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Developing and validating a technology upgrade model

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ABSTRACT

While prior research has recognized users' upgrading behavior as a key to successful tech-innovation adoption, few studies have investigated the determinants of the behavioral intention to upgrade. The current paper bridges this gap through an exploration of upgrade intentions that incorporates the status quo bias (SQB) theory with Warshaw's purchase intention model (PIM). Data collected from 213 system users was analyzed using partial least squares (PLS). The results show that perceived need (positively) and inertia (negatively) influenced users' behavioral intentions to upgrade to a new generation system. The indirect effects of inertia mediated the impact of incumbent system habit, procedural switching costs, and benefit loss costs on the behavioral intention to upgrade. In addition, perceived need mediated the impacts of procedural switching costs, benefit loss costs, and social norms on the behavioral intention to upgrade. Finally, inertia significantly weakened the positive relationship between perceived need and behavioral intention to upgrade. Based on these findings, this study proposed a theoretical framework of a technology upgrade model (TUM) and provided valuable information to both academics and practitioners that is highly pertinent to understanding IT upgrading behaviors.

1. Introduction

Information systems (IS) research has long focused on user acceptance of information technology (IT) innovations and decisions about continued use. Recently, IS researchers have studied users' replacement behavior (e.g., Bhattacherjee, Limayem, & Cheung, 2012; Chang & Chen, 2007; Claybaugh, Ramamurthy, & Haseman, 2015; Fan & Suh, 2014; Fang & Tang, 2017; Huh & Kim, 2008; Lai & Wang, 2015; Liu, Li, Xu, Kostakos, & Heikkilä, 2016; Peng, Zhao, & Zhu, 2016; Tseng & Lo, 2011; Wu, Vassileva, & Zhao, 2017; Zhou, 2016). Users' replacement behavior is believed to have an important influence on the profitability and viability of IT vendors in today' marketplace (Peng et al., 2016). Understanding replacement behavior is increasingly important because as IT innovations continue to evolve and improve, consumers tend to replace old technologies with newer generations (Danaher, Hardie, & Putsis Jr., 2001). Replacement of current IT products/services with substitutes that serve similar needs can occur either *horizontally* or *vertically* (Bhattacherjee et al., 2012). Horizontal *switches* occur when users change to a similar product/service from a different vendor: common examples include operating systems (e.g., from Microsoft Windows to Linux), mobile platforms (e.g., from Apple iOS to Google Android), web browsers (e.g., from Mozilla Firefox to Google Chrome), and virus scanners (e.g., from Kaspersky to Norton). In contrast, vertical replacement refers to *upgrades* (or vertical switches) from an older version to a newer version of the same IT supplier's product/service, such as from Windows 7 or 8 to Windows 10, or from Apple's iOS 7 or 8 to iOS 9. In fact, there is a major difference between system upgrades and updates. An update modifies the current system while an upgrade totally replaces it. Specifically, updates are usually free and typically very small. Updates are patches of code that are released to address specific issues or to activate additional functionality. On the other hand, an upgrade replaces the existing system with a newer and often superior version. Therefore, an upgrade is usually much larger and not free.

While there is a long tradition of IS-related theories/models that focus on understanding user decision making and IT adoption behavior, little is known about users' system upgrading behaviors (Bhat, Burkhard, O'Donnell, & Wardlow, 1998). A comprehensive understanding of users' upgrade decisions is essential for researchers and practitioners to support innovative technological approaches (Bhat et al., 1998; Claybaugh et al., 2015; Huh & Kim, 2008; Kim & Srinivasan, 2009). Specifically, previous researchers have mainly focused on understanding users' adoption behaviors with respect to either first-time use or repeat use of existing (non-upgraded) systems or applications. However, a system upgrade behavior is clearly neither a first-time use nor a repeat use behavior. Because users are already familiar with their needs and the benefits of the current system, first-time use and repeat use characteristics are not present in the upgrade

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decision (Bhat et al., 1998). Thus, factors affecting the first-time use and/or repeat use may be different from those affecting the system upgrade decision. Usually, upgrades help solve glitches present in the older version. New versions of systems and applications are released on a regular basis to eliminate bugs, remove security loopholes and unpopular abilities, and incorporate improvements and user-friendly features; all of these can assist performance by enhancing software and hardware compatibility (Dude, 2013; King, 2015). The advantages of upgrading systems and applications for users include improving security and features, keeping the product working, and receiving vendor support. To some extent, there is greater risk to the users if systems and applications are not upgraded (King, 2015). Furthermore, the product support lifecycle suggests that when upgrades are not performed regularly, they take longer and are painful when they finally are performed (King, 2015). Even though continuous improvement and innovation are necessary, many users are often unwilling to upgrade existing systems or applications to newer versions because of concerns about security, privacy, compatibility, performance, driver support, product activation and configuration changes. One notable example of users unwilling to upgrade occurred when many users did not like Microsoft's removal of the "start button" in Windows 8.

Unlike common first-time use and repeat-use decisions, the decision to upgrade a system hinges on whether the user's needs are better satisfied with the current version of the system or with an upgraded version. Thus, system upgrade decision-making and upgrade behaviors are substantively different from both first-time use and repeat-use procedures. Given the importance and uniqueness of system upgrade behaviors, the relative paucity of information on this subject points to the need for further investigation. Further, the novelty of upgrading behavior in the IS literature has led to a situation where we lack a widely accepted model pertaining to IT upgrading behavior. Most of the existing models are variants of theories taken from the social psychology literature; they focus primarily on the role of *conscious* intentions and their antecedents in making predictions about future users' technology adoption behavior (Polites & Karahanna, 2012). For instance, previous relevant research has employed different behavioral theories to examine the constructs (i.e., perceived usefulness, perceived ease of use and satisfaction) of the technology acceptance model (TAM; Davis, 1989; Davis et al., 1989) and the expectation confirmation model (ECM; Bhattacherjee, 2001); however, these attempts have failed to explain the significance of users' replacement behavior, especially with respect to upgrading behavior (Tseng & Lo, 2011). Thus, this study attempted to propose a theoretical framework of a technology upgrade model (TUM) to bridge the theoretical gap.

For a new generation system, even when users have positive attitudes toward it or realize the potential benefits of using it, they may not intend to upgrade. Even when they have this intention, actual adoption still may be dominated by other *subconscious* or automatic predictors of behavior, such as a strong incumbent system habit (Thompson, Higgins, & Howell, 1994). Incumbent system habit will likely have reduced the extent to which positive attitudes impact on intentions themselves, as well as on actual upgrading behavior (Aladwani, 2001; Lai & Wang, 2015; Polites & Karahanna, 2012). The influence of the affective component decreases as the user's experience increases, and it thereby potentially serves as an inhibitor to any newly introduced technology adoption (Triandis, 1971). Rogers & Shoemaker (1971) described such phenomena as "innovative dissonance", which refers to "situations where use (or nonuse) of an innovation is inconsistent with the individual's attitude towards the innovation" (Thompson et al., 1994, p.173). In that case, experienced old system users will create a situation of innovation dissonance, resulting in a weaker link between affect and actual behavior. In addition to innovation dissonance, the impact of the subconscious has been associated with the theoretical concepts of *status quo inertia* or *behavioral lock-in* (Barnes, Gartland, & Stack, 2004; Polites & Karahanna, 2012), and *resistance to change* (Aladwani, 2001; Hellriegel & Slocum, 2003). In sum, despite the importance of understanding and exploring user upgrade decisions, relevant research remains scant and ambiguous. As such, additional examinations of users' decision-making processes and intentions to upgrade are required.

In light of the apparent enabling and inhibiting effects involved in upgrading behaviors, the main purpose of the current research is to develop and test a new theoretical model that can explain users' upgrading behaviors. One potentially very important influence on upgrade decisions—*status quo bias*—has received very little empirical research attention. More specifically, users' incumbent system habits, inertia, and switching costs may negatively affect their perceptions of a newly introduced system, and thus potentially inhibit upgrading behavior (Kim & Perera, 2008; Polites & Karahanna,2012). In addition to these suggested influences, some previous researchers have identified user perceptions of the new generation's affordability, value, and demand as important motivational influences on user upgrade intentions (Tseng & Lo, 2011). Current research accomplishes this by incorporating elements from status quo bias (SQB) theory (Samuelson & Zeckhauser, 1988) and the purchase intention model (PIM; Warshaw, 1980) perspectives in explaining how conscious and subconscious predictors of behavior toward an incumbent system can act as motivators or inhibitors of new generation system upgrades. This proposed research model explains how motivational factors (i.e., perceived need) and non-motivational factors (i.e., purchasability) influence intentions to upgrade. In addition, this study determines whether other factors (i.e., procedural switching costs, benefit loss costs, and social norms) serve as antecedents to the motivational factors. The model also includes the moderating effects of status quo bias (i.e., inertia) on the relationships between motivational factors and behavioral intention to upgrade, as well as non-motivational factors and behavioral intention to upgrade. For researchers, the findings should be useful for the further development and verification of theories related to users' upgrading behaviors. By developing a better theoretical understanding of the role of conscious (e.g., upgrading costs), subconscious (e.g., incumbent system habit), and inertial consequences, this study extends the existing literature by clearly acknowledging the role of the incumbent system in the decision to upgrade to a new generation system. For practitioners, these findings suggest useful methods to promote user newer generation system upgrades based on users' system requirements, social influence, upgrading costs, incumbent system habits, and inertia.

The remainder of this study is organized as follows. The next section reviews the relevant literature. Following this, the research model and hypotheses are introduced, followed by descriptions of the construct measures and data collection methods used. Then the results are presented. The paper concludes with a discussion of the theoretical and practical implications of the findings in relation to users' system upgrading behaviors.

2. Theoretical foundations

When users encounter a new alternative product/service, they face both visible and invisible costs and benefits, which determine which conversion behavior they choose to follow. Some information systems (IS) researchers (e.g., Bhattacherjee et al., 2012; Fan & Suh, 2014; Tseng & Lo, 2011) have examined users' upgrading/switching behaviors in IT settings. These researchers generally used one of several theoretical perspectives, including the theory of reasoned action (TRA), the technology acceptance model (TAM), and the expectation confirmation model (ECM). In contrast to prior studies, the authors of the current study assert the presence of a theoretical connection between the purchase intention model (PIM) and the status quo bias (SQB) theory, which can predict users' upgrading intentions. The relative limitations of TRA, TAM, and ECM, and the advantages of PIM and SQB are discussed next.

TRA (Fishbein & Ajzen, 1975) is a well-researched model of