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A Decomposed Model of IT Artifact-related Beliefs as Antecedents of IT Acceptance and Use

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ABSTRACT

Past research on IT acceptance and use has largely focused on relationships between constructs in models that are based on a small number of overlapping theoretical frameworks, and has neglected to integratively examine the IT artifact-related antecedents of these models' constructs. The present paper addresses this issue by incorporating into the Theory of Planned Behavior the IT artifact-related belief antecedents that were identified in a review of IT acceptance and use literature published since 1990.

Keywords

IT acceptance and use, IT artifact, Theory of planned behavior.

INTRODUCTION

The acceptance and use of Information Technology (IT) in organizations has been an important research topic since the 1980s. A number of different theoretical frameworks have been examined by this research stream, including the Technology Acceptance Model (TAM) (Davis, Bagozzi and Warshaw, 1989), the Theory of Planned Behavior (TPB) (Mathieson, 1991), and Innovation Diffusion Theory (IDT) (Moore and Benbasat, 1996). More recently, Venkatesh, Morris, Davis and Davis (2003) developed a Unified Theory of Acceptance and Use of Technology (UTAUT) which synthesizes eight theoretical models investigated in past research. An examination of these models and of the integrative UTAUT model proposed by Venkatesh et al. (2003) indicates that a significant proportion of past Information System (IS) acceptance and use research has examined relationships between the main constructs of these overlapping research models while treating their antecedents in a generic way. In particular, IT artifact-related antecedents have remained largely unexplored. As also underscored by Benbasat and Zmud (2003), IS researchers have often treated the IT artifact or the IS as a "black box." Arguing along similar lines, Orlikowski and Iacono (2001) noted that researchers have applied different theories without considering the specificities of the technology. Very often, they have studied individual characteristics and psychological constructs while treating technology as a generic entity. As suggested by Benbasat and Zmud (2003), IS aspects of the phenomena being examined should be brought to the forefront with research focusing on the interactions between individuals, organizations and IT artifacts. Thus, researchers need to open the IT "black box" and theorize about the IT artifact in an effort to go beyond the boundaries of current user acceptance and use models. As a first step in that direction, the IT artifact-related antecedents of user intentions and behaviors can be identified. To address this issue, the present paper develops a TPB-based theoretical model founded on a literature review of individuals' IT artifact-related beliefs modeled as antecedents of TPB's key constructs.

Theoretical framework and model development

Based on its applicability to varied contexts and the widespread empirical support it has received from researchers in different disciplines, we chose TPB (Ajzen, 1991) as our starting point in formulating our research model. Recall that, according to Ajzen (1991), antecedents of human behavior and actions are attitude, subjective norm and perceived behavioral control, and TPB is a function of underlying salient belief structures relevant to the behavior (Taylor and Todd, 1995a). Ajzen (1991) distinguishes three sets of salient beliefs: behavioral, normative and control beliefs. Behavioral beliefs are thought to influence attitudes toward the behavior; normative beliefs are the underlying determinants of subjective norm, and control beliefs influence perceived behavioral control. According to Ajzen (1991), for every specific context, salient beliefs must be identified. In the context of IT use, beliefs about technology attributes are salient to the population (IT users). According to Benbasat and Barki (2005), extensions of the belief set are a natural application of the TPB since the salient antecedents that

will be identified and how they will be modeled within TPB will vary depending on the specific technology being used. Since our goal is to theorize about the IT artifact, we propose to consider beliefs about technology attributes instead of behavioral beliefs.

TPB's antecedents can be categorized into three groups: antecedents related to beliefs about technology attributes (antecedents of attitude), antecedents related to normative beliefs (antecedents of subjective norm), and antecedents related to control beliefs (antecedents of perceived behavioral control).

Further, in the specific context of systems use in organizations, perceived usefulness, and perceived ease of use have been identified as two salient beliefs. These constructs were proposed by Davis et al. (1989) as perceived characteristics of innovations that capture all relevant beliefs in IT acceptance and use contexts. While Venkatesh et al. (2003) eliminated attitude from their UTAUT model based on weak empirical results, the construct of attitude is an integral part of TPB and its elimination purely on empirical grounds does not provide a strong justification. Moreover, many past empirical results have found both perceived ease of use (Agarwal and Prasad, 1999; Malhotra and Galletta, 2005; Wixom and Todd, 2005) and perceived usefulness to be a significant antecedent of attitude (Agarwal and Prasad, 1999; Chau and Hu, 2002; Karahanna, Straub and Chervany, 1999; Taylor and Todd, 1995b; Wixom and Todd, 2005). We therefore suggest including these two constructs within TPB as antecedents of attitude. Figure 1 presents the proposed theoretical model of IT acceptance and use.

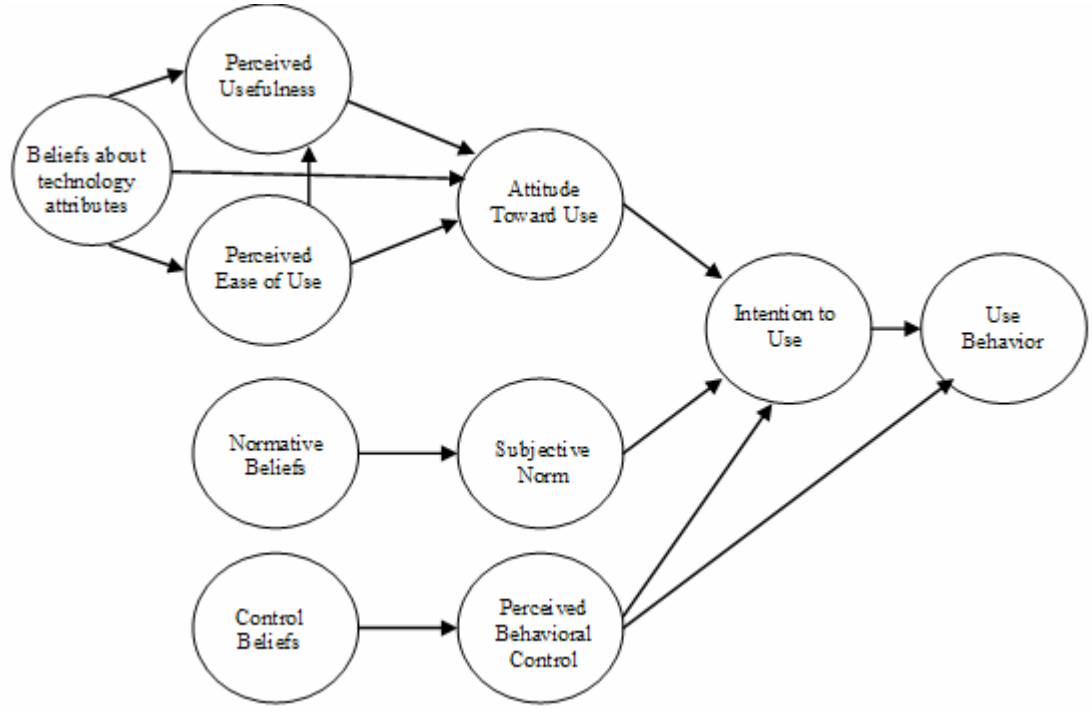

Figure 1. Proposed theoretical model of IT acceptance and use

While the choice of TPB as the basis of our theoretical model may be limited by the inflated correlations between its constructs that stem from common method variance (Straub, Limayem and Karahanna-Evaristo, 1995; Szajna, 1996), the consensus around the UTAUT model emerging from past acceptance and use research speaks to the general stability and applicability of TPB.

IDENTIFYING IT ARTIFACT RELATED ANTECEDENTS OF TPB

Method

In order to identify the IT artifact-related antecedents of TPB, we conducted a literature review in which we examined articles published since 1990. As suggested by Webster and Watson (2002), a structured approach was followed to select the source material for the review. First, the selection of leading journals was considered based on Mylonopoulos and Theoharakis's

(2001) IS Journals World Classification and Top 10 IS Journals Readership. As proposed by Webster and Watson (2002), each journal's table of contents was scanned to identify the relevant papers.

In addition, IT and Management journals listed in the Journal Citation Reports (from ISI Web of Knowledge), Sciences Edition (under Computer Science/Information Systems category), and Social Sciences Edition (under Information Science category) were also considered and journals with an impact factor over 0.8 were selected. The final set of journals retained for the literature review included Information System Research, Journal of Management Information Systems, MIS Quarterly, Communications of the ACM, Information & Management, Decision Support Systems, Decision Sciences, and Management Science.

Finally, as recommended by Webster and Watson (2002), relevant papers in different journals and conference proceedings were identified using ABI/Inform (ProQuest). Each paper that identified and tested antecedents of perceived ease of use, perceived usefulness, attitude, subjective norm and perceived behavioral control was considered to be relevant to the review and was selected for further analysis. Different definitions and verbal designations of each construct were considered (e.g., perceived usefulness and perceived ease of use, as well as performance expectancy and effort expectancy in the UTAUT model (Venkatesh et al., 2003) were included).

The above procedure resulted in the identification of ninety-five papers that investigated at least one relevant antecedent[1]. Each paper was then further classified based on the constructs it studied, their antecedents, the detailed findings, the research method used, the study sample's source and size, and its authors. We then classified antecedents into two sets of beliefs: beliefs about technology attributes and general beliefs. General beliefs were excluded from the final model as they do not pertain to the IT artifact, and only antecedents that have been found to have a significant influence were considered for inclusion in the proposed model. The following section presents the results of the literature review and the proposed decomposed theoretical model of IT acceptance and use.

Findings from the literature review and refining of the comprehensive theoretical model

Based on a concept-centric approach (Webster and Watson, 2002), each construct of the revised TPB was decomposed with its relevant antecedents to develop the proposed model. With such an approach, the unidimensional pitfall that results from combining TPB's belief structure into unidimensional constructs can be avoided (Taylor and Todd, 1995a), and the use of a decomposition approach is therefore recommended in order to clarify the relationship between beliefs and behavior. Shimp and Kavas (1984) also suggest a decomposition of beliefs, arguing that the cognitive components of beliefs would not be organized into a single conceptual or cognitive unit. In addition, according to Taylor and Todd (1995a), decomposition can provide a stable set of beliefs that can be applied across a variety of settings, thus helping to overcome future operationalization problems. The analysis of the 95 papers resulted in the identification of a list of antecedents for each construct which were organized as described below.

ANTECEDENTS OF PERCEIVED EASE OF USE, PERCEIVED USEFULNESS AND ATTITUDE TOWARD USE: Perceived ease of use refers to the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). Attitude toward behavior refers to individual's positive or negative feelings about performing the target behavior (Fishbein and Ajzen, 1975).

We identified twenty-five antecedents found to have a significant influence on at least one of these three constructs (i.e., perceived ease of use, perceived usefulness, and attitude). Based on Wixom and Todd (2005), these antecedents can be grouped into three sets of attributes: beliefs about hardware attributes, beliefs about software attributes, and beliefs about information attributes. While the first two correspond to Wixom and Todd's system quality, the third one represents Wixom and Todd's information quality construct. In order to classify each antecedent to one of these three categories, an electronic card sort approach was used by asking nine IS experts to perform the card sort exercise (4 IS professors and 5 IS Ph.D. students). A Word document with each construct's definition and the instructions to perform the card sort was prepared and each participant was asked to sort the twenty-five antecedents into one or more of the three beliefs categories. The result is shown in Table 2.

Beliefs about hardware attributes	Beliefs about software attributes	Beliefs about information attributes

[1] The classification sheet can be obtained upon request from the authors.

- **Compatibility** (Chau and Hu, 2002; Chau and Hu, 2001; Fu, Farn and Chao, 2005; Hardgrave, Davis and Riemenschneider, 2003; Hu, Clark and Ma, 2003), - **Implementation Gap** (Chau, 1996), - **Objective Usability** (Venkatesh and Davis, 1996), - **Performance** (Gorla, 2003), - **Perceived System Quality** (Lucas and Spitler, 2000; Lucas and Spitler, 1999), - **Perceived physical accessibility** (Karahanna and Straub, 1999), - **System Satisfaction** (Wixom and Todd, 2005), - **Social presence**[2] (Karahanna and Straub, 1999), - **Tool Functionality** (Dishaw and Strong, 1999), - **Task-technology Fit** (Dishaw and Strong, 1999), - **Triability** (Karahanna et al., 1999), - **Visibility** (Karahanna et al., 1999).	- **Compatibility** (Chau and Hu, 2002; Chau and Hu, 2001; Fu et al., 2005; Hardgrave et al., 2003; Hu et al., 2003), - **Complexity** (Hardgrave et al., 2003), - **Dimensionality** (Gorla, 2003), - **Implementation Gap** (Chau, 1996), - **Navigation** (Gorla, 2003), - **Objective Usability** (Venkatesh and Davis, 1996), - **Performance** (Gorla, 2003), - **Perceived visual Attractiveness** (Heijden, 2003), - **Perceived System Quality** (Lucas and Spitler, 2000; Lucas and Spitler, 1999), - **Query** (Gorla, 2003) - **Result demonstrability** (Karahanna et al., 1999; Venkatesh and Davis, 2000), - **System Satisfaction** (Wixom and Todd, 2005), - **System characteristics** (Hong, Thong, Wong and Tam, 2001), - **Sophisticated Analysis** (Gorla, 2003), - **Social presence**[3] (Karahanna and Straub, 1999), - **Tool Functionality** (Dishaw and Strong, 1999), - **Task-technology Fit** (Dishaw and Strong, 1999), - **Triability** (Karahanna et al., 1999), - **Visibility** (Karahanna et al., 1999). - **Visualization** (Gorla, 2003) , - **Web Security and Access Costs** (Shih, 2004)	- **Compatibility** (Chau and Hu, 2002; Chau and Hu, 2001; Fu et al., 2005; Hardgrave et al., 2003; Hu et al., 2003), - **Complexity** (Hardgrave et al., 2003), - **Dimensionality** (Gorla, 2003), - **Information Quality** (Rai, Lang and Welker, 2002), - **Information Satisfaction** (Wixom and Todd, 2005), - **Implementation Gap** (Chau, 1996), - **Navigation** (Gorla, 2003), - **Objective Usability** (Venkatesh and Davis, 1996), - **Perceived visual Attractiveness** (Heijden, 2003), - **Perceived System Quality** (Lucas and Spitler, 2000; Lucas and Spitler, 1999). - **Result demonstrability** (Karahanna et al., 1999; Venkatesh and Davis, 2000), - **System characteristics** (Hong et al., 2001), - **Summarization** (Gorla, 2003), - **Sophisticated Analysis** (Gorla, 2003), - **Social presence**[3] (Karahanna and Straub, 1999), - **Task-technology Fit** (Dishaw and Strong, 1999), - **Triability** (Karahanna et al., 1999), - **Visualization** (Gorla, 2003) , - **Visibility** (Karahanna et al., 1999). - **Web Security and Access Costs** (Shih, 2004)

Table 2. Classification of beliefs about technology attributes

This classification of beliefs about technology attributes can be useful in understanding user behaviors in different technological and organizational contexts. In fact, by theorizing about the IT artifact we cannot apply a generic set of beliefs that shapes user behavior. This is in accordance with Benbasat and Zmud (2003) who suggest bringing different aspects of the technologies to the forefront in order to better understand their interactions with individuals. Thus, for each different technology, the importance of the three sets of beliefs is likely to be different. For instance, if one was going to consider the acceptance and use of the iPod, Apple's MP3 player, it would be important to take into account hardware attributes, since beliefs about the iPod's compatibility, triability or visual attractiveness are likely to influence the acceptance and use of this technology. At the same time, in this case, beliefs about software or information attributes are likely to be less significant (e.g., beliefs about software attributes such as visualization or dimensionality would not be relevant). As another example, consider a study of the acceptance and use of a tactile screen by nurses in a hospital. While nurses' beliefs about hardware attributes such as the screen's compatibility, complexity, perceived physical accessibility, and its task-technology fit are likely to be relevant in this context, their beliefs about the attributes of the software driving the screen might be less salient. In contrast, beliefs about software attributes can be important in a different context for a different technology. For instance, the acceptance and use of iTunes, Apple's online music store, is likely to be influenced by beliefs about software attributes

[2] As social presence is defined as the capacity of a medium to transmit information about facial expression, direction of looking, posture, dress and non-verbal cues (Karahanna and Strub, 1999), it is not surprising that it was viewed as a hardware, software, as well as an information attribute.

such as system compatibility, navigation, visualization, web security and access costs, while beliefs about hardware attributes are likely to be mostly irrelevant. In the case of an ERP deployed in an organization, users' beliefs about software attributes such as its compatibility, performance, perceived system quality, or query are likely to be relevant, while their beliefs about hardware attributes are unlikely to matter (because most ERP users do not interact directly with the hardware components of the system such as the data warehouse or its servers).

Finally, beliefs about information attributes can be salient in certain contexts and for certain technologies, while not as relevant in others. For example, beliefs about information attributes are likely to be important in ERP contexts since the quality of the information provided by the system to the users is an important factor in their assessment of the system. Similarly, the acceptance and use of Summarizer, Copernic's text-summarizing editor, is also likely to be influenced by beliefs about information attributes such as beliefs about the quality of information the software provides, as well as its summarization and sophisticated analysis capabilities.

ANTECEDENTS OF SUBJECTIVE NORM: Subjective norms reflect the perceived opinions of referent others (Mathieson, 1991). A referent other is a person or group whose beliefs may be important to the individual. The review identified seven significant antecedents: Peer Influence (Karahanna et al., 1999; Taylor and Todd, 1995b), Superior Influence (Karahanna et al., 1999; Taylor and Todd, 1995b), MIS Department (Karahanna et al., 1999), Local Computer Specialists (Karahanna et al., 1999), Organizational Climate (Bock, Zmud, Kim and Lee, 2005), Normative Beliefs from Family and Friends (Karahanna et al., 1999; Song and Zahedi, 2005; Yu, Ha, Choi and Rho, 2005), and Sense of Self-Worth[3] (Bock et al., 2005). Local Computer Specialists and MIS Department, as conceptualized by Karahanna et al. (1999), are very similar. In fact, these items encompass the influence of local computer specialists on technology users. Due to this similarity, we decided to replace them by a unique construct that was labeled Local Computer Specialists' Influence. Thus, the final set of antecedents for Subjective Norms included six constructs: Peer Influence, Superior Influence, Local Computer Specialists Influence, Organizational Climate, Family and Friends Influence and Sense of Self-Worth.

ANTECEDENTS OF PERCEIVED BEHAVIORAL CONTROL: Perceived behavioral control refers to the individual's perceptions of the presence or absence of requisite resources and opportunities necessary to perform the behavior (Ajzen and Madden, 1986). Three significant antecedents of perceived behavioral control were identified in the review: Self-Efficacy[4] (Hsu and Chiu, 2004; Song and Zahedi, 2005; Taylor and Todd, 1995b), Resource Facilitating Conditions (Song and Zahedi, 2005; Taylor and Todd, 1995b) and Punishment Certainty (Peace, Galletta and Thong, 2003). All three antecedents were included in the proposed model. The final model including all identified antecedents is shown in Figure 2.

DISCUSSION

Theoretical contributions and implications

The current paper adds to our understanding of factors affecting IT acceptance and use. While research on this topic has investigated different theoretical models, few researchers have focused on the IT artifact-related determinants of IT acceptance and use. The proposed model is also integrative in that it incorporates TAM's two main constructs, perceived usefulness and perceived ease of use. As one of the first syntheses of IT artifact-related antecedents of TPB's key constructs, the present paper provides an original contribution. Each link of the proposed model implies a refutable proposition. For instance, the model hypothesizes that perceived visual attractiveness, as a software attribute belief will have a positive influence on both perceived ease of use, and perceived usefulness. Further, perceived visual attractiveness is also hypothesized to have an influence on attitude toward use. Moreover, the model suggests that certain beliefs about technology attributes will not always influence perceived ease of use, perceived usefulness, and attitude toward use at the same time. For instance, information quality as an information attribute belief can be hypothesized to positively influence attitude toward use and perceived usefulness but not perceived ease of use. The planned empirical study of the research model intends to examine these and related propositions that will be formulated. Further, as suggested by Benbasat and Weber (1996), IS researchers need to build their own theories to account for those phenomena that differentiate the IS discipline from others. By focusing on IT artifact-related antecedents, the proposed research model can also help in the development of a TPB based IS-specific theory.

[3] As the classification in two groups of beliefs (beliefs about technology attributes and general beliefs) is applied only to antecedents of perceived ease of use, perceived usefulness and attitude toward use, sense of self worth and self-efficacy were excluded from consideration.

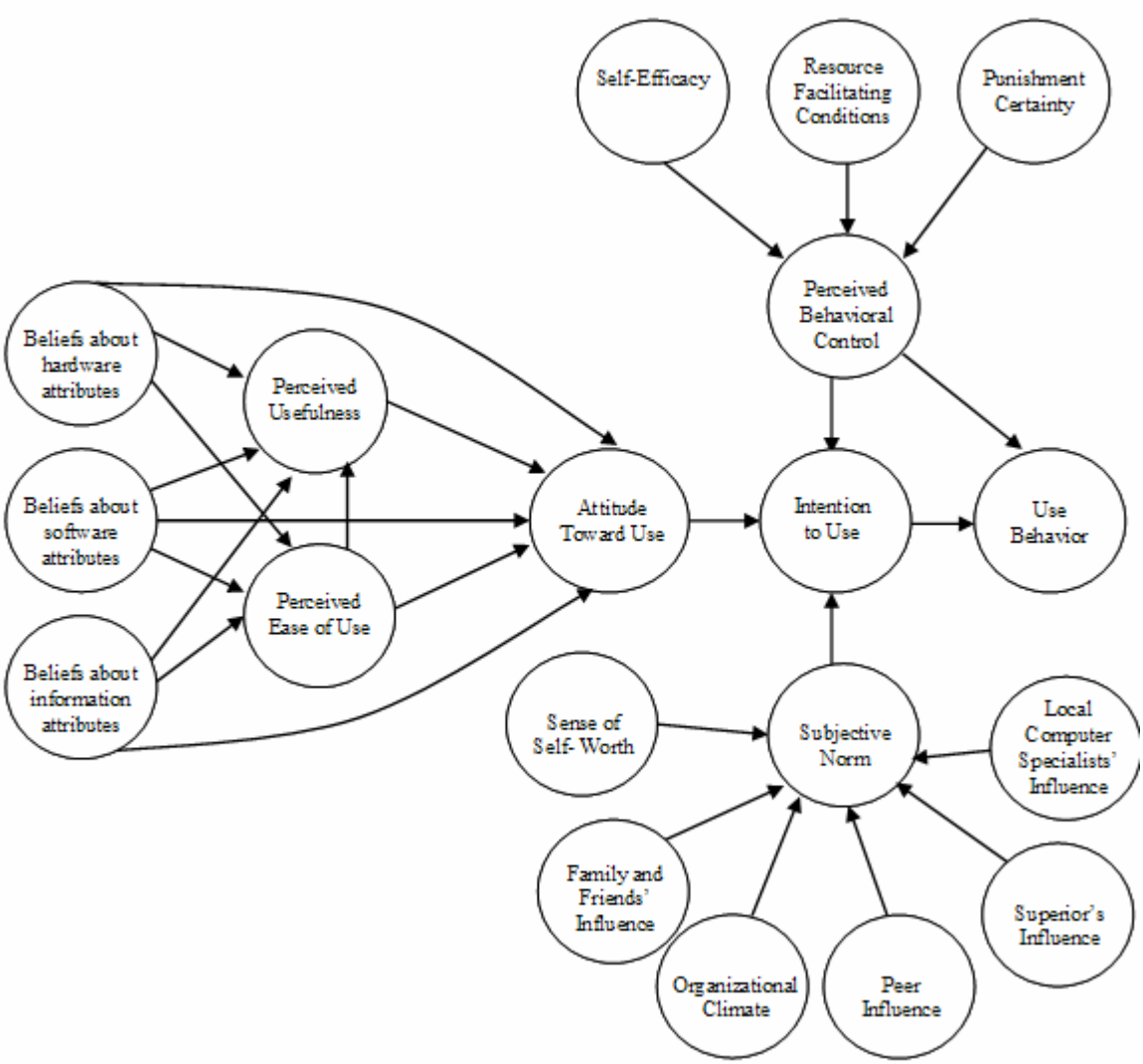

Figure 2. Final decomposed model of IT acceptance and use

Implications and future research

The proposed model may be too large to be investigated in a single study. However, testing it partially is possible and should yield interesting results (for example, attitude towards use and its antecedents can be examined separately). One potential direction for future research is the investigation of the proposed model's applicability in different organizational and technological contexts. This could provide a better understanding of how different belief sets and specific IT attributes (hardware, software, and information) influence IT use and acceptance behavior. A different study might compare two TPB-based models, one including beliefs about technology attributes and the other including general beliefs, in order to assess the relative importance of each set. Finally, conducting a meta-analytic study to assess the relationship between attitude and intention could generate interesting outcomes, as it would not only help to clarify the mixed results obtained in past research, but would also help to better understand the nature of this relationship and the effects of potential moderating factors.

As stated by Davis (1989), one goal of developing IT acceptance and use models is to build diagnostic tools to predict information systems acceptance and facilitate design changes before users have experience with a system. By helping in the identification of salient hardware, software, and information attributes that influence IT acceptance and use, researching the model proposed here is also relevant to system designers. While a large amount of time during system design and development is typically spent on the user interface (Venkatesh, 2000), the present paper suggests that some other technology attributes and functionalities also need to be considered to enhance IT acceptance and use.

The present paper can also be helpful for project managers. In fact, several antecedents identified in this research can help project managers to recognize a number of important aspects they need to consider so as to attain technology acceptance and use. For instance, project managers can use the influence of superiors and local computer specialists to convince users. Furthermore, the hardware, software and information attributes identified thanks to the proposed model can be used by project managers to ensure greater acceptance and use of IT.

CONCLUSION

This paper represents a first attempt to integrate within a well-established theoretical model the characteristics of IT artifacts that past research has examined within an IT acceptance and use context. An extensive literature review was conducted in an effort to develop a theoretical model of IT acceptance and use that also incorporated theorizing about the IT artifact. The relatively large number of papers that addressed the IT acceptance and use issue rendered the identification of all IT artifact attributes that have been studied somewhat difficult. Hence, even though a structured approach was applied, some relevant research may have been excluded. Nonetheless, the proposed theoretical model is thought to provide a comprehensive view and synthesis of the past fifteen years' empirical research on IT acceptance and use from an IT artifact perspective.

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