Understanding Exploratory Use of ERP Systems[1]

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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 to uncover new ways of using it, either on their own or with the help of others, i.e., through exploratory use. This study focuses on ERP systems as an example of complex IT. Building on 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 also included in the research model. Hypothesis testing will be performed with structural equation modeling, using data collected through a cross-sectional field survey of ERP users. From an academic standpoint, this study contributes to a conceptualization of the exploratory use of complex information technologies and adds empirical work to ERP research. From a practical standpoint, this study identifies several managerially leverageable variables that should move an organization toward higher levels of use and more benefits.

Keywords: Complex information technology, ERP systems, exploratory use, TPB, knowledge, motivation

Introduction

The complexity of information technology is characterized by a large number and variety of components, a high potential for interaction and interdependency among components, combined rates of change, and the consequent difficulty of users understanding the IT system. Complex information technology is potentially powerful but also usually both costly and very difficult to implement. The complexity increases when the information technology is packaged, forming a tight bundle that is difficult to separate into parts. ERP systems exhibit these characteristics and thus constitute a good example of complex information technology.

Organizations endure costly and lengthy ERP implementation processes because they expect to achieve huge benefits from an integrated infrastructure, such as a better coordination among functions and a global view of the organization's operations and performance. Unfortunately, ERP systems are often under-utilized following implementation (Ross and Vitale, 2000). Even though the potential of such systems is great, users frequently take advantage of only the most basic capabilities of the system. Only a comprehensive and full usage of the system capabilities will deliver major benefits. To achieve them, firms need to move from a superficial to a more comprehensive usage of their ERP systems.

One way of increasing the usage level of complex information technology may be through exploratory use, i.e., to get the users to move beyond routine use and uncover new ways of using the system, either on their own or with the help of others (Nambisan,

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et al., 1999). To tap users as a source of innovation, management needs to understand the factors that work as primary determinants of a user's intention to explore and to engage in exploratory use. Thus, this study seeks to answer the following questions:

- What are the primary determinants of the exploratory use of complex information technology such as ERP systems?
- What managerially leverageable factors have a positive impact on previously identified primary determinants?

From a conceptual standpoint, this study contributes to a more comprehensive look at the usage of complex technologies, adds to still scarce ERP post-implementation research, and differentiates from the predominant case studies of ERP research by adopting a theory-driven approach and providing a model that can be empirically evaluated.

From a practical standpoint, this study will show the relative importance of factors that managers can act upon to get the most out of complex information technologies such as ERP systems. Encouraging users to "experiment" with complex IT may raise some concerns. However, users often have unique business insights that enable them to better identify what business processes may benefit from uncovered IT functionalities. Tapping users' expertise through exploratory use may be a source of a type of innovation that training and consultants can hardly provide.

Theoretical Basis and Research Model

Extensive research on the individual use of IT has drawn on theories from social psychology such as the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), the Diffusion of Innovations Theory, and Social Cognitive Theory. To look into the exploratory use of the ERP system at the individual level, this study draws on TPB, an extension of the more general explanation provided by TRA.

TRA shows that actual behavior is determined by the intention of performing the behavior; intention, in turn, is determined by the individual's attitude towards the behavior and the subjective norm concerning the behavior. Since "the successful performance of an intended behavior is contingent on the presence of required information, skills and abilities" (Ajzen, 1985, p.26), TPB adds another determinant of behavior: perceived behavioral control. As a result, TPB suggests three determinants of behavioral intention: attitude, an evaluation of the consequences of the behavior; subjective norms, the perceived social pressure to perform or not perform the behavior as determined by normative beliefs; and perceived behavioral control, a multidimensional construct that includes the perceived difficulty and the perceived facilitating conditions of performing the behavior. These three determinants are respectively determined by their behavioral, normative, and control beliefs.

In addition, previous research shows that knowledge and motivational factors are expected to play an important role in lowering the organizational learning burden associated with the effective use of complex information technology. Those factors assume particular importance for exploratory use, which is, in essence, a way of learning. The research model (Figure 1) results from putting together a deconstructed TPB model, knowledge and motivational factors, and additional variables for control.

Deconstructed Theory of Planned Behavior

Behavioral Beliefs

Behavioral beliefs refer to the individual's beliefs about the consequences of performing the behavior. The Technology Acceptance Model (Davis, 1989), one of the most researched and accepted models that explains individual IT use at the acceptance stage, has identified two salient beliefs that predict 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 relatively free of effort). This study goes beyond the acceptance stage targeted by the TAM model to focus on post-implementation stages like routinization and infusion, when exploratory use is more likely to occur. However, mirroring Davis's findings, the same beliefs for exploratory use as the focal behavior are expected to positively impact Intention to Explore (H1; H2).

An ERP system is a complex technology composed of multiple, diversified parts, which are tightly interconnected. A behavior like exploratory use may be perceived as risky when users are not fully aware of the global consequences of local changes while exploring the system. Thus, Perceived Risk of Exploratory Use—the chance of inadvertently changing something in the system

with negative consequences for the organization while one is looking for new functionalities or new information—is added to the set of behavioral beliefs that determine the Intention to Explore (H3).

Normative Beliefs

Normative beliefs refer to the individual's beliefs about others' expectations to perform or not perform the behavior. Determined by normative beliefs, a Subjective Norm is 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*" (Fishbein and Ajzen, 1975, p.302). Exploratory use may or may not be approved by others whose opinion an individual values, regardless of the individual's attitude toward exploratory use. Thus, Subjective Norm should positively impact Intention to Explore (H4).

Control Beliefs

Control beliefs, the individual's beliefs concerning the presence or absence of resources and opportunities to perform the behavior, include both internal and external dimensions. Whereas the internal dimension refers to whether people consider a behavior to be easy or difficult to perform according to their capabilities (perceived self-efficacy), the external dimension refers to the perception of opportunity to perform the behavior (facilitating conditions).

Perceived self-efficacy in the IT domain has received empirical support as a predictor either of intention to use (Hill, et al., 1987) or actual use (Compeau, et al., 1999). An individual's confidence in his or her computer abilities to perform a challenging task like exploratory use in a complex IT environment like an ERP system, Specific Computer Self-Efficacy for Exploratory Use, is likely to have a positive impact on Intention to Explore (H5). In addition, Resource Facilitating Conditions such as time or technical help availability will positively impact Intention to Explore (H6),

Overcoming Knowledge and Motivational Barriers

Different types of knowledge are likely to play an important role in making the system not only more easily understandable but also more amenable to exploratory use. In addition, motivation is key for one to engage in a challenging behavior such as exploratory use of complex IT.

Knowledge Factors

Building on the six-level knowledge framework of Sein, et al. (1999), Procedural Knowledge, Application Conceptual Knowledge, and Business Context Knowledge are proposed for effective exploratory use.

Procedural Knowledge—the understanding of the syntax and semantics of the application commands, how to combine them, and how to use them to complete a job task—is likely to increase Perceived Ease of Exploratory Use because it makes it easier to navigate the system when one is looking for new functionalities or new information (H7). Furthermore, Procedural Knowledge is likely to build a user's confidence (Specific Computer Self-Efficacy) in exploring a complex IT such as an ERP system because commands are executed and menus are structured across the several modules in a similar way (H8).

Application Conceptual Knowledge—the understanding of the business processes' workflow mapped in the application—provides knowledge about how all the modules work together in the ERP system, making it easier to identify the possible benefits of using the application in new ways (H9). Furthermore, in providing an understanding of the 'big picture', Application Conceptual Knowledge makes easier to find new functionalities or new information (H10, Perceived Ease of Exploratory Use). Moreover, this type of knowledge will increase users' beliefs in their capabilities to perform effective exploratory use (H11, Specific Computer Self-Efficacy).

Business Context Knowledge—the understanding of the processes specific to the business, their goals and their interdependencies across the organizational functions—makes users aware of the impact of local changes on others' jobs and allows them to identify opportunities in their work practices to increase their job performance (H12, Perceived Usefulness of Exploratory Use).

Motivational Factors

Psychological Ownership—the state of mind in which an individual experiences possessive feelings for the target (Pierce, et al., 2001)—has been associated with high levels of motivation and has been empirically linked to the performance of extra-role behaviors both in non-work (Vandewalle, et al., 1995) and work settings (Dyne and Pierce, 2002).

This sense of possession results in a higher sense of responsibility for and control of the target, leading the individual to act proactively and make a large investment of self in the target. Thus, when experiencing Psychological Ownership of a complex information technology, users feel motivated to invest extra effort in a discretionary, extra-role behavior such as exploratory use because they care and feel it their responsibility to get the most out of the complex IT (H13, Intention to Explore).

In addition, when willing 'to go the extra mile', users will more likely search for and find reasons to see the exploration of the complex information technology as useful (H14, Perceived Usefulness of Exploratory Use).

Additional Variables for Control

Mirroring findings from other contexts (Hartwick and Barki, 1994; Venkatesh and Davis, 2000) that show the importance of considering voluntariness in IT use, this study will control for Voluntariness to Explore—the extent to which exploratory use is perceived as voluntary (H15).

Personal Innovativeness in the domain of Information Technology (PIIT)—the willingness to try out any new information technology—has been linked to behavioral intention through cognitive absorption (Agarwal and Karahanna, 2000), a state of mind that a user may experience while exploring complex IT. Thus, this study will also control for PIIT (H16).

Research Design

This is a cross-sectional field study using a survey methodology for data collection. More than a hundred Portuguese companies will be requested to participate in the survey; their main contacts have already been identified. They will be asked to engage at least four individuals in answering the survey, which will be administered via the Web. Any individual that has access to an ERP system is a potential respondent. Following recommended procedures for the wording and translation of research instruments (Brislin, 1986), the survey will be available both in English and Portuguese.

Instrument Development

Scales such as Personal Innovativeness in IT and Psychological Ownership were borrowed from the literature without any change in the wording. However, some items were dropped from the latter to get a more parsimonious instrument, while still keeping Cronbach's alpha above 0.80. The three Knowledge types and Perceived Risk scales were developed from scratch, based on a literature review. The remaining scales were adapted from existing measures to account for the focal behavior in question—exploratory use.

Using a sorting card methodology (Moore and Benbasat, 1991), a pre-test has been conducted for all scales. Individuals from different backgrounds in the business school at the University of Georgia have participated as judges. As a result of the pre-test, some items were dropped and some were rewritten.

Data Analysis

Analysis will be performed using Structural Equation Modeling, taking advantage of the simultaneous estimation of both structural and measurement models. Three categories of goodness-of-fit measures—absolute fit measures, incremental fit measures, and parsimonious fit measures—will be used to facilitate a consensus on the acceptability of the model.

Discussion of Possible Implications

Exploratory use is essentially a self-motivated learning process that cannot be effectively mandated. As a discretionary work behavior, exploratory use is not part of formal job expectations, but it may contribute to the organization's success. To have the users trained on the appropriate knowledge levels (procedural knowledge, application conceptual knowledge, and business context knowledge), to develop their psychological ownership of the system, and to identify personally innovative users (if possible) may be implications of this study for management. In this way, management may lower the burden of organizational learning and increase the propensity for innovation, making the best potential of a complex IT by tapping on users' unique insights into the business.

Future Avenues for Research

The links among exploratory use, comprehensive usage, and organizational benefits need to be evaluated. The findings in this study may also apply to other complex IT environments. Thus, the model should be tested in other settings as complex as ERP systems. In addition, training strategies, situated learning, and user participation (either by assuming responsibility for ERP implementation outcomes or by taking part in extensive business and workflow process analyses) are possible variables to look into and relate to the already identified determinants of exploratory use of complex IT.
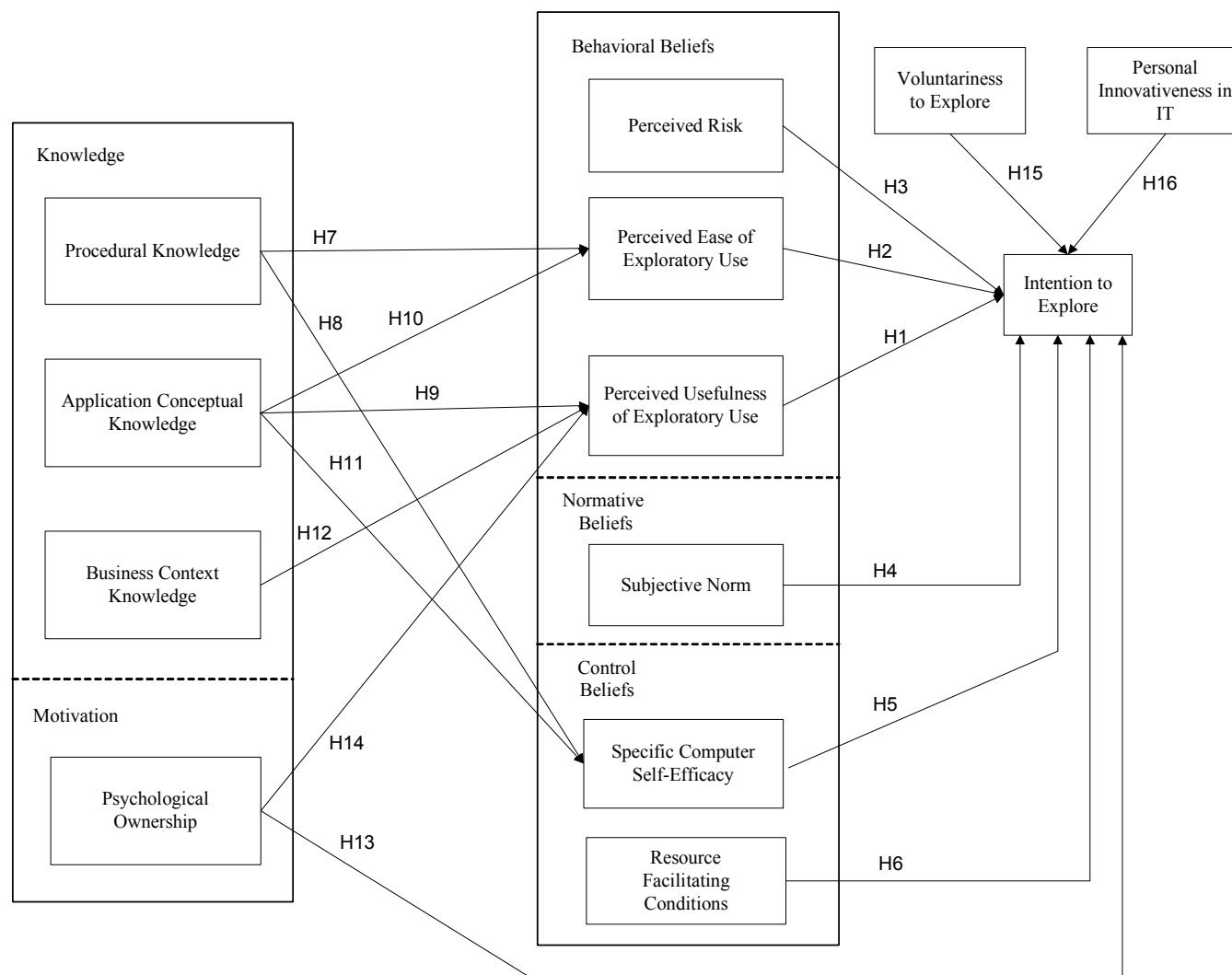

Figure 1. Exploratory Use of Complex IT

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