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Information Technology Adaptation: A Study of Its Determinants and Effects

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Abstract

This paper is one of the first to examine a potentially important yet ignored area of information technology usage research, namely IT adaptation. Integrating adaptive structuration theory with findings from prior IT usage research, we propose a theoretical model of IT adaptation that elaborates the causative drivers, effects, and underlying dynamics of the adaptation process. A longitudinal study is proposed to empirically test the hypothesized model. We present results from a pretest study that validated our choice of constructs and generated initial measurement items for new constructs, and expect to complete and present instrument validation, data collection, and statistical analysis at the conference. Potential contributions of this study for IT usage research and practice are discussed.

Keywords: IT adaptation, IT continuance, IT usage

Introduction

Information technology (IT) continuance, defined as the extent to which IT users continue using an existing IT, has recently been proposed as a key requirement of long-term IT success. The purported benefits of IT, such as productivity, efficiency, or effectiveness, cannot be realized if those systems are not used over the long-term by their intended users. Contrasting IT continuance with IT acceptance, Bhattacherjee (2001, p. 351) states, "While initial acceptance of [IT] is an important first step toward realizing [IT] success, long-term viability of an [IT] and its eventual success depend on its *continued* use rather than *first-time* use."

Prior research has employed the expectation-disconfirmation paradigm to propose user satisfaction as the sole factor driving IT continuance (e.g., Bhattacherjee 2001). In this study, we propose IT adaptation as a second driver, particularly for customizable IT. This suggestion is motivated by recent industry trends toward building customizable systems (e.g., Web portals) that can adapt to the diverse needs and preferences of different users (or user groups) as a means of improving user retention. Customizing an IT is purported to increase its utility to the intended users, over and above that of a comparable generic system, thereby motivating them to continue using the system. The time and effort invested by users in customizing a system may also act as a *switching cost*, further discouraging subsequent IT discontinuance. This study examines the key drivers and effects of IT adaptation and the underlying dynamics, which have several implications for the future design of IT products and future research on IT usage.

IT adaptation is defined as the process of modifying a generic IT in order to align it better to individual preferences or work requirements. We view IT in a broad sense to include not only computer hardware and software, but also other means of information delivery such as networks and online media. IT adaptation may, therefore, include customized software or Web portals tailored to individual needs and preferences. Although software customization is still a relatively novel concept, customized portals are not a new phenomenon. Popular Web portals such as Yahoo, America Online, and Microsoft Network have offered customizable interfaces (e.g., MyYahoo, MyAOL, MyMSN) for several years as a means of delivering user-specified

content to desktops. Such content may include news from preferred sources (e.g., Reuters) or geographic regions (e.g., Europe), weather forecasts in specified cities, quotes for favorite stocks, real-time sports scores, and so forth.[1] Despite their limited adaptability (i.e., they provide a limited set of predefined options and do not allow user behaviors to change in unanticipated ways), these portals create value for users by delivering targeted content and reducing information overload, while presumably improving user retention on those sites.

The research questions of interest to this study are (1) does IT adaptation really enhance IT continuance, (2) what is the process by which adaptation influences IT continuance, and (3) what are the underlying factors driving IT adaptation? To answer these questions, we integrate adaptive structuration theory with findings from prior IT usage research to construct a theoretical model of IT adaptation. An empirical study is then proposed to test the above model. We describe a pilot study that validated our choice of constructs and developed instruments for measuring new constructs. Instrument validation, data collection, and statistical analysis are planned for completion and presentation at the conference. The paper ends with a discussion of the potential contributions of this study for IT research and practice.

Theory and Research Model

Adaptive structuration theory (AST) provides a theoretical frame for understanding the adaptation process. AST suggests that use of new technology is not deterministic; technologies are structured or appropriated by users in the context of their use, while simultaneously modifying preexisting social structures (e.g., decision-making responsibility, group interaction norms). *Structures* are defined as the rules and resources that actors employ to sustain recurrent social practices such as decision-making or collaborative activities (DeSanctis and Poole 1994). These rules are generally appropriated from larger social institutions, but may be modified intentionally or unintentionally during a *structuration* process, often triggered by a social change such as introduction of a new IT (Orlikowski 1993). For instance, group interaction norms (a preexisting structure) may impose constraints on how a collaborative IT is used and be modified by users during the process of their IT usage. Much of this structuration is believed to occur during the initial stages of IT introduction, although structuration may continue over time in a continuous, sporadic, or episodic manner (Tyre and Orlikowski 1996).

Orlikowski (1993) demonstrated the validity of structuration processes in her study of computer-aided software engineering tool adoption, and Majchrzak et al. (2000) elaborated the applicability of this perspective in studying the adaptation of collaborative technology in virtual team settings. While these studies examined AST at the organizational and group level of analysis respectively, no study has yet examined its applicability at the individual level. We contend that AST and the structuration process are equally applicable to the individual level and personal usage contexts since individual IT usage also involves recurrent social practices (e.g., information search and usage patterns) that shape and are shaped by subsequent IT usage. For example, recent enhancements in word processing software have changed the way we identify and correct typographical or grammatical errors, typeset documents using columns or embedded graphics, and convert documents into hypertext format for online publishing.

DeSanctis and Poole (1994) describe three sets of structures relevant to understanding group decision support in organizations: technology structures (an IT's technical features as well as its general spirit or intent), organizational structures (the organizational and task context in which the technology is being implemented), and group structures (interaction patterns and decision-making processes of group members). Given this study's focus on personal IT usage contexts, organizational and group structures are not pertinent to our analysis (although these structures are still important in organizational settings), and we choose to focus on individual work patterns instead. Rationally, individuals use IT to improve their efficiency or effectiveness at work, and such improvements are often contingent on appropriately modifying preexisting work patterns to take advantage of a new IT, while simultaneously modifying the IT to fit the work context better. The outcome of this structuration process is an improved fit between IT and the work context, which, according to the task-technology fit stream of IS research (Goodhue 1998), leads to continued IT usage in the pursuit of IT-driven performance gains.

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[1] *Customized* interfaces such as MyYahoo are different from *personalized* interfaces such as Amazon in that the former rely solely on user-specified preferences (which does not change unless proactively changed by the user), while the latter extrapolate potential preferences from purchase patterns of similar users. Personalization is sometimes inaccurate, e.g., Amazon may recommend children's books to a childless buyer who previously bought a parenting book as a gift for a friend. A recent survey of Web users found that 52 percent of surveyed users preferred customized news while only 7 percent preferred personalized news (Nunes and Kambil 2001).

Drawing on AST's duality between technology and preexisting (work) structures, we posit that IT users confronted with a new (adaptable) IT engage in two related and concurrent behaviors: IT adaptation and work adaptation. *IT adaptation* is defined as to the extent to which an IT is modified to suit preexisting work structures (e.g., activities, roles, procedures), while *work adaptation* is the modification of work structures to accommodate and benefit from the new IT. Both forms of adaptation are presumed to occur iteratively until IT and work structures are aligned with each other, which may recur if this alignment is altered due to emergent changes in technology or extant work structures. Collectively, IT and work adaptations help improve *IT-work fit* (alignment), which then has a positive impact on *IT continuance* (see Figure 1).

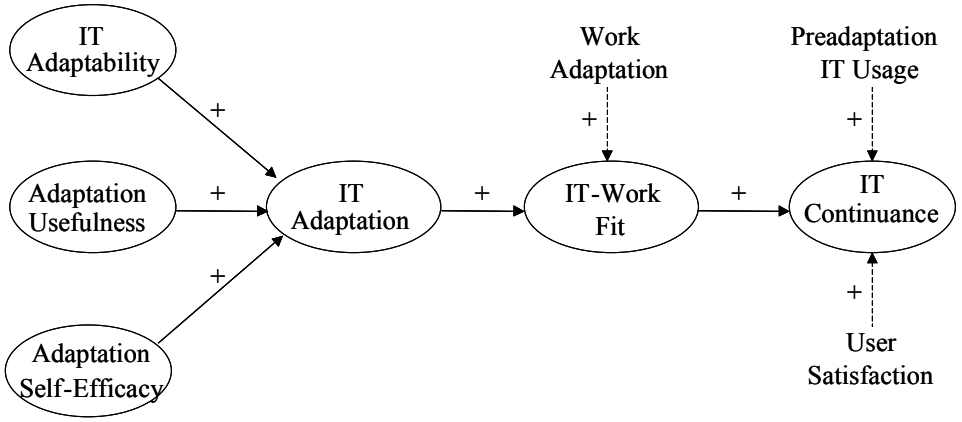

Figure1. Research Model of IT Adaptation

What are the key determinants of IT adaptation? Since AST does not elaborate any causative driver, we draw on IT usage research to examine the above question. Factors influencing IT usage may also be related to IT adaptation because adaptation and usage are adjacent and related stages in the overall process of IT implementation (Kwon and Zmud 1987). Two factors consistently found to influence IT usage are perceived usefulness and self-efficacy.[2] Usefulness refers to user perceptions of the utilitarian value of a new IT, while self-efficacy is the belief that users possess the ability to use a new IT. Theoretical support for perceived usefulness comes from the technology acceptance model (Davis et al. 1989), while social-cognitive theory supports the choice of self-efficacy (Compeau et al. 1999). These factors may influence IT adaptation if users view adaptation as contributing to utilitarian outcomes (usefulness) and requiring adequate ability on the part of the adapting user (self-efficacy), over and above the perceived usefulness and self-efficacy required for preadapted IT usage.

To distinguish adaptation-related usefulness and self-efficacy from similar constructs related to general (non-adapted) IT usage, we refer to the former constructs as adaptation usefulness and adaptation self-efficacy. *Adaptation usefulness* is defined as the extent to which users believe that adapting an IT will benefit their work over not adapting it, while *adaptation self-efficacy* is the extent to which users believe in their ability to adapt an IT appropriately to their needs and preferences. Just as perceived usefulness and general self-efficacy have positive effects on usage of preadapted or non-adaptable systems, adaptation usefulness and adaptation self-efficacy are expected to be positively related to IT adaptation.

We propose *IT adaptability*, defined as the extent to which users perceive a given IT as being adaptable to their work patterns and preferences, as the third key determinant of IT adaptation. From an AST perspective, IT adaptability is a technology structure that helps align the spirit of an adaptable IT to its expected performance. IT adaptability is a new construct in the IS usage literature, but is relevant to the current context because users may adapt an IT only if they view the IT as being adaptable. Including this construct, therefore, helps us build a generalized model of IT adaptation that can apply to both adaptable and non-adaptable systems. Note that some users may not adapt an adaptable IT for reasons such as lack of self-efficacy, hence this association is not tautological.

[2]Other factors such as ease of use and attitude are found to have inconsistent effects on IT usage and are, in general, being dropped in many recent studies.

Of the three determinants of IT adaptation described above, adaptation usefulness captures the *motivation* for IT adaptation, while IT adaptability and adaptation self-efficacy represent the *means* of adaptation. These determinants present three complementary reasons why users may adapt IT: (1) because the IT is adaptable (IT adaptability), (2) because adaptation adds value to their work (adaptation usefulness), and (3) because users have the ability to adapt it (adaptation self-efficacy). The role of these factors is clearly evident at the organizational level in the case of enterprise resource planning (ERP) adaptation, where firms view ERP systems as being customizable to their internal work processes, expect such customization to increase the overall utility of the system, and can procure the necessary expertise to adapt the system appropriately (often by hiring external consultants). While additional drivers of IT adaptation are clearly possible, such considerations are left open for future research.

Finally, since IT-work fit depends on both IT adaptation and work adaptation, we specify work adaptation as a control variable to tease out its possible confounding effect on IT-work fit (see Figure 1). We presumed IT adaptation to impact IT continuance over and above user satisfaction, and hence, user satisfaction with the preadapted IT is included as a control variable. To account for the possible lingering effect of preadaptation IT usage on post-adaptation IT continuance, we add preadaptation usage as a third control variable.

Proposed Empirical Study

In order to empirically test the above model of IT adaptation, we propose a longitudinal study of MyYahoo customization by Web users. MyYahoo, a customizable Web portal powered by Yahoo, was chosen specifically because of Yahoo's large installed user base and MyYahoo's potential impact on users' browsing, searching, and other online behaviors (work structures). For instance, MyYahoo's photo album, address book, and scheduler/calendar features can obviate users' reliance on offline media such as paper-based address books and personal digital assistants. Further, MyYahoo's customized real-time news feeds from multiple sources (e.g., Reuters, USA Today, CBS Marketwatch) may reduce users' browsing of vertical portals.

Subjects will be drawn from students in a large public university. Using student subjects will provide the researchers with greater control over subjects' knowledge of and exposure to the MyYahoo portal, which in turn may enhance the internal validity of our empirical findings. Since students use IT routinely for their everyday work (e.g., searching for information, purchasing, bill payment), the observed findings are expected to be fairly representative of the IT user population at large. Subjects' participation will be voluntary.

The study will proceed in two sessions. At the start of the first session, a fill-in questionnaire will be used to capture demographic data and subjects' usage and user satisfaction with preadapted Yahoo. Subjects will then be introduced to the concept of customized portals and the benefits of such customization via a live in-class demonstration of the customization process (including content, format, and layout of the MyYahoo portal). At the end of this session, subjects will complete a second questionnaire intended to measure their perceptions of IT (MyYahoo) adaptability, adaptation usefulness, and adaptation self-efficacy. The second session, conducted one month later, will consist of a third questionnaire, asking subjects' their extent of IT adaptation, work adaptation, IT-work fit, and IT continuance since the in-class demonstration. Responses from the three questionnaires will be matched using the last four digits of subjects' home telephone number (self-reported) to create a single temporal record for each respondent.

Constructs will be measured using multiple-item Likert-scaled and semantic differential measures. Adaptation usefulness will be measured using a modified version of Davis et al.'s (1989) four-item perceived usefulness scale, reworded to reflect subjects' perceptions of MyYahoo adaptation. Adaptation self-efficacy and user satisfaction will be measured using validated scales taken from Compeau et al. (1999) and Bhattacherjee (2001) respectively. IT continuance and preadaptation IT usage will both be measured using appropriate variants of Compeau et al.'s usage scale (since IT continuance is essentially post-adaptation IT usage). IT-work fit was expanded from Goodhue's (1998) scale. Given the lack of prevalidated scales for IT adaptability, IT adaptation, and work adaptation, these constructs will be measured using new scales created based on our pretest study (described below) and validated using a follow-up study. Actual scale items are not reported here due to space constraints, but are available from the authors upon request.

Several experimental controls will be employed to minimize the potential effects of extraneous factors that may confound IT adaptation behavior (i.e., increase internal validity of our findings). The effect of technology-induced variance (e.g., due to new MyYahoo features added over time) on adaptation is controlled by restricting our study to a single Web portal, and by limiting the time frame of our longitudinal study to one month. The potential impact of environmental factors, such as subjects' awareness and nonuniform IT exposure on their adaptation behavior, are ruled out by formally introducing all subjects to the target IT via

a uniform demonstration, led by a single instructor. Additionally, as previously described, three control variables—preadaptation IT usage, user satisfaction, and work adaptation—are measured to account for the potential effects of subjects' fit perceptions and IT continuance.

Pretest Results

An initial pretest study was conducted to test the appropriateness of our chosen constructs and to derive an initial set of items for measuring unique adaptation-related constructs. The subject pool consisted of 14 graduate students, who were given a live demonstration of MyYahoo customization and asked a set of open-ended questions about why they may or may not want to customize the portal, what specific features of the portal they would want to customize (e.g., content, layout), and how customization may change their portal usage behavior. Subjects' textual responses were content analyzed by three independent raters into predefined categories: the hypothesized constructs plus additional ones derived from prior IT usage research, such as ease of use, compatibility, awareness, and other. Initial inter-rater agreement was 83 percent. The remaining differences were resolved through discussion until a consensus was reached.

Adaptation usefulness was observed to be an overwhelming rationale for MyYahoo customization (in 13 out of 14 subjects), while use of alternative IT (e.g., myAOL) and lack of awareness (of Yahoo's customizability) emerged as key inhibitors.[3] Since usefulness is assessed relative to the next best alternative (e.g., preadapted or alternative IT use), high alternative IT usage was implicitly factored as low adaptation usefulness in our model. Lack of awareness is a reflection of subjects' IT adaptability perceptions, which was already specified in our model. Adaptation self-efficacy was not cited, but this was probably due to the fact that subjects were not asked to customize the portal during the pretest and hence they never considered their ability to adapt. From prior research, we expected this factor to be prominent in our longitudinal study, and hence decided to retain it in our hypothesized model.

MyYahoo features (e.g., news, stock quotes, music, horoscope, scheduler, TV listings, weather) and attributes (e.g., content, layout, format) that subjects considered worthy of adaptation were used to create measurement scales for the new adaptation-related constructs. Subjects' perceptions regarding the extent to which key MyYahoo features and attributes are customizable to their personal work behaviors and preferences were used to create the IT adaptability scale. Subjects' actual (self-reported) customization of the content, layout, format, and overall portal served as items for our IT adaptation scale. Subjects indicated that MyYahoo could change how they accessed news on the Internet, searched for information, bought products or services, and used portals in general. Hence, these issues were translated into items for our work adaptation scale. The extent to which subjects' MyYahoo customization (e.g., content, layout, format) met their work patterns (e.g., accessing news, information search, product or service purchase, portal use in general) were used to create the IT-work fit scale, with two items from Goodhue's (1998) scale.

Statistical estimation of scale properties was not possible in view of the small sample size of the pretest sample. This is scheduled for examination in a subsequent pilot study, for purposes of scale assessment and refinement and presentation at the conference. However, the pretest demonstrated the study's feasibility, validated its choice of constructs, and generated initial sets of items for the new constructs.

Potential Contributions

What are the potential contributions of this study for IT research and practice? In this section, we describe three research contributions and two practical contributions of our study, and suggest potential areas of future research. First, though we know that some users adapt IT (e.g., Web portals) to their personal preferences and work processes, we know very little about why or how they adapt. This paper not only draws our attention to this potentially important but neglected area of IT usage research, but also provides an initial model of IT adaptation describing its causes and effects and the complex dynamics underlying the adaptation process, which may stimulate future research and knowledge building in this area. Second, we contribute to the theoretical referent by applying and testing the applicability of AST at the individual level of analysis, and thereby extend the

[3]Awareness is controlled for our empirical study formally introducing all users to MyYahoo, but may become a concern if subjects have varying levels of IT exposure.

bounds of this theory from organizational and group levels of analyses (e.g., Majchrzak et al. 2000; Orlikowski 1993). Further, while prior AST-based studies were primarily interpretivistic in their research approach, our work is one of the earliest positivistic studies using AST. Third, we propose IT adaptability as a new construct of interest to the academic community and develop an instrument to measure this construct. We expect this construct to assume increasing prominence with future trends toward building customizable systems.

For practitioners, this study has two implications. First, it provides the first empirical test of a widely accepted industry hypothesis that building customizable software is a potent way of improving user retention. The outcome of this study will, therefore, have important ramifications for future development and deployment of customizable systems. Second, we provide an initial set of attributes (IT adaptability, adaptation usefulness, etc.) that users perceive as being important in their adaptation process, which IT vendors should target in designing marketing programs to motivate the adoption and adaptation of customizable systems.

Being the first model of IT adaptation, our choice of only three independent variables reflects a trade-off between model explanation and parsimony. Future research may explore additional determinants salient to the IT adaptation context. Second, our proposed model focuses on the adaptation of personal-usage IT in individual settings. Future research may examine how this model can be extended to organizational settings, e.g., by considering the role of organizational work patterns and politics in shaping IT adaptation. Third, researchers may compare the usage patterns of non-adaptable and adaptable versions of IT (e.g., Yahoo and MyYahoo) to uncover potential differences between their key drivers and process dynamics.

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