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Factors Influencing Employees' Deep Usage of Information Systems

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Abstract

The adoption process within organizational settings, which is different from traditional individual adoption, involves both the primary adoption by managers and the secondary adoption by employees. Understanding what determinants influence employees to deeply use information systems (IS) would help managers improve the process of facilitating system implementation. This study explores the determinants that can affect employees to deeply use information systems, in particular when there is an organizational mandate to adopt an IS. A new framework is developed that combines insights from the individual innovation post-acceptance model as well as from organizational adoption and assimilation frameworks. The research methodology used to test the hypotheses is discussed, and contributions of this study are presented.

Keywords: Technology Adoption, Technology Diffusion, Deep Usage, Post-acceptance, Organizational Adoption

1. Introduction

Information systems (IS) that are not used are of little value. That is the reason why a large number of studies focus on system usage (Melone 1990; Srinivasan 1985). Several theories have been developed to explain individual adoption and acceptance of IS. Among these are Diffusion of Innovations (DOI) (Rogers 1983), the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975), the Technology Acceptance Model (TAM) (Davis et al. 1989), and the Theory of Planned Behavior (TPB) (Ajzen 1985; Taylor and Todd 1995). These traditional innovation adoption models are well-suited to a particular range of adoption scenarios and technology types, that is, individuals voluntarily decide whether to use a "personal use" technology, such as PCs, word processing software, or spreadsheets (Adams et al. 1992; Brancheau and Wetherbe 1990; Davis 1989; Szajna 1996).

The adoption process within organizational settings follows "contingent authority innovation decisions" (Zaltman et al. 1973), where authorities make the initial decision to adopt the innovation, while employees generally have to implement their decision and make some necessary adjustments for using this innovation in their jobs (Gallivan 2001). Therefore, IS adoption within organizations can be viewed as two stages: the primary adoption by a firm, division, or department and the secondary adoption/assimilation by employees. Employees' adoption and acceptance is necessary for effective use of IS, and effective use can bring about maximum benefits from the system (Boudreau 2003). We have strong evidence for this link from the early studies on learning curves that found workers often obtained production output from machines that exceeded the maximum indicated by manufacturers (Dutton and Thomas 1984). IS

can be used broadly, in ways that expand the capacities of the medium, or can be used narrowly (Carlson and Zmud 1999). In essence, employees' secondary adoption can be viewed as a mandatory and deep usage issue, where deep usage can involve the employee identifying usage beyond those envisioned by management. Although much of the past diffusion research has introduced the general themes and frameworks related to adopting, diffusing, or infusing information systems into organizational life, employees' adoption issues have not received sufficient attention. This can be reflected from the ideas presented at the meeting of the Diffusion Interest Group in Information Technologies (IT) in 2001. At this meeting, Zmud suggested that traditional technology adoption and acceptance research, which is categorized into simple, voluntary and "shallow usage" diffusion models, should be expanded into complex, mandatory and "deep usage" diffusion models. Here, deep usage means behavior that actually is meant to increase individual productivity, shallow usage means the simple measures of whether an IT was used and the extent of its usage (Chin and Marcolin 2001).

This shift towards examining "deep usage" implies that many existing models dealing with factors and processes will need to be revisited. The key factors that influence an individual's desire and behavioral attempts to use an information system to its fullest potential may differ from those that influence his or her initial usage. Deep usage, as a new construct, has no recognized definition. According to the early research in IS implementation by Zmud and his colleagues (Cooper and Zmud 1990; Kwon and Zmud 1987), "deep usage" refers to post-acceptance behavior, which includes technology routinization and infusion. Routinization means the extent to which an IS has become a stable and regular part of organizational procedures and behavior. Infusion is defined as the extent to which system features are used in a complete and sophisticated way (Fichman 2000). Burton-Jones and Straub (2003) proposed "deep structure usage", which is defined by the extent to which deep structure features are used. Here, deep structure features are those that relate most closely to the nature of the tasks. During the deep usage stages, a user has progressed to have a positive affective state toward the information technology, and is constantly looking for new ways to use the information technology with his/her job. Therefore, in this study, deep usage is defined as the extent to which an individual fully uses a technology to enhance his/her productivity and the degree to which they find ways to actually extend its productive contributions to tasks not originally envisioned by the managerial adopters. Thus, unlike motivation research, which focuses on the factors needed to ensure workers keep doing their job (Pinder 1998), deep usage is focused on exceeding the normal demands of one's tasks, and hopefully sharing insights with fellow employees. In this way it can also enhance organizational learning (Cohen 1991).

The present study focuses on the employee as the level of analysis and explores the determinants to affect employees' deep usage of information systems, in particular when there is an organizational mandate to adopt an information system. The aim of this study is to propose a model to better understand IS deep usage issue. The study is organized as follows. Firstly, employees are often mandated to use an information system, which is different from individuals in traditional technology adoption and acceptance research. Therefore, in the literature review, the literature related to individual adoption and acceptance frameworks is examined in terms of its limitations in explaining the secondary adoption by employees within organizational settings. Because employees' deep usage is associated with post-acceptance behavior and organizational adoption and assimilation process, this study also reviews these two research streams and

underscores their value in explaining employees' secondary adoption behavior. Secondly, based on the literature review, this study proposes a theoretical model of IS deep usage by employees, which is the basis for several research propositions. Finally, this study discusses the research methodology used to test the hypotheses, and summarizes the contributions.

2. Literature Review

2.1 Review of Individual Technology Acceptance Research

There has been considerable research on the factors that predict whether individuals will accept and voluntarily use information systems. A number of theoretical frameworks, such as DOI, TRA, TPB and TAM, have been validated for a variety of technological innovations. Although these frameworks differ in their theoretical structures, constructs and relationships posited, all of them address technology usage. Since it is beyond the scope of this paper to describe all of these models, only the most relevant models are reviewed.

DOI and TAM have received the most attention in the IS literature. These two models identify the perceived attributes of an innovation as key predictors explaining adoption. DOI identifies five perceived attributes—relative advantage, complexity, compatibility, trialability, and observability as influencing adoption behavior (Rogers 1995). TAM posits just two perceived attributes—perceived usefulness and perceived ease of use as influencing adoption (Davis et al. 1989). In addition, both of these two models put users' intention to adopt a technology as their dependent variable, and they apply most readily to situations where the individual user can voluntarily choose whether to adopt the innovation or not. However, there is an important difference between these two models. DOI theory has a broader focus in seeking to explain how communication channels and opinion leaders shape adoption, while TAM is much narrower in its objective to predict technology acceptance and usage by potential adopters.

TAM was derived from TRA (Fishbein and Ajzen 1975). While TRA is a general theory of human behavior, TAM is specific to IS usage. TAM is parsimonious, and explains technology usage quite well. However, a limitation of TAM is that it assumes usage is volitional, that is, there are no barriers that would prevent an individual from using an IS if he or she chose to do so. Based on TRA, Ajzen (1991) developed TPB. TPB includes subjective norms (SN) and perceived behavior control (PBC) constructs that do not appear in TAM. SN reflects the degree to which referent others want an individual to perform a particular behavior. PBC refers to "people's perception of the ease or difficulty of performing the behavior of interest" (Ajzen 1991, p. 183). TPB includes more effects that may be important in some situations. However, TPB is less parsimonious than TAM. TAM explained 34% of the variance in usage, while TPB explained 36%. The small increase in predictive power of TPB comes at the cost of a large increase in model complexity. Instead of developing TPB, other researchers have begun to extend TAM to include the extra constructs found in TPB while retaining the model's parsimony and IS focus to increase TAM's ability to predict and explain IS usage (Taylor and Todd 1995).

Although many efforts have been made to explain individual innovation adoption, the traditional innovation adoption models have their own applicability. They are only well-suited to simple technology, individual voluntary adoption decision, and shallow usage contexts. These models are not suited to the following contexts: (1) Adoption occurs within an organizational setting

where users are mandated to use the innovation; (2) Adoption is subject to heavy coordination requirements or strong interdependences across multiple adopters; (3) Adoption requires extensive, specialized training to learn the principles underlying the innovation (Gallivan 2001).

2.2 Review of Individual Technology Post-Acceptance Research

In some research the focuses have been on post-acceptance behavior. Kwon and Zmud (1987) suggested that research should explore the impact of contextual factors on post-acceptance stages. Based on this research, some studies have articulated or tested differences across stages of the IS implementation process (Bracheau and Wetherbe 1990; Cale and Eriksen 1994; Cooper and Zmud 1990). There are two primary schools of thought that focus on psychological motivations leading a user to continue to use an IS.

The first school employs the same set of beliefs to explain both continuance and acceptance decisions, implicitly view continuance as an extension of acceptance behavior. For example, Karahanna, Straub and Chervany (1999) investigated the antecedents of post-adoption, which described users using Windows 3.1. They found that perceived usefulness, image, top management support, and supervisor and peer usage are important factors. They suggested that social norms alone induce initial adoption while continued usage decision, when non-mandated, is based solely on attitudinal considerations. This study indicates that continued usage under a volitional basis can be explained using traditional innovation adoption models.

The second school includes other beliefs that might influence a user's subsequent continuance decisions but not his/her prior acceptance. Bhattacherjee (2001) created a model of IS continuance based on Expectation-Confirmation Theory (ECT) (Oliver 1980), which draws on the consumer behavior literature. This study is one of the earliest to conceptualize and test a theoretical model of IS continuance, which takes into account the distinctions between acceptance and post-acceptance behaviors. He suggested that users' continuance intention is determined by their satisfaction with IS use and perceived usefulness. He further suggested that one's disconfirmation and dissatisfaction with IS use may lead to its eventual discontinuance, despite positive perceptions of pre-acceptance variables. This study validated that ECT can be applied to study continued usage under a voluntary basis.

These studies put their focus on post-acceptance behavior. They are only limited to the volitional usage of individual users and need to be modified if they are used to explain deep usage in mandatory contexts or organizational adoption and assimilation.

2.3 Review of Organizational Adoption Research

Organizational adoption involves a two-part decision process in which a formal decision to make an IS innovation available to the organization or department as a whole is then followed by employees' decisions about whether and how to actually use the IS innovation. Mandatory usage often occurs in an organization when an end user is forced to utilize the IS in a way that replaces at least one previous work practice. There is a growing literature stream focusing on organizational adoption and implementation research. Factors research and stage research streams have received widespread attention.

Some researchers have conducted organizational adoption studies based on factors research, where a single respondent is asked to complete a survey indicating whether his or her organization has adopted an innovation or not. These key informants are senior managers. Many innovation studies have been conducted to explain organizational adoption and acceptance behavior using this approach. However, this line of research has been challenged because conclusions were only based on senior managers' response, which may differ from those of employees at lower levels. Therefore, the validity of these studies for understanding organizational innovation adoption behavior has been challenged in IS research field (Gallivan 2001).

There is another research stream that has focused on stage research models as a way of better understanding organizational implementation of innovations. One well-known model describing technology implementation in organizations was proposed by Saga and Zmud (1994). They suggested that organizational adoption and implementation experiences six stages: initiation, adoption, adaptation, acceptance, routinization and infusion. The last two stages belong to post-acceptance behavior. Saga and Zmud (1994) clearly described change processes that are very useful for understanding the various stages of technology assimilation. Therefore, their research will be applied to create the new framework for this study. On the other hand, the individual IS continuance model (Bhattacherjee 2001) is suited to volitional cases, but employees' secondary adoption often occurs in mandatory settings. In order to have an accurate and clear understanding of employees' deep usage within organizational settings, the IS continuance model will be combined into the new framework creation.

3. Theoretical Foundations and Research Propositions

3.1 Theoretical Foundations

The focus of this study is on the post-acceptance stage, in particular IS deep usage within organizational settings. In organizational settings, it is not technology adoption and usage that matters as a dependent variable, but rather how extensively and deeply the technology is used by employees. Deep usage occurs in the post-acceptance stage and is critical to system effectiveness. In order to attain IS deep usage, employees are firstly required to continue using the system. The continuance construct captures this meaning. Then, usage behavior should gradually go into its' fullest extent. Routinization and infusion can help us to understand this meaning. Based on this understanding, this study combines the IS continuance research model and the organizational adoption process to propose a new framework to explain employees' secondary adoption behavior.
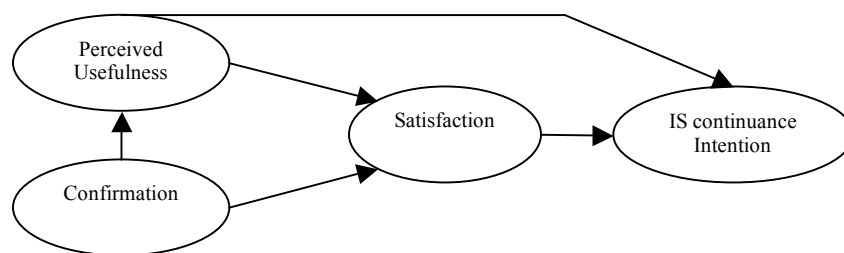
Figure 1 A Post-Acceptance Model of IS Continuance

Bhattacherjee (2001) developed an IS continuance model (Figure 1), which is best suited to post-acceptance stages. There are two kinds of post-acceptance behavior: continuance and discontinuance. The IS continuance model posits that users' IS continuance intention is determined primarily by their satisfaction with prior system usage. User satisfaction is determined by perceived usefulness and confirmation of expectation following actual use. The model also posits that perceived usefulness is expected to directly influence IS continuance intention. In addition, users' extent of confirmation is positively associated with their perceived usefulness of IS use. This model only focuses on voluntary settings. Employees' secondary adoption belongs to post-acceptance behavior within organizational settings. Their continued deep usage is subject to organizational interventions. Therefore, IS continuance intention is not a suitable dependent variable in the organizational adoption process. Employees' deep usage, the behavior following the intention, is a more appropriate dependent variable in this study.
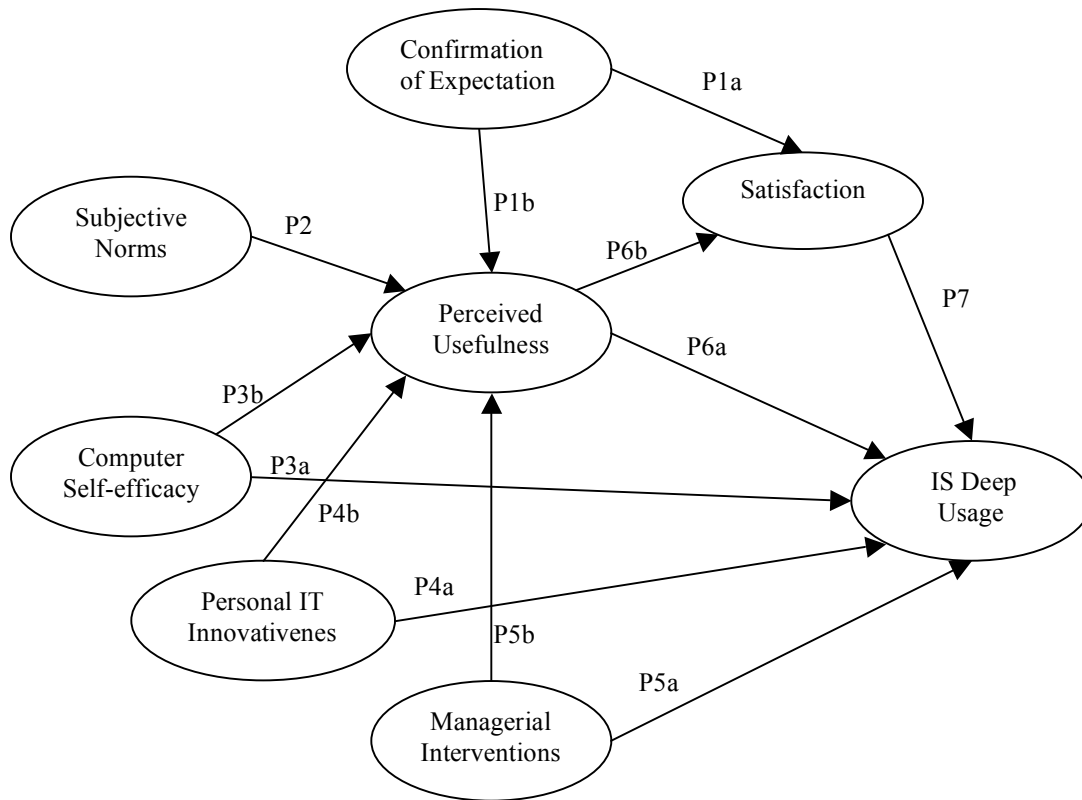
Figure 2 IS Deep Usage Research Model from Employees' Perspective

The research model of employees' secondary adoption and assimilation, developed in this study, is presented in Figure 2. IS deep usage can be directly influenced by perceived usefulness and satisfaction with IS use. Confirmation of employees' expectation about IS use can indirectly influence IS deep usage mediated by satisfaction or perceived usefulness. In addition, perceived usefulness can also indirectly influence IS deep usage mediated by satisfaction with IS use. Support for the above links is based on the individual IS continuance model (Bhattacherjee 2001).

Employees' secondary adoption is often mandated by senior managers. Information systems within organizations are often complicated and interdependent across employees. Specialized training to learn the principles of the system is required and peer's influence is inevitable.

Therefore, management intervention and subjective norms are added in the new framework. In addition, employees' deep usage is also associated with users' ability and characteristics. Thus, computer-self efficacy and personal IT innovativeness are added in the new research model.

3.2 Research Propositions

The present research model rests on the combination of the post-acceptance model of IS continuance, and the organizational adoption and assimilation frameworks. The post-acceptance model of IS continuance suggests that deep usage behavior is influenced by attitudinal considerations and perceived usefulness. The organizational adoption and assimilation frameworks show that employees' secondary adoption is influenced by managerial interventions and other influences coming from employees themselves and their colleagues. These important factors are used for generating the following propositions.

In post-acceptance contexts, confirmation of expectation and perceived usefulness are two important constructs of cognitive beliefs. As a new construct in IS research, confirmation is a direct function of the reality-expectation gap, i.e., the ability of adopters to achieve expected levels of benefits from IS (Bhattacherjee 2001; Parthasarathy and Bhattacherjee 1998). Disconfirmation occurs when expected performance and actual performance differ from one another (Szajna and Scamell 1993). Confirmation is positively related to satisfaction with IS use because it implies realization of the expected benefits of IS use.

Just as perceived ease of use can influence perceived usefulness in IS acceptance contexts, confirmation can also affect perceived usefulness in IS post-acceptance contexts. In the acceptance stage, because users do not have enough information about the system, they are unsure what to expect from system usage. Under this circumstance, they may have low initial usefulness perceptions of new IS (Bhattacherjee 2001). These low initial usefulness perceptions are easily confirmed. Such perceptions may be adjusted higher as they come to know more about the system. However, users may experience cognitive dissonance or psychological tension if their pre-acceptance usefulness perceptions are not confirmed during actual usage. Users often have the tendency to adjust their perceptions to be consistent with reality. That is, confirmation can elevate perceived usefulness. The above discussions lead to the following research propositions:

P1a: Confirmation of expectation has a positive effect on satisfaction.
P1b: Confirmation of expectation has a positive effect on perceived usefulness.

Subjective norms describe individuals' beliefs about their expectations of relevant others regarding their own secondary adoption. The particular norms may vary for a given innovation and adoption context, however, subjective norms shape potential adopters' beliefs about when and why to adopt an innovation, or how much effort to undertake to learn it. When an important referent thinks they should use a system, potential adopters often incorporate the referent's belief into their own belief structure. If a supervisor or co-worker suggests that a particular system is useful even if they have not felt this way during the acceptance stage, they would accept the idea that the system is useful in the post-acceptance stage (Rice and Aydin 1991; Venkatesh et al. 2003). They expect to experience the system's usefulness after using it in an appropriate way. In addition, if the system is used by co-workers, users are more likely to "believe in" and feel its

importance and relevance (Fulk et al. 1990). Based on the above discussion, the following proposition is postulated:

P2: Subjective norms have a positive effect on perceived usefulness.

The most proximate influences on an individual's cognitive interpretations and performance of information systems are individual-related factors, among which computer self-efficacy and personal IT innovativeness are the two constructs that have received consistent support as important predictors.

Self-efficacy is defined as beliefs about one's ability to perform a specific behavior (Bandura 1977). It is viewed as an important antecedent to IS usage to the extent that it fosters both the adoption of a new behavior and its maintenance. The inclusion of computer self-efficacy is critical to the recognition that adoption and implementation of IS is not just about convincing people of the benefits to be derived from an IS, but also about the requisite skills and confidence needed. Newly introduced systems are often based on complex technologies that pose a high knowledge burden and are difficult for end users to grasp (Attewell 1992; Fichman 1992). In such cases, the ability of end users to learn and use IS effectively is often critical to IS deep usage and successful implementation. In addition, IS researchers have found that self-efficacy tailored to an IS context is an important determinant of a variety of users' perceptions of information systems. Compeau and Higgins (1995) argued that computer self-efficacy influences outcome expectation, which includes the items in perceived usefulness. Based on the above discussion, the following propositions are presented:

P3a: Computer self-efficacy has a positive effect on IS deep usage.
P3b: Computer self-efficacy has a positive effect on perceived usefulness.

Personal IT innovativeness represents the degree to which an individual is willing to try out any new IT (Agarwal and Prasad 1998). It is treated as an individual propensity that is associated with more positive beliefs about technology use. Individuals are identified as innovative if they are early to adopt an IS innovation. Such individuals can then serve as key change agents and opinion leaders to facilitate further diffusion of a new technology (Rogers 1995). Personal IT innovativeness could potentially affect how individuals respond to IS innovations (Agarwal and Prasad 1998). Innovative users in IT dimension have the propensity to try out more features of an IS, rather than remaining at a superficial usage level. It is reasonable to expect that innovative persons are more likely to deeply use the system and achieve implementation success compared with less innovative ones.

Personal IT innovativeness epitomizes the risk-taking propensity that exists in innovators. Rogers (1995) argues that innovators are able to cope with higher levels of uncertainty. Therefore, it is reasonable to expect that individuals with higher personal IT innovativeness will develop more positive perceptions about IS innovations. The reason why different users have different perceptions of the same IS is because of individual differences. Personal IT innovativeness, which is an important individual difference variable, helps us to further understand how perceptions are formed and what subsequent role they play in the process of system implementation and assimilation (Agarwal and Prasad 1998). IT innovators are more

likely to embrace IS innovations, explore the system and appreciate the usefulness of the system compared with less innovative persons. Thus, the following propositions are proposed:

P4a: *Personal IT innovativeness has a positive effect on IS deep usage.*
P4b: *Personal IT innovativeness has a positive effect on perceived usefulness.*

Managerial interventions refer to the ways organizations encourage the use of the system and the degree to which they provide necessary resources to facilitate system implementation. Managerial interventions include activities such as mandating usage, as well as offering company-sponsored training, resource support, hiring new employees or hiring consultants experienced with the technology to serve as mentors (Gallivan 2001). These activities have important implications for secondary adoption because substantial materials and managerial resources are required not only to develop IS applications and infrastructures, but also to support end users during implementation. Bhattacherjee (1996) found that support and supervision of end users during the implementation process contributes to implementation success. During this process, managers need to work closely with end users to mandate, negotiate, persuade, motivate, and support them in adopting and using IS innovations. In addition, management intervention is also considered critical for reconceptualizing work processes and for changing existing routines and processes that are critical for employees' deep usage and for successful implementation in organizations (Purvis et al. 2001). Furthermore, lack of organizational interventions is considered a critical barrier to effective utilization of the system (Furest and Cheney 1982; Igbaria 1990; Massey et al. 2001).

Perceived usefulness is a significant variable in affecting system implementation success. High levels of organizational interventions such as user training, consulting and technical support services can promote more favorable beliefs about the system among employees (Igbaria and Chakrabarti 1990; Lucas 1978). Management support reflects the formal stance of an organization toward the behavior of usage, and may therefore provide clues about the likely consequences of using the system. In addition, user training and technical support are also instrumental in understanding the system, which enable users to develop realistic expectations associated with implementation success (Davis et al. 1989; Ives and Olson 1984; Lucas et al. 1990). Thus, organizational interventions have been found to be associated with favorable beliefs, and it is based on this that the following propositions are proposed:

P5a: *Managerial interventions have a positive effect on IS deep usage.*
P5b: *Managerial interventions have a positive effect on perceived usefulness.*

TAM research has shown that perceived usefulness is the salient belief influencing individuals to accept an IS. Post-consumption expectation is represented as ex post perceived usefulness in the proposed research model. Perceived usefulness captures the instrumentality of IS use. Previous studies found that perceived usefulness impacts an individual's affect substantively and consistently during both acceptance and post-acceptance stages of IS use (Davis et al. 1989; Karahanna et al. 1999). Attitude is a pre-acceptance affect, while satisfaction is a post-acceptance affect. It is validated that perceived usefulness can directly influence attitude in acceptance contexts. Likewise, perceived usefulness is expected to be the most salient ex post expectation influencing users' post-acceptance affect (satisfaction).

Perceived usefulness in the acceptance stage may override low affect in motivating usage intentions because of high instrumental consideration of perceived usefulness. It is noted that perceived usefulness in the acceptance stage is typically based on others' opinions or information disseminated through the mass media, while perceived usefulness in post-acceptance stage is formed mostly through users' first-hand experience and is, therefore, more reliable (Bhattacherjee 2001). In addition, in organizational contexts, employees' secondary adoption and usage are often mandatory. Their system usage may be mandated by an organization through reward inducements or threats of punishment or a combination of both. Therefore, continuance intention may not be suitable to predict employees' IS deep usage. Similarly, perceived usefulness in the post-acceptance stage may also directly motivate employees' deep usage overriding satisfaction with the system. This is because enhanced performance is instrumental in achieving various rewards that are extrinsic to the task context (Vroom 1964). In order to receive these expected rewards, employees are more likely to explore how to use the system in a sophisticated and efficient way. Based on the above discussion, the following propositions are presented:

P6a: Perceived usefulness has a positive effect on IS deep usage.
P6b: Perceived usefulness has a positive effect on satisfaction.

Satisfaction is a transient and experience-specific affect. Attitude is a relatively more enduring affect transcending all prior experiences (Oliver 1980). Employees' secondary adoption is different from traditional individual adoption in a volitional context, where adoption decision and ensuing usage behavior emanate from the same person. Attitude-intention-behavior relations may hold in voluntary settings, while they may not hold in mandatory settings (Nah et al. 2004; Rawstorne et al. 1998). Because continuance intention may not be suitable to predict employees' IS deep usage, this study deletes this variable from the above relationships. Traditional adoption studies have validated that affect can predict system usage (Davis et al. 1989). These studies provide indirect support for the satisfaction-behavior relationship. In organizational settings, if employees are satisfied with the system, they are more likely to embrace it, and attempt to use it creatively and efficiently. This leads to the following proposition:

P7: Satisfaction has a positive effect on IS deep usage.

4. Research Methodology

4.1 Research Strategy
Information systems are general concepts. Different industries and organizations use different information systems. Since different information systems have different functions, this study focuses on the usage of Enterprise Resources Planning (ERP) systems. An ERP system is viewed as an enterprise-wide information system that integrates all aspects of a business. Because the ERP system touches so many aspects of a company's internal and external operations, its successful deployment and use are critical to organizational performance and survival. The scope of this study is restricted to the ERP systems that are initially adopted by senior management and then needs to be diffused and infused throughout the organizations. Surveys are used as information gathering techniques to record responses as data to be used for analysis (Small 1993).

This study will use a large cross-sectional field survey methodology to examine ERP deep usage issues in business organizations in Guangzhou City, China.

4.2 Research Sample
Sample constituency is an important consideration in IS research on mandatory use. In order to investigate the determinants of IS deep usage in mandatory contexts, it is important to conduct research in the context in which system usage has been mandated with respect to all research participants.

The unit of analysis is end-users of an ERP system within organizations. It is impossible to obtain a random sample in my case, so I use convenient sampling method. I will contact large organizations in Guangzhou to see if they use ERP system or not. Four large organizations in Guangzhou, two from manufacturing industry and two from non-manufacturing industry will be selected to participate in this study. With the support of the CEOs and CIOs from these organizations, 150 employees using the ERP system in each organization will be randomly selected to participate in my research. These four organizations will be selected on the following composite criteria:
- These enterprises should have more than 500 full-time-equivalent (FTE) employees in manufacturing industry and more than 100 FTE employees in non-manufacturing industry.
- The ERP systems should be installed and used in the enterprise for more than one year.
- The enterprises installed ERP systems are generally categorized in two industry types: manufacturing and non-manufacturing (Damanpour 1991).

4.3 Data Analysis
The Partial Least Squares (PLS) analysis will be used to analyze the data. PLS follows a component-based strategy and does not depend on having multivariate normal distribution, interval scales, or a large sample size (Chin and Frye 1995). As suggested by Lohmoller (1981, p.7), "PLS methods are more close to the data, more explorative, more data analytic." The present study is one of the early studies of IS deep usage issue. In addition, it has a complex model and a large sample size is needed for the model testing using LISREL. Therefore, PLS is more suitable for this study.

5. Contributions and Conclusions
It is a common belief that appropriate IS utilization by individual users is requisite for successful system implementation. However, even if a decision to adopt has been made in an organization, implementation does not always follow directly. Compared to the IS innovation-decision process by individuals, the decision process in organizations is much more complex. Previous research put its focus on primary adoption, while neglecting the importance of secondary adoption. In essence, secondary adoption is an issue of deep usage in mandatory contexts. Traditional innovation adoption models are not suitable to address this issue. Therefore, there is a need to shift our focus from voluntary and shallow usage towards mandatory and deep usage. This study is an initial step in this direction.

IS deep usage is a new issue. This study has proposed a hybrid model that draws its insights from the individual innovation post-acceptance model as well as from organizational adoption and

assimilation frameworks. The focus of this study is on employees' secondary adoption, in particular when there is an organizational mandate to adopt an IS. This study suggests that IS deep usage can be influenced by perceived usefulness belief, satisfaction with IS use, managerial interventions and other influences coming from employees and their colleagues. It is not claimed here that the model developed in this research is exhaustive. Rather, it is expected that the proposed model will be further elaborated and extended in future research. A good understanding of the employees' secondary adoption will provide an immediate linkage to specific dimensions that managers and employees can focus on for improvement. In addition, the goal of this study is theory development. Theory testing will be conducted in the near future.

References

Adams, D. A., Nelson, R. R., and Todd, P. A. "Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication," *MIS Quarterly (16),* 1992, pp. 227-247.

Agarwal, R., and Prasad, J. "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology," *Information Systems Research* (9:2), 1998, pp. 204-215.

Ajzen, I. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50:1), 1991, pp.179-211.

Ajzen, I. "From Intentions to Actions: A Theory of Planned Behavior," in *Action-Control: From Cognition to Behavior*, K. Beckmann (Ed.), Springer-Verlag, Berlin, 1985, pp. 11-39.

Attewell, P. "Technology Diffusion and Organizational Learning," *Organization Science* (3:1), 1992, pp. 1-19.

Bandura, A. *Social Learning Theory*, Prentice-Hall, Englewood Cliffs, NJ, 1977.

Bhattacherjee, A. "Understanding Information Systems Continuance: An Expectation-Confirmation Model," *MIS Quarterly* (25:3), 2001, pp. 351-370.

Bhattacherjee, A. "Explaining the Effect of Incentives and Control Mechanisms on Information Usage: A Theoretical Model and an Empirical Test," *Proceedings of the Seventeenth International Conference on Information Systems*, Cleveland, OH, 1996, pp. 307-325.

Boudreau, M.-C. "Learning to Use ERP Technology: A Causal Model," *Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)*, 2003.

Brancheau, J. C., and Wetherbe, J. C. "The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-user Computing," *Information Systems Research* (1:2), 1990, pp. 115-143.

Burton-Jones, A., and Straub, D. W. "*Reconceptualizing System Usage,*" CIS Department Working paper No. CIS 03-1, Georgia State University, 2003.

Cale, E. J. J., and Eriksen, S. E. "Factors Affecting the Implementation Outcome of a Mainframe Software Package: A Longitudinal Approach," *Information & Management* (26), 1994, pp. 165-175.

Carlson, J. R., and Zmud, R. W. "Channel Expansion Theory and the Experiential Nature of Media Richness Perceptions," *Academy of Management Journal* (42:2), 1999, pp. 153-170.

Chin, W. W. and Frye, T. A. PLS-Graph, version 2.9.1.02.08. University of Calgary, 1995.

Chin, W. W., and Marcolin, B. L. "The Future of Diffusion Research," *The DATA BASE for Advances in Information Systems* (32:3)*,* 2001, pp. 8-12.

Cohen, M. D. "Individual Learning and Organizational Routine: Emerging Connections," *Organization Science* (2:1), 1991, pp.135-139.

Compeau, D. R., and Higgins, C. A. "Computer Self-Efficacy: Development of a Measure and Initial Test," *MIS Quarterly* (19:2), 1995, pp. 189-211.

Cooper, R. B., and Zmud, R. W. "Information Technology Implementation Research: A Technology Diffusion Approach," *Management Science* (36:2), 1990, pp.123-139.

Damanpour, F. "Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators," *Academy of Management Journal* (34:3), 1991, pp. 555-590.

Davis, F. D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13), September 1989, pp. 318-340.

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science* (35:8)*, 1989, pp. 982-1003.

Dutton, J. M., & Thomas, A. "Treating Progress Functions as a Managerial Opportunity," *Academy of Management Review* (9:2), 1984, pp. 235-247.

Fichman, R. G. "The Diffusion and Assimilation of Information Technology Innovations," in *Framing the Domains of IT Management: Projecting the Future Through the Past*, R. W. Zmud (Ed.), Pinnaflex Education Resources, Cincinnati, Ohio, 2000, pp. 105-127.

Fichman, R. G. "Information Technology Diffusion: A Review of Empirical Research," *Proceedings of the thirteenth international conference on information systems*, Dallas, TX, 1992, pp. 195-206.

Fishbein, M., and Ajzen, I. *Belief, attitude, intention, and behavior: An introduction to theory and research,* Addison-Wesley, Reading, MA, 1975.

Fuerst, W., and Cheney, P. "Factors Affecting the Perceived Utilization of Computer-based Decision Support Systems in the Oil Industry," *Decision Sciences* (13:4), 1982, pp. 554-569.

Fulk, J., Schmitz, J., and Steinfield, C. (1990). "A Social Influence Model of Technology Use," in *Organizations and Communication Technology,* J. Fulk & S. C. (Eds.), Sage, 1990.

Gallivan, M. J. "Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework," *The DATA BASE for Advances in Information Systems* (32:3), 2001, pp. 51-85.

Igbaria, M. "End-user Computing Effectiveness: A Structural Equation Model," *OMEGA* (18:6), 1990, pp. 637-652.

Igbaria, M., and Chakrabarti, A. "Computer Anxiety and Attitudes towards Microcomputer Use," *Behavior Information Technology* (9:3), 1990, pp. 229-241.

Ives, B., and Olson, M. "User Involvement and MIS Success: A Review of Research," *Management Science* (30:5), 1984, pp. 586-603.

Karahanna, E., Straub, D. W., and Chervany, N. L. "Information Technology Adoption Across Time: A Cross-Sectional Comparison of Pre-adoption and Post-adoption Beliefs," *MIS Quarterly* (23:2), 1999, pp. 183-213.

Kwon, T. H., and Zmud, R. W. "Unifying the Fragmented Models of Information Systems Implementation," in *Critical Issues in Information Systems Research,* R. J. Boland, Jr. and R. A. Hirschem (Eds.), Wiley, New York, 1987.

Lohmoller, J. B. *LVPLS 1.6: Latent Variables Path Analysis with Partial Least Squares Estimation,* University of Federal Armed Forces, Munich, 1981.

Lucas, H. C. "Empirical evidence for a descriptive model of implementation," *MIS Quarterly* (2:2), 1978, pp. 27-41.

Lucas, H. C., Jr., Ginzberg, M. J., and Schultz, R. L. *Information Systems Implementation: Testing a Structural Model,* Ablex Publishing Corporation, Norwood, New Jersey, 1990.

Massey, A. P., Montoya-Weiss, M. M., and Brown, S. A. "Reaping the Benefits of Innovative IT: The Long and Winding Road," *IEEE Transactions on Engineering Management* (48:3), 2001, pp. 348-357.

Melone, N. P. A "Theoretical Assessment of the User-satisfaction Construct in Information System Research," *Management Science* (36:1), 1990, pp. 76-91.

Nah, F. F.-H., Tan, X., and Teh, S. H. "An Empirical Investigation on End-Users' Acceptance of Enterprise Systems," *Information Resources Management Journal* (17:3), 2004, pp. 32-53.

Oliver, R. L. "A Cognitive Model for the Antecedents and Consequences of Satisfaction," *Journal of Marketing Research* (17), 1980, pp. 460-469.

Parthasarathy, M., and Bhattacherjee, A. "Understanding Post-Adoption Behavior in the Context of Online Services," *Information Systems Research* (9:4), 1998, pp. 362-379.

Pinder, C. C. *Work Motivation in Organizational Behavior*, Prentice-Hall, Upper Saddle River, New Jersey, 1998.

Rawstorne, P., Jayasuriya, R., and Caputi, P. "An Integrative Model of Information Systems Use in Mandatory Environments," *Proceedings of the International Conference on Information Systems*, Helsinki, Finland, 1998, pp. 325-330.

Rice, R. E., and Aydin, C. "Attitudes Toward New Organizational Technology: Network Proximity as a Mechanism for Social Information Processing," *Administrative Science Quarterly* (36:2), 1991, pp. 219-246.

Rogers, E. M. *Diffusion of Innovations (4th ed.)*, Free Press, New York, 1995.

Rogers, E. M. *Diffusion of Innovation (Third ed.),* The Free Press, New York, 1983.

Saga, V. L., and Zmud, R. W. "The Nature and Determinants of IT Acceptance, Routinization, and Infusion," in *Diffusion, Transfer and Implementation of Information Technology,* L. Levine (Ed.), North-Holland, Amsterdam, 1994.

Small, M. H. *Towards Successful Implementation of Advanced Manufacturing Technology: A Process-Factor-Process Approach, D. B. A. Dissertation,* Cleveland State University, Cleveland, Ohio, 1993.

Srinivasan, A. "Alternative measures of system effectiveness: associations and implications," *MIS Quarterly* (3), 1985, pp. 243-253.

Szajna, B. "Empirical Evaluation of the Revised Technology Acceptance Model," *Management Science* (42:1), 1996, pp. 85-92.

Szajna, B., and Scamell, R. W. "The Effects of Information System User Expectations on Their Performance and Perceptions," *MIS Quarterly* (17:4), 1993, pp. 493-516.

Taylor, S., and Todd, P. A. "Understanding Information Technology Usage: A Test of Competing Models," *Information Systems Research* (6:4), 1995, pp. 144-176.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly* (27:3), 2003, pp. 425-478.

Vroom, V. H. *Work and Motivation*, Wiley, New York, 1964.

Zaltman, G., Duncan, R., and Holbek, J. *Innovations and Organizations,* John Wiley, New York, 1973.