1-1-2005

Modeling Multilevel Structures of Information Technology Acceptance: An Investigation of Group Level Effects on Individual Usage of Web-Based Systems

Sung-Hee Park
University of South Carolina, spark@sc.edu

Lorraine Lee
University of South Carolina, lorrain_lee@moore.sc.edu

Mun Y. Yi
University of South Carolina, myi@moore.sc.edu

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ABSTRACT

Despite the sizable and continually increasing amount of investment in information technology (IT), IT often falls short of realizing its expected benefits due to inadequate user acceptance. Understanding the key factors that facilitate user acceptance of IT is an issue that has considerable practical implications. While much research effort has been directed to investigating the effects of various variables operating at the individual level, little effort has been made to modeling and assessing the effects of group level variables on individual usage behavior. Our study addresses this issue by proposing a multilevel model composed of individual level variables and group level variables, integrating the Unified Theory of Acceptance and Use of Technology model with Resource-Based Theory. Research hypotheses derived from this integrative model will be empirically validated in a field study setting involving college students who use a Web-based system over a 12-week period. The proposed model will be tested using a hierarchical linear modeling approach, which is specifically designed to examine multilevel data structures. The findings are expected to provide important insights into the dynamic interplay between individual level variables and group level variables and their joint effects on individual acceptance of IT.

Keywords

Hierarchical Linear Modeling, Acceptance of IT, Unified Theory of Acceptance and Use of Technology, Resource-Based Theory, Web-Based systems.

INTRODUCTION

Information technology (IT) investment in today's organizations has expanded dramatically to achieve various objectives such as increasing productivity, reducing costs, enhancing the quality of information available, or serving the customer better. According to the Bureau of Economic Analysis, average growth in IT investment between 1995 and 2000 was 24 percent per year and IT investment in 2002 had surged to $401.6 billion, close to 44 percent of the equipment and software investment in U.S. (Doms, 2004). A Computer Sciences Corporation (CSC) survey for the Grocery Manufacturers of America member companies indicated that the average IT spending per employee for 2002 was $9,414 (CSC, 2003, p.35). However, despite the sizable and continually increasing amount of IT investment, IT often falls short of realizing its expected benefits due to inadequate user acceptance (Yi and Hwang, 2003).

Determining the key factors that facilitate user acceptance of IT is often described as one of the most mature research areas in contemporary information systems (IS) literature (Venkatesh, Morris, Davis, and Davis, 2003). In investigating the key factors that facilitate user acceptance of IT, researchers have relied on several theoretical models such as the Technology Acceptance Model (Davis, 1989), Theory of Planned Behavior (Ajzen, 1991; Mathieson, 1991; Taylor and Todd, 1995), and Innovation Diffusion Theory (Rogers, 1983, 1995). However, little effort has been made to examining both the effects of individual and group level (i.e., higher than individual level) variables on those models from a multilevel perspective. Studies in individual level research area have rarely considered effects beyond the individual level of analysis while group level studies often ignore individual variations. This limitation stems from not only a lack of conceptual clarity about the relationships between the group level variables and individual level variables, but also a methodological difficulty in relating the variables measured at the two related but distinct levels.

By nature, organizations are multilevel systems. Individual usage behaviors as micro phenomena are often embedded in macro contexts. In turn, group level variables as macro level elements often have an effect on individual usage behavior through the interactions and dynamics of micro level elements such as users' socio-demographic factors and salient perceptions of IT innovation characteristics. Thus, no single-level model can adequately account for user acceptance of IT because only limited conclusions can be drawn from a single-level model. Accordingly, the goal of our study is to help resolve this issue by proposing a multilevel model composed of individual level variables and group level variables, while synthesizing and extending prior works on the user acceptance research with the multilevel theory. We sought to clarify how group level variables are conceptualized from the different levels of analysis perspective. In this vein, Random Coefficient Modeling (RCM; also frequently known as Hierarchical Linear Modeling), which is specifically designed to accommodate nested or multilevel data structures, is used as our analysis approach.

UTAUT (UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY) MODEL

Over the past decades, IS researchers proposed several competing models that can explain and predict individual usage behavior. In a recent study, Venkatesh et al. (2003) integrated the elements from eight of the dominant models of IT acceptance and unified those elements into one model, namely the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2003). Figure 1 depicts their final model.

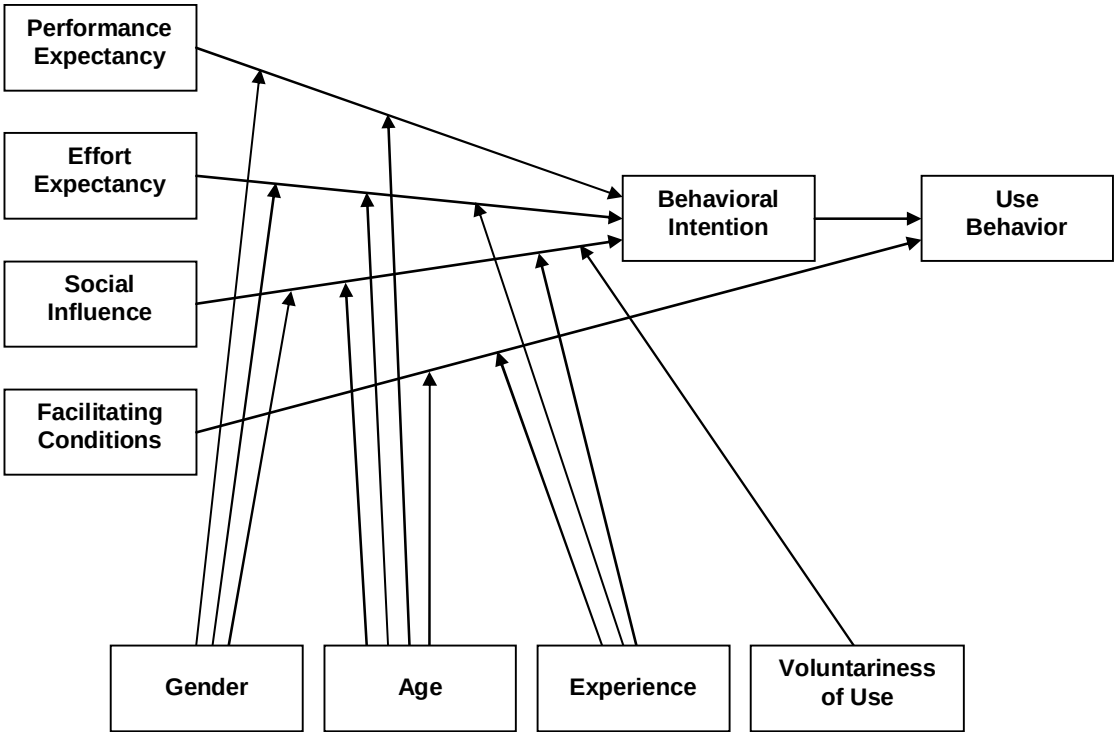

Figure 1. UTAUT Final Model (Venkatesh et al., 2003)

UTAUT identifies four constructs that are direct determinants of user acceptance and usage behavior: performance expectancy (as the degree to which an individual believes that the use of the system will help achieve gains in job performance), effort expectancy (as the degree of ease associated with using the system), social influence (as the degree to which an individual perceives that important others believe he or she should use the system), and facilitating conditions (as the degree to which the individual believes that organizational and technical infrastructure is available to support the use of the system). Additionally, 4 key moderators (i.e., gender, age, voluntariness, and experience) were found to improve the predictive ability of UTAUT and included in the final model.

UTAUT predicts that performance expectancy, effort expectancy, and social influences are direct determinants of behavioral intention. Behavioral intentions and facilitating conditions are direct determinants of use behavior. Venkatash et al. (2003) found that UTAUT outperformed the original eight models in explaining the amount of variance in user intentions to use information technology. Venkatash et al. (2003) conclude that "UTAUT is a definitive model that synthesizes what is known and provides a foundation to guide future research in this area" (Venkatesh et al 2003, p. 467). Our investigation thus utilizes the UTAUT framework in identifying salient individual variables and examining their effects on usage behavior.

RESOURCE-BASED THEORY

Resource-Based Theory (RBT) or Resource-Based View (RBV) of firms is perhaps the most influential framework for understanding strategic management (Barney, Wright, and Ketchen, 2001). Based on the concept of economic rent, RBT views the company as a collection of resources. While traditional strategy models such as Michael Porter's (1985) five forces model focus on the company's external competitive environment, RBT highlights the need for a fit in terms of its capabilities between the external market context in which a company operates and its internal environment. Capabilities are resources that, by working together, result in a firm's ability to accomplish a task (Grant, 1991).

According to Barney et al. (2001), RBT has important implications for the study of IS. The interface between skilled users and IT might prove to be inimitable. In other words, an organization highly proficient in translating computing power into knowledge might develop a substantial edge over its competitors (Barney et al., 2001, p. 636). In fact, RBT is not a new theory for IS. As an overarching theory or a theoretical base, it has been used in many IS studies such as investigations of IT as a resource to sustain competitive advantage (Mata, Fuerst, and Barney, 1995), human resources in concert with IT contributed to improved performance (Powell and Dent-Micallef, 1997), IS outsourcing (Grover, Teng, and Cheon, 1998), and knowledge management (Gold, Malhotra, and Segars, 2001) (see Wade and Hulland (2004) for more details).

MULTILEVEL STRUCTURES OF INFORMATION TECHNOLOGY ACCEPTANCE

In an organization, individuals are embedded within groups1, and groups are embedded within the organization. Thus, each level of an organizational system is included in a higher-level context. Fundamentally, organizational variables may have a direct and/or a moderating effect(s) on the behavior of its individual employees. Top-down processes describe this influence of higher-level contextual factors on lower levels of the system (Kozlowski and Klein, 2000). From the top-down processes perspective, it is believed that organizational level variables shape group level variables and in turn, group level variables influence the IT acceptance patterns of employees. Figure 2 depicts our research model composed of salient individual level variables and group level variables while integrating UTAUT model with RBT. In the model, group level variables affect individual acceptance outcomes (i.e., current and future usage) directly and also indirectly by moderating the relationships between individual perceptions and acceptance outcomes.

Resources as Group Level Facilitating Conditions

Powell and Dent-Micallef (1997) divide information systems resources into three categories: human resources, business resources, and technology resources. In a study of the U.S. retail industry, they found that only human resources in concert with IT contributed to improved performance. Among the business resources only IT training positively affected performance, while no technology resources were positively linked to performance at all. Venkatesh et al. (2003) define facilitating conditions as the degree to which an individual believes that organizational and technical infrastructure exists to support the use of the system. Extending prior research, we theorize that facilitating conditions can be conceptualized at two levels: 1) individual-level facilitating conditions as a user's perceptions of the environmental support and 2) group-level facilitating conditions as human, business, and technology resources available within a group. Individual-level facilitating conditions are defined as the factors in the environment controlled and influenced by the user, while group resources are those which are controlled and influenced collectively by the group. The extent to which group resources are available in their working environment will influence how members perceive facilitating conditions at the individual level. However, group-level resources reflect more objectively the reality of the resource availability within a group and have a more common, stable, and widespread influences than the individual perceptions of facilitating conditions. Thus, we separate these two concepts and, consistent with RBT, hypothesize that group resources will have a direct effect and moderating effects on the acceptance outcomes at the individual level as follows:

H1: Group resources will have a significant influence on individual acceptance outcomes.

[1] In this study we use supervisors' span of control to delineate the boundary of groups. It also should be noted that we assume an individual is under a control of one and only a supervisor.

H2: The influence of individual perceptions on individual acceptance outcomes will be moderated by the group resources.

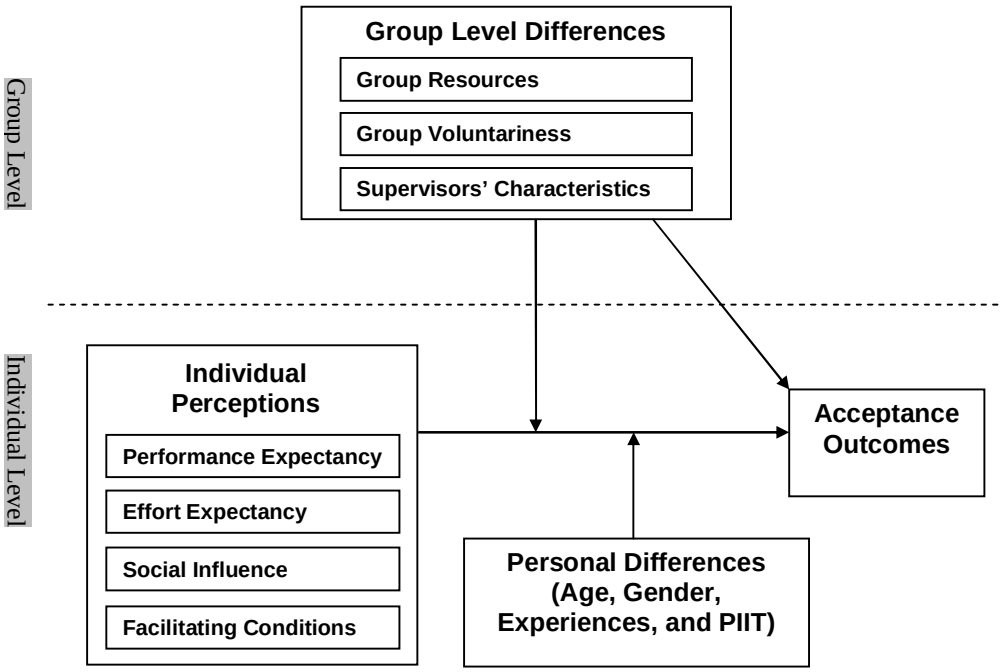

Figure 2. Research Model

Voluntariness as a Group Level Strategy

Potential adopters can perceive varying levels of choice in adopting a new system (Agarwal and Prasad, 1997; Rogers, 1983) even though perceived voluntariness has been often considered as a binary (i.e., voluntary vs. mandatory) variable by prior research. In this study, we extend the prior conceptualization of voluntariness by distinguishing the voluntariness constructs operating at two different levels. First, at the individual level, voluntariness can be conceptualized as the extent to which potential users perceive the technology acceptance to be voluntary, or of free will (Moore and Benbasat, 1991). Second, at the group level, voluntariness can be conceptualized as the extent to which system use is non-mandated by the management. Thus, group voluntaries captures the objective nature of the system use implemented within a group, often advocated or determined by organizational decision-makers, while individual voluntaries captures the subjective nature of the system use filtered by the perception of an individual user. For instance, the group level voluntariness can be driven by conversion strategies (e.g., direct changeover, parallel conversion, gradual conversion, modular prototype conversion, and distributed conversion). Those group level conversion strategies will sometimes mandate the use of a newly introduced system. A direct changeover conversion strategy requires users to adapt to the new system on a specified date without recourse. Other conversion strategies can also force users to get involved with the new system even though the conversion may take longer than the direct conversion. As such, the voluntariness at the group level can have a significant effect on individual acceptance outcomes. Further, we also explore the possibility of moderating the effects of individual perceptions on the acceptance outcomes. Individual perceptions may not result in noticeable changes in the acceptance outcomes when a group mandates the use or non-use of the system. Therefore, we hypothesize that:

H3: Group voluntariness will have a significant influence on individual acceptance outcomes.
H4: The influence of individual perceptions on individual acceptance outcomes will be moderated by group voluntariness.

Supervisor Differences as a Group Level Domain

Across each level and across each domain, there are reasonably stable differences that reflect important variance across people, groups, departments, organizations, etc. (Ployhart and Oswald, 2004). In an organizational system, the boundary of a group is often based on a supervisor's span of control. Thus, it can be argued that supervisors' differences (e.g., supervising style) may have effects on subordinates' behaviors and may moderate the effects of individual perceptions on the acceptance outcomes. Therefore, we hypothesize that:

> H5: Supervisor characteristics will have a significant influence on individual acceptance outcomes.
> H6: The influence of individual perceptions on individual acceptance outcomes will be moderated by supervisor characteristics.

RESEARCH METHOD

Research hypotheses derived from the integrative model will be empirically validated in a series of field studies utilizing both college students and professional workers. The first study is currently underway, involving college students enrolled in multiple sections of an introductory IS course at a major university. The target system of the study is the Blackboard system, which is a Web-based comprehensive class management system accessible via the Internet. The individual level variables have been measured via questionnaire after the introduction of the system. The group level variables have been measured by contacting key informants (i.e., instructors). The individual acceptance outcomes will be measured both via questionnaire and by gathering actual usage of the system over a 12-week period. The proposed model will be tested using a hierarchical linear modeling (HLM; a specific type of Random Coefficient Model) approach, which is specifically designed to examine multilevel data structures. HLM is a frequently used technique to handle nested data structures that often correspond to hierarchical levels in an organization. Hypothesis testing in HLM will follow the Generic Model Comparison Sequence for HLM (Ployhart, in press). Based on the findings from the first study, the subsequent studies will be modified and conducted at an organizational setting involving professional workers. The findings from the planned studies are expected to provide important insights into the dynamic interplay between individual level variables and group level variables and their joint effects on individual acceptance of IT. At the time of conference, we will be able to share the results from the first study and present our plan for the subsequent studies.

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