived Risk of Exploratory Use) that seems to be the right factor for this item.

A too complex statement for PREU1 may be at the root of the problem: “I have to worry about negative consequences while exploring new functionalities or new information in the ERP system even when I am careful not to change anything important”. PREU2 and PREU3 are more similar in wording (“it is risky...”, “it is dangerous”) than PREU1 “I have to worry ... even when I am not careful”. While PREU1 stresses the danger of the behavior even when someone is careful, there is no such call for the remaining two items.

In summary, PREU1 has its highest loading on the “wrong” factor. PREU2 and PREU3 load on another factor. Since PREU1 does not align with the other items and presents more difficulties for interpretation than the others, PREU1 is removed and new analysis is performed (Table 5.8).

This time a good solution is achieved. The solution has a clear interpretation. First, all items have the strongest loadings on the intended factors, the minimum being 0.51. Second, the second strongest loading for each item is at a reasonable distance from the first, presenting a difference always above 0.20.

In summary, six indicators have been eliminated to ensure the discriminant validity of the ten exogenous variables reflected now in the remaining 29 indicators (Table 5.9).

### **Endogenous variables**

The same analysis process is now applied to the four endogenous variables starting with the initial set of 14 indicators (Table 5.10).

**Table 5.8: Pattern matrix for exogenous variables (BCK3, BCK2, ACK4, PIIT1, PIIT3, and PREU1 removed)**

	1	2	3	4	5	6	7	8	9	10
ACK1				<b>-0,88</b>						
ACK2				<b>-0,75</b>			0,25			
ACK3	0,30	0,21		<b>-0,51</b>						
BCK1									<b>0,83</b>	
BCK4				-0,27					<b>0,76</b>	
PIIT2							<b>0,84</b>			
PIIT4							<b>0,74</b>			-0,29
PK1	<b>0,87</b>									
PK2	<b>0,80</b>									
PK3	<b>0,91</b>									
PK4	<b>0,90</b>									
PO1						<b>0,64</b>				
PO2						<b>0,87</b>				
PO3						<b>0,80</b>				
PO4				0,24	0,26	<b>0,61</b>			0,26	
PO5						<b>0,77</b>				-0,23
PREU2			<b>0,93</b>							
PREU3			<b>0,95</b>							
RFCA1					<b>0,70</b>					
RFCA2					<b>0,95</b>					
RFCA3					<b>0,92</b>					
RFCT1								<b>-0,82</b>		
RFCT2		0,22						<b>-0,75</b>		-0,31
SN1		<b>-0,76</b>								
SN2		<b>-0,88</b>								
SN3		<b>-0,53</b>			0,31		0,27			
VEU1		0,26		0,23					0,29	<b>0,67</b>
VEU2		0,29					0,29	0,33		<b>0,57</b>
VEU3									-0,21	<b>0,74</b>

The weakest item in discriminating is IE3, “I intend to spend considerable time and effort in the next couple of months exploring the ERP for potential applications”, that loads 0.43 on factor 3 and 0.41 on factor 4. This cross loading may have been caused by a different time reference.

**Table 5.9: Surviving items for exogenous variables**

<b>Construct</b>	<b>Surviving</b>	<b>Removed</b>
Application Conceptual Knowledge	ACK1, ACK2, ACK3	ACK4
Business Context Knowledge	BCK1, BCK4	BCK2, BCK3
Perceived Risk of Exploratory Use	PREU2, PREU3	PREU1
Personal Innovativeness in IT	PIIT2, PIIT4	PIIT1, PIIT3
Procedural Knowledge	PK1, PK2, PK3, PK4	
Psychological Ownership	PO1, PO2, PO3, PO4, PO5	
Resource Facilitating Conditions - Assistance	RFCA1, RFCA2, RFCA3	
Resource Facilitating Conditions - Time	RFCT1, RFCT2	
Subjective Norm	SN1, SN2, SN3	
Voluntariness of Exploratory Use	VEU1, VEU2, VEU3	
<b>Number of items</b>	<b>29</b>	<b>6</b>

**Table 5.10: Pattern matrix for endogenous variables**

	1	2	3	4
IE1				<b>0,76</b>
IE2				<b>0,82</b>
IE3	0,20	-0,34	<b>0,43</b>	0,41
PEEU1	<b>0,57</b>		0,35	
PEEU2		<b>0,93</b>		
PEEU3	<b>0,66</b>	0,22	0,35	-0,22
PEEU4	<b>0,63</b>	0,32		
PUEU1			0,24	0,69
PUEU2			<b>0,90</b>	
PUEU3			<b>0,65</b>	0,31
PUEU4			<b>0,71</b>	
SCSE1	<b>0,51</b>			0,37
SCSE2	<b>0,58</b>	0,22		0,30
SCSE3	<b>0,82</b>	-0,23		

While IE1 and IE2 use “next six months” as the time reference, IE3 uses “next couple of months”. In addition, IE3 adds “considerable time and effort”. That stressing may explain why IE3 loads together with Perceived Usefulness of Exploratory Use (PUEU) items since it emphasizes the importance or usefulness of the behavior to justify the dedication of “considerable time and effort”. IE1, “Over the next six months, I intend to search for new ways to use the system in my work context.” and IE2, “Over the next six months, I intend to look for new functionalities and/or new information in the ERP.” do not present such emphasis. Thus, IE3 is removed and a new analysis is run again (Table 5.11).

**Table 5.11: Pattern matrix for endogenous variables (IE3 removed)**

	1	2	3	4
IE1		<b>-0,84</b>		
IE2		<b>-0,88</b>		
PEEU1	0,23		0,22	<b>0,46</b>
PEEU2	-0,19			<b>0,90</b>
PEEU3	0,33		0,25	<b>0,59</b>
PEEU4	0,43			<b>0,50</b>
PUEU1		<b>-0,63</b>	0,30	
PUEU2			<b>0,94</b>	
PUEU3		-0,21	<b>0,75</b>	
PUEU4			<b>0,73</b>	
SCSE1	<b>0,45</b>	-0,34		0,24
SCSE2	<b>0,52</b>	-0,25		0,29
SCSE3	<b>0,93</b>			

Now there is a strong cross loading from PUEU1 on what would be the “wrong” factor (factor 2), since the remaining items for PUEU load strongly together on factor 3. It is not apparent what might have caused such a strong loading of PUEU1 together with “Intention to Explore” items because its wording is very similar to the remaining PUEU items. However, since PUEU1 is not essential and its removal does not affect the content validity of the construct

measured through the remaining three PUEU items, PUEU1 is removed and a new EFA is run (Table 5.12).

**Table 5.12: Pattern matrix for endogenous variables (IE3 and PUEU1 removed)**

	1	2	3	4
IE1				<b>0,87</b>
IE2				<b>0,91</b>
PEEU1		<b>0,54</b>		
PEEU2		<b>0,89</b>		
PEEU3	0,23	<b>0,66</b>		
PEEU4	0,37	<b>0,53</b>		0,20
PUEU2			<b>0,97</b>	
PUEU3			<b>0,79</b>	
PUEU4			<b>0,76</b>	
SCSE1	<b>0,44</b>	0,25		0,31
SCSE2	<b>0,50</b>	0,29		0,25
SCSE3	<b>0,96</b>			

The next weakest discriminant item to be considered is PEEU4 that loads 0.53 on the “true” factor and 0.37 on the “wrong” factor. Although the strongest loading is in the “true” factor, PEEU4 loads onto another factor that represents a close concept (Specific Computer Self-Efficacy for Exploratory Use). To get a better interpretation, since we still can afford losing one item and keep a recommended minimum of three items for Structural Equation Modeling purposes, PEEU4 is removed. Table 5.13 presents the pattern matrix for the new analysis.

The final solution for the endogenous variables allows a clear interpretation for the factors. All items have their strongest loadings on the intended factors. The lowest strongest loading for any indicator is above 0.50 except for SCSE1 (0.46). However, it was decided to keep it to have at least three items for Specific Computer Self-Efficacy for Exploratory Use.

**Table 5.13: Pattern matrix for endogenous variables (IE3, PUEU1, and PEEU4 removed)**

	1	2	3	4
IE1	<b>0,87</b>			
IE2	<b>0,90</b>			
PEEU1	0,20	<b>0,56</b>		
PEEU2		<b>0,88</b>		
PEEU3		<b>0,66</b>		-0,24
PUEU2			<b>-0,97</b>	
PUEU3			<b>-0,80</b>	
PUEU4			<b>-0,75</b>	
SCSE1	0,31	0,26		<b>-0,46</b>
SCSE2	0,25	0,30		<b>-0,52</b>
SCSE3				<b>-0,96</b>

In summary, three indicators have been eliminated to ensure the discriminant validity of the four endogenous variables reflected now in the remaining 11 indicators (Table 5.14).

**Table 5.14: Surviving items for endogenous variables**

<b>Construct</b>	<b>Surviving</b>	<b>Removed</b>
Intention to Explore	IE1, IE2	IE3
Perceived Ease of Exploratory Use	PEEU1, PEEU2, PEEU3	PEEU4
Perceived Usefulness of Exploratory Use	PUEU2, PUEU3, PUEU4	PUEU1
Specific Computer self-Efficacy for Exploratory Use	SCSE1, SCSE2, SCSE3	
<b>Number of items</b>	<b>11</b>	<b>3</b>

#### **5.4.2 Ensuring internal consistency**

For each and every one of the ten latent variables, all the observed variables should hang together, underlying just one and only one latent variable. Using again SPSS to perform an exploratory factor analysis using just the indicators of a single construct, this time, the number of factors is left unspecified. Each set of indicators representing one construct should converge on a

single factor. Both for the exogenous variables (Table 5.15) and the endogenous variables (Table 5.16), all the indicators converge on a single factor. There is no single loading below 0.60.

**Table 5.15: Ten EFAs for ten exogenous variables**

	ACK	BCK	PIIT	PK	PO	PREU	RFCA	RFCT	SN	VEU
ACK1	.88									
ACK2	.86									
ACK3	.74									
BCK1		.91								
BCK4		.91								
PIIT2			.86							
PIIT4			.86							
PK1				.90						
PK2				.88						
PK3				.88						
PK4				.93						
PO1					.74					
PO2					.95					
PO3					.91					
PO4					.74					
PO5					.63					
PREU2						.95				
PREU3						.95				
RFCA1							.83			
RFCA2							.93			
RFCA3							.94			
RFCT1								.86		
RFCT2								.86		
SN1									.90	
SN2									.81	
SN3									.86	
VEU1										.81
VEU2										.81
VEU3										.76

### 5.4.3 Improving internal consistency

To ensure that the internal consistency is the highest one can get while still maintaining a minimum of three items given the probability of identification problems in SEM, an examination of alpha coefficients is performed (Table 5.17 and Table 5.18).

**Table 5.16: Four EFAs for four endogenous variables**

	IE	PEEU	PUEU	SCSE
IE1	.91			
IE2	.91			
PEEU1		.86		
PEEU2		.61		
PEEU3		.91		
PUEU2			.86	
PUEU3			.89	
PUEU4			.89	
SCSE1				.85
SCSE2				.86
SCSE3				.76

Among the exogenous variables (Table 5.17), there still some room for improvement of Psychological Ownership internal consistency. An increase of 0.05 (from 0.84 to 0.89) is obtained when dropping PO4 and PO5, while still keeping three items (PO1, PO2 and PO3).

Among the endogenous variables (Table 5.18), keeping IE3 would have improved the internal consistency of Intention to Explore, but a discriminant problem previously detected with Perceived Usefulness prevents its inclusion. The surviving items for SCSE and PUEU do not justify further eliminations.

## 5.5 Measurement Model Evaluation

The measurement model is evaluated in two steps; first, the set of exogenous variables and then the set of endogenous variables are separately subjected to a confirmatory factor analysis using LISREL. The indicators to be used in this analysis are the ones that survived to the previous analysis steps taken to ensure discriminant validity and internal consistency of both exogenous and endogenous variables.

**Table 5.17: Cronbach's alpha coefficients for the exogenous variables**

Scale	Items	Alpha
Application Conceptual Knowledge (ACK)	ACK1, ACK2, ACK3	0.77
	ACK1, ACK2	0.80
Business Context Knowledge (BCK)	BCK1, BCK4	0.79
Perceived Risk of Exploratory Use (PREU)	PREU2, PREU3	0.89
Personal Innovativeness in IT (PIIT)	PIIT2, PIIT4	0.63
Procedural Knowledge (PK)	PK1, PK2, PK3, PK4	0.92
Psychological Ownership (PO)	PO1, PO2, PO3, PO4, PO5	0.84
	PO1, PO2, PO3, PO4	0.87
	PO1, PO2, PO3	0.89
Resource Facilitating Conditions – Assistance (RFCA)	RFCA1, RFCA2, RFCA3	0.88
	RFCA2, RFCA3	0.92
Resource Facilitating Conditions – Time (RFCT)	RFCT1, RFCT2	0.66
Subjective Norm (SN)	SN1, SN2, SN3	0.82
	SN1, SN3	0.83
Voluntariness	VEU1, VEU2, VEU3	0.71

### 5.5.1 Exogenous variables

The measurement model for the exogenous variables comprises ten latent variables reflected in 27 indicators (5.19).

**Table 5.18: Cronbach's alpha coefficients for the endogenous variables**

Scale	Items	Alpha
Intention to Explore (IE)	IE1, IE2	0.79
	IE1, IE2, IE3	0.82
Perceived Ease of Exploratory Use (PEEU)	PEEU1, PEEU2, PEEU3	0.69
	PEEU1, PEEU3	0.83
Perceived Usefulness of Exploratory Use (PUEU)	PUEU2, PUEU3, PUEU4	0.85
	PUEU1, PUEU2, PUEU3, PUEU4	0.84
Specific Computer Self Efficacy (SCSE)	SCSE1, SCSE2, SCSE3	0.77
	SCSE1, SCSE2	0.78

**Table 5.19: Indicators for exogenous variables**

Construct	Indicators
ACK	ACK1, ACK2, ACK3
BCK	BCK1, BCK4
PREU	PREU2, PREU3
PIIT	PIIT2, PIIT4
PK	PK1, PK2, PK3, PK4
PO	PO1, PO2, PO3
RFCA	RFCA1, RFCA2, RFCA3
RFCT	RFCT1, RFCT2
SN	SN1, SN2, SN3
VEU	VEU1, VEU2, VEU3

Running a Confirmatory Factor Analysis, the model presents a chi-square of 408.57 with 279 degrees of freedom. All fit indices under examination are acceptable according to recommended cutoff values (Table 5.20).

**Table 5.20: Measurement model fit indices (exogenous variables)**

Fit Index	Recommended Cutoff	Index Value
RMSEA	< 0.080	0.063
SRMR	< 0.100	0.071
NNFI	> 0.90	0.93
CFI	> 0.90	0.94

Despite the acceptable fit indices, it is worth to look at the correlations among the variables. High correlations (above 0.60) are to be examined carefully (Table 5.21); they may be a sign of lack of discriminant validity.

**Table 5.21: Correlations among the exogenous variables**

(\* significant at 0.05 level (cr: 1.96); \*\* significant at 0.01 level (cr. 2.58))

	PREU	SN	RFCA	RFCT	PO	PK	ACK	BCK	PIIT	VEU
PREU										
SN	-0.22*									
RFCA		0.55**								
RFCT	-0.26*	0.46**	0.34**							
PO		0.23*	0.24**	0.22*						
PK	-0.21*	0.30**	0.22*	0.42**	0.45**					
ACK					0.30**	0.29**				
BCK			0.26**		0.43**	0.28**	0.59**			
PIIT		0.45**		0.45**		0.41**	0.35**			
VEU		-0.65**	-0.30**	-0.46**						

Among the significant correlations for exogenous variables, Voluntariness of Exploratory Use (VEU) and Subjective Norm (SN) share a relatively high correlation (0.65). However, a chi-square difference test just for the pair VEU-SN shows that they are distinct constructs, although they share a high correlation (Table 5.22).

**Table 5.22: VEU vs. SN**

Model (501a3)	Chi-square	Df	Difference in Chi-square	p	CFI
Unconstrained	12.80	8			0.99
Constrained	40.28	9	27.48 (1 d.f.)	< 0.001	0.91

The next high correlation is 0.59 between ACK and BCK. Performing a chi-square difference test and a CFI improvement test for the pair in question, nothing leads to believe that the constructs do not discriminate enough among themselves (Table 5.23).

**Table 5.23: ACK vs. BCK**

Model (500b2)	Chi-square	df	Difference in Chi-square	p	CFI
Unconstrained	2.94	4			1.00
Constrained	43.16	5	40.22 (1 d.f.)	< 0.001	0.84

When assessed in the context of the full measurement model, the chi-square difference test still supports discriminant validity, although the CFI improvement falls below the 0.02 cutoff (Table 5.24).

**Table 5.24: ACK vs. BCK in a full model context**

Model (500b and 500b1)	Chi-square	Df	Difference in Chi-square	p	CFI
Unconstrained	408.57	279			0.94
Constrained	444.79	288	36.22 (9 d.f.)	< 0.001	0.93

Since the remaining exogenous variables intercorrelate below 0.50, no further examination is warranted based on high correlations. Next step will be to look at construct reliability and variance extracted as determined by CFA (Table 5.25).

### **Exogenous variables excluded**

When the indicators are truly representative of the latent construct, the recommended values of 0.70 for construct reliability and 0.50 for variance extracted are usually exceeded (Hair, Anderson et al 1998). Three constructs present either construct reliability or variance extracted below the recommended values: PIIT (Personal Innovativeness), VEU (Voluntariness of Exploratory Use) and RFCT (Resource Facilitating Conditions – Time).

The research model is a very large model and the sample size in this study places significant constraints on the number of parameters to be estimated. Poorly measured constructs can cause problems hard to solve. PIIT, VEU and RFCT do not measure up to the recommended standards. In addition, PIIT and VEU have been included as control variables and are not at the core of the model; RFCT is a dimension of Resource Facilitating Conditions that still has in Assistance a representative dimension. Because of all the reasons above and for this particular study, based on their weak measurement properties and relative importance, these constructs

were excluded from the model. The result is a simpler and a testable model composed by constructs with adequate measurement properties.

**Table 5.25: Construct reliability and variance extracted for exogenous variables**

	ack	bck	piit	pk	po	preu	rfca	rfct	sn	veu	Error
ACK1	0.78										0.40
ACK2	0.85										0.27
ACK3	0.56										0.69
BCK1		0.71									0.49
BCK4		0.93									0.13
PIIT2			0.72								0.48
PIIT4			0.66								0.57
PK1				0.84							0.30
PK2				0.82							0.33
PK3				0.85							0.27
PK4				0.93							0.13
PO1					0.70						0.51
PO2					0.94						0.11
PO3					0.95						0.10
PREU2						0.94					0.11
PREU3						0.85					0.28
RFCA1							0.69				0.53
RFCA2							0.90				0.19
RFCA3							0.95				0.09
RFCT1								0.75			0.44
RFCT2								0.65			0.57
SN1									0.81		0.34
SN2									0.60		0.64
SN3									0.88		0.22
VEU1										0.57	0.67
VEU2										0.88	0.23
VEU3										0.51	0.74
<b>Construct Reliability*</b>	0.78	0.81	0.64	0.92	0.90	0.89	0.89	0.66	0.81	0.70	
<b>Variance Extracted**</b>	0.55	0.69	0.48	0.74	0.76	0.80	0.73	0.49	0.60	0.45	

\* Construct reliability =  $(\text{Sum of standardized loadings})^2 / ((\text{Sum of standardized loadings})^2 + \text{Sum of indicator measurement error})$

\*\* Variance extracted =  $\text{Sum of squared standardized loadings} / (\text{Sum of squared standardized loadings} + \text{Sum of indicator measurement error})$

## Fit Indices

After the removal of the three variables, all fit indices improve for the resulting model with chi-square of 216.57 with 149 d.f. and p-value of 0.00025 (Table 5.26).

**Table 5.26: Measurement model fit indices after constructs removal**

Fit Index	Recommended Cutoff	Original Model	After constructs removal
RMSEA	< 0.080	0.063	0.062
SRMR	< 0.100	0.071	0.062
NNFI	> 0.90	0.93	0.95
CFI	> 0.90	0.94	0.96

### 5.5.2 Endogenous variables

The measurement model for the endogenous variables comprises four latent variables reflected in 11 indicators (Table 5.27).

**Table 5.27: Indicators for endogenous variables**

Construct	Indicators
IE	IE1, IE2
PEEU	PEEU1, PEEU2, PEEU3
PUEU	PUEU2, PUEU3, PUEU4
SCSE	SCSE1, SCSE2, SCSE3

Running a Confirmatory Factor Analysis, the model presents a chi-square of 33.43 with 38 degrees of freedom and a p-value of 0.68. All fit indices under examination are acceptable according to recommended cutoff values (Table 5.28).

**Table 5.28: Measurement model fit indices (endogenous variables)**

Fit Index	Recommended Cutoff	
RMSEA	< 0.080	0.000
SRMR	< 0.100	0.035
NNFI	> 0.90	1.01
CFI	> 0.90	1.00

The fit indices are good, but once again the correlation matrix this time for the endogenous variables is examined looking for potential discriminant validity problems (Table 5.29).

**Table 5.29: Correlations among the endogenous variables**

(\*\* significant at 0.01 level (cr. 2.58))

	IE	PEEU	PUEU	SCSE
IE				
PEEU	0.45**			
PUEU	0.71**	0.61**		
SCSE	0.69**	0.73**	0.71**	

The highest correlation is between Specific Computer Self-Efficacy and Perceived Ease of Exploratory Use. When looking at discriminant validity, this pair survives both tests of chi-

square difference and CFI improvement either on a pair context (Table 5.30) or on a full model context (Table 5.31).

**Table 5.30: SCSE vs. PEEU in a pair context**

Model (500b2)	Chi-square	df	Difference in Chi-square	p	CFI
Unconstrained	2.93	8			1.00
Constrained	46.42	9	43.49 (1 d.f.)	< 0.001	0.93

**Table 5.31: SCSE vs. PEEU in a full model context**

Model (501a1)	Chi-square	df	Difference in Chi-square	p	CFI
Unconstrained	33.43	38			1.00
Constrained	69.89	41	36.46 (3 d.f.)	< 0.001	0.98

The difference in chi-square is significant at the 0.001 level. The improvement in CFI meets the 0.02 cutoff. Thus SCSE and PEEU are kept as distinct constructs.

## 5.6 Overall Model Evaluation

When running the SEM of the paths among the latent variables, the model with a chi-square of 650.26 and 399 degrees of freedom meets all the recommended cutoff values, except for the Standardized Root Mean Square Residual (Table 5.32).

**Table 5.32: Overall model fit indices (first run)**

Fit Index	Recommended Cutoff	Model fit index value
RMSEA	< 0.080	0.073
SRMR	< 0.100	0.110
NNFI	≥ 0.90	0.94
CFI	≥ 0.90	0.95

Exogenous variables were allowed to correlate but no correlations among error terms have been allowed. It is a widespread misuse of structural equation modeling to include correlated terms in the model for the sole purpose of obtaining a better fit to the data. In cross-sectional studies as it is this one, correlated error terms either within or across constructs is something to avoid. However, there may be a theoretical justification besides an empirical one to allow error terms to correlate within a construct.

If the error terms for two indicators correlate, something is being measured in addition to the construct. That must not happen when constructs are well enough understood. However, new constructs such as the knowledge types, having their measurement items developed from scratch, are more prone to show that kind of problem.

Looking at the modification indices, correlated error terms are suggested for items on Procedural Knowledge (pk3 and pk4), Application Conceptual Knowledge (ack1 and ack2) and Subjective Norm (sn1 and sn2). Although subjective norm was based on a validated instrument, the items were adapted and a new item (sn2) has been introduced. These actions can be at the root of the correlated measurement error. When the error terms for the above indicators are allowed to correlate, a significant improvement in fit is achieved (Table 5.33). In particular, SRMR is now below the recommended cutoff value.

**Table 5.33: Overall model fit indices (second run)**

<b>Fit Index</b>	<b>Recommended Cutoff</b>	<b>Model fit index value (first run)</b>	<b>Model fit index value (second run)</b>
RMSEA	< 0.080	0.073	0.053
SRMR	< 0.100	0.110	0.078
NNFI	≥ 0.90	0.94	0.90
CFI	≥ 0.90	0.95	0.92

Before comparing the structural estimates with and without correlated error terms, given the non-normal data, the evaluation of the significance of the paths has to be carefully examined. Instead of the traditional 0.05 level of significance, a 0.025 level or even a 0.01 level should be used (Bollen 1989; Hoogland and Boomsma 1998; Boomsma and Hoogland 2001). If a one-tailed test is used since the direction of every relationship has been hypothesized, a critical value of 1.960 will have to be used for a 0.025 level of significance while a critical t-value of 2.326 will have to be used for a 0.01 level of significance. In this study, we adopted the most conservative approach selecting 0.01 for the level of significance.

Table 5.34 allows for the comparison of the structural estimates with and without errors. Only the relationship between Psychological Ownership and Perceived Usefulness of Exploratory turns out non-significant from the first run (without correlated error terms) to the second run (with correlated error terms for Procedural Knowledge, Application Conceptual Knowledge and Subjective Norm). At the same time, the effects for Application Conceptual Knowledge on Perceived Ease of Exploratory Use, Perceived Usefulness of Exploratory Use and

on Specific Computer Self-Efficacy increase substantially while there is a slight decrease for the effect of Procedural Knowledge on the belief determinants of exploratory use.

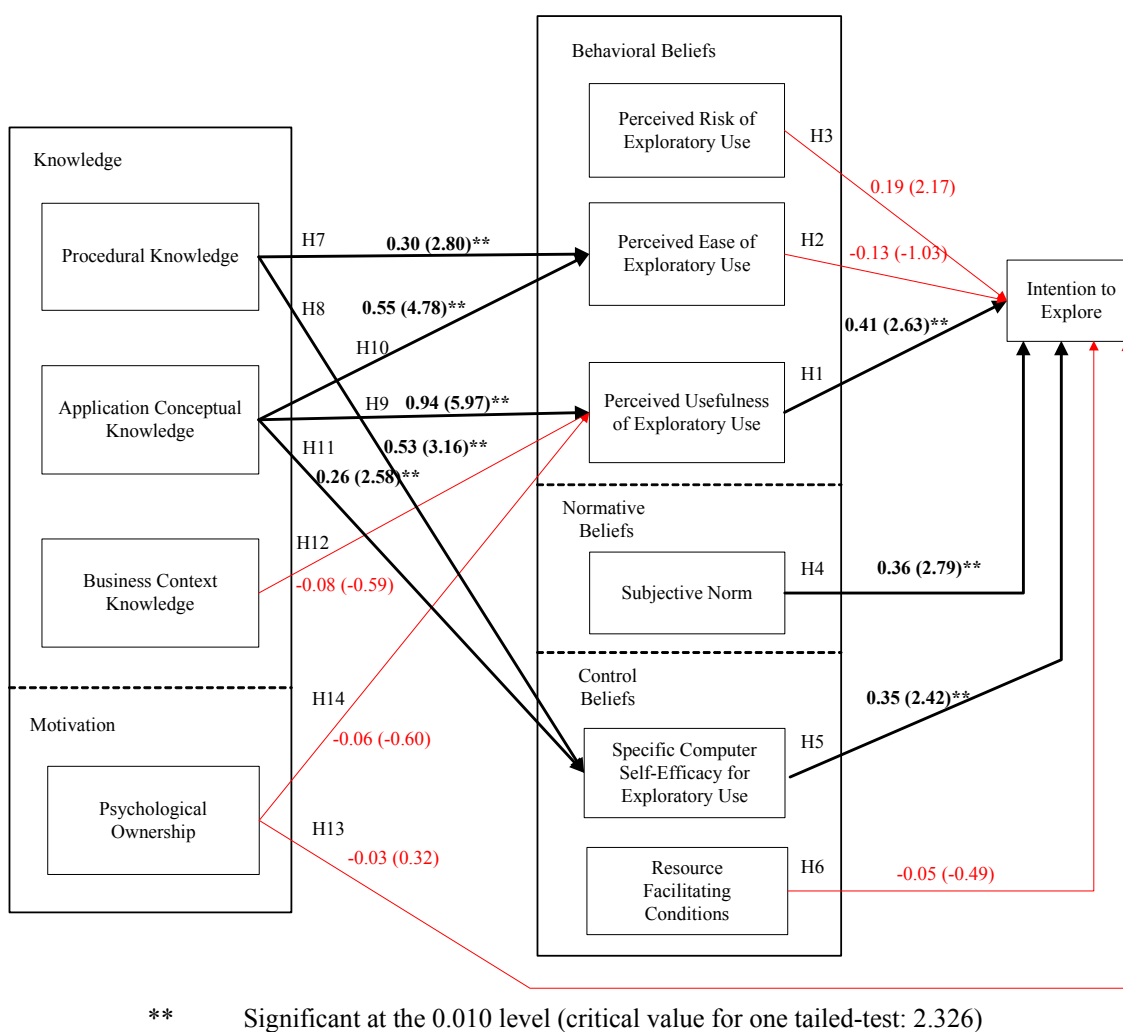
**Table 5.34: Structural Estimates**

Structural Relationship		First Run	Second Run
PREU	→ IE	0.21 (2.25)	0.19 (2.17)
PEEU	→ IE	-0.03 (-0.24)	-0.13 (-1.03)
PUEU	→ IE	<b>0.45</b> <b>(4.01)</b>	<b>0.41</b> <b>(2.63)</b>
SN	→ IE	<b>0.45</b> <b>(3.81)</b>	<b>0.36</b> <b>(2.79)</b>
SCSE	→ IE	<b>0.33</b> <b>(2.92)</b>	<b>0.35</b> <b>(2.42)</b>
RFCA	→ IE	-0.06 (-0.54)	-0.05 (-0.49)
PO	→ IE	-0.11 (-1.01)	0.03 (0.32)
ACK	→ PEEU	<b>0.29</b> <b>(2.85)</b>	<b>0.55</b> <b>(4.78)</b>
PK	→ PEEU	<b>0.46</b> <b>(4.41)</b>	<b>0.30</b> <b>(2.80)</b>
ACK	→ PUEU	<b>0.41</b> <b>(3.10)</b>	<b>0.94</b> <b>(5.97)</b>
BCK	→ PUEU	0.17 (1.30)	-0.08 (-0.59)
PO	→ PUEU	0.21 (2.12)	0.03 (0.32)
ACK	→ SCSE	<b>0.26</b> <b>(2.58)</b>	<b>0.58</b> <b>(5.24)</b>
PK	→ SCSE	<b>0.53</b> <b>(5.16)</b>	<b>0.32</b> <b>(3.05)</b>
Chi-square		650.26	525.97
Degrees of freedom		399	396
Squared Multiple Correlations for	R <sup>2</sup>		
IE		0.59	0.65
PEEU		0.39	0.56
PUEU		0.41	0.83
SCSE		0.43	0.63

All in all, the model presents a better fit having the explained variance on intention to explore increased from 0.59 to 0.65.

## 5.7 Results of the structural relationships

Figure 5.1 presents the structural relationships to be now individually addressed.



**Figure 5.1: Structural Estimates**

### **5.7.1 Behavioral Beliefs**

*H1: Perceived Usefulness of Exploratory Use has a positive effect on Intention to Explore.*

This hypothesis was supported at the 0.01 level of significance. Among all the primary belief determinants of Intention to Explore, Perceived Usefulness of Exploratory Use emerges as the strongest one (standardized estimate of 0.41). This is consistent with the importance of usefulness in explaining other types of computer usage (Taylor and Todd 1995b; Agarwal and Prasad 1998; Venkatesh and Davis 2000).

*H2: Perceived Ease of Exploratory Use has a positive effect on Intention to Explore.*

This hypothesis was not supported. It comes as a surprise since past research has usually found perceived ease of use as a determinant of behavioral intention. However, the context in this study differs from previous studies by looking at a particular, demanding type of usage complex information technology in an organizational setting of, instead of usage of simpler technology in a personal setting. An explanation may come from this context change.

*H3: Perceived Risk of Exploratory Use has a negative effect on Intention to Explore.*

This hypothesis was not supported. This is something unexpected since we are dealing with complex IT and the probability of making errors with serious consequences at the organizational level may be quite high.

### **5.7.2 Normative Beliefs**

*H4: Subjective Norm has a positive effect on Intention to Explore.*

This hypothesis was supported at the 0.01 level of significance. Past research suggests that the effect of subjective norm is only significant in mandatory settings. Unfortunately though voluntariness has been included in this study, its weak measurement properties did not allow keeping it in the model. The voluntariness construct does seem to indicate neither completely mandatory nor completely voluntary setting. The mean score was right in the middle of the seven-Lickert scale (Appendix G).

### **5.7.3 Control Beliefs**

*H5: Specific Computer Self-Efficacy for Exploratory Use has a positive effect on Intention to Explore.*

This hypothesis was supported at the 0.01 level of significance. Self-efficacy has been shown as a determinant of intention both directly (Hill, Smith et al. 1987) and indirectly fully mediated by perceived ease of use. In this context of exploratory use of complex IT, specific self-efficacy for exploratory has become a more important determinant of behavioral intention than perceived ease of use. This is consistent with past research (Taylor and Todd 1995), although just the opposite may also be found (Venkatesh, Morris et al. 2003).

*H6: Resource Facilitating Conditions have a positive effect on Intention to Explore.*

*H6a: Assistance has a positive effect on Intention to Explore.*

*H6b: Available Time has a positive effect on Intention to Explore.*

Both hypotheses were not supported. The effect of facilitating conditions on behavioral intention has already been found non-significant due the effect being captured by effort expectancy, the degree of use associated with the use of the system, i.e., perceived ease of use.

That would not be the explanation in this study. The effect of Perceived Ease of Use on Intention to Explore is not even significant.

#### **5.7.4 Knowledge types**

*H8: Procedural Knowledge has a positive effect on Perceived Ease of Exploratory Use.*

This hypothesis was supported at the 0.01 level of significance. As expected, the understanding of the commands, menus, and screens of the application, how to combine and use them to complete a job task is necessary to engage in exploratory use. Increased familiarity with the diversity of commands and menus leads users to find the system easier to explore. That does not necessarily mean the system is easy to explore.

*H9: Procedural Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.*

This hypothesis was supported at the 0.01 level of significance. As expected, users' judgment of their efficacy in the domain of the specific IT to engage in exploratory use increases as their knowledge on how to perform a task using the system increases too.

*H10: Application Conceptual Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.*

This hypothesis was supported at the 0.01 level of significance. All key factors considered, this is the only and most important key factor effect on Perceived Usefulness of Exploratory Use. Understanding the big picture of what can be done in the system by knowing how the work practices are mapped into the system and how they interrelate and depend on each

other leads users to better recognize the value of looking for new functionalities and new information.

*H11: Application Conceptual Knowledge has a positive effect on Perceived Ease of Exploratory Use.*

This hypothesis was supported at the 0.01 level of significance. Understanding how the business processes are supported by the system leads users to easier identify where they can look for new functionalities or find new information.

*H12: Application Conceptual Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.*

This hypothesis was supported at the 0.01 level of significance. Understanding how the business processes are mapped into the tool and how they depend on each other builds users' confidence in looking for new ways of using the system even when no one is around to help them.

*H13: Business Context Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.*

This hypothesis was not supported. The driver to engage in exploratory use does not come from knowing how the group work contributes to the overall success of the organization. The driver seems not to be at such high level organizational impact.

### **5.7.5 Motivation**

*H14: Psychological Ownership has a positive effect on Intention to Explore.*

*H15: Psychological Ownership has a positive effect on Perceived Usefulness of Exploratory Use.*

These hypotheses were not supported. Both the direct and indirect effect through Perceived Usefulness of Exploratory Use on Intention to Explore could not be detected. Psychological Ownership presents very high construct reliability (0.90) and variance extracted (0.76) leading to think that has been adequately measured. The mean score is 5.6 on a 7-point scale, about 80%. It is a high score. However, even if users exhibit high Psychological Ownership that is not the driver to engage in exploratory use (direct effect) or even to recognize the usefulness of such behavior (indirect effect).

Table 5.35 presents a summary of the statistical findings.

## **5.8 Exploratory Analysis**

Since some results counter our expectations, some exploratory analysis is performed. It is not a thorough analysis for a model respecification. It is just intended to help interpret some of the surprising results in the final chapter of this dissertation. Therefore, this section presents basically the results from the exploratory analysis and further discussion and implications are addressed in the final chapter. Among the surprising results, the lack of effect of Perceived Ease of Exploratory Use on Intention to Explore and the lack of effect of Business Context Knowledge on Perceived Usefulness of Exploratory Use were selected for this analysis.

### **5.8.1 Perceived Ease of Exploratory Use**

The link between perceived ease of use and behavioral intention is empirically supported in the basic Technology Acceptance Model (Davis, Bagozzi et al. 1989) but drops off with more usage experience as found in other studies (e.g., Thompson, Higgins et al. 1994).

**Table 5.35: Statistical Findings**

(\*\* at the 0.01 level)

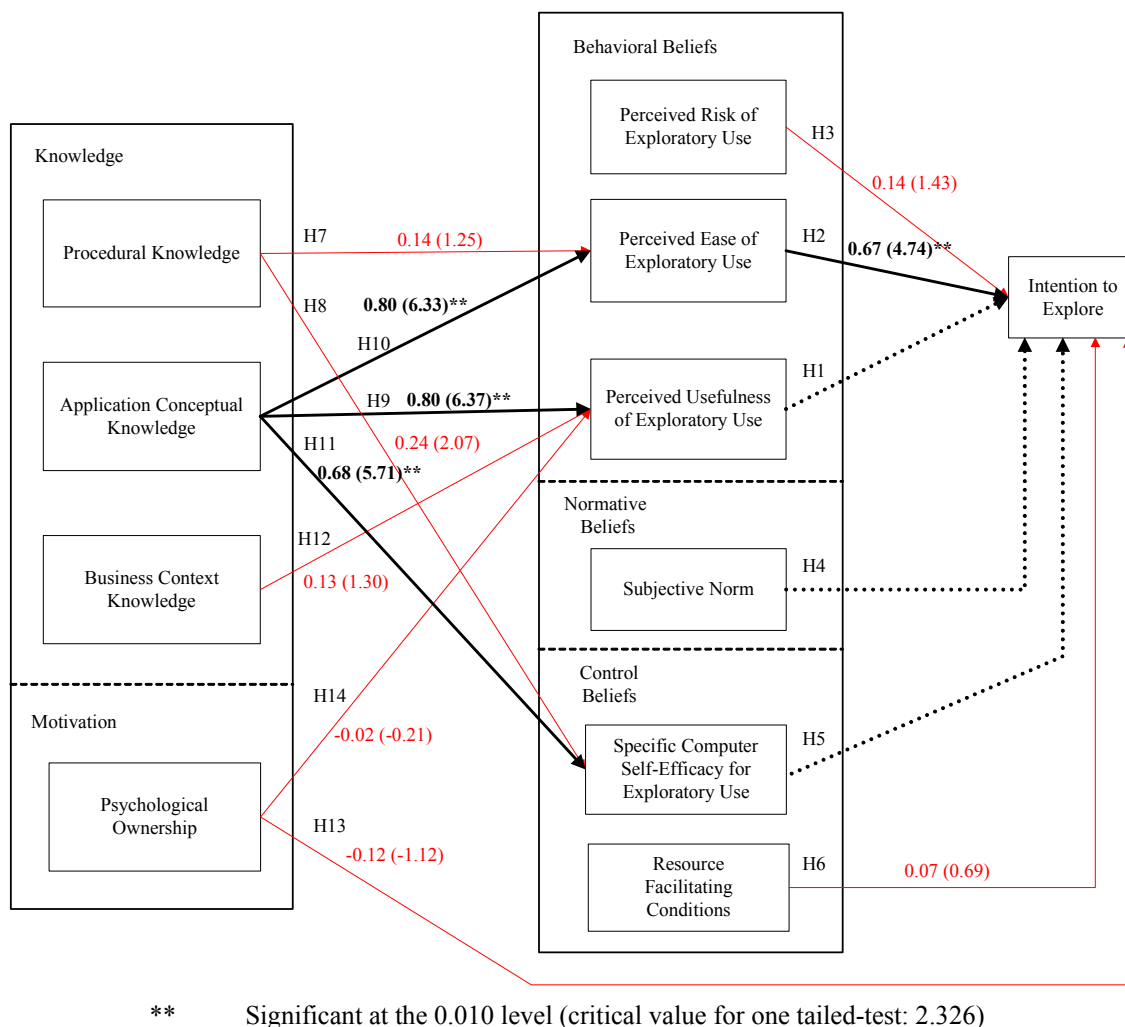
<b>Research Scope</b>	<b>Hypothesis</b>	<b>Statistical finding</b>
<b>Behavioral Beliefs</b>	H1: Perceived Usefulness of Exploratory Use has a positive effect on Intention to Explore.	<b>Supported **</b>
	H2: Perceived Ease of Exploratory Use has a positive effect on Intention to Explore.	Not supported
	H3: Perceived Risk of Exploratory Use has a negative effect on Intention to Explore	Not supported
<b>Normative Beliefs</b>	H4: Subjective Norm has a positive effect on Intention to Explore.	<b>Supported **</b>
<b>Control Beliefs</b>	H5: Specific Computer Self-Efficacy for Exploratory Use has a positive effect on Intention to Explore.	<b>Supported **</b>
	H6: Resource Facilitating Conditions have a positive effect on Intention to Explore.	
	H6a: Assistance has a positive effect on Intention to Explore.	Not supported
	H6b: Available Time has a positive effect on Intention to Explore.	
<b>Knowledge</b>	H7: Procedural Knowledge has a positive effect on Perceived Ease of Exploratory Use.	<b>Supported **</b>
	H8: Procedural Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.	<b>Supported **</b>
	H9: Application Conceptual Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.	<b>Supported **</b>
	H10: Application Conceptual Knowledge has a positive effect on Perceived Ease of Exploratory Use.	<b>Supported **</b>
	H11: Application Conceptual Knowledge has a positive effect on Specific Computer Self-Efficacy for Exploratory Use.	<b>Supported **</b>
	H12: Business Context Knowledge has a positive effect on Perceived Usefulness of Exploratory Use.	Not supported
<b>Motivation</b>	H13: Psychological Ownership has a positive effect on Intention to Explore.	Not supported
	H14: Psychological Ownership has a positive effect on Perceived Usefulness of Exploratory Use.	Not supported

We did not expect users to have considerable experience on exploratory use since it is a small portion of their total usage of the system (Table 4.29). Counter to expectations, Perceived Ease of Exploratory Use shows no statistically significant effect on Intention to Explore.

Looking at the correlations among the endogenous variables (Table 5.29), Perceived Ease of Exploratory Use correlates highly with Perceived Usefulness of Exploratory Use (0.61) and Specific Computer Self-Efficacy for Exploratory Use (0.73). To assess to what extent the effect of Perceived Ease of Use on Intention to Explore is captured by other statistically significant links everything else that is statistically significant is removed except the effect of Perceived Ease of Use (Figure 5.2; dotted lines represent removed links).

As a result, Perceived Ease of Exploratory Use becomes statistically significant. The model drops the variance explained on intention to explore from 65% to 42% and presents a worst fit (RMSEA=0.060; SRMR=0.083; NNFI=0.95; CFI=0.96) when compared to the original model. When Perceived Usefulness of Exploratory Use is included in the model, then Perceived Ease of Exploratory Use is no more statistically significant (Figure 5.3). The model explains now 58% of the variance on intention to explore and presents a better fit (RMSEA=0.054; SRMR=0.080; NNFI=0.95; CFI=0.96).

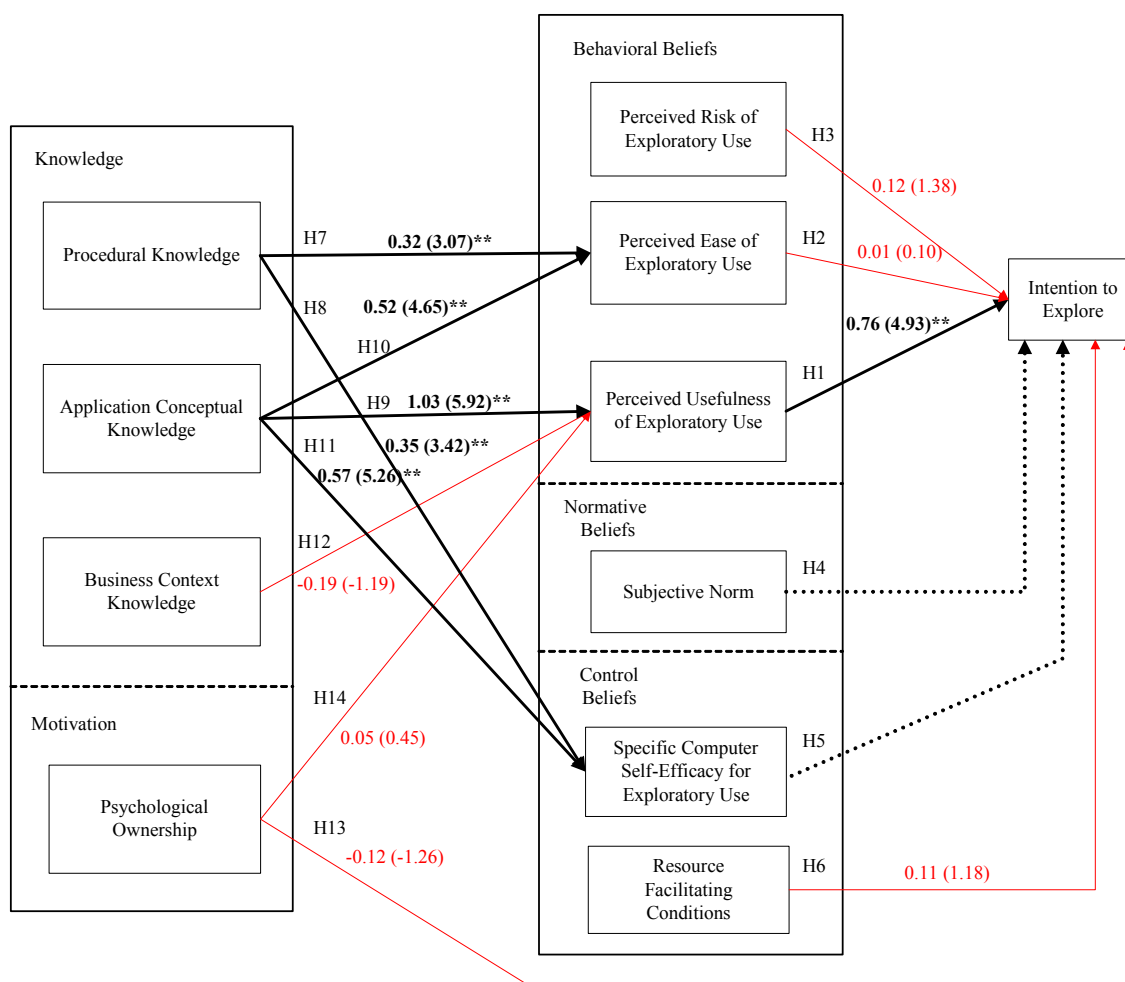
Instead of Perceived Usefulness of Exploratory Use, if Specific Computer Self-Efficacy is added to the model, the same result is obtained: the effect of Perceived Ease of Exploratory Use on Intention to Explore becomes statistically not significant (Figure 5.4). The explained variance on intention to explore is now 61% and the goodness-of-fit indices are better (RMSEA=0.056; SRMR=0.082; NNFI=0.95; CFI=0.96).



**Figure 5.2: Perceived Ease of Exploratory Use becomes statistically significant**

Either the inclusion of Perceived Usefulness of Exploratory Use or Specific Computer Self-Efficacy for Exploratory Use turns the effect of Perceived Ease of Exploratory Use not statistically significant.

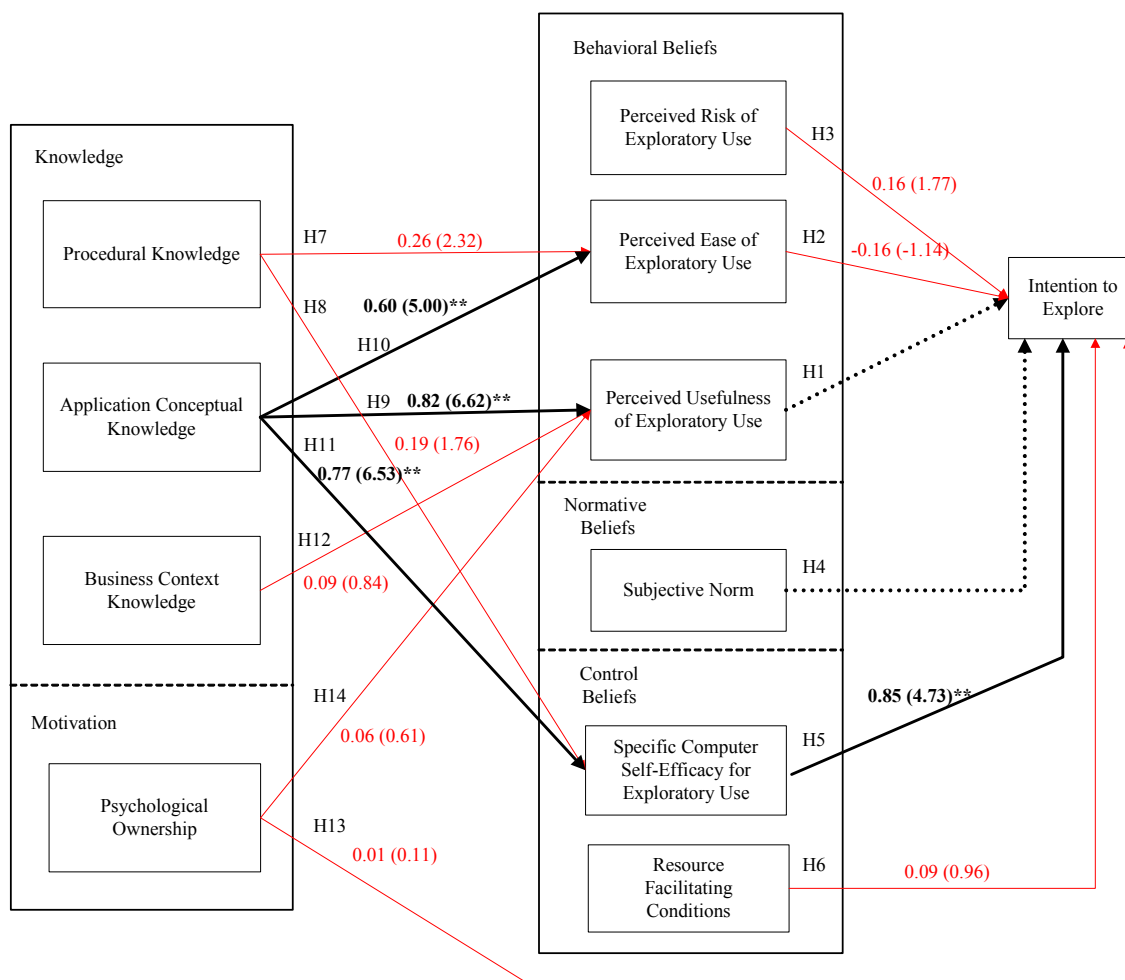
Modification indices for the final model in this study presented in Figure 5.1 suggest a link between Specific Computer Self-Efficacy for Exploratory Use and Perceived Ease of Exploratory Use (Figure 5.5).



\*\* Significant at the 0.010 level (critical value for one tailed-test: 2.326)

**Figure 5.3: Including Perceived Usefulness of Exploratory Use**

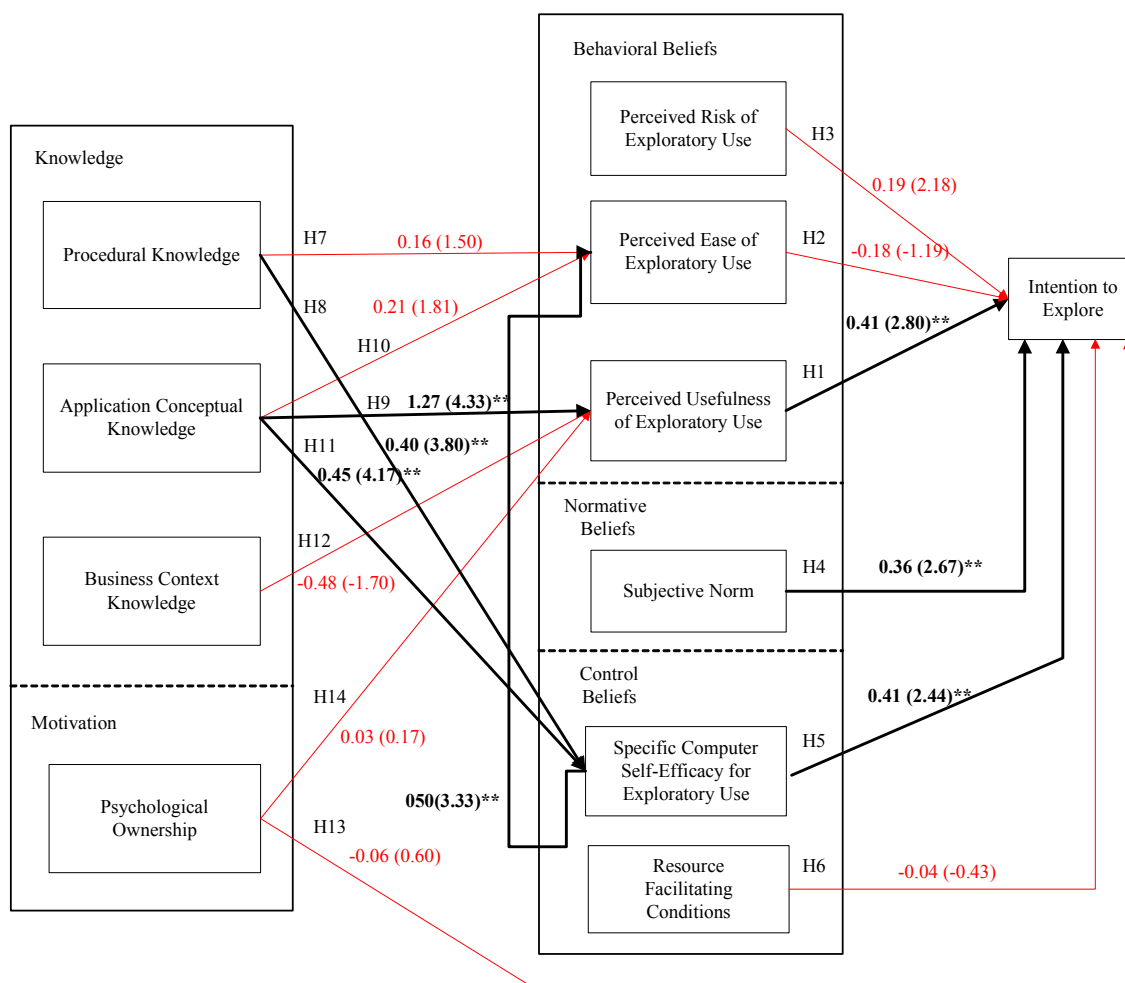
Allowing that link, the explained variance on intention to explore remains the same (65%); RMSEA improves from 0.053 to 0.050, SRMR increases from 0.078 to 0.079 while the remaining goodness-of-fit indices NNFI and CFI do not change.



\*\* Significant at the 0.010 level (critical value for one tailed-test: 2.326)

**Figure 5.4: Including Specific Computer Self-Efficacy for Exploratory Use**

Important to notice is that the effect of Perceived Ease of Exploratory Use (PEEU) on Intention to Explore remains statistically not significant and the effect of Specific Computer Self-Efficacy for Exploratory Use (SCSE) on Intention to Explore (IE) remains statistically significant. The effect of SCSE on Intention to Explore is not mediated by PEEU. Thus SCSE has an independent explanatory power.



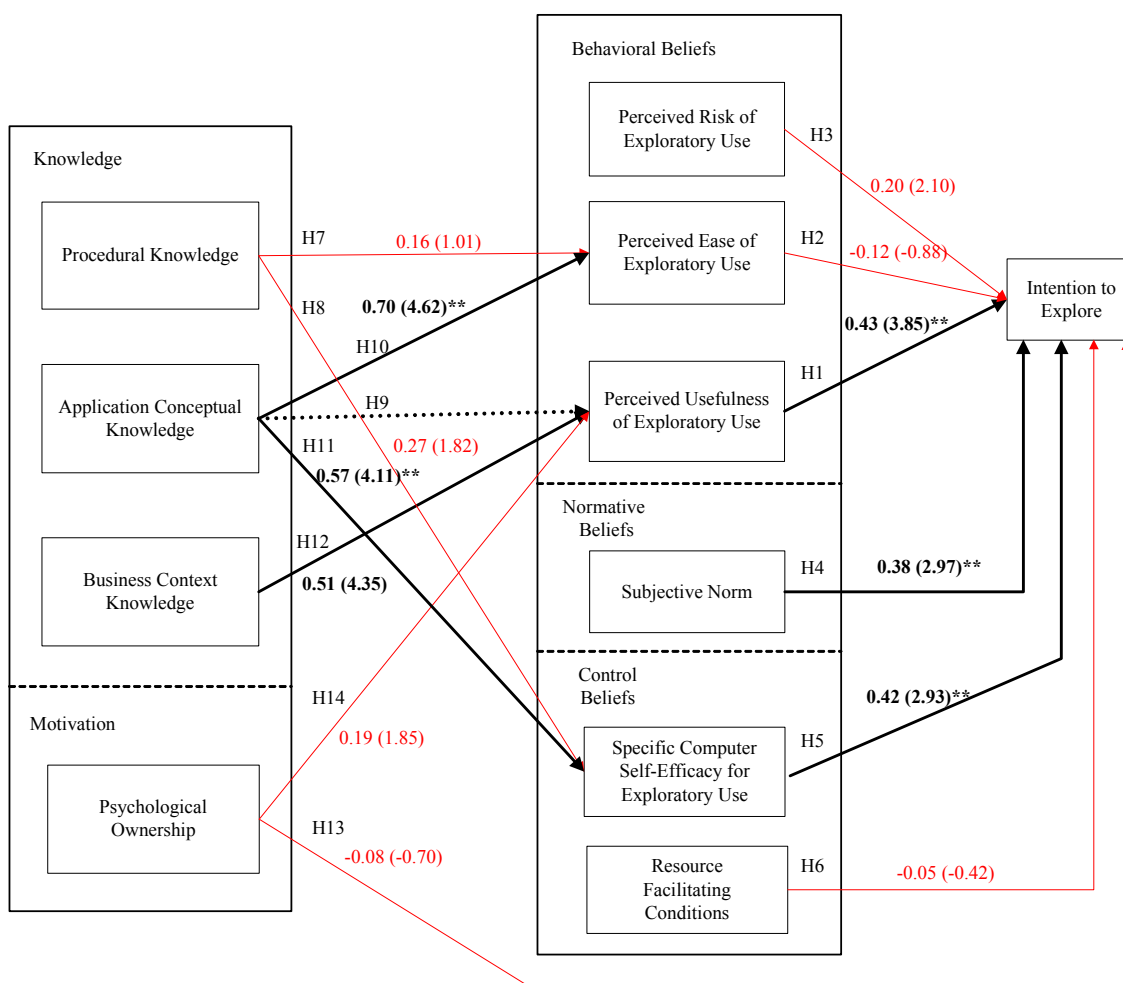
\*\* Significant at the 0.010 level (critical value for one tailed-test: 2.326)

**Figure 5.5: Including a link between SCSE and PEEU**

### 5.8.2 Business Context Knowledge

Counter to expectations, Business Context Knowledge does not present a statistically significant effect on Perceived Usefulness of Exploratory Use. It is the only type of knowledge that seems not to matter to engage in exploratory use. Since Application Conceptual Knowledge correlates at 0.59 Business Context Knowledge with and shows a statistically significant effect on Perceived Usefulness of Exploratory Use, that effect was removed. As a result, the effect of

Business Context Knowledge on Perceived Usefulness of Exploratory Use becomes statistically significant (Figure 5.6). There is a drop in the variance explained on intention to explore from 65% to 58% and a considerable drop on the variance explained on Perceived Usefulness of Exploratory Use from 83% to 39%. Thus, we can conclude that although weak Business Context Knowledge may work as a surrogate for Application Conceptual Knowledge.



\*\* Significant at the 0.010 level (critical value for one tailed-test: 2.326)

**Figure 5.6: Dropping the effect of ACK on PEEU**

## 5.9 IT users vs. non-IT users

A considerable number of respondents to the survey come from the IT function (Table 4.26). Users in the IT function are arguably not the same as other users in the remaining functions. Thus, an overall comparison between the two groups for the scores on the 11 constructs in the model is performed through a multivariate analysis of variance (MANOVA).

MANOVA assumes the equivalence of covariance matrices across groups. Typically the Box's M test is used to test that assumption (Table 5.36).

**Table 5.36: Box's Test of Equality of Covariance Matrices**

<b>Box's M</b>	906.702
<b>F</b>	1.289
<b>df1</b>	496
<b>df2</b>	33877
<b>Sig.</b>	.000

Since this test shows a significance level of 0.000, the null hypothesis of equality of covariance matrices is rejected. The assumption is not met. However, this test is very sensitive to departures from normality and we are dealing with non-normal data in this study. Fortunately, when the groups are approximately equal size (50 IT users and 68 non-IT users), a violation of this assumption has minimal impact (Hair, Anderson et al. 1998). Thus, we proceed to the multivariate tests (Table 5.37).

Among the measures of multivariate differences, Pillai's Trace or Wilk's Lambda are the most immune to violations of the assumptions underlying MANOVA. Either these measures or the remaining measures, all present a significance level above the 0.05 level. At this level of

significance, we conclude that there is no overall difference between the two groups. Therefore, IT users may be regarded as the same as non-IT users on the 11 measured constructs.

**Table 5.37: Multivariate Tests**

	Value	F	Hypothesis df	Error df	Sig.
<b>Pillai's Trace</b>	.358	1.548	31	86	.059
<b>Wilks' Lambda</b>	.642	1.548	31	86	.059
<b>Hotelling's Trace</b>	.558	1.548	31	86	.059
<b>Roy's Largest Root</b>	.558	1.548	31	86	.059

## CHAPTER

### 6 CONCLUSIONS

Despite large investments in IT, IT under-utilization remains a problem (Lewis 2004; Swanton 2004). Organizations endure costly and lengthy IT implementations in the expectation that resulting benefits will ultimately outweigh such organizational investment. But full benefits will probably only come when systems are used to their maximum potential. As the complexity and organizational scope of the IT implementations increases, the probability of having an IT system under-utilized increases. ERP systems, the empirical setting chosen for this study, are an archetypical example of complex IT. ERP systems often remain under-utilized following implementation (Ross and Vitale 2000). To get the most out of complex IT such as ERP systems, management should foster its innovative and comprehensive usage. Organizational users are a key potential source of innovation. Any local improvement made by a user has the potential to be multiplied many times given the network and ripple effects of an organization-wide system. By the same token, under-utilization may particularly hurt the potential for huge benefits by preventing value-added tasks from being performed.

This study argues that exploratory use may be a way of recovering from under-utilization and moving to more comprehensive usage of IT. Thus, this study seeks to answer the question “What factors are likely to determine the extent of exploratory use of complex information technology?” under the assumption that exploratory use would lead to getting the most benefits out of complex IT.

This chapter starts with a discussion of the major findings reported in the previous chapter framed by the similarities and differences when moving from individual use of simple IT to organizational use of complex IT. The following section acknowledges limitations drawing attention to the caution under which results have to be interpreted. The practical and academic contributions are then highlighted and this last chapter ends by setting the implications and guidelines for future research.

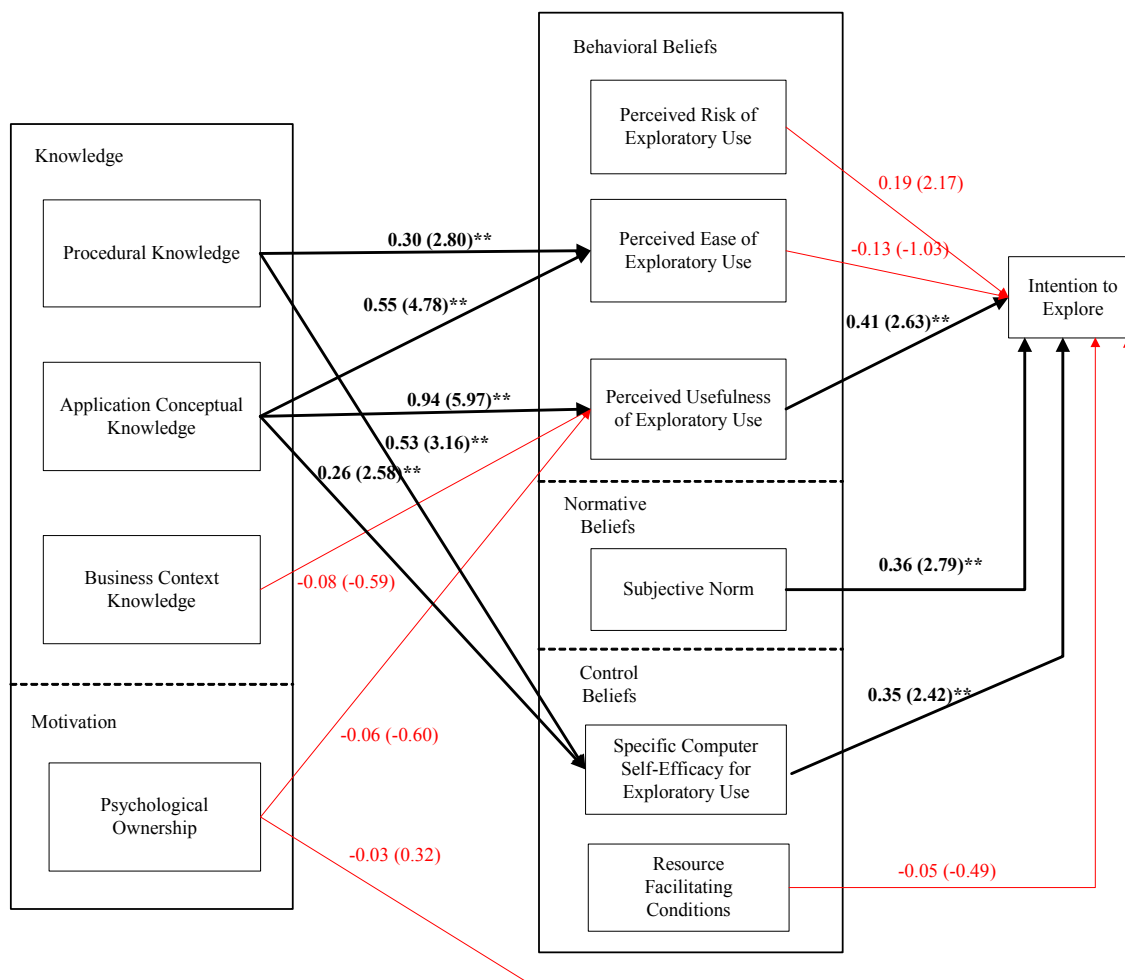
## **6.1 Discussion**

To answer the research question on an empirical basis, a research model was developed drawing upon the Theory of Planned Behavior (TPB). Sets of salient beliefs (behavioral, normative, and control) were identified as primary determinants of intention to explore, the key antecedent of exploratory use. Moving back one additional level, key factors acting directly on the primary belief determinants and thus indirectly on intention to explore were then identified.

Data was collected from ERP users coming mainly from the Portuguese SAP Users Group. The relationships among all the constructs as depicted in the research model (Figure 6.1) were analyzed through structural equation modeling. As the data did not meet the assumption of multivariate normality, some caution was taken to minimize the sampling error's impact. First, a proper model solution was obtained making sure that appropriate fit indices that are relatively insensitive to violations of multivariate normality met the recommended criteria (Bentler 1990; Vandenberg and Lance 2000). Second, the statistical significance of the relationships in the model was determined using the 0.01 more stringent level of significance than the 0.05 that is traditionally used (Bollen 1989; Hoogland and Boomsma 1998; Boomsma and Hoogland 2001).

Among the sets of salient beliefs, the effects of Perceived Usefulness of Exploratory Use, Subjective Norm and Specific Computer Self-Efficacy for Exploratory Use on Intention to

Explore are statistically significant at the 0.01 level. Counter to expectations, Perceived Risk of Exploratory Use, Perceived Ease of Exploratory Use and Resource Facilitating Conditions show no statistically significant effect on Intention to Explore.



\*\* Significant at the 0.010 level (critical value for one tailed-test: 2.326);

**Figure 6.1: Research Model Structural Estimates**

Among the key factors acting on those sets of beliefs, Application Conceptual Knowledge shows a statistically significant effect on Perceived Ease of Exploratory Use, Perceived Usefulness of Exploratory Use, and Specific Computer Self-Efficacy for Exploratory

Use; in addition, Procedural Knowledge shows a statistically significant effect on Perceived Ease of Exploratory Use and Specific Computer Self-Efficacy for Exploratory Use. Counter to expectations, Business Context Knowledge and Psychological Ownership show no statistically significant effect on Perceived Usefulness of Exploratory Use. In addition, the direct effect of Psychological Ownership on Intention to Explore is not statistically significant.

Based on these empirical findings, it seems users intend to engage in exploratory use because they recognize first the potential benefits (perceived usefulness of exploratory use), they feel the pressure (subjective norm), and have confidence on their abilities (specific computer self-efficacy for exploratory use) to do it. These abilities come from knowing how to use the system (procedural knowledge) and how the different parts of the system work together to accomplish organizational tasks (application conceptual knowledge). Among the different types of knowledge, application conceptual knowledge is the major contributor to better understanding of the usefulness in exploring the system (perceived usefulness of exploratory use), which emerged as the strongest direct determinant of intention to explore. Perceived Risk of Exploratory Use, Perceived Ease of Exploratory Use, Resource Facilitating Conditions, Business Context Knowledge and Psychological Ownership are the constructs that do not seem to operate as expected.

This study is a departure from previous studies on IT utilization in two ways. In the first and more obvious way, this study focuses on more complex IT; past studies were mainly focused on simple technologies.

In the second and less obvious way, this study moves away from a focus on individual-oriented impacts to more organizational-oriented impacts. In this study, exploratory use was framed in a context where collective impacts matter more than individual impacts. In this

context, the choices that individuals make about how to use the system are more important for their impact on others around them than for their individual impact. Thus the presumption is that exploratory usage of complex IT has a ripple effect in the organization, as others learn of innovative ways to use the technology and these innovative ways become commonly used by many in the organization.

The way in which the types of knowledge incorporated in the research model have been defined expresses this organizational perspective. Business Context Knowledge, Application Conceptual Knowledge and Procedural Knowledge have been defined with the collective impacts of the usage of the complex IT in mind, not personal and local impacts. By the same token, the usefulness of engaging in exploratory use was expressed in terms of what the organization has to gain not the individual.

As the importance of the findings and non findings for the model are discussed, these two departures from previous studies frame the discussion: what determinants of use remain the same as have been found in individual-oriented usage of simple information technology, and what is somehow different when considering organizational-oriented complex information technology.

### ***6.1.1 Perceived Usefulness of Exploratory Use***

Perceived Usefulness of Exploratory Use is among the primary belief determinants of exploratory use -- the strongest belief driving users to engage in such a challenging behavior. This is a result consistent with other studies that have looked at perceived usefulness in other usage contexts with relatively simple, individual-oriented information technologies and have found it also as the strongest determinant. However, this study has moved into a different realm. We are not talking about usage in a standard way. We are talking about a particular type of usage --exploratory use --that is expected to have an impact on other types of usage --non-routine use

and deep use. In addition, Perceived Usefulness of Exploratory Use was defined as a slightly different construct from Perceived Usefulness in past studies. The emphasis for perceived usefulness is not about the impact on an individual's productivity but on the organization's productivity. Arguably, organizational-oriented usage of more complex information technology is of more interest to management than individual usage of simple IT. Thus it becomes even more crucial to know what factors may have a positive effect on perceived usefulness when use is expected to have a considerable collective impact at the organizational level.

### **6.1.2 Subjective Norm**

Subjective Norm is another behavioral belief whose important effect on behavioral intention is confirmed. Subjective Norm (Ajzen 1991), Social Norms (Thompson, Higgins et al. 1991) or Social Influence (Venkatesh, Morris et al. 2003) are different labels for the same basic concept: individuals' perception that important others believe they should perform the behavior.

The mechanism underlying the strong effect of Subjective Norm on Intention to Explore is open for discussion. Several constructs have been suggested, as moderating variables that determine how strong the effect of Subjective Norm is. Voluntariness is one of them. For example, Hartwick and Barki (1994) showed that subjective norm was not significant in voluntary settings. Although Voluntariness has been dropped from the model because of its weak measurement properties, the average score on each measurement item is around the middle of the scale, suggesting a mix of both mandatory and voluntary contexts for exploratory use in this study. From other questions in the survey regarding the time dedicated to different types of use, the voluntary settings appear even slightly more preponderant than the mandatory settings for those who engage in exploratory use (Table 4.29).

### ***6.1.3 Perceived Ease of Exploratory Use***

Perceived Ease of Exploratory Use shows no statistically significant effect on Intention to Explore. This is a surprising finding since perceived ease of use and behavioral intention are linked in the basic TAM model (Davis et al. 1989). In addition, in this sample they are correlated at 0.41 (consistent with a direct impact). However, an indirect impact was also proposed in TAM for perceived ease of use on behavioral intention through perceived usefulness. Therefore, some exploratory analysis was done in this study to explore this unexpected finding and see to what extent the effect of perceived ease of use is being mediated by usefulness.

In fact, Perceived Ease of Exploratory Use is highly correlated with Perceived Usefulness of Exploratory Use (0.61). In addition, the same happens with Specific Computer Self-Efficacy for Exploratory Use (0.73). These two constructs both show a statistically significant effect on Intention to Explore. When everything except the relationship between Perceived Ease of Exploratory Use and Intention to Explore is removed from the model, the effect of Perceived Ease of Exploratory Use on Intention to Explore becomes strong and statistically significant.

As soon as the link from either Perceived Usefulness of Exploratory Use or Specific Computer Self-Efficacy for Exploratory Use to Intention to Explore is added to the model, then the effect of Perceived Ease of Exploratory Use is no longer statistically significant. In other words, the impact of Perceived Ease of Exploratory Use on Intention to Explore is entirely mediated by either Perceived Usefulness of Exploratory Use or Specific Computer Self-Efficacy for Exploratory Use.

Like Davis et al. (1989), other studies have found that the effect of Perceived Ease of Use on behavioral intention drops off with more usage experience (e.g., Thompson, Higgins et al. 1994). However, exploratory use is something that users probably do not have considerable

experience with since exploratory use always involves trying new things. Another explanation has to be found.

The different usage context in this study may provide an explanation. Complex IT is not easy to understand. ERP systems are usually seen as complex and no one really expects them to be easier to explore. When it comes to engage in such a challenging behavior as exploratory use, difficulties are expected. It is hard enough that if the users did not have any other reasons to do it they would not do it. Everybody basically assumes that it is hard to explore a complex IT even though there are differences in the opinion on how hard it is. Thus relative differences in perceptions of how hard exploratory use will be (above some hurdle level), seem to not be a factor that motivates people to engage in more or less exploratory use of complex IT. It does not predict the behavior beyond what other constructs Perceived Usefulness of Exploratory Use, Specific Computer Self-Efficacy for Exploratory Use, and Subjective Norm, already do.

#### ***6.1.4 Specific Computer Self-Efficacy***

Specific Computer Self-Efficacy shows a strong statistically significant effect on Intention to Explore. Besides seeing its importance confirmed in a different context, self-efficacy beliefs assume even a more important role in organizational-oriented of complex IT usage in light of the findings concerning Perceived Ease of Exploratory Use. Unlike Perceived Ease of Exploratory Use that shows no statistically significant effect on Intention to Explore, Specific Computer Self-Efficacy appears to be a strong determinant leading to exploratory use of a complex information technology.

Although computer self-efficacy and perceived ease of use are close concepts, past research has shown them to be conceptually and empirically distinct (Venkatesh 2000). Past research has also shown opposite results when both self-efficacy and ease of use are present as

determinants of intention and not linked to each other. Taylor and Todd (1995) used a decomposed Theory of Planned Behavior model looked into usage of a Computing Resource Center by undergraduate and graduate business students for document and presentation production. They found the effect of perceived ease of use to be non-significant and effect of computer self-efficacy to be significant. On the other hand, Venkatesh, Morris et al. (2003) found just the opposite. One possibility is that above some upper hurdle level (i.e. when all agree the system is relatively easy to use) or below some lower hurdle level (i.e. when all agree the system is relatively hard to use), Ease of Use does not affect intention. Only in the middle range does it come into play.

Some exploratory analysis of the data in this study provides support for a possible relationship between perceived ease of use and specific computer self-efficacy. They share a high correlation (0.71). When Specific Computer Self-Efficacy for Exploratory Use is removed, Perceived Ease of Exploratory Use remains not statistically significant. Interestingly, removing Perceived Ease of Exploratory Use causes the link between Specific Computer Self-Efficacy and intention to drop to just below the .01 level of significance. This suggests that some multicollinearity exists between these two constructs.

### ***6.1.5 Knowledge Types***

Complex Information Technology is expected to create considerable knowledge barriers for exploratory use. The roles played by different types of knowledge fostering exploratory use of exploring complex IT are some of the most important findings of this study.

### **Application Conceptual Knowledge**

Among the different types of knowledge, Application Conceptual Knowledge emerges as the most important one. This includes understanding the workflow of the business processes mapped in the system and knowing the big picture of what the application does. Not only does this type of knowledge have a strong and statistically significant impact on Perceived Usefulness but it also affects Specific Computer Self-Efficacy. Both of these are strong primary belief determinants of intention to explore. This result is consistent with empirical findings from an experiment showing that tool conceptual knowledge is an important component in ERP training because it improves the end-users' mental model accuracy (Coulson, Olfman et al. 2003).

### **Procedural Knowledge**

Procedural Knowledge, the understanding of the application commands, menus and screens, how to combine them, and how to use them to complete a job task, has a strong and significant impact on Perceived Ease of Exploratory Use and Specific Computer Self-Efficacy for Exploratory Use. Perceived Ease of Exploratory Use shows statistically non-significant effect on Intention to Explore; however, Specific Computer Self-Efficacy for Exploratory Use is a strong determinant of Intention to Explore. This makes Procedural Knowledge an important type of knowledge to take into account. It is certainly often the focus of many training sessions. But even though Application Conceptual Knowledge appears to be perhaps more critical to exploratory use, that does not mean attention should not continue to be given to training in procedural knowledge.

### **Business Context Knowledge**

Business Context Knowledge is the only type of knowledge that does not have a significant relationship with other constructs in this sample. Why is this type of knowledge not significant? We conducted some exploratory analysis to investigate this. Business Context Knowledge and Application Conceptual Knowledge correlate at 0.59. If the construct of Application Conceptual Knowledge is removed from the model, then the link between Business Context Knowledge and Perceived Usefulness of Exploratory Use becomes statistically significant. This suggests some multicollinearity between these two types of knowledge, or perhaps one mediates the effect of the other.

Business Context Knowledge and Application Conceptual Knowledge are similar concepts but with important differences. Business Context Knowledge relates to a high level knowledge of how the business processes relate to overall organizational performance. Application Conceptual Knowledge relates to the interrelationships of the business processes that are supported by the IT. In a way, while the first relates to organizational level performance, the second relates to work processes performance, getting the work done using IT.

In addition, users are more likely to be driven by the issues of using the technology to accomplish specific work goals and by how this might relate to the group performance than by how this group performance may relate to overall organizational performance. They may just be trying to get their work done effectively. It is easier to be task-oriented than higher level organizational impact-oriented. That may explain why Application Conceptual Knowledge but not Business Context Knowledge shows a strong and statistically significant effect on Perceived Usefulness of Exploratory Use. Both these types of knowledge matter, but Application Conceptual Knowledge is dominant.

### **6.1.6 *Perceived Risk of Exploratory Use***

Perceived Risk of Exploratory Use shows no statistically significant effect on Intention to Explore. This is something unexpected since we are dealing with complex IT and the probability of making errors with serious consequences at the organizational level may be quite high.

On average, the respondents in the sample place themselves in about the middle of the scale. They do not find the behavior particularly risky. That may be explained by the high scores on the several types of knowledge in this sample that may prevent the users from making serious mistakes with unintended and serious consequences. However, that knowledge is not enough to make them just say it is not risky at all. Overall, they find the behavior worthwhile to perform because they may think in the long run the benefits will outweigh the costs. Perceived Risk is not a determining factor. There is some risk but not enough to prevent the users from engaging in exploratory use.

### **6.1.7 *Personal Motivation***

It was not possible to detect any significant impact of personal motivator factors (represented in the study by Psychological Ownership) on Intention to Explore, either directly or indirectly. Contrary to what was hypothesized, whatever the feelings of possessiveness Portuguese ERP users might have developed toward the ERP system (on average in the sample, between slightly and moderately agree), these feelings did not lead them to invest more of themselves into the system by exploring it. Cross-cultural differences may be at the root of the lack of an effect.

The issue of cross-cultural differences had already surfaced when we struggled with the wording for the measurement items for the Psychological Ownership construct. The results from a 10-country study (Kostova 1996) suggest that Portugal was a collectivistic country. Therefore

careful attention was devoted to the operationalization of the Psychological Ownership construct. As suggested, words such as “my” or “mine” were eliminated and only words as “we” or “our” were kept in the survey items for this study. Despite these efforts, in this sample the Psychological Ownership construct was not found to have any impact on Intention to Explore. This finding is worthy of some discussion.

Perhaps the concept does not really operate in the same way across cultures. Feelings of ownership may be experienced to a different extent in different cultures. When this is combined with the meaning that people give to work in their lives, work objects such as complex IT systems as potential targets for psychological ownership may present different salencies according to the culture. Unlike the American culture where the construct was originally developed and operationalized in the work context, the Portuguese culture in which this study took place is collectivistic (Hofstede 1984).

A collectivistic culture is relationship-based and much more oriented toward family and friends than to work. An individualistic culture such as the American culture is more oriented to personal achievements and successes and more focused on work related issues and material possessions. The efficacy motive underlying psychological ownership that would be somehow related to perceived usefulness of exploratory use may be more salient in individualistic than in collectivistic cultures. That may explain the lack of effect of Psychological Ownership on perceived usefulness of exploratory use and intention to explore in this study placed in a collectivistic society.

It is possible that other constructs from the personal motivation area would constitute better alternatives. Psychological attachment from the organizational commitment research may be an alternative to psychological ownership in future studies (Meyer and Allen 1991).

### **6.1.8 Resource Facilitating Conditions**

Resource Facilitating Conditions was operationalized looking at two specific facilitating conditions: available time and assistance for exploratory use. Due to measurement problems, available time had to be dropped leaving assistance as the facilitating condition to be assessed. The effect of assistance as a facilitating condition on intention to explore was not statistically significant. Although suggested by TPB, that effect on behavioral intention may be fully mediated if other constructs such as perceived ease of use are included in the model (Venkatesh 2000). However, facilitating conditions, as also suggested by TPB, may be modeled as a direct antecedent of behavior. Venkatesh, Morris et al. (2003) show that its effect on usage becomes stronger for older individuals with increasing experience.

Exploratory analysis on the resulting model for this study shows that perceived ease of use becomes significant when all the other statistical significant effects on intention to explore are dropped. In this case, there is a drop in explained variance on intention to explore from 65% to 42%. When the effect from perceived ease of exploratory use is dropped, then resource facilitating conditions becomes statistically significant, although the model only explains 16% of the variance on intention to explore. This is a consistent result with past studies that have shown the effect of facilitating conditions on behavioral intention being captured by other constructs.

## **6.2 Limitations**

Prior to discussing the implications of the findings in this study, limitations have to be recognized. One limitation concerns the scales used to measure important constructs. It would have been preferable to work with validated instruments, but they were not available in the literature. Of the eleven constructs in the research model, five were developed from scratch while

the others had to be adapted to the context of the study. Thus, considerable efforts were devoted to the development of the new scales.

In the case of the knowledge scales, six measurement items were originally developed for each one. Even after several revisions by experts and an extensive pre-test with very good results, of the 49 items in the final survey, nine had to be eliminated because of their weak measurement properties. Because of dropping problematic items, the Business Context Knowledge measure lost the dimension of interdependence among business processes while keeping the other dimension of contribution to the overall success of the organization. This may be because, despite the efforts during the pre-test, there may have been some overlap between Application Conceptual Knowledge and Business Context Knowledge in the respondents' minds. This led to a very short scale for Business Context. In addition, personal innovativeness in IT and voluntariness – two control variables – did not measure up to the measurement standards and were dropped. Thus this study has to be considered more exploratory than confirmatory.

Sources of bias that may affect the external validity of the statistical results in this study are other limitations to be considered. The generalizability of the findings to the population cannot be made without representative sampling and valid statistical assumptions. An ideal sample would have been obtained by selecting users from a list of all ERP users in Portugal at random. However, that list does not exist and would have been extremely difficult to build. A convenience sample was used instead by getting the sponsorship of SAP Portugal for the study. In that way, it was possible to reach almost the totality of key contacts in the organizations that have installed SAP.

In this sample, almost half of the respondents come from the IT department. This is worthy of some comment since IT users are arguably not the same as other users in the

remaining functions. These IT users might be presumed to be more familiar with the system and they may well have some responsibility for keeping it running. Many of them may have been informally “nominated” as the individuals that other users depend upon for the solution of problems that arise in using the system. Because of the complexity of ERP systems, other users may avoid doing anything but the basic operations they know well, and feel that “it is up to the “nominated” users to discover any new ways of using the system”. These “nominated” users may therefore feel social pressure to explore the system and come up with new insights.

Using a multivariate analysis of variance (MANOVA) to compare the overall scores on the 11 measured constructs for IT and non-IT users, no statistically significant difference is found between them. Although some caution may be suggested on interpreting the results, we note that we are not talking about usage in general but about a particular type of usage. IT users are as good candidates as the other users from non-IT functions for this type of usage. In fact, they may often be called upon to be the ones to engage in exploratory use, since they may have greater familiarity with the system.

If users in the IT function are usually more familiar with technological issues, users in other functions are usually more familiar with business issues. Both types of users are needed for exploratory use. The sample presents a good balance between IT and non-IT respondents and it is representative of the population of Portuguese users of SAP (the leader in ERP systems in Portugal and the world in general). We believe these are the relevant respondents for studying the exploratory use of ERP systems.

Just one type of technology - ERP systems - was the instantiation of complex information technology in this study. Therefore the ability to generalize to other complex ITs is somewhat limited. This issue will be best addressed when there have been replications with other complex

ITs, such as Data Warehousing, Supply Chain Management, and Customer Relationship Management. However, having selected one of the most complex technologies widely installed in organizations today, this study is a good starting point towards generalizability.

Small sample size and non-normality constituted another set of limitations that may have impacted the validity of the structural equation modeling. Both non-normal and sample and non-normal data may increase the bias of parameter estimates in structural equation modeling (SEM). A large sample would be a remedy to obtain unbiased parameter estimates, but the sample in this study is not large. However, Maximum Likelihood (ML), the estimation procedure used in SEM for this study is recognized as robust against violations of multivariate normality (Hoogland and Boomsma 1998; Boomsma and Hoogland 2001). To assure that a proper solution would be found, multiple criteria were taken in account when assessing model fit (Bollen 1989). For example, among the several fit indices evaluated, the Comparative Fit Index was one of them that is particularly recommended for small sample, non-normal data (Bentler 1990; Bentler 1992). Recommendations were followed for the selection of the other fit indices that are less sensitive to sample size and violations of basic assumptions like the multivariate normality (Vandenberg and Lance 2000). In addition, a more stringent significance level of 0.01 was applied to identify statistically significant relationships to minimize the impact of sampling error.

Sample size also put some other constraints on this study. For an initial testing of the research model and given the analysis strategy, the sample was just big enough. But a bigger sample would have allowed cross-validating the research instrument. Despite having SAP sponsorship for the study and having followed Dillman's (2000) recommended guidelines to increase survey response, the measurement model had to be refined and the structural model had to be assessed using the same sample. This may have lead to some capitalization on chance.

Limitations also result from sources of bias concerning the type of study and research method used. Performing a cross-sectional study and using a single method to assess the research model suggests caution in evaluating the results. A longitudinal study would have allowed checking to what extent users would have moved from the intention to the actual exploration of the system. Besides using a survey to collect data, other techniques such as getting data directly from the system on functionalities and information in use would have allowed for controlling for potential sources of bias. However, the time frame for this research as a dissertation process did not allow for that.

### **6.3 Contributions to Practice**

Empirical findings from this study provide support for the importance of three determinants of intention to explore. Assuming that exploratory use is valuable for the organization in achieving considerable benefits from complex IT, management can now focus the attention on the key factors that can act upon those three determinants, some of which were evaluated in the study.

Since the strongest determinant of intention to explore is perceived usefulness of exploratory use, this should be the one to get the most attention from management. To answer the question on how to increase that perception of usefulness, the study shows that providing users with application conceptual knowledge is crucial. To allow the users to get an understanding of the workflow of the business processes that are mapped into the system and thus get a big picture of what can be done with the system, management will have to make this type of knowledge an important component of their training strategies. Since exploratory use is not for everyone and not everyone is in the position of doing it, an *a priori* selection of users might be made. In addition, conceptual training is something more difficult and expensive to do

than just procedural training. The users somehow involved directly in providing suggestions or making decisions during the implementation, namely, those on the implementation team, are probably the best candidates to be the first recipients of this training. And they may later become trainers of their own colleagues.

Subjective norm has also been found as strong determinant of intention to explore. Although no factors acting upon subjective norm have been evaluated in this study, a couple of suggestions can be made. Just by rethinking and adapting the rewarding system in the organization, management can make clear that exploratory use is something expected and desirable. That may also mean creating an organizational climate conducive to acceptable failures and expenditure of time in the process of looking for new functionalities and new information. Some compliance mechanism may be needed until, through internalization, the users come to realize how beneficial such behavior is for the organization. Putting some means of assistance at the disposal of potential explorers facilitate and stress the importance of that behavior.

Specific Computer Self-Efficacy for Exploratory Use is the third strongest determinant of exploratory use, affected by both Application Conceptual Knowledge and Procedural Knowledge. That means that both types of knowledge should be part of a training strategy. Knowing what to do is not enough. It is also important for users to understand the usefulness of exploration. To engage in exploratory usage, users have to be confident in their abilities on the system. Thus, particular attention should be paid in incorporating in training strategies the development of competences in the users that will allow them to be on their own while exploring the system.

#### **6.4 Contributions to Academia**

Overall, this work represents a contribution to a better understanding of the use of complex information technology. There is a general paucity of research on complex IT, since the object of study so far has tended to be personal and simpler technologies. The focus in this study has been placed in a post-acceptance stage of usage, while previous usage research has been focused mainly on IT acceptance. By looking at exploratory use, new insights about what matters to get the most out of complex IT are provided.

We learned that Perceived Usefulness remains a key determinant regardless of the context. Its importance, already supported for simple, individual use in past studies, is confirmed in this study in a context of organizational, complex IT. The importance of Subjective Norm is also confirmed. Specific Computer Self-Efficacy seems to dominate Perceived Ease of Exploratory Use in explaining complex IT use. Assuming that complex IT is never going to be easy to explore, the goal should be to provide the users with specific abilities to deal with the complexity of IT.

To this nomological network of already established constructs in the literature, this study adds several knowledge types, at the same time providing a validation of Sein, Bostrom et al.' (1999) framework on knowledge levels and reinforcing the Coulson's (2002) findings on the importance of including application conceptual knowledge as a key component of training strategies.

In addition, this study reinforces the importance of the Theory of Planned Behavior as a reference framework for looking into complex IT usage and adds to empirical research on ERP systems, a research stream that has mainly focused on case studies.

The inclusion of Perceived Risk of Exploratory Use, although showing no statistically significant effect, is a valuable contribution to the nomological network of constructs. More exploration of the impact (or the lack of impact) of this construct is important. Although Psychological Ownership did not emerge as an important construct, we do not dismiss the importance of personal motivation factors in the nomological network. Cross-cultural issues may explain the lack of impact in the current context. Other constructs less sensitive to those issues may constitute better alternatives.

## **6.5 Future Research**

During the course of this work, several issues were identified that may constitute future research.

Since the research instrument incorporates some new constructs, further research is called for to validate the instrument in other settings. Some of the constructs deserve an especially careful examination. For example, Business Context Knowledge did not emerge as an important construct when Application Conceptual Knowledge was present. It would be worthwhile to work to better understand the distinction between these two constructs.

The overall model explains 65% of the variance on Intention to Explore. Other variables that have not been considered or faced measurement problems in this study may improve the variance explained. Among them, control variables such as age, gender, experience, voluntariness and personal innovativeness in IT should be considered in further studies.

Besides the research that is still needed to re-test the model in other empirical settings, further research should be carried out to effectively assess actual exploratory use (as opposed to the intention to explore). One way to do this would be to get a record of all transactions in the system and look for new functionalities and new information accessed during the evaluation

period. The time frame could be six months, the one that was used to assess the intention to explore. That would allow confronting the link between intention and exploration.

Exploratory use has been studied here under the assumption that it leads to considerable benefits. But it is still necessary to empirically show that exploratory use leads to more comprehensive usage, which leads to organizational benefits.

In addition, research needs to be carried out on the antecedents of the primary determinants that the research model suggests. Coulson (2002) has already shown through an experiment with senior undergraduate students that application conceptual knowledge should be a key component in training strategies for ERP systems. This study reinforces the importance of application conceptual knowledge in an organizational context, and shows its role in explaining the exploratory use of ERP systems. Other knowledge levels in Sein, Bostrom et al.'s (1999) framework – business motivational, meta-cognition – have yet to be operationalized and validated and may constitute alternatives for other research models in the realm of complex IT usage.

Still in the realm of the antecedents to exploratory use, the motivational factors represented by Psychological Ownership deserve further investigation. Portugal is a collectivistic society and the construct may have been interpreted in a different manner than intended. Organizational commitment literature may provide some alternative constructs. Three forms of commitment as a psychological attachment have already been proposed in the literature: affective commitment, continuance commitment, and normative commitment (Meyer and Allen 1991). Affective commitment refers to an individual's attachment to, identification with, and involvement within the respective entity. Continuance commitment refers to an awareness of the costs associated with leaving or abandoning the respective entity. Normative commitment refers

to the totality of internalized normative pressures to act in a way that meets organizational goals. Other classification schemes have proposed different forms for commitment: compliance (instrumental involvement for specific, intrinsic rewards); internalization (involvement predicated on congruence between individual and organizational goals); and identification (involvement based on a desire for affiliation) (O'Reilly and Chatman 1986). However, internalization and identification have been found difficult to differentiate (Vandenberg, Self et al. 1994) and are regarded more as mechanisms by which affective commitment may develop. Compliance or instrumental commitment has received criticism because of its link to extrinsic rewards (Meyer and Allen 1997) but was also found to be useful as another form of commitment (Abrahamsson 2002).

In this study, to some extent, the normative commitment has been covered by subjective norm and the instrumental commitment has been covered by perceived usefulness of exploratory use. Among the remaining, affective commitment seems to be the one to be explored as an alternative to psychological ownership.

One interesting possibility to explore is to admit that the model may change as we go from culture to culture. In this case, appropriate substitutes for motivation factors may have to be proposed according to the culture where the study of the phenomenon takes place.

## **Summary**

In conclusion, we can explain exploratory use through a model based on the Theory of Planned Behavior. Decomposing the basic model of salient beliefs that matter for exploratory use and expanding that model to incorporate key factors behind the salient beliefs, the resulting model explains a good amount of variance on intention to explore a complex IT. The proposed

key factors call for further contributions from researchers and allow practitioners to get more value out of their complex IT systems.

As organizations move to the use of more complex Information Technology to survive in what has also become a more complex world, the results of this study become even more important. Considerable efforts and huge investments are associated with the implementation of complex IT. Through appropriate use and deep use of complex IT, considerable benefits can be obtained to compensate for the huge investments. Exploratory use may be a way of getting there.

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**APPENDICES**

**A. Construct Definitions**

(in alphabetical order)

**Application Conceptual Knowledge (ACK)**

*Understanding the workflow of the business processes mapped in the system to know the big picture of what to do with the system.*

**Business Context Knowledge (BCK)**

*Understanding of the business processes and their interdependencies across the organizational functions.*

**Intention to Explore (IE)**

*User's willingness and purpose to find new ways of applying the ERP system to work tasks.*

**Perceived Ease of Exploratory Use (PEEU)**

*The belief that looking for new ways of using the system is possible without having great difficulty.*

**Perceived Risk of Exploratory Use (PREU)**

*The chance of inadvertently changing something in the system with negative consequences for the organization while looking for new functionalities or new information.*

**Perceived Usefulness of Exploratory Use (PUEU)**

*The belief that looking for new ways of using an application has a good potential to lead to greater effectiveness in the organization.*

**Personal Innovativeness in IT (PIIT)**

*The willingness to try out any new information technology.*

**Procedural Knowledge (PK)**

*The understanding of the application commands, menus and screens, how to combine them, and how to use them to complete a job task.*

**Psychological Ownership (PO)**

*The state of mind in which individuals feel as if a material or immaterial target of ownership or part of it is theirs.*

**Resource Facilitating Conditions (RFC)**

*Objective factors “out there” in the environment that make easy to perform a behavior.*

**Specific Computer Self-Efficacy for Exploratory Use (SCSE)**

*An individual’s judgment of efficacy in a specific computer application domain (e.g., ERP systems) to perform exploratory use.*

**Subjective Norm (SN)**

*A person’s perception that most people who are important to him think he should or should not perform the behavior in question.*

**Voluntariness of Exploratory Use (VEU)**

*The extent to which users perceive the search for new ways of using the system to be voluntary*

**B. Pre-test: item changes from session 1 to session 2**

Item	Session 1	Session 2
ACK1	I have a reasonable sense of the kinds of things that can be done with the ERP at least in Materials Management.	I have a reasonable sense of the kinds of things that can be done with the ERP (at least in the ERP modules I use).
ACK2	I understand how the ways I use the ERP system affect others in the Materials Management area.	I understand how the ways I use an ERP module affect others using the same module.
ACK3	I understand how my use of the ERP system affects people's work in other areas.	I understand how my use of an ERP module affects people's work in other ERP modules.
ACK4	I understand how our work processes in the Management Materials area flow through the ERP system to affect other areas.	I understand how work processes in the ERP modules I use flow through the ERP system to affect other modules. .
ACK5	I have a good enough understanding of the ERP system to make sense of the system messages perhaps using the online help when I perform my job tasks.	I understand the ERP system enough to make sense of the system messages perhaps using the online help when I perform my job tasks.
ACK6	I understand how things I do with the ERP system can affect people in other parts of the business.	Unchanged

Item	Session 1	Session 2
PEEU1	The menus, screens and online help within the ERP make it clear and understandable for me to look for new ways of using the system.	The ERP system is clear and understandable enough to facilitate my looking for new ways of using it. .
PEEU2	Finding new ways of using the ERP system does not require a lot of my mental effort.	Unchanged
PEEU3	I find the ERP system to be easy to explore.	Unchanged
PEEU4	When I am looking for new ways of using the ERP, I find it easy to navigate through the system.	I find it easy to look for new ways of using the ERP system.

Item	Session 1	Session 2
PK1	I know how to use the ERP commands and menus typically available in Materials Management.	I understand how to use the ERP commands and menus typically available in Materials Management.
PK2	I know how to combine the ERP commands, menus and screens to accomplish a job task in Materials Management.	I understand how to combine the ERP commands, menus and screens to accomplish a job task in Materials Management..
PK3	I know how to use the search capabilities in the ERP system.	Unchanged
PK4	I know how to retrieve the ERP data needed to perform job tasks in Materials Management.	I understand how to access the ERP data needed to perform job tasks in Materials Management.
PK5	I know what steps to take in the ERP system to complete a job task in Materials Management.	Unchanged
PK6	I know how to use the functionalities in the ERP system to complete job tasks in Materials Management.	Unchanged

Item	Session 1	Session 2
SCSE1	I would feel comfortable looking in areas of the system I hadn't been before.	I feel capable of exploring in areas of the system I hadn't been before.
SCSE2	If I wanted to, I could easily use new functionality of ERP software on my own, at least in certain areas of the system.	If I wanted to, I could easily figure out how to use new functionality on my own, at least in certain areas of the ERP system.
SCSE3	For those aspects of the system I know the best, I would be able to use new ERP features even if there was no one around to show me how to use it.	For those parts of the system I know the best, I have confidence I would be able to figure out new ERP features even if there was no one around to show me how to use them.

**C. Pre-test: item changes from session 2 to session 3**

Item	Session 2	Session 3
ACK1	I have a reasonable sense of the kinds of things that can be done with the ERP (at least in the ERP modules I use).	Removed.
ACK2	I understand how the ways I use an ERP module affect others using the same module.	I understand how my use of an ERP module affects people's work in other ERP modules.
ACK3	I understand how my use of an ERP module affects people's work in other ERP modules.	Unchanged.
ACK4	I understand how work processes in the ERP modules I use flow through the ERP system to affect other modules. .	I understand how work processes in the ERP modules I use flow through the ERP system and how they may affect other modules.
ACK5	I understand the ERP system enough to make sense of the system messages perhaps using the online help when I perform my job tasks.	Removed.
ACK6	I understand how things I do with the ERP system can affect people in other parts of the business.	Unchanged.

Item	Session 2	Session 3
PK1	I understand how to use the ERP commands and menus typically available in Materials Management.	I understand how to use the commands and menus that are available to me in the ERP system (for example, in Materials Management).
PK2	I understand how to combine the ERP commands, menus and screens to accomplish a job task in Materials Management.	I understand how to combine the ERP commands, menus and screens (for example, in Materials Management) to accomplish a job task.
PK3	I know how to use the search capabilities in the ERP system.	Removed.
PK4	I understand how to access the ERP data needed to perform job tasks in Materials Management.	I understand how to access the ERP data (for example, in Materials Management) needed to perform the necessary work.
PK5	I know what steps to take in the ERP system to complete a job task in Materials Management.	Removed.
PK6	I know how to use the functionalities in the ERP system to complete job tasks in Materials Management.	I know how to use the functionalities in the ERP system (for example, in Materials Management) to complete the necessary job tasks.

Item	Session 2	Session 3
PEEU1	The ERP system is clear and understandable enough to facilitate my looking for new ways of using it.	Unchanged.
PEEU2	Finding new ways of using the ERP system does not require a lot of my mental effort.	Unchanged.
PEEU3	I find the ERP system to be easy to explore.	I find the ERP system easy to explore when I am looking for new ways of using it.
PEEU4	I find it easy to look for new ways of using the ERP system.	I find it easy to look for new ways to use the ERP system.

Item	Session 1	Session 2
SCSE1	I feel capable of exploring in areas of the system I hadn't been before.	Unchanged.
SCSE2	If I wanted to, I could easily figure out how to use new functionality on my own, at least in certain areas of the ERP system.	Unchanged.
SCSE3	For those parts of the system I know the best, I have confidence I would be able to figure out new ERP features even if there was no one around to show me how to use them.	For those parts of the system I know the best, I have confidence I would be able to figure out new ways of using the system, even if there was no one around to show me how to do it.

**D. E-Mail Letter**

(English Version)

Dear Sir/Madam

We invite you to participate in a study on the factors affecting the extent of use of an ERP system. Jointly sponsored by the University of Georgia, USA, the University of Minho in Portugal, and the Foundation for Science and Technology, Portugal, this study is part of a research program which primary goal is to evaluate the expected gains from investing in and implementing ERP systems within the organization.

To do so, we are asking you to confidentially share your experience regarding ERP systems by filling in a Web survey at <http://erp.uga.edu>.

The survey will only take between 15 and 20 minutes to complete. We know how your time is limited, but as a key contact in your organization regarding the implementation of an ERP system, your participation is critical to the success of this study. If you wish, you may later receive a copy of the results. Further, Institutional Review Board policies here at The University of Georgia require that your responses be kept confidential, and that no published results will ever identify individuals or organizations. We will send you with pleasure the results of this study, in case you manifest that interest at the end of the survey.

As a key decision maker with respect to ERP implementation in your organization, in addition to your own responses, we would ask that you please identify at least two users, one with a strong knowledge of how the system is or may be used in his/her department and another with little knowledge of that. The purpose in doing so is to capture a range of responses representing quite different usage experiences. Again, doing so is critical to the success of this project, and we would be grateful for your assistance in this given your key role in the ERP implementation process. Thus, would you please send this email and the survey web address to those two individuals as soon as you read this?

Your participation in this project is greatly appreciated, and we look forward to hearing from you and receiving the responses from the other individuals in your organization.

If you have any questions do not hesitate to ask now or at a later date. You may contact Rui Sousa at +1 (706) 369-6078 or by email: [rsousa@uga.edu](mailto:rsousa@uga.edu).

Sincerely,

Rui Sousa, MSc., Researcher

(Portuguese Version)

Caro Senhor(a)

Vimos por este meio convidá-lo a participar num estudo sobre os factores que afectam o grau de utilização de um sistema ERP. Conjuntamente patrocinado pela Universidade da Georgia, EUA, a Universidade do Minho, Portugal, e pela Fundação para a Ciência e Tecnologia, Portugal, este estudo enquadra-se num programa de investigação cujo objectivo primordial é avaliar os antecipados ganhos no investimento em e implementação de sistemas ERP nas organizações.

Para tal, pedimos-lhe que confidencialmente partilhe connosco a sua experiência em sistemas ERP através do preenchimento de um inquérito via Web em <http://erp.uga.edu>.

O inquérito poderá levar entre 15 e 20 minutos a preencher. Sabemos quão limitado é o seu tempo, mas como contacto chave na sua organização em termos da implementação de um sistema ERP, a sua participação é crucial para o sucesso deste estudo. Além disso, aqui na Universidade da Georgia, a comissão (Institutional Review Board) que a nível institucional supervisiona a investigação, requer que as suas respostas sejam tratadas confidencialmente, e que resultados que venham a ser publicados nunca identifiquem indivíduos ou organizações. Teremos todo o gosto em enviar-lhe os resultados deste estudo, caso indique no fim do inquérito que está interessado em recebê-los.

Como elemento chave na implementação do sistema ERP na sua organização, para além das suas respostas, pedir-lhe-íamos que identificasse, por favor, pelo menos dois utilizadores, um com muito conhecimento e outro com pouco conhecimento na utilização do sistema nos respectivos departamentos. O objectivo é recolher uma gama de respostas que representem experiências de utilização bem diferentes. Uma vez mais, tal participação é crítica para o sucesso do projecto, e muito gratos ficaríamos pela sua assistência nesta identificação, dado o seu papel relevante no processo de implementação do sistema ERP. Neste sentido, importar-se-ia de enviar este e-mail com o endereço Web para tais utilizadores logo que haja lido isto?

A sua participação é muito apreciada, e esperamos com antecipado prazer as suas respostas e as dos utilizadores que tenha identificado na sua organização.

Se tiver quaisquer questões, não hesite em contactar Rui Sousa pelo telefone +1 (706) 369-6078 ou pelo e-mail [rsousa@uga.edu](mailto:rsousa@uga.edu).

Cordialmente,

Rui Sousa, MSc., Investigador

**E. Survey**



The University of Georgia



Terry College of Business

Department of Management Information Systems



The University of Minho



School of Engineering

Department of Information Systems

FCT Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA E DO ENSINO SUPERIOR

Portugal

ERP Systems Usage

Please use  
**Internet  
Explorer**



Start

Utilização de Sistemas ERP

Utilize, por  
favor,  
**Internet  
Explorer**



Iniciar

English Version

**Dear Participant,**

“Enterprise Resource Planning (ERP) Usage,” is a study that focuses on factors affecting the extent of use of an ERP system. Organizations implement ERP packages expecting to realize significant benefits. However, levels of usage may hinder the achievement of these benefits. This Web survey is asking you to confidentially share your experience regarding your usage of this type of system. Please answer the survey regardless of your level of usage of the system.

Your participation is important! It will provide an assessment of the current state of ERP usage. Your participation is completely voluntary, and you may withdraw from answering this Web survey at any time, just by closing the browser. The survey should take between 10 and 15 minutes to answer.

All collected data will remain confidential. However, there is a limit to the confidentiality that can be guaranteed due to the Internet technology itself. Only the researchers will have access to collected data. Results that may be published will present the data in the aggregate form and will never identify individuals or organizations. You may later receive a copy of the results by providing your email after having completed the survey.

This is a study undertaken by Rui Sousa, instructor at the University of Minho, Portugal, while on leave at The University of Georgia, Department of Management Information Systems, at the Terry College of Business, working with Professor Dale L. Goodhue, 312 Brooks Hall, Athens, Georgia, 30602, USA, tel. +1 (706) 542-3746. If you have any questions do not hesitate to ask now or at a later date. You may contact Rui Sousa at +1 (706) 369-6078 or by e-mail: [rsousa@uga.edu](mailto:rsousa@uga.edu).

Continue

Additional questions or problems regarding your rights as a research participant should be addressed to Chris A. Joseph, Ph.D. Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address [IRB@uga.edu](mailto:IRB@uga.edu).

## Your ERP System

1. What ERP system do you use?

If "Other", please specify

2. What is your department or activity area?

If "Other", please specify

3. What % of the people working in your department have access to the ERP system?

4. Which of the following best describes what part(s) of the ERP system you are using?

- Financials**
- Financial Accounting
  - Controlling
  - Assets Management
  - Treasury

- Logistics**
- Purchasing
  - Sales
  - Warehouse Management
  - Production
  - Plant Maintenance
  - Quality Management
  - Service Management
  - Project Management

- Human Resources**
- Personnel Management
  - Personnel Development
  - Payroll Accounting

- Systems Administration**
- 

**Others**

## 5. During the ERP implementation

5.1 Were you on the ERP implementation team?

- Yes
- No

5.2 Whether or not you were on the ERP implementation team, how frequently did you interact with the implementation team during the ERP implementation at your highest level of involvement?

- Never
- Less than once a month
- One to three times a month
- One to four times a week
- Daily

5.3 Whether or not you were on the ERP implementation team,

	Often	Sometimes	Rarely	Never
During implementation, how frequently were you <b>asked</b> for suggestions about the ERP implementation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During implementation, how frequently did you on your own <b>initiative</b> offer suggestions about the ERP implementation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How frequently do you think that your suggestions were taken in consideration?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. In terms of what you need for **your** work, how would you classify your ERP system training?

	Very Good	Good	Reasonable	Mediocre	Bad
During the ERP implementation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
After the ERP implementation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. In terms of global evaluation of your ERP system

	Strongly Agree	Moderately Agree	Slightly Agree	Neither Agree nor Disagree	Slightly Disagree	Moderately Disagree	Strongly Disagree
The ERP system <b>currently</b> helps your department to be more effective.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The ERP system will help your department to be more effective <b>in the future</b> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The benefits of the ERP system will ultimately outweigh its costs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Continue

## Your ERP Usage Experience - Part A

This section addresses many aspects of **your own** ERP usage experience.

Although some statements appear to be similar, please provide a response to each one so that we may better understand your experiences and opinions.

From your **personal** viewpoint, please indicate your agreement to the following statements:

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
1. I consider the ERP system to be important.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I understand how the way in which I use an ERP module affect others' work that use the same module.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Over the next six months, I intend to search for new ways to use the system in my work context.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. The ERP system is clear and understandable enough to facilitate my looking for new ways to use it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. If I heard about a new information technology, I would look for ways to experiment with it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I identify myself with this ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I understand how to use the commands and menus that are available to me in the ERP system (for example, in Financial Accounting).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I have to worry about negative consequences while exploring new functionalities or new information in the ERP system even when I am careful not to change anything important.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
9. My looking for new ways of using the ERP has the potential to uncover something useful for the organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I have the technical support that I need to look for new functionalities or new information in the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. I feel capable of exploring areas of the system I hadn't used before.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. People who influence my behavior in the organization encourage me to explore new ways of using the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I am not required to search for new ways of using the system as a part of my job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I understand how our work in Finance/Accounting contributes to important processes in the organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. In the last six months, I used either new functionalities or new information in the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. The ERP system means nothing to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
17. Over the next six months, I intend to look for new functionalities and/or new information in the ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I understand how my use of an ERP module affects people's work in other ERP modules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Among my peers, I am usually the first to try out new information technologies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I understand how to combine the ERP commands, menus and screens (for example, in Financial Accounting) to accomplish a job task.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I sense that this ERP system is OUR system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Finding new ways to use the ERP system does not require much of my mental effort.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. My exploration of ERP functionalities has the potential to increase the productivity of the organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. If I wanted to, I could easily figure out how to use new functionalities on my own, at least in certain areas of the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
25. I have the time I need to look for new ways of using the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. My supervisor/manager does not require me to look for new ways of using the system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. Most of the people that work with this ERP system feel that this is our system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. In the last six months, I was explicitly taught on how to use new information or new functionalities in the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. I understand how work in my area contributes to the overall success of my organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. The ERP system is relevant to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

You are almost half done.

Continue

## Routine vs. non-routine usage

1. I **started using** the ERP system  years and  months ago.

2. In an **average week**, I use the ERP system for  hours.

3. Over the past **six months**:

### **routine usage**

- Percent of time I used the ERP system in about the same way as always, i.e., using the same functionalities and the same type of information I typically use.

%

### **non-routine usage**

- Percent of time I used the ERP system in a somehow different way, i.e., using either new functionalities or new types of information.

%

+  
-----  
100 %

Continue

## Non-routine usage: taught vs. not taught

Over the past **six months**,

### routine usage

- Percent of time I used the ERP system in about the same way as always, i.e., using the same functionalities and the same type of information I typically use. **75 %**

### non-routine usage

- Percent of time I used the ERP system in a somehow different way, i.e., using either new functionalities or new types of information. **25 %**

---

For the **25 %** of my usage which was somehow different from usual:

### taught

- Percent of time I did something I was explicitly taught to do.  %

### not taught

- Percent of time I did something I was **not** explicitly taught to do.  %

+ \_\_\_\_\_  
**100 %**

## Not taught non-routine usage: requested vs. voluntary

Over the past **six months**,

### routine usage

- Percent of time I used the ERP system in about the same way as always, i.e., using the same functionalities and the same type of information I typically use. **75 %**

### non-routine usage

- Percent of time I used the ERP system in a somehow different way, i.e., using either new functionalities or new types of information. **25 %**

---

For the **25 %** of my usage which was somehow different from usual:

### taught

- Percent of time I did something I was explicitly taught to do. **60 %**

### not taught

- Percent of time I did something I was not explicitly taught to do. **40 %**

---

For the **40%** of my non-routine usage which I was not taught to do:

**requested**

- Percent of time that my non-routine usage was the result of an explicit request.

%

**voluntary**

- Percent of time that my non-routine usage was the result of my own initiative.

%

+ \_\_\_\_\_

**100 %**

Continue

## Your ERP Usage Experience - Part B

You have already answer more than half of this questionnaire.

This is the last section that addresses many aspects of **your** ERP usage experience.

Although some statements appear to be similar, please provide a response to each one so that we may better understand your experiences and opinions

From your **personal** viewpoint, please indicate your agreement to the following statements:

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
1. I have a good understanding of the big picture of what is important in this business.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I intend to spend considerable time and effort in the next couple of months exploring the ERP for potential applications.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I consider the ERP system to be essential.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I find the ERP system easy to explore when I am looking for new ways of using it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. In general, I am hesitant to try out new information technologies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I understand how to access the ERP data (for example, in Financial Accounting) needed to perform the necessary work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. This is OUR system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. In the last six months, I was requested to use new information or new functionalities in the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
9. It is dangerous to look for new functionalities or new information since my unintentional changes may lead to negative outcomes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. My searching for different ways of using the ERP system has the potential to enhance the effectiveness in my organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. When looking for new ways of using the system, I have someone whom I can ask for assistance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. The ERP system is of no concern to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. For those parts of the system I know the best, I have confidence I would be able to figure out new ERP features, even if there was no one around to show me how to use them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. People who are important to me are supportive of my looking for new ways of using the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Although it might be helpful, searching for new ways to use the system is certainly not compulsory in my job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. It is risky to look into new ways of using the ERP system because I might inadvertently change something important, with possible unpleasant consequences.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
17. I understand how work processes in the ERP modules I use flow through the ERP system and how they may affect other modules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. I understand how the work we do in Finance/Accounting relates to tasks in other parts of the business.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I find it easy to look for new ways to use the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I consider the ERP system to be significant.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. I like to experiment with new information technologies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. I know how to use the functionalities in the ERP system (for example, in Financial Accounting) to complete the necessary job tasks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. It is hard for me to think about this ERP system as <i>OURS</i> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. My exploration of the ERP system for new information or new functionality is potentially useful for the organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Moderately agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Moderately disagree	Strongly disagree
25. I am too busy to explore new ways of using the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. I understand how things I do with the ERP system can affect people in other parts of the business.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. People whose opinion I value think I should look for new ways of using the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. The ERP system matters to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. In the last six months, I took the initiative to use new information or new functionalities in the ERP system without being explicitly taught on how to do this.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. I can rely on someone when facing problems while exploring the ERP system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**You are 80% done. The following section is the last one.**

Continue

## Context

To better contextualize this study, we need some personal and organizational data.

All individual responses will be kept **confidential**.

Results from this study will present collected data in the **aggregate** form.

### Data to be kept CONFIDENTIAL

<b>Your Organization</b>	What industry type best classifies your business?	Please select an industry	▼
		If "Other", please specify: <input type="text"/>	
	What is the ownership type?	Private	▼
	Does your organization own or control production, distribution, services or other facilities outside the country?	No	▼
	How many people work in your entire organization?	Employees in the entire organization	▼
	How many people work in your department?	Employees in your department	▼
	What are the total annual revenues of your entire organization?	Annual total revenues (Dollars)	▼
Your organization's name		<input type="text"/>	
<hr/>			
<b>Your</b>	How many years are you with the organization?	<input type="text"/>	
<b>Job</b>	What is your job title?	<input type="text"/>	
	What organizational level best describes your job?	Select organizational level	▼
		If "Other", please specify: <input type="text"/>	
	How many people report directly to you?	0	<input type="text"/>
	How many of those people have also someone reporting to them?	0	<input type="text"/>

**Your  
personal  
data**

Sex  
Age group  
Education

M  F

Select your age group

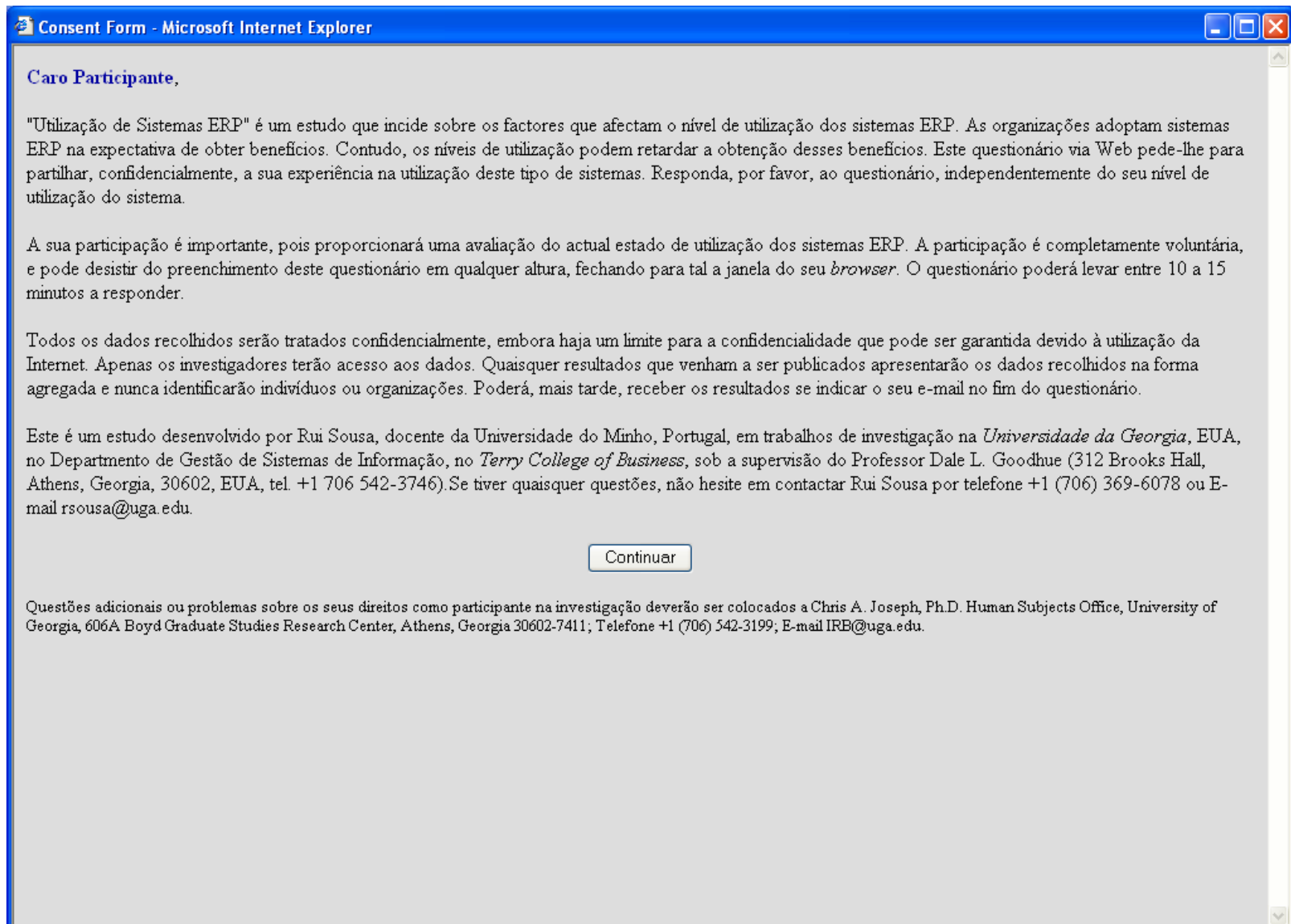
Select your highest level

- To receive the results of this survey, please provide your **e-mail**:
- Please provide any **comments** about something that was not asked but you feel that is relevant in the search for new ways to use the ERP system.

**Thank you for your participation!**

Submit all data from my participation

Portuguese Version



## O seu sistema ERP

1. Que sistema ERP utiliza?

Seleccione o sistema ERP ▾

Se "Outro", por favor especifique

2. Qual o departamento/área em que trabalha?

Por favor, seleccione o seu departamento ▾

Se "Outro(a)", por favor especifique:

3. Qual a % das pessoas que no departamento em que trabalha tem acesso ao sistema ERP?

4. Quais das seguintes partes utiliza no sistema ERP?

- Financeira**
- Contabilidade Financeira
  - Contabilidade Analítica
  - Gestão de Imobilizado
  - Tesouraria

- Recursos Humanos**
- Gestão de Pessoal
  - Formação
  - Processamento de Salários

**Administração de Sistemas**

- Logística**
- Compras
  - Gestão de Armazéns
  - Gestão da Manutenção
  - Gestão de Projectos
  - Gestão da Qualidade
  - Produção
  - Serviços
  - Vendas

**Outras Partes**

## 5. Durante a implementação do sistema ERP

5.1 Fez parte da equipa de implementação?

- Sim
- Não

5.2 Quer tenha ou não feito parte da equipa de implementação, qual foi a sua maior frequência de interacção com a equipa durante a implementação do sistema?

- Nunca
- Menos de uma vez por mês
- Uma a três vezes por mês
- Uma a quatro vezes por semana
- Diariamente

5.3 Quer tenha ou não feito parte da equipa de implementação,

	Muitas vezes	Algumas vezes	Poucas vezes	Nunca
Durante a implementação, com que frequência lhe foram <b>solicitadas</b> sugestões para o sistema ERP?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Durante a implementação, com que frequência foram da sua <b>iniciativa</b> sugestões para o sistema ERP?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Com que frequência acha que as suas sugestões foram tidas em consideração?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Em termos do que necessita para o seu trabalho, como classificaria a formação que recebeu sobre o sistema ERP?

	Muito Boa	Boa	Suficiente	Mediocre	Má
Durante a implementação do sistema ERP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Após a implementação do sistema ERP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Em termos de avaliação global do sistema ERP

	Concordo totalmente	Concordo moderadamente	Concordo ligeiramente	Nem concordo nem discordo	Discordo ligeiramente	Discordo moderadamente	Discordo totalmente
<input type="radio"/> sistema ERP ajuda <b>actualmente</b> o seu departamento a ser mais eficaz.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/> sistema ERP ajudará o seu departamento a ser mais eficaz <b>no futuro</b> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/> Os benefícios do sistema ERP serão, em última análise, superiores aos seus custos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Continuar

## Aspectos da Utilização do ERP - Parte A

Esta secção considera vários aspectos da **sua** utilização do sistema ERP.

Embora algumas afirmações lhe pareçam semelhantes, por favor, responda a cada uma delas de modo a que possamos melhor compreender as suas experiências e opiniões.

Do seu ponto de vista muito **pessoal**, indique a sua concordância com cada uma das seguintes afirmações:

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
1. Considero que o sistema ERP é importante.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Compreendo como a forma como utilizo um módulo ERP afecta o trabalho de outros que utilizam o mesmo módulo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Nos próximos seis meses, tenciono procurar novas formas de utilizar o sistema no meu ambiente de trabalho.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. O sistema ERP é suficientemente claro e compreensível para facilitar a minha procura de novas formas de utilizá-lo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Se tomasse conhecimento de uma nova tecnologia, procuraria arranjar formas de experimentá-la.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Identifico-me com este sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Sei como usar os comandos e menus que me estão disponíveis no sistema ERP (por exemplo, em Contabilidade Financeira).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Tenho que me preocupar com consequências negativas da minha exploração por novas formas de utilizar o sistema mesmo quando tenho cuidado em não alterar algo importante.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
9. A minha procura de novas formas de utilizar o sistema ERP pode levar à descoberta de algo útil para a organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Tenho o apoio técnico que preciso na procura de novas funcionalidades ou novos tipos de informação no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Sinto-me capaz de explorar áreas do sistema onde não tenha estado antes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Pessoas que influenciam o meu comportamento na organização encorajam-me a explorar novas formas de utilizar o sistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Como parte do meu trabalho, não me é exigida a procura de novas formas de utilizar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. Compreendo como o nosso trabalho em Contabilidade contribui para importantes processos na organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Nos últimos seis meses tenho usado novas funcionalidades ou novos tipos de informação no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. O sistema ERP nada significa para mim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
17. Nos próximos seis meses, tenciono procurar novas funcionalidades e/ou novos tipos de informação no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Compreendo como a minha utilização de um módulo ERP afecta o trabalho das pessoas noutros módulos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Entre os meus colegas, sou geralmente dos primeiros a experimentar novas tecnologias da informação.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. Sei como combinar os comandos, menus e écrans (por exemplo, em Contabilidade Financeira) para executar uma tarefa.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Sinto que este é o "NOSSO" sistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Encontrar novas formas de utilizar o sistema ERP não requer muito do meu esforço mental.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. A minha exploração de funcionalidades no sistema ERP pode levar ao aumento de produtividade na organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. Se quisesse, poderia facilmente descobrir por mim mesmo como usar novas funcionalidades, pelo menos em certas áreas do sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
25. Tenho o tempo de que preciso para procurar novas formas de utilizar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. O meu supervisor/gestor não exige que eu procure novas formas de utilizar o sistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. Muitas das pessoas que trabalham com este sistema ERP sentem que este é o "nosso" sistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. Nos últimos seis meses fui explicitamente ensinado a utilizar novos tipos de informação ou novas funcionalidades no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. Compreendo como o trabalho na minha área contribui para o sucesso global da minha organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. O sistema ERP é relevante para mim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Já respondeu a quase metade do inquérito.**

## Utilização: habitual vs. nova

1. Comecei a utilizar o sistema ERP há  anos e  meses.

2. Em média, por semana, utilizo o sistema ERP durante  horas.

3. Nos últimos seis meses:

### utilização habitual

- Percentagem do tempo em que utilizei o sistema ERP na mesma forma de sempre, i.e., utilizando as mesmas funcionalidades e o mesmo tipo de informação que geralmente utilizo.

%

### nova utilização

- Percentagem do tempo em que utilizei o sistema ERP duma forma algo diferente, i.e., usando novas funcionalidades ou novos tipos de informação.

%

+ \_\_\_\_\_  
100 %

## Nova utilização: ensinada vs. não ensinada

Nos últimos **seis meses**,

### utilização habitual

- Percentagem do tempo em que utilizei o sistema ERP na mesma forma de sempre, i.e., utilizando as mesmas funcionalidades e o mesmo tipo de informação que geralmente utilizo. **75 %**

### nova utilização

- Percentagem do tempo em que utilizei o sistema ERP duma forma algo diferente, i.e., usando novas funcionalidades ou novos tipos de informação. **25 %**

---

Para os **25 %** da minha utilização que foi algo diferente do habitual:

### ensinada

- Percentagem do tempo que fiz algo que fui explicitamente ensinado a fazer.  %

### não ensinada

- Percentagem do tempo que fiz algo que **não** fui explicitamente ensinado a fazer.  %

+ \_\_\_\_\_

**100 %**

Continuar

## Nova utilização não ensinada: requerida vs. voluntária

Nos últimos seis meses,

### utilização habitual

- Percentagem do tempo em que utilizei o sistema ERP na mesma forma de sempre, i.e., utilizando as mesmas funcionalidades e o mesmo tipo de informação que geralmente utilizo. 75 %

### nova utilização

- Percentagem do tempo em que utilizei o sistema ERP duma forma algo diferente, i.e., usando novas funcionalidades ou novos tipos de informação. 25 %

---

Para os 25 % a minha utilização que foi algo diferente do habitual:

### ensinada

- Percentagem do tempo que fiz algo que fui explicitamente ensinado a fazer. 60 %

### não ensinada

- Percentagem do tempo que fiz algo que **não** fui explicitamente ensinado a fazer. 40 %

Para os **40%** da minha nova utilização para a qual não fui ensinado:

**Requerida**

- Percentagem de tempo em que tal resultou de um pedido explícito.

%

**Voluntária**

- Percentagem do tempo em que tal resultou da minha livre iniciativa.

%

+ \_\_\_\_\_

**100 %**

Continuar

## Aspectos da Utilização do ERP - Parte B

Já respondeu a mais de metade do questionário.

Esta é a última secção que lhe coloca à consideração vários aspectos da sua experiência na utilização do sistema ERP.

Mais uma vez, embora algumas afirmações lhe pareçam semelhantes, por favor, responda a cada uma delas de modo a que possamos melhor compreender as suas experiências e opiniões.

Do seu ponto de vista muito **pessoal**, indique a sua concordância com cada uma das seguintes afirmações:

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
1. Tenho uma boa ideia, em termos globais, do que é importante neste negócio.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Tenciono dispendir tempo e esforço consideráveis nos próximos meses explorando potenciais utilizações do sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Considero que o sistema ERP é essencial.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Acho que o sistema ERP é fácil de explorar na procura de novas formas de utilizá-lo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Em geral, hesito em experimentar novas tecnologias da informação.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Sei como aceder aos dados no sistema (por exemplo, em Contabilidade Financeira) necessários para executar o trabalho necessário.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Este é o "NOSSO" sistema.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Nos últimos seis meses, pediram-me que utilizasse novos tipos de informação ou novas funcionalidades no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
9. É perigoso procurar novas funcionalidades ou novos tipos de informação uma vez que alterações sem intenção podem levar a sérios problemas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. A minha procura por diferentes formas de utilizar o sistema ERP pode levar a minha organização a ser mais eficaz.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. Na procura por novas formas de utilizar o sistema, tenho alguém a quem posso pedir ajuda.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. O sistema ERP não me diz qualquer respeito.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Para aquelas partes do sistema que melhor conheço, sinto que seria capaz de encontrar novas formas de utilizar o sistema, mesmo sem que alguém me mostrasse como fazê-lo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. Pessoas que são importantes para mim apoiam a minha procura por novas formas de utilização do sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. Embora pudesse ser útil, procurar novas formas de utilizar o sistema não é certamente obrigatório no meu trabalho.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. É perigoso andar à procura de novas formas de utilizar o sistema ERP, porque, sem saber, posso alterar algo importante com possíveis consequências desagradáveis .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
17. Compreendo como os processos de trabalho dos módulos ERP que utilizo se encontram integrados no sistema e como podem afectar outros módulos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18. Compreendo como o trabalho em Contabilidade se relaciona com o trabalho noutras partes da organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. Acho fácil procurar por novas formas de utilizar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. Acho que o sistema ERP é signficante.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21. Gosto de experimentar novas tecnologias da informação	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22. Sei como utilizar as funcionalidades no sistema ERP (por exemplo, em Contabilidade Financeira) para executar o trabalho necessário.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23. É difícil para mim pensar neste sistema como "NOSSO".	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24. A minha procura no sistema ERP por novos tipos de informação ou novas funcionalidades é potencialmente útil para a minha organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	CONCORDO totalmente	CONCORDO moderadamente	CONCORDO ligeiramente	Nem concordo nem discordo	DISCORDO ligeiramente	DISCORDO moderadamente	DISCORDO totalmente
25. Estou demasiado ocupado para explorar novas formas de utilizar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26. Compreendo como as coisas que faço com o sistema ERP podem afectar o trabalho noutras partes da organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27. Pessoas cuja opinião tenho em conta pensam que eu devia procurar novas formas de utilizar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
28. Tenho interesse no sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29. Nos últimos seis meses tomei a iniciativa de utilizar novos tipos de informação ou novas funcionalidades no sistema ERP sem que me tenha sido explicitamente ensinado como fazê-lo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30. Posso contar com alguém quando encontrar problemas ao explorar o sistema ERP.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Já respondeu a 80% do inquérito. A próxima secção é a última.

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## Contexto

Para melhor contextualizar este estudo, precisamos obter alguns dados sobre si e a sua organização.

Os dados recolhidos serão tratados **confidencialmente**.

Os resultados deste estudo apresentarão os dados recolhidos de forma **agregada**.

### DADOS CONFIDENCIAIS

<b>A sua organização</b>	Qual é o sector de actividade da sua organização?	Por favor, seleccione um sector <input type="button" value="v"/>
	Se "Outro", por favor especifique	<input type="text"/>
	Qual é o tipo de organização?	Privada <input type="button" value="v"/>
	A sua organização possui ou controla produção, distribuição, serviços ou instalações no estrangeiro?	Não <input type="button" value="v"/>
	Quantas pessoas trabalham em toda a organização?	Empregados em toda a organização <input type="button" value="v"/>
	Quantas pessoas trabalham no seu departamento ou área de actividade?	Empregados no seu departamento <input type="button" value="v"/>
	Qual é o volume de negócios anual da sua organização?	Volume de Negócios Anual (Euros) <input type="button" value="v"/>
Nome da sua organização:		<input type="text"/>
<hr/>		
<b>A sua área de actividade</b>	Há quantos anos trabalha nesta organização?	<input type="text"/>
	Qual é a designação do seu cargo/função?	<input type="text"/>
	Que melhor classifica a sua posição na organização?	Selecione a sua posição <input type="button" value="v"/>
	Se "Outra", por favor especifique	<input type="text"/>
	Quantas pessoas tem directamente sob a sua dependência?	<input type="text" value="0"/>
	Quantas dessas pessoas também têm alguém directamente sob a sua dependência?	<input type="text" value="0"/>

**Os seus**

Sexo

M  F

**dados**

Faixa etária

Selecione a faixa ▼

**personais**

Nível de habilitações adquirido

Selecione o nível ▼

- Se estiver interessado em receber os resultados deste estudo, por favor indique o seu *e-mail*:
- Por favor inclua quaisquer **comentários** sobre algo que não haja sido perguntado, mas que acha relevante na procura de novas utilizações para o seu sistema ERP.

**Obrigado pela sua participação!**

Submeter os dados da minha participação

**F. Skewness and Kurtosis**

	Mean	Min	Max	Z <sub>Skewness</sub>	Z <sub>Kurtosis</sub>		Mean	Min	Max	Z <sub>Skewness</sub>	Z <sub>Kurtosis</sub>
ACK1	6,534	3	7	-8,7	9,8	PREU1	6,051	1	7	-8,3	6,8
ACK2	6,449	3	7	-7,6	6,0	PREU2	3,975	1	7	-0,1	-2,8
ACK3	6,449	3	7	-6,5	5,8	PREU3	4,102	1	7	-0,8	-2,8
ACK4	6,398	1	7	-11,4	26,6	PUEU1	6,331	1	7	-9,0	13,2
BCK1	6,619	4	7	-8,3	8,6	PUEU2	6,178	2	7	-6,9	6,2
BCK2	6,661	5	7	-6,4	2,5	PUEU3	6,025	2	7	-5,6	6,2
BCK3	6,458	5	7	-2,9	-1,2	PUEU4	6,042	2	7	-5,1	3,3
BCK4	6,475	2	7	-10,0	18,3	RFCA1	5,110	1	7	-3,3	-0,3
IE1	5,915	3	7	-2,8	-1,8	RFCA2	5,059	1	7	-3,8	-0,1
IE2	5,898	1	7	-5,2	4,0	RFCA3	5,203	1	7	-4,1	0,3
IE3	5,695	1	7	-3,5	2,7	RFCT1	3,517	1	7	0,5	-2,3
PEEU1	4,881	1	7	-3,3	-0,1	RFCT2	3,475	1	7	2,7	-1,6
PEEU2	4,076	1	7	-0,8	-2,6	SCSE1	5,610	1	7	-5,0	2,4
PEEU3	4,814	1	7	-3,0	-0,5	SCSE2	5,119	1	7	-3,7	0,1
PEEU4	4,890	1	7	-3,4	-0,4	SCSE3	5,466	1	7	-6,4	5,8
PIIT1	5,797	1	7	-4,8	2,2	SN1	5,195	1	7	-4,1	0,4
PIIT2	5,542	1	7	-3,2	-0,1	SN2	4,864	1	7	-2,9	-0,2
PIIT3	5,729	1	7	-5,8	2,0	SN3	5,229	1	7	-3,9	-0,1
PIIT4	6,280	2	7	-7,8	8,2	VEU1	3,127	1	7	2,3	-2,6
PK1	6,263	2	7	-9,4	11,4	VEU2	3,534	1	7	0,2	-2,5
PK2	6,178	2	7	-7,0	6,0	VEU3	3,500	1	7	0,7	-3,0
PK3	6,169	1	7	-7,4	11,7						
PK4	6,237	2	7	-8,0	9,5						
PO1	5,788	2	7	-4,3	0,7						
PO2	5,831	2	7	-4,4	0,7						
PO3	5,898	2	7	-5,7	2,2						
PO4	5,085	1	7	-2,6	-0,8						
PO5	5,610	1	7	-5,1	-0,1						

**G. Text, codes, means and standard deviations for measurement items**

(in alphabetical order by construct)

### Application Conceptual Knowledge

Code	Text from the survey	Mean	SD
ACK1	I understand how the way in which I use an ERP module affect others' work that use the same module.	6.53	0.77
ACK2	I understand how my use of an ERP module affects people's work in other ERP modules.	6.45	0.85
ACK3	I understand how work processes in the ERP modules I use flow through the ERP system and how they may affect other modules.	6.45	0.76
ACK4	I understand how things I do with the ERP system can affect the work in other parts of the business.	6.40	0.87

### Business Context Knowledge

Code	Text from the survey	Mean	SD
BCK1	I understand how our work in <my area> contributes to important processes in the organization.	6.62	0.64
BCK2	I understand how the work we do in Purchasing relates to tasks in other parts of the business.	6.66	0.56
BCK3	I have a good understanding of the big picture of what is important in this business.	6.46	0.61
BCK4	I understand how work in my area contributes to the overall success of my organization.	6.47	0.79

### Intention to Explore

Code	Text from the survey	Mean	SD
IE1	Over the next six months, I intend to search for new ways to use the system in my work context.	5.92	1.10
IE2	Over the next six months, I intend to look for new functionalities and/or new information in the ERP.	5.90	1.19
IE3	I intend to spend considerable time and effort in the next couple of months exploring the ERP for potential applications.	5.69	1.13

### Perceived Ease of Exploratory Use

Code	Text from the survey	Mean	SD
PEEU1	The ERP system is clear and understandable enough to facilitate my looking for new ways to use it.	4.88	1.46
PEEU2	Finding new ways to use the ERP system does not require much of my mental effort.	4.08	1.82
PEEU3	I find the ERP system easy to explore when I am looking for new ways of using it.	4.81	1.49
PEEU4	I find it easy to look for new ways to use the ERP system.	4.89	1.51

### Perceived Risk of Exploratory Use

Code	Text from the survey	Mean	SD
PREU1	I have to worry about negative consequences while exploring new functionalities or new information in the ERP system even when I am careful not to change anything important.	6.05	1.47
PREU2	It is risky to look into new ways of using the ERP system because I might inadvertently change something important, with possible unpleasant consequences.	3.97	1.95
PREU3	It is dangerous to look for new functionalities or new information since my unintentional changes may lead to negative outcomes.	4.10	2.00

### Perceived Usefulness of Exploratory Use

Code	Text from the survey	Mean	SD
PUEU1	My looking for new ways of using the ERP has the potential to uncover something useful for the organization.	6.33	1.01
PUEU2	My exploration of ERP functionalities has the potential to increase the productivity of the organization.	6.18	1.01
PUEU3	My searching for different ways of using the ERP system has the potential to enhance the effectiveness in my organization.	6.03	1.00
PUEU4	My exploration of the ERP system for new information or new functionality is potentially useful for the organization.	6.04	1.02

### Personal Innovativeness in Information Technology

Code	Text from the survey	Mean	SD
PIIT1	If I heard about a new information technology, I would look for ways to experiment with it.	5.80	1.27
PIIT2	Among my peers, I am usually the first to try out new information technologies.	5.54	1.29
PIIT3	In general, I am hesitant to try out new information technologies.	5.73	1.59
PIIT4	I like to experiment with new information technologies.	6.28	0.99

### Procedural Knowledge

Code	Text from the survey	Mean	SD
PK1	I understand how to use the commands and menus that are available to me in the ERP system (for example, in <user's selected module>).	6.26	1.07
PK2	I understand how to combine the ERP commands, menus and screens (for example, in <user's selected module>) to accomplish a job task.	6.18	1.04
PK3	I understand how to access the ERP data (for example, in <user's selected module>) needed to perform the necessary work.	6.17	1.00
PK4	I know how to use the functionalities in the ERP system (for example, in <user's selected module>) to complete the necessary job tasks.	6.24	1.02

### Psychological Ownership

Code	Text from the survey	Mean	SD
PO1	I identify myself with this ERP system.	5.79	1.18
PO2	I sense that this ERP system is OUR system.	5.83	1.26
PO3	This is OUR system.	5.90	1.35
PO4	Most of the people that work with this ERP system feel that this is our system.	5.08	1.47
PO5	It is hard for me to think about this ERP system as OURS.	5.61	1.85

### Resource Facilitating Conditions (Assistance)

Code	Text from the survey	Mean	SD
RFCA1	I have the technical support that I need to look for new functionalities or new information in the ERP system.	5.11	1.53
RFCA2	When looking for new ways of using the system, I have someone whom I can ask for assistance.	5.06	1.75
RFCA3	I can rely on someone when facing problems while exploring the ERP system.	5.20	1.66

### Resource Facilitating Conditions (Time)

Code	Text from the survey	Mean	SD
RFCT1	I have the time I need to look for new ways of using the ERP system.	3.52	1.70
RFCT2	I am too busy to explore new ways of using the ERP system.	3.47	1.81

### Specific Computer Self-Efficacy for Exploratory Use

Code	Text from the survey	Mean	SD
SCSE1	I feel capable of exploring areas of the system I hadn't used before.	5.61	1.40
SCSE2	If I wanted to, I could easily figure out how to use new functionalities on my own, at least in certain areas of the ERP system.	5.12	1.59
SCSE3	For those parts of the system I know the best, I have confidence I would be able to figure out new ERP features, even if there was no one around to show me how to use them.	5.47	1.39

### Subjective Norm

Code	Text from the survey	Mean	SD
SN1	People who influence my behavior in the organization encourage me to explore new ways of using the ERP system.	5.19	1.68
SN2	People whose opinion I value think I should look for new ways of using the ERP system.	4.86	1.59
SN3	People who are important to me are supportive of my looking for new ways of using the ERP system.	5.23	1.66

### Voluntariness of Exploratory Use

Code	Text from the survey	Mean	SD
VEU1	I am not required to search for new ways of using the system as a part of my job.	3.13	2.08
VEU2	My supervisor/manager does not require me to look for new ways of using the system.	3.53	1.84
VEU3	Although it might be helpful, searching for new ways to use the system is certainly not compulsory in my job.	3.50	1.99