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# Developing and validating a technology upgrade model

Yu-Yin Wang[a], Yi-Shun Wang[a,*], Tung-Ching Lin[b]

[a] Department of Information Management, National Changhua University of Education, Taiwan
[b] Department of Information Management, National Sun Yat-sen University, Taiwan

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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

* Corresponding author.
*E-mail address:* yswang@cc.ncue.edu.tw (Y.-S. Wang).

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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 consumer intentions with individual motivational factors as determinants of the likelihood of performing a specific behavior. The model posits that the most proximal volitional behavior is a person's intentions, which are thought to be the result of both *individual influence* and *normative influence*. Individual influence refers to a person's *attitudes* toward performing a behavior. Normative influence is a person's *subjective norms* (Ajzen & Fishbein, 1980). However, this model gives less weight to an important non-motivational dimension of intentions: product purchase situations. Prior research has suggested that in marketing applications product purchase situations can be a key determinant of whether users will upgrade to a new generation system (Tseng & Lo, 2011). Warshaw (1980) also suggested that product purchase situations should be considered when pinpointing intentions. Therefore, the authors of this current study argue that including "purchasability" as a factor in predicting users' upgrading intentions is necessary and important. Incorporating product purchase situations (i.e., purchasability) and the key variables from TRA (i.e., social norms, perceived need as attitudes), Warshaw (1980) proposed the PIM as a useful starting point to better understand the factors that drive consumers' intentions to upgrade.

With TRA as a theoretical basis, TAM (Davis, 1989) posits that two primary beliefs predict an individual's behavioral intentions: *perceived usefulness* and *perceived ease of use*. Perceived usefulness refers to the users' perception that using a new system will enhance or improve their performance. Perceived ease of use is the extent to which a person believes that using a new system is free of effort (Davis, 1989; Davis et al., 1989). TAM has been applied to various situations in IS-related research. However, Tseng & Lo's (2011) empirical results indicate that TAM fails to explain users' behavioral intentions to upgrade in sequence. In their study, perceived usefulness and perceived ease of use did not directly influence participants' intention to upgrade. Their findings suggest that users' attitudes toward upgrading are more likely linked to perceived value of the product/service than to its usefulness or ease of use. As such, the current authors suggest that the construct "perceived need" from PIM can bridge this gap because users' perceived values are clearly reflected in meeting their needs. Moreover, according to SQB theory, users are likely to evaluate the overall value of upgrading to a new product/service by comparing the benefits and costs (Kahneman & Tversky, 1979; Samuelson & Zeckhauser,1988). As a result, the current authors argue that combining PIM and SQB theory creates an accurate framework for understanding users' behavioral intentions to upgrade.

Lastly, ECM (Bhattacherjee, 2001) seeks to explain users' post-adoption behavior. It posits that *satisfaction* with an existing system is the most important requirement determining a user's continuous usage intentions (Bhattacherjee, 2001; Liao, Palvia, & Chen, 2009; Thong, Hong, & Tam, 2006). Satisfied users tend to continue using their current system and are unlikely to switch, even if the alternative is better (Bhattacherjee et al., 2012). Accordingly, in the post-adoption stage, user satisfaction with the current system is one of the most significant predictors of behavioral intentions (Oliver, 1980), plans to continue using the system in the future (Bhattacherjee, 2001), satisfaction with the manufacturer, and the decision to upgrade (Bolton, Lemon, & Verhoef, 2008). However, past research results have not supported ECM: User satisfaction does not explain the change in behavior from using a previous generation system to intending to adopt a new generation system, and it does not directly influence both users' perceived value and intentions to upgrade (Tseng & Lo, 2011). Because of the inexactitudes in TRA, TAM, and ECM in the upgrade context, the current authors chose to adopt PIM and SQB as the basis for the theoretical framework in this research.

### 2.1. Purchase intention model

PIM assumes that an individual's behavioral intentions are determined by both *motivational elements* and *non-motivational elements*. Motivational elements are a person's *perceived need,* which in turn is driven by *perceived pressure* and *own desire*. Perceived pressure is defined as a person's perceptions of the social connotations or social imagery the object possesses. Own desire signifies a person's perception of the object's capability of satisfying a set of relevant needs, wants, and desires (Warshaw, 1980). Users often evaluate their experience of a system based on their perceptions of the system that they currently use (Zeithaml, 1988; Caruana, Money, & Berthon, 2000), which may directly influence their upgrading decisions. Moreover, based on motivational factors, the current study also includes three antecedents (i.e., procedural switching costs, benefit loss costs, and social norms) to predict perceptions of need. According to SQB theory, users are likely to evaluate the overall value of upgrading to a new system based on their comparisons of benefits and costs (Kahneman & Tversky, 1979; Samuelson & Zeckhauser,1988). As losses increase, users become increasingly reluctant to upgrade because they are loss averse (Kahneman & Tversky, 1979). Previous research has proposed that procedural switching costs and benefit loss costs are causes of user resistance and demand reduction (Kim & Kankanhalli, 2009; Perera & Kim, 2007; Polites & Karahanna, 2012; Samuelson & Zeckhauser, 1988; Yanamandram & White,2010). Therefore, the authors incorporate these two costs as two antecedents in the current study. The third antecedent, social norms, is included because PIM suggests normative beliefs result in perceived social pressure as a reason for user needs (Warshaw, 1980).

The non-motivational element in PIM, *purchasability*, refers to *affordability* and *accessibility* in purchase situations related to a user's upgrading intentions. Affordability refers to the system's price (Jamieson & Bass, 1989), while accessibility refers to the system's availability. Greater purchasability is associated with an increased ability to carry out purchase intentions (Jamieson & Bass, 1989). The authors argue that the degree to which users intend to upgrade to a new generation system depends on differing perceptions of their ability to purchase it. As such, this study investigates whether these two elements of PIM create an effective framework for understanding user's upgrade intentions.

### 2.2. Status quo bias theory

SQB theory is used to collectively predict and explain users' upgrading intentions (Abdul-Gader & Kozar, 1995; Jeong, Yoo, & Heo, 2009; Warshaw, 1980) in addition to motivational (i.e., perceived need) and non-motivational factors (i.e., purchasability). SQB theory suggests that individuals often prefer to maintain their current behavior status or situation (Kim & Kankanhalli, 2009). The theory provides valuable theoretical explanations for understanding users' upgrading intentions.

Samuelson & Zeckhauser (1988) proposed that status quo bias falls into three main categories. The first category, *rational decision making*, implies that an assessment of relative switching costs incurred by users usually results in proactive, rational managers remaining with perceived unsatisfactory providers. From the viewpoint of rational decision making, *procedural switching costs* and *uncertainty costs* lead to status quo inertia (Perera & Kim, 2007; Samuelson & Zeckhauser,1988). Procedural switching costs are the costs incurred when adopting a new system. Uncertainty costs are psychological uncertainties and risk perceptions associated with switching to an unfamiliar alternative (Sharma, 2003; Sharma & Patterson, 2000).

The second category is *cognitive misperceptions*. Cognitive misperceptions of loss aversion are a psychological rule that has been examined from the perspective of users' decision-making processes. Loss aversion suggests that *benefit loss costs* lead to status quo bias (Kahneman & Tversky, 1979). Benefit loss costs are the potential loss of benefits when a user leaves a current system provider for another (Burnham, Frels, & Mahajan, 2003; Jones, Reynolds, Mothersbaugh, & Beatty, 2007). According to Kim & Kankanhalli (2009), when switching costs exceed switching benefits, the status quo

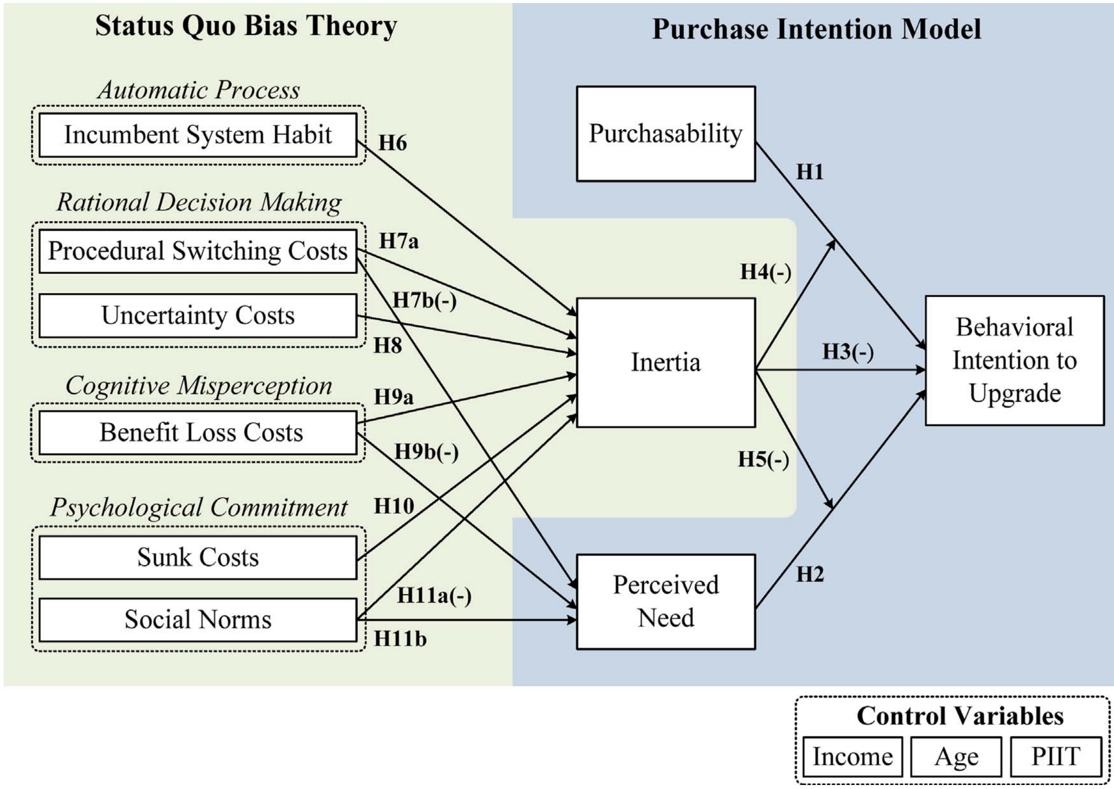


**Fig. 1.** Research model.

is favored. Cognitive misperception of loss aversion implies that people tend to evaluate potential losses as greater than potential gains when switching to alternatives from the status quo.

The third category is *psychological commitment,* which includes *sunk costs* (e.g., incumbent system investment), *social norms,* and efforts to feel in *control* (Samuelson & Zeckhauser, 1988). Sunk costs refer to users' past involvement or commitment, which causes unwillingness to upgrade or switch to a new system (Kim & Kankanhalli, 2009). Social norms and efforts to feel in control are similar to normative and control beliefs, respectively, which are described in the technology acceptance literature (Ajzen, 1991).

In addition to these three categories, based on the SQB theory, Polites & Karahanna (2012, p.28) suggested that "inertia is the mechanism by which incumbent system habit impacts behavioral beliefs and intention toward using a new system." From the *automatic process* viewpoint, *incumbent system habit* also leads to status quo inertia. Incumbent system habit refers to situations where users are accustomed to using their current collaboration systems (Polites & Karahanna, 2012).

Based on the above, this study includes a total of four categories and six specific influencing factors (i.e., procedural switching costs, uncertainty costs, benefit loss costs, sunk costs, social norms, and incumbent system habit) to explain users' behavioral intentions to upgrade.

## 3. Hypotheses development and research model

The research model is cross-sectional, which means it measures perceptions and intentions at a single point in time. Since the current research adopted PIM and SQB conceptual constructs, a snapshot research approach is highly suitable for this pioneering study. Fig. 1 illustrates the research model. It provides a comprehensive explanation of how users' motivational (i.e., perceived need) and non-motivational factors (i.e., purchasability), automatic processes (i.e., incumbent system habit), rational decision making (i.e., procedural switching costs and uncertainty costs), cognitive misperceptions (i.e., benefit loss costs), and psychological commitment (i.e., sunk costs and social norms) drive users' behavioral intentions to upgrade to a new generation system. Furthermore, based on PIM, the determinants of behavioral intention are purchasability and perceived need. Moreover, SQB's constructs are combined with PIM, which directly and indirectly influence behavioral intentions. In addition, the research model further explores the moderating relationships between inertia and PIM. The theories described below help to further develop the hypotheses shown in Fig. 1.

### 3.1. Purchasability

When users intend to adopt a system, they usually conduct a *cost-benefit evaluation* before making a decision. Kim, Chan, & Gupta (2007) argued that a cost-benefit evaluation refers to the tradeoff between total sacrifice and total benefits received. If users perceive that the monetary cost of a product/service is high, then their desire to purchase will be reduced or they will postpone their purchase until the cost becomes acceptable. In the IT context, Danaher et al. (2001) argued that the diffusion of a subsequent generation is affected by the price/costs of the current and earlier generations. Aoyama & Izushi (2003) presented information showing that the relative price competitiveness of available services undoubtedly influences users' choices.

Many studies have observed that perceived fees are an essential element that affects users' behavioral intentions (Alalwan, Dwivedi, & Rana, 2017; Davies, 1979; Hung, Ku, & Chang, 2003; Luarn & Lin, 2005; Mathieson, Peacock, & Chin, 2001; Wang & Tsai, 2002;Wu & Wang, 2005; Wang, Yeh, & Liao, 2013). Jeong et al. (2009) noted that purchasability often explains users' behavioral intentions (e.g., purchase intentions). Cheraghi, Dadashzadeh, & Subramanian (2004) also found that the increased cost of a product/service is likely one of the most critically important factors that leads users to switch between different alternatives. Similary, users' system upgrading intentions can be regarded as a type of new product/service adoption or

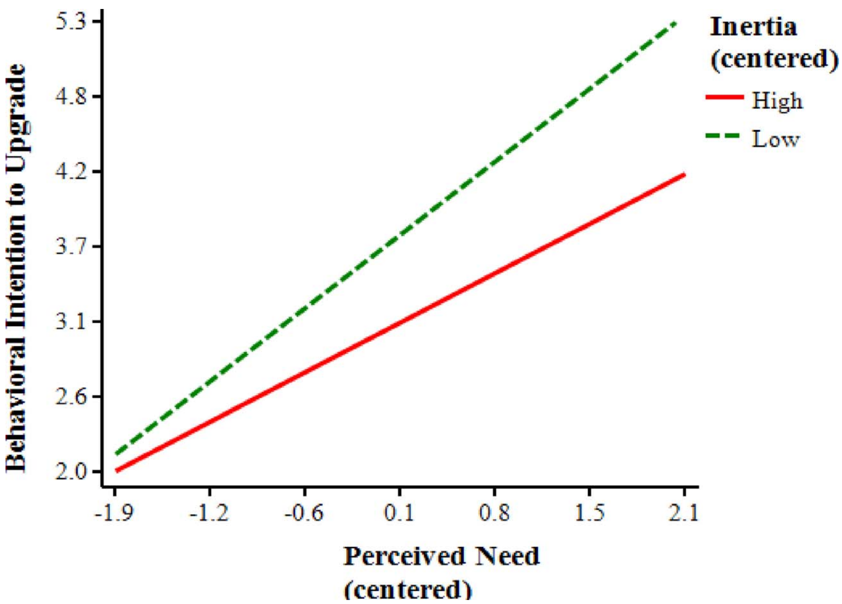


**Fig. 2.** The moderating effect of inertia on the link between perceived need and the behavioral intention to upgrade.

purchase behavior (Tseng & Lo, 2011). Based on the above, the authors infer that users expressing high levels of purchasability toward a new generation system tend to have a positive intention to upgrade, as noted in the following hypothesis:

**H1.** Purchasability has a positive relationship with behavioral intention to upgrade to a new generation system.

### 3.2. Perceived need

Perceived need comprises *perceived internal pressure* and *own desires* (Warshaw, 1980). In PIM, perceived internal pressure is an individual's perception of the social connotations or social imagery that the object possesses. To the extent that perceived pressure is contaminated by internalization and identification, perceived internal pressure and own desires are intercorrelated (Warshaw, 1980). Within the IS adoption literature, perceived internal pressure has been found to be an important factor in predicting users' technology use attitudes and subsequent behaviors (Currie & Gozman, 2014; Hiltz & Turoff,1985; Kaba & Touré, 2014; Venkatesh, Morris, Davis, & Davis, 2003; Wang, Meister & Gray, 2013). Bandyopadhyay & Fraccastoro (2007) examined perceived internal pressure on users' engagement in IT-based innovation behaviors. They found that social influence provides additional explanatory power concerning users' behavioral intentions to use a technology. For example, Anandarajan, Igbaria & Anakwe (2002) showed that perceived internal pressure is the dominant factor of information and communication technology (ICT) adoption and use. Moreover, Pelling & White's (2009) research found that users who feel more pressure from others to use social networking sites (SNS) are more likely to intend to engage in high-level SNS use. On the other hand, own desire is associated with an individual's perception of the object's capability of satisfying a set of relevant needs, wants, and desires (Warshaw, 1980). Sartre (1969) argued that desire increases from individuals' physical need through a growing attentiveness towards the existential choice between the desire to own and the desire to be. Several conceptualizations of need identification view the construct as being caused by an appreciable difference between an "actual need" and a "desire" with respect to a particular need or want (Engel, Blackwell, & Miniard, 1993). Warshaw (1980) also noted that a desire for an attractive product is made up of both need and longing elements.

Prior research (e.g., Leonard-Barton & Deschamps, 1988; Rogers, 1983) has indicated that perceived need is a key factor in the acceptance of IT innovation. Teng, Lu, & Yu (2009) argued that users' progress through the adoption decision stages begins with their recognition of need. In PIM, perceived need positively affects behavioral intentions. Similarly, Jeong et al. (2009) found that users' perceived need explains behavioral intentions (i.e., upgrading intentions). When users perceive themselves as having a high need for a product/service, they will become more anxious and eager to own/use it (Leonard-Barton & Deschamps, 1988; Rogers, 1983; Teng et al., 2009). In the case of system upgrades (or acquiring a newer versions), users who have a higher perceived need for a new generation system are assumed to be more likely to upgrade their existing system than users who have a lower perceived need. Thus, the authors state the following hypothesis:

**H2.** Perceived need has a positive relationship with behavioral intention to upgrade to a new generation system.

### 3.3. Inertia

Inertia refers to passively reusing/repurchasing the same products/services as part of a relatively unaware process (Huang & Yu, 1999). In the context of IS, inertia equates to persistence in using an incumbent system even if there are other options or reasons to change (Polites & Karahanna, 2012; Samuelson & Zeckhauser,1988). It implies that an individual tends to make similar decisions and is unwilling to abandon the status quo irrespective of available alternatives (Kim, 2009). Some studies (e.g., Colgate & Lang, 2001; Ye, 2005) have pointed out that inert users prefer the status quo and lack the required relative motivation to consider alternatives, meaning that inertia has a direct impact on behavioral intentions (Lucia-Palacios, Pérez-López, & Polo-Redondo, 2016; Polites & Karahanna, 2012). Based on the above, the authors infer that users with a higher level of inertia associated with an incumbent system are more likely to persist with the status quo and not consider upgrading to a new generation. The following hypothesis states this relationship:

**H3.** Inertia has a *negative* relationship with behavioral intention to upgrade to a new generation system.

Moreover, Bagozzi, Baumgartner, & Yi (1992) argued that individuals with a static orientation move through their decision-making process passively, which means these individuals habitually avoid change and, consequently, have high inertia. Inert users are likely to avoid making new decisions (Yanamandram & White, 2004), avoid learning new system routines and practices, avoid making price comparisons (Pitta, Franzak, & Fowler, 2006), and repeatedly and passively use the same system (Yanamandram & White, 2004). In the other words, inertia is due

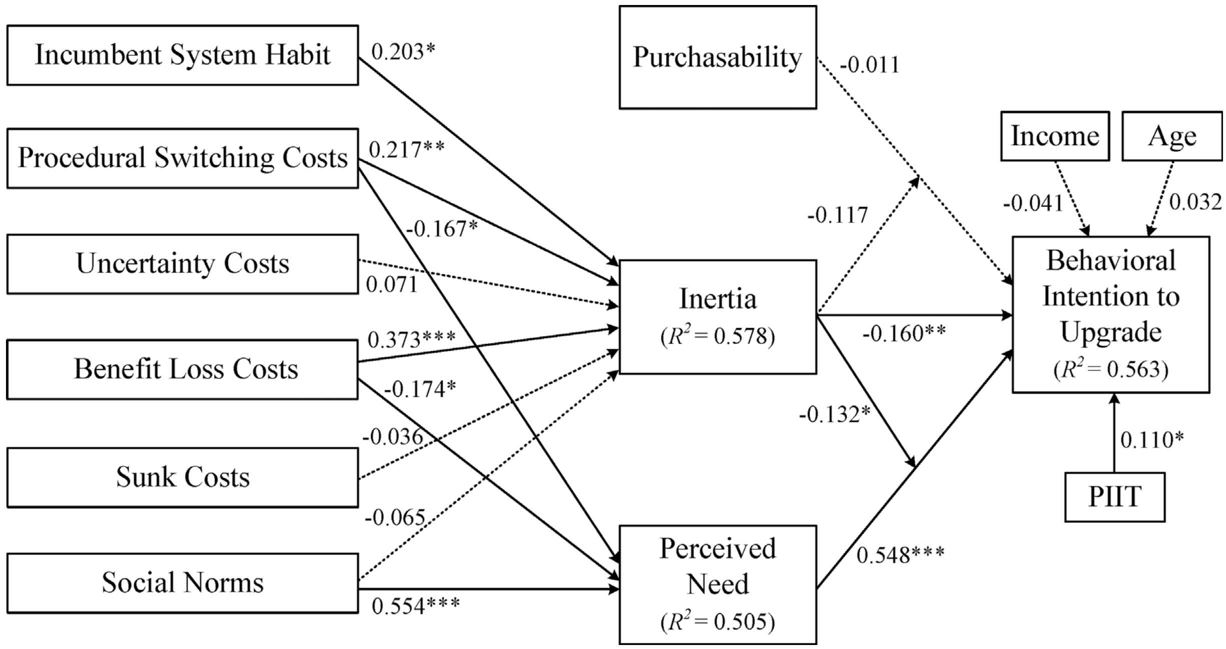


**Fig. 3.** Standardized path coefficients.
*Notes*: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$ (two-tailed test) — Significant path — Non-significant path.

to passive patronage without a real cognitive evaluation of the options and subsequent behaviors (Huang, Leu, & Farn, 2008; Nayebzadeh, Abdolvand, & Khajouei, 2013). In an e-commerce case study, Anderson & Srinivasan (2003) examined the moderating effects of inertia on customer satisfaction and loyalty. Their results showed that when customers had a higher level of inertia, the impact of satisfaction on loyalty decreased. Conversely, a lower level of inertia was associated with a greater impact of satisfaction on loyalty. Generalizing these results, inertia seems to have an impact on individuals' consideration of feasible replacements, and inert users do not consider choosing alternative service providers even when they are dissatisfied (Yanamandram & White, 2004). Lai, Liu & Lin (2011) also pointed out that the relationship between satisfaction and customer retention is moderated by inertia. The impact of satisfaction on customer retention decreased under conditions of high inertia. Because inert users' tolerance of poor service or system performance is relatively high (Wu, 2011), these users tend to continue to use their current systems if alternatives are not attractive enough (Lee, Ahn, & Kim, 2008). Prior research has pointed to three causes of user inertia: 1) low usage time because users avoid using the new system or comparing different system prices or services, 2) a preference to use the system they are already familiar with, and 3) the belief that there are minimal differences in terms of the feature sets of the current system and newer generation systems (Saqib, Mahmood, Khan, & Hashmi, 2015). Based on these causes, inert users lack the motivation to carefully consider alternatives, and to fully analyze and systematically evaluate a newer generation system (Polites & Karahanna, 2012). Therefore, the roles of purchasability (regarding the price comparison) and perceived need (regarding the similar functional requirements) are limited, and the effects of purchasability and perceived need on behavioral intention to upgrade are reduced. Thus, the authors expect that when users have higher levels of inertia, users prefer keeping the incumbent system even though they show high purchasability and have a high perceived need for the new generation system. When users' purchasability and perceived need are high, inertia has negative effects on users' willingness to upgrade their systems to newer generation versions, as stated in the following hypotheses:

**H4.** When inertia is higher, the positive relationship between purchasability and behavioral intention to upgrade to a new generation system is *weaker*.

**H5.** When inertia is higher, the positive relationship between perceived need and behavioral intention to upgrade to a new generation system is *weaker*.

### 3.4. *Incumbent system habit*

A habit is defined as a "type of behavior or action, although not reasoned action. It may nevertheless derive from an action that at one time was reasoned" (Kahle & Beatty, 1987, p.229). Murray & Häubl (2007) argued that habitual behavior involving a specific product/service becomes increasingly automated as a consequence of repeated experience with that product/service. For example, if a person reads a particular publisher's newspaper as part of his or her daily routine, then not reading the paper would make the daily routine feel incomplete. Woisetschläger, Lentz, & Evanschitzky (2011) pointed out that repeated use of a particular product/service can reduce the required effort associated with it becoming a familiar part of a daily routine. Past research has examined the role of habits in individual attitudes and behaviors (e.g., Aladwani, 2001; Bargh, 1989; Jasperson, Carter, & Zmud, 2005; Lai & Wang, 2015; Lending & Straub,1997; Limayem, Hirt, & Cheung, 2007; Ouellette & Wood, 1998; Triandis, 1971; Triandis, 1980; Ye and Potter, 2011). When using a new system, users most likely engage in active cognitive processing in determining prior use behavior (Bargh, 1989; Jasperson et al., 2005; Logan, 1989; Ouellette & Wood, 1998) and use habits (Triandis, 1980; Aladwani, 2001). In stable contexts, prior use history has a direct effect on future behavioral intentions (Conner & Armitage, 1998; Jasperson et al., 2005; Limayem et al., 2007; Ouellette & Wood, 1998). Incumbent system habit refers to users' familiar use of a current system (Polites & Karahanna, 2012). Users tend to automatically and unthinkingly continue using a familiar system for some time (Limayem et al., 2007). In the current research context, incumbent system habit leads users to become more committed to their current system.

Aladwani (2001) argued that incumbent system habits cause users to resist innovation. Based on SQB theory, Polites & Karahanna (2012, p.28) suggested that "inertia is the mechanism by which incumbent system habit impacts behavioral beliefs and intention toward using a new system." When users sustainably reuse an incumbent system, they become more likely to stick with the status quo, resulting in higher

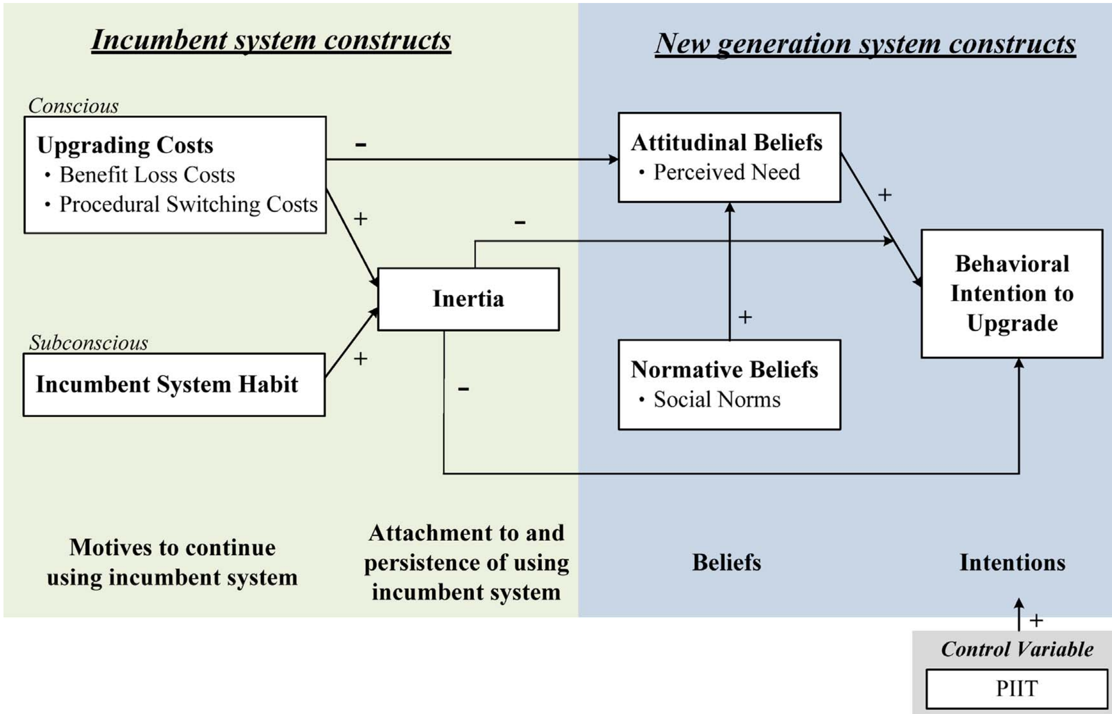


**Fig. 4.** Technology upgrade model (TUM).
*Note*: All paths represent significant effects.

inertia. Incumbent system habit enables users to automatically defer to the status quo and save related costs (e.g., time and effort) when taking usage actions (Lending & Straub, 1997; Samuelson & Zeckhauser,1988). Continued use of an incumbent system is determined by inertia, which is a manifestation of the status quo bias (Polites & Karahanna, 2012). This relationship is stated in the following hypothesis:

**H6.** Incumbent system habit has a positive relationship with inertia.

### 3.5. Procedural switching costs

Procedural switching costs involve "the time, effort, and hassle of finding and adapting to a new provider" (Jones et al., 2007, p.336). Burnham et al. (2003) noted that procedural switching costs primarily involve spending time and effort in association with *economic risk costs*, *evaluation costs*, *learning costs*, and *setup costs*. Economic risk costs imply that a new product/service provider with insufficient information leads to uncertain cost levels and possible negative outcomes for users (Guiltinan, 1989; Klemperer, 1995; Jackson, 1985; Samuelson & Zeckhauser, 1988). Evaluation costs refer to the time and effort associated with searching for, collecting, and analyzing the information needed to evaluate a potential alternative product/service provider and then making a decision to switch (Liu et al., 2016; Shugan, 1980; Samuelson & Zeckhauser, 1988). Learning costs are the time and effort needed to learn and adapt to a new alternative and use it effectively (Burnham et al., 2003; Jones, Mothersbaugh, & Beatty, 2002; Yanamandram & White, 2010). Finally, setup costs refer to the time and effort associated with establishing a relationship with the new alternative and setting up the new usage situation, such as installing and configuring required software (Guiltinan, 1989; Klemperer, 1995).

Procedural switching costs are sometimes contrasted with prospective costs, which are future costs that are incurred or charged only if an effective action is taken (Shapiro & Varian, 1998). Furthermore, procedural switching costs negatively affect users' switching behavior (Jones et al., 2007). In previous studies, Burnham et al. (2003) suggested that greater procedural switching costs are associated with higher user intentions to stay with an incumbent product/service provider, while Kim & Perera (2008) argued that procedural switching costs lead users to continue to use an existing product/service rather than switch to an alternative. For instance, switching Internet browser software requires time and effort to identify available alternative programs, download the software from the relevant website, install it, and then learn how to use it (Kim & Perera, 2008). For these reasons, many users continue to use the old browser software rather than upgrade. When these procedural switching costs are deemed to be high, status quo bias often comes into play (Perera & Kim, 2007; Samuelson & Zeckhauser, 1988; Yanamandram & White,2010). Moreover, prior research has identified the significantly positive relationship between procedural switching costs and inertia (e.g., Yanamandram & White, 2010). Taking into account these ideas, the following hypothesis is presented:

**H7a.** Procedural switching costs have a positive relationship with inertia.

One perspective of SQB theory is rational decision making based on assessing procedural switching costs. Common procedural switching costs include the time and effort required to upgrade to a new product/service provider. These costs make upgrading from the status quo much less likely. Past studies have shown that users justify continued use of their current product/service due to concerns about the costs required to switch to a new alternative (Perera & Kim, 2007; Polites & Karahanna, 2012; Samuelson & Zeckhauser, 1988; Yanamandram & White,2010). In other words, once procedural switching costs have set in, they result in lower ease of use, so users are likely persist using their current product and have a reduced perception of need. This implies that the more time and effort users have invested in their existing systems, the more likely their perceived need is inhibited because of perceived high procedural switching costs. Thus, the following hypothesis is proposed:

**H7b.** Procedural switching costs have a *negative* relationship with perceived need.

**Table 1**
Definition and reference citation for each construct.

| Construct | Definition | Reference |
|---|---|---|
| BITU | The degree to which a person has formulated conscious plans to upgrade from their current system to a new version. | Teng et al. (2009) |
| BLC | The potential loss of benefits that occurs when users upgrade to a new system from their current version. | Burnham et al. (2003); Jones et al. (2007); Yanamandram & White (2010) |
| ISH | Users who have been using a current system for some time are predisposed to continue using it in an automatic and unthinking manner. | Bhattacherjee et al. (2012); Limayem et al. (2007) |
| IN | Users' attitudinal propensity to maintain the status quo with respect to the current system out of passiveness or inaction. | Bawa (1990); Lee & Neale (2012); Polites & Karahanna (2012); Zeelenberg & Pieters (2004) |
| PA | A user's affordability and accessibility of a new system. | Warshaw (1980); Jeong et al. (2009); O'Reilly (1982) |
| PN | A user's desire and perception of pressure from others to upgrade to a new system. | Warshaw (1980); Teng et al. (2009); Jeong et al. (2009) |
| PSC | A type of switching cost associated with the time, effort, and hassle of finding and adapting to a new system. | Jones et al. (2007) |
| SC | User perceptions of the non-recoupable time and effort invested in establishing and maintaining their existing system. | Jones et al. (2002); Yanamandram & White (2010) |
| SN | Users believe that their important referents think they should perform the upgrade. | Hsu & Lin (2008) |
| UC | The psychological uncertainty or risk perception when a user upgrades their current system to a new version. | Inder & O'Brien (2003); Jones et al. (2002); Yanamandram & White (2010) |

*Notes*: BITU: behavioral intention to upgrade; BLC: benefit loss costs; ISH: incumbent system habit; IN: inertia; PA: purchasability; PN: perceived need; PSC: procedural switching costs; SC: sunk costs; SN: social norms; UC: uncertainty costs.

### *3.6. Uncertainty costs*

Uncertainty costs are the psychological uncertainty or risk perception associated with switching to an unfamiliar alternative (Sharma, 2003; Sharma & Patterson, 2000), which includes lack of information about a new product/service provider (Inder & O'Brien, 2003; Jones et al., 2002). Even with insufficient information about an alternative product's performance, users may still have certain expectations about it. The gap between these expectations and their own knowledge represents a potential risk or cost (Aladwani, 2001; Yanamandram & White, 2010). For example, users may perceive an increased likelihood of lower work performance if they upgrade or switch to a new system/software program (Jones et al., 2002). The degree of perceived risk or cost is highest when users cannot evaluate the new product's quality before switching (Aladwani, 2001; Sharma, Patterson, Cicic, & Dawes, 1997).

Furthermore, Yanamandram & White (2010) pointed out that uncertainty costs, which are a vital component of switching costs, often lead to inertia. In the IS field, uncertainty costs can lead to an unpleasant psychological reaction and a reluctance to switch to a new alternative (Kim & Kankanhalli, 2009). This unpleasant psychological reaction, in turn, makes users more unwilling to lose something they already have in hopes of making a gain, which leads to status quo inertia (Inder & O'Brien, 2003). Therefore, the authors hypothesize that uncertainty costs are positively affect users' inertia, stated as follows:

**H8.** Uncertainty costs have a positive relationship with inertia.

### *3.7. Benefit loss costs*

Benefit loss costs (i.e., lost performance costs) refer to the potential loss of some benefits (e.g., skills and familiarity with the current system) that occur when users leave their current systems for alternatives (Burnham et al., 2003; Jones et al., 2007). When users upgrade to a new generation system/software program, they may lose the benefits that they currently enjoy with current ones, which might lead to lower task performance (e.g., efficiency, quality, and compatibility; Perera & Kim, 2007). Yanamandram & White (2010) found that benefit loss is a significant switching cost. The benefit loss costs associated with contractual linkages create an economic argument for staying with the incumbent product/service provider (Guiltinan, 1989). Similarly, benefit loss costs contribute to status quo bias due to loss aversion (Perera & Kim, 2007; Samuelson & Zeckhauser,1988). Specifically, users are more averse to potential losses associated with switching than attracted to possible gains (Inder & O'Brien, 2003; Kahneman & Tversky,1979). Burnham et al. (2003) pointed out that benefit loss costs are significantly associated with higher user intentions to stay with an existing product/service provider. Perera & Kim (2007) argued that users keep using an existing system and resist change due to loss aversion. Thus, benefit loss costs may positively affect inertia (Perera & Kim, 2007; Yanamandram & White,2010). The authors, therefore, propose the following hypothesis:

**H9a.** Benefit loss costs have a positive relationship with inertia.

Based on the SQB perspective, in the absence of rational reasons for maintaining the status quo, bias may be the result of cognitive misperceptions of loss aversion whereby the losses of switching from the current product/service appear larger than the gains (Kim & Kankanhalli, 2009). This may result in lowered perceptions of relative advantage of upgrading to a new alternative (Polites & Karahanna, 2012). Thus, the authors expect that if users do not want to give up their current incumbent system, they view alternatives negatively to avoid potential losses, and they may reduce their perceived need for a new product and thus maintain the status quo. In this regard, benefit loss costs may be an inhibitor for users' perceptions of need. The following hypothesis states this predicted relationship:

**H9b.** Benefit loss costs have a *negative* relationship with perceived need.

### *3.8. Sunk costs*

Sunk costs refer to users' perceptions of the non-recoupable time, money, and effort invested in initially establishing and maintaining an existing exchange relationship (Jones et al., 2002; Yanamandram & White, 2010). While the existing exchange relationship based on previous investments is economically irrelevant, it is psychologically highly relevant (Dick & Lord, 1998; Guiltinan, 1989), which is a crucial part of the switching costs associated with terminating an existing exchange relationship (Kim, Kliger, & Vale, 2003; Whitten & Wakefield, 2006). For example, if employees have already invested a great deal time and effort learning about an incumbent system as part of their job, all their efforts are lost if the company decides to switch to another system.

Based on the same logic, sunk costs contribute to status quo bias in

**Table 2**
Respondent characteristics ($n = 213$).

| Characteristic | Items | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 109 | 51.2 |
| | Female | 104 | 48.8 |
| Age | 20 or below | 19 | 8.9 |
| | 21–25 | 93 | 43.7 |
| | 26–30 | 65 | 30.5 |
| | 31–35 | 26 | 12.2 |
| | 36–40 | 5 | 2.3 |
| | 41–45 | 2 | 0.9 |
| | 46–50 | 2 | 0.9 |
| | 51 or above | 1 | 0.5 |
| Educational background | High school | 9 | 4.2 |
| | Junior college | 2 | 0.9 |
| | Bachelor's degree | 131 | 61.5 |
| | Master's degree | 69 | 32.4 |
| | Doctorate degree | 2 | 0.9 |
| Income (NT) | 20,000 or below | 90 | 42.3 |
| | 20,001–40,000 | 80 | 37.6 |
| | 40,001–60,000 | 38 | 17.8 |
| | 60,001–80,000 | 4 | 1.9 |
| | 80,001–100,0-00 | 1 | 0.5 |
| Industry | Manufacturing | 19 | 8.9 |
| | Service | 37 | 17.4 |
| | Science and technology | 29 | 13.6 |
| | Student | 78 | 36.6 |
| | Government agencies | 12 | 5.6 |
| | Education and research | 19 | 9.0 |
| | Medicine | 3 | 1.4 |
| | Self-employed professional | 11 | 5.2 |
| | Others | 5 | 2.3 |
| Existing OS version | Windows XP | 65 | 30.5 |
| | Windows Vista | 10 | 4.7 |
| | Windows 7 | 135 | 63.4 |
| | Other | 3 | 1.4 |
| Use time of existing OS | Less than 1 year | 42 | 19.7 |
| | 1–2 years | 60 | 28.2 |
| | 2–3 years | 48 | 22.5 |
| | Over 3 years | 63 | 29.6 |
| Upgrade experiences over the past three years | Zero | 61 | 28.6 |
| | 1 time | 118 | 55.4 |
| | 2 times | 23 | 10.8 |
| | 3 times or more | 11 | 5.2 |
| Considered new OS | Windows Vista | 14 | 6.6 |
| | Windows 7 | 69 | 32.4 |
| | Windows 8 | 127 | 59.7 |
| | Other | 3 | 1.3 |

*Note*: OS: operating system.

decision making and subsequent behaviors (Perera & Kim, 2007; Samuelson & Zeckhauser,1988). Kim & Kankanhalli (2009) noted that sunk costs (e.g., previous investments or commitments) often lead to an unwillingness to switch to a new product/service provider. So, when the status quo has required high sunk costs, existing relationships tend to be retained, as noted in the following hypothesis:

**H10.** Sunk costs have a positive relationship with inertia.

### 3.9. Social norms

Social norms in SQB theory reflect an individual's belief about whether surrounding referents think he or she should perform a particular action. The normative influence of social norms implies that a person's decision making is under the influence of external social pressure. That is, social norms are determined by individuals' normative beliefs about important referents associated with (not) performing the behavior, weighed by their motivation to please those referents. As such, if an individual believes that important referents think a particular behavior should be performed, that individual is strongly influenced by social norms and has increased motivation to please the referents. For example, the results of an Internet blog case-study indicated that social norms reflect the degree to which users think that other people very much approve of their participating in the blog (Hsu & Lin, 2008).

Moreover, Kim & Kankanhalli (2009) argued that social norms can either strengthen or weaken a user's status quo bias, especially in the context of a changing work environment. For example, whether a user resists or accepts a new system can be easily influenced by colleagues' suggestions (Lewis, Agarwal, & Sambamurthy, 2003). In the current study, upgrading to a new system is considered to be a change in the daily work situation. As such, if social norms are aligned with upgrading to a new generation system, users' degree of inertia should be weakened, as hypothesized here:

**H11a.** Social norms have a *negative* relationship with inertia.

Several theoretical studies, such as the expanded technology acceptance model (TAM 2; Venkatesh & Davis, 2000) and the unified theory of acceptance and use of technology (UTAUT; Venkatesh et al., 2003), have indicated that social norms (or social influences expressed by means of subjective norms) significantly affect users' acceptance and use of new technology. The reason is that when a new system is generally perceived to be useful or easy to use, potential users tend to exhibit a higher intention to accept it (Sun & Zhang, 2006). However, users must first determine their level of perceived need (Dias, Silva, Schmitz, & Dias, 2009). In PIM, social norms are proposed as an important driving force of perceived need (Warshaw, 1980). Social norms can be internalized or assimilated via identification, which is reflected mainly in an individual's own actual need and longing. Furthermore, requirements for compliance as well as social pressure from referents means that people tend to conform to their referents' opinions. Thus, users' perceived need with respect to decision making is affected by their own desires and perceived pressures (Warshaw, 1980). Based on the above, the authors present the following hypothesis:

**H11b.** Social norms have a positive relationship with perceived need.

## 4. Method

To test the hypotheses, data was first collected from an online survey. The questionnaire was uploaded to a survey portal (http://survey.youthwant.com.tw/) in Taiwan and made available for Internet users. Respondents reported their answers on the questionnaire by choosing the number that best described their degree of agreement with each statement about the research target.

### 4.1. Target system

The target system in this study was a computer operating system (OS). An OS is an essential software program that manages a computer's memory, processes, hardware and software resources, provides common services for many different software programs running at the same time, and gets users' daily digital tasks done. Popular desktop computer operating systems include Microsoft Windows, Apple's Mac OS X, and the numerous distributions of Linux. Microsoft's Windows holds the largest total share (about 91.51%) of the desktop computer OS market. As of June 2017, data from NetMarketShare.com showed that Microsoft's Windows 10 held 26.8% market share, while Windows 7 retained the lead with 49.04% market share. Windows XP came in third place with a total market share of 6.94%. Windows 8.1, dropped

**Table 3**
Descriptive statistics and factor loadings.

| Construct | Items | Mean | S.D. | Factor loading | *t* statistics |
|---|---|---|---|---|---|
| Behavioral intention to upgrade | BITU1 | 3.516 | 1.550 | 0.950 | 148.546 |
| | BITU2 | 4.070 | 1.575 | 0.934 | 83.097 |
| Benefit loss costs | BLC1 | 5.150 | 1.369 | 0.922 | 54.834 |
| | BLC2 | 5.324 | 1.293 | 0.933 | 60.532 |
| | BLC3 | 5.465 | 1.341 | 0.907 | 49.970 |
| Incumbent system habit | ISH1 | 5.981 | 0.986 | 0.916 | 66.670 |
| | ISH2 | 5.873 | 1.076 | 0.906 | 44.806 |
| | ISH3 | 5.883 | 1.082 | 0.878 | 32.565 |
| | ISH4 | 5.516 | 1.235 | 0.824 | 29.061 |
| Inertia | IN1 | 4.568 | 1.567 | 0.701 | 17.576 |
| | IN2 | 4.685 | 1.557 | 0.809 | 31.027 |
| | IN3 | 5.000 | 1.611 | 0.818 | 32.258 |
| | IN4 | 4.967 | 1.419 | 0.846 | 29.964 |
| | IN5 | 4.934 | 1.442 | 0.836 | 26.934 |
| | IN6 | 5.070 | 1.377 | 0.832 | 27.264 |
| Purchasability | PA1 | 4.507 | 1.627 | 0.807 | 5.534 |
| | PA2 | 4.343 | 1.634 | 0.858 | 5.721 |
| | PA3 | 4.427 | 1.611 | 0.835 | 5.695 |
| | PA7 | 3.770 | 1.243 | 0.795 | 7.154 |
| Perceived need | PN1 | 3.394 | 1.490 | 0.872 | 43.152 |
| | PN2 | 3.930 | 1.614 | 0.798 | 23.109 |
| | PN3 | 3.272 | 1.518 | 0.925 | 96.774 |
| | PN4 | 3.329 | 1.592 | 0.882 | 48.261 |
| | PN5 | 2.793 | 1.525 | 0.810 | 28.033 |
| | PN6 | 3.221 | 1.649 | 0.847 | 43.895 |
| Procedural switching costs | PSC2 | 5.141 | 1.383 | 0.919 | 60.267 |
| | PSC3 | 5.465 | 1.101 | 0.810 | 18.978 |
| Sunk costs | SC1 | 5.113 | 1.235 | 0.943 | 71.454 |
| | SC2 | 5.235 | 1.229 | 0.944 | 78.257 |
| | SC3 | 5.174 | 1.187 | 0.948 | 99.316 |
| Social norms | SN1 | 3.216 | 1.486 | 0.970 | 178.602 |
| | SN2 | 3.258 | 1.537 | 0.970 | 170.407 |
| Uncertainty costs | UC1 | 5.333 | 1.168 | 0.912 | 60.924 |
| | UC2 | 5.150 | 1.235 | 0.892 | 42.994 |
| | UC3 | 5.315 | 1.213 | 0.893 | 44.916 |

to 6.4% market share. Microsoft claims that 76% of its enterprise users are piloting its latest version and there are more than 200 million devices worldwide running the latest version by home users.

Most people use the operating system that comes pre-installed on their computer, but it is possible to upgrade or even change operating system if the platforms are compatible. Some hardware/software requirements apply and feature availability may vary by device and market. And while a significant proportion of businesses may experiment with the latest OS, outright adoption of the new OS usually takes some time because businesses typically lag behind home users due to the complexity of managing such upgrades at scale. Each OS's user interface has a different look and feel, so if users upgrade to a newer version, it may feel unfamiliar at first. For instance, Windows 8 came with the new "metro" style interface and the traditional "start" menu was replaced with a new tile interface. Many users were annoyed about the lack of a start button and the introduction of the "start screen." Windows 8.1 update was mainly an upgrade for Windows 8 and was meant to address the complaints of Windows 8 users. Though Windows 8.1 received better reviews than Windows 8, there were still some problems that were not fixed and many users even decided to downgrade from 8.1 to Windows 7.

The latest version of Windows (10) combines old and new features in a cohesive package, while correcting nearly all of the missteps of Windows 8. The upgrade to Windows 10 was offered for free to most Windows 7 and 8.1 users. Each day, nearly one billion users boot up with the familiar Windows icon. And similar to most addictions, the Microsoft Windows habit has been hard to break for many users. Thus, the concurrent presence of several generations of Microsoft's Windows OS on the market made this system ideal for investigating the reasons underlying users' upgrade intentions and how ingrained habits and inertia toward an incumbent system affect users' perceptions of newer generation systems.

### 4.2. Measures of the constructs

To ensure the content validity of the measurement items, they must characterize the concepts about which valid generalizations are to be made (Bohmstedt, 1970). Therefore, most measurement items in this study were adapted from prior studies and then slightly modified to suit the context of upgrading to a new desktop computer OS. Table 1 shows summarized operational definitions and includes references for each construct. Personal innovativeness in the domain of IT (PIIT) refers to the willingness of a user to try out any new information technology (Agarwal & Prasad, 1998). Prior research has indicated that personal innovativeness can cause users to make upgrade decisions (Bhattacherjee et al., 2012). Thus, PIIT is included as a control variable in addition to income and age. The measurement items associated with PIIT were adapted from and Jeong et al. (2009). Responses for all items were reported on 7-point Likert scales (1 = strongly disagree; 7 = strongly agree).

Before conducting the survey, both a pre-test and pilot test were performed to validate the research instrument. The survey items were pre-tested by 8 IS experts and modified to fit the OS upgrade context being studied. The experts were asked to comment on whether list items matched the constructs, including wording, statement length, and questionnaire format. Moreover, to reduce potential ambiguity, a pilot test was performed to ensure that each question could be easily understood. A total of 36 usable responses were gathered from users who

Table 4
Reliability analysis and cross loadings.

| Items | BITU | BLC | ISH | IN | PA | PN | PSC | SC | SN | UC |
|---|---|---|---|---|---|---|---|---|---|---|
| BITU1 | **0.950** | −0.417 | −0.359 | −0.523 | 0.208 | 0.701 | −0.384 | −0.098 | 0.672 | −0.293 |
| BITU2 | **0.934** | −0.360 | −0.352 | −0.447 | 0.200 | 0.607 | −0.339 | −0.161 | 0.543 | −0.304 |
| BLC1 | −0.389 | **0.922** | 0.582 | 0.652 | −0.104 | −0.408 | 0.635 | 0.282 | −0.228 | 0.536 |
| BLC2 | −0.358 | **0.933** | 0.624 | 0.644 | −0.113 | −0.378 | 0.669 | 0.330 | −0.202 | 0.530 |
| BLC3 | −0.396 | **0.907** | 0.592 | 0.656 | −0.178 | −0.440 | 0.653 | 0.278 | −0.322 | 0.530 |
| ISH1 | −0.343 | 0.570 | **0.916** | 0.569 | −0.156 | −0.452 | 0.594 | 0.464 | −0.292 | 0.476 |
| ISH2 | −0.297 | 0.599 | **0.906** | 0.545 | −0.131 | −0.400 | 0.588 | 0.440 | −0.268 | 0.434 |
| ISH3 | −0.331 | 0.560 | **0.878** | 0.527 | −0.173 | −0.475 | 0.549 | 0.394 | −0.328 | 0.439 |
| ISH4 | −0.360 | 0.565 | **0.824** | 0.544 | −0.097 | −0.395 | 0.458 | 0.490 | −0.272 | 0.427 |
| IN1 | −0.495 | 0.499 | 0.411 | **0.701** | −0.095 | −0.419 | 0.458 | 0.234 | −0.183 | 0.397 |
| IN2 | −0.470 | 0.558 | 0.457 | **0.809** | −0.129 | −0.470 | 0.523 | 0.279 | −0.261 | 0.421 |
| IN3 | −0.483 | 0.659 | 0.543 | **0.818** | −0.251 | −0.531 | 0.679 | 0.219 | −0.305 | 0.511 |
| IN4 | −0.348 | 0.589 | 0.484 | **0.846** | −0.125 | −0.383 | 0.474 | 0.230 | −0.209 | 0.375 |
| IN5 | −0.339 | 0.564 | 0.576 | **0.836** | −0.192 | −0.414 | 0.522 | 0.254 | −0.207 | 0.388 |
| IN6 | −0.343 | 0.533 | 0.526 | **0.832** | −0.079 | −0.402 | 0.478 | 0.257 | −0.260 | 0.402 |
| PA1 | 0.180 | −0.123 | −0.099 | −0.175 | **0.807** | 0.255 | −0.248 | 0.053 | 0.108 | −0.203 |
| PA2 | 0.089 | −0.146 | −0.112 | −0.130 | **0.858** | 0.217 | −0.231 | 0.049 | 0.071 | −0.167 |
| PA3 | 0.123 | −0.095 | −0.082 | −0.112 | **0.835** | 0.210 | −0.199 | 0.046 | 0.061 | −0.135 |
| PA7 | 0.236 | −0.113 | −0.182 | −0.161 | **0.795** | 0.382 | −0.220 | 0.033 | 0.198 | −0.094 |
| PN1 | 0.603 | −0.362 | −0.414 | −0.449 | 0.354 | **0.872** | −0.355 | −0.167 | 0.567 | −0.323 |
| PN2 | 0.492 | −0.304 | −0.318 | −0.362 | 0.296 | **0.798** | −0.283 | −0.106 | 0.457 | −0.250 |
| PN3 | 0.666 | −0.407 | −0.466 | −0.530 | 0.302 | **0.925** | −0.397 | −0.154 | 0.623 | −0.321 |
| PN4 | 0.667 | −0.482 | −0.487 | −0.574 | 0.295 | **0.882** | −0.417 | −0.182 | 0.525 | −0.380 |
| PN5 | 0.518 | −0.253 | −0.343 | −0.313 | 0.318 | **0.810** | −0.277 | −0.020 | 0.613 | −0.142 |
| PN6 | 0.615 | −0.451 | −0.456 | −0.545 | 0.261 | **0.847** | −0.437 | −0.135 | 0.511 | −0.347 |
| PSC2 | −0.375 | 0.734 | 0.568 | 0.673 | −0.226 | −0.410 | **0.919** | 0.272 | −0.273 | 0.543 |
| PSC3 | −0.281 | 0.451 | 0.508 | 0.426 | −0.267 | −0.316 | **0.810** | 0.373 | −0.124 | 0.534 |
| SC1 | −0.133 | 0.299 | 0.455 | 0.305 | 0.069 | −0.147 | 0.326 | **0.943** | −0.085 | 0.414 |
| SC2 | −0.118 | 0.290 | 0.484 | 0.264 | 0.041 | −0.138 | 0.339 | **0.944** | −0.103 | 0.431 |
| SC3 | −0.132 | 0.323 | 0.502 | 0.288 | 0.039 | −0.145 | 0.347 | **0.948** | −0.082 | 0.444 |
| SN1 | 0.640 | −0.275 | −0.326 | −0.311 | 0.142 | 0.617 | −0.250 | −0.096 | **0.970** | −0.195 |
| SN2 | 0.620 | −0.256 | −0.312 | −0.267 | 0.161 | 0.630 | −0.222 | −0.089 | **0.970** | −0.181 |
| UC1 | −0.236 | 0.539 | 0.477 | 0.467 | −0.140 | −0.280 | 0.583 | 0.439 | −0.125 | **0.912** |
| UC2 | −0.289 | 0.492 | 0.445 | 0.453 | −0.124 | −0.273 | 0.514 | 0.413 | −0.187 | **0.892** |
| UC3 | −0.328 | 0.525 | 0.437 | 0.481 | −0.210 | −0.380 | 0.568 | 0.376 | −0.211 | **0.893** |
| *CR* | 0.940 | 0.944 | 0.933 | 0.919 | 0.894 | 0.943 | 0.857 | 0.962 | 0.970 | 0.927 |
| Cronbach's α | 0.873 | 0.911 | 0.904 | 0.893 | 0.854 | 0.927 | 0.679 | 0.940 | 0.937 | 0.882 |

*Notes*: 1. BITU: behavioral intention to upgrade; BLC: benefit loss costs; ISH: incumbent system habit; IN: inertia; PA: purchasability; PN: perceived need; PSC: procedural switching costs; SC: sunk costs; SN: social norms; UC: uncertainty costs. 2. CR: composite reliability.

had not upgraded to the latest version of their operating system. This study examined participants' perceptions and behavioral intentions related to upgrading from their current operating system to the newer generation system. If they had the latest version of the operating system, they did not have an upgrade option. Almost all of the participants were students (83.3%), and Windows 7 was the most widely used OS (86.1%). After the pre-test and pilot test, four measurement items (IN2, IN4, PSC1 and UC3) were partially modified and two others were dropped. The final survey items are listed in Appendix A.

### 4.3. Data collection

Since one of the purposes of this study was to explore the determinants of behavioral intentions to upgrade to a new generation OS, participants were required to have a desktop operating system but not have upgraded to the latest version. To ensure that respondents had experience using a desktop operating system, a description and a filter question were posted at the beginning of questionnaire. The description listed each version of Microsoft's Windows OS and indicated that an operating system upgrade constituted a large-scale upgrade to a new version (e.g., from Windows 7 to Windows 8), rather than a small-scale version (e.g., from Windows 8 to Windows 8.1).

The survey yielded 213 usable responses, including 109 males and 104 females. About 95% were under 35 years of age, while nearly 95% had at least a college degree, indicating that the respondents were mainly young and educated. The largest number of respondents had experience with Windows 7 (63.4%). Furthermore, most of the respondents were considering upgrading their current operating system to the latest version at that time (59.7%). Table 2 shows the summarized demographics of the respondents.

## 5. Results

Data were analyzed using partial least squares (PLS), which has several advantages over regression and covariance-based structural equation modeling (CBSEM). First of all, PLS is a suitable and powerful technique that is appropriate for complex research models that include direct variables (i.e., purchasability, incumbent system habit, procedural switching costs, uncertainty costs, benefit loss costs, sunk costs and social norms), indirect variables (i.e., inertia and perceived need) and a moderating variable (i.e., inertia). Also, PLS has an advantage over regression in that it can easily analyze the entire model as a unit, rather than dividing it into several pieces (Goodhue, Lewis, & Thompson, 2012). In addition, the sample size was relatively small at 213 participants. For smaller sample sizes, CBSEM may not converge, while PLS has the smallest occurrence of false positives. Finally, since this research adopted PIM and SQB conceptual constructs, PLS was highly suitable for this initial exploratory stage.

SmartPLS software (Ringle, Wende, & Will, 2005) was utilized during the two-stage data analysis. The first step examined the measurement models and psychometric properties, while the second step focused on testing the structural model and hypotheses. SmartPLS

**Table 5**
Inter-construct correlations and reliability measures.

| | BITU | BLC | ISH | IN | PA | PN | PSC | SC | SN | UC |
|---|---|---|---|---|---|---|---|---|---|---|
| BITU | **0.942** | | | | | | | | | |
| BLC | −0.414 | **0.921** | | | | | | | | |
| ISH | −0.377 | 0.651 | **0.882** | | | | | | | |
| IN | −0.517 | 0.707 | 0.620 | **0.809** | | | | | | |
| PA | 0.217 | −0.143 | −0.158 | −0.185 | **0.824** | | | | | |
| PN | 0.698 | −0.444 | −0.488 | −0.546 | 0.354 | **0.857** | | | | |
| PSC | −0.385 | 0.708 | 0.621 | 0.655 | −0.277 | −0.425 | **0.867** | | | |
| SC | −0.136 | 0.322 | 0.508 | 0.303 | 0.053 | −0.152 | 0.357 | **0.945** | | |
| SN | 0.649 | −0.274 | −0.329 | −0.298 | 0.156 | 0.643 | −0.243 | −0.095 | **0.970** | |
| UC | −0.316 | 0.578 | 0.504 | 0.520 | −0.176 | −0.347 | 0.618 | 0.455 | −0.194 | **0.899** |

*Notes*: 1. BITU: behavioral intention to upgrade; BLC: benefit loss costs; ISH: incumbent system habit; IN: inertia; PA: purchasability; PN: perceived need; PSC: procedural switching costs; SC: sunk costs; SN: social norms; UC: uncertainty costs. 2. Diagonal elements are the square roots of the average variance extracted (AVE) values; off-diagonal elements are correlations among constructs.

affords a convenient approach for simultaneous analysis of the measurement model and the structural model.

### 5.1. Measurement model

Assessment of the measurement models involved evaluations of reliabilities, convergent validities, and discriminant validities of the construct measures. First, to ensure that each indicator shared more variance with the component score than with the error variance when assessing the reliability of each indicator, Chin, Monroe & Fiscella (2000) suggested that a construct (also known as a *latent variable*) should explain a substantial part (usually at least 50%) of the variance of each indicator. Items with factor loadings that were lower than 0.5 were dropped (i.e., BLC4, PA4, PA5, PA6 and PSC1). All of the remaining items' loadings were greater than 0.6 (see Table 3); therefore, reliability at the indicator level was satisfactory. Cronbach's α and composite reliability (CR) were used to assess the reliability of the scales at the construct level. Henseler, Ringle & Sinkovics (2009) suggested that, to show a measure's internal consistency, the CR value must not be lower than 0.6. As shown in Table 4, the Cronbach's α and CR values of each construct exceeded 0.6. Thus, reliability was also adequate at the construct level.

Table 4 also shows that all items had stronger loadings on their associated factors than on others. Thus, convergent and discriminant validity were demonstrated. Moreover, convergent validity was assessed using average variance extracted (AVE). Table 5 shows the AVE value for each construct exceeded 0.5, meaning that more than half of the variance observed in the indicators was accounted for by their corresponding constructs. Furthermore, comparison of the shared variances between constructs with the AVE values of the individual variables (Fornell & Larcker, 1981) indicated that the shared variances between constructs were lower than the AVE value of individual variables, thereby confirming discriminant validity (see Table 5). In addition, multicollinearity was checked using the variance inflation factor (VIF). Hair, Anderson, Tatham, & Black (1998) indicated that there is cause for some concern about multicollinearity only if the VIF exceeds 5. However, the highest VIF was found to be only 2.804, indicating that multicollinearity was well within acceptable limits. To conclude, the measurement model demonstrated adequate reliability as well as convergent and discriminant validities.

Common method bias (CMB) was a potential concern in this study due to both the dependent and independent variables being gathered simultaneously while using the same instrument (i.e., Likert scales). Harman's single-factor test (Harmon, 1967) was performed to ensure that the relationships among the causal variables were originally insignificant. All the indicators in this study were examined via exploratory factor analysis (EFA) using principal component analysis (PCA) without rotation; the 10 variables were extracted and explained 37.8% of the first component with no single factor accounting for the majority of the covariance among the measures (Podsakoff, MacKenzie, & Podsakoff, 2003). The latent method factor approach (Liang, Saraf, Hu, & Xue, 2007; Podsakoff et al., 2003; Saraf, Langdon, & Gosain, 2007; Williams, Edwards, & Vandenberg, 2003) was also used to test for CMB. The method model included factor loadings linking the method effect's latent variable to the substantive indicators. Most of the latent variable's factor loadings were found to be insignificant (71.4%), and the method variances were substantially less than the indicators' substantive variances. Based on the above, CMB was unlikely to have seriously affected the results of this study (Liang et al., 2007; Saraf et al., 2007; Williams et al., 2003).

### 5.2. Structural model

Path significance was tested using a bootstrapping re-sampling technique with 500 sub-samples, as recommended by Chin (1998). The research included three variables (income, age, and PIIT) as main control variables to concentrate attention on the effects of the proposed independent variables on the dependent variables. Table 6 shows the statistics of the structural model, including path coefficients, standard errors, and *t*-values. Path coefficients indicate the strength of the relationships between the independent variables and dependent variables.

**Hypotheses 1.** and 2 state that purchasability (H1) and perceived need (H2) are positively related to the behavioral intention to upgrade to a new generation system. As shown in Table 6, the results support H2: perceived need had a significant positive relationship with behavioral intention to upgrade ($\beta = 0.548$, $p < 0.001$). However, the relationship between purchasability and behavioral intention to upgrade was not significant ($\beta = -0.011$, $p > 0.05$). Thus, H1 is not supported.

**Hypotheses 6.** 7a, 8, 9a and 10 state that incumbent system habit (H6), procedural switching costs (H7a), uncertainty costs (H8), benefit loss costs (H9a) and sunk costs (H10) have positive relationships with inertia. Moreover, Hypothesis 11a states that social norms have negative relationships with inertia. The results support H6, H7a, and H9a ($\beta = 0.203$, $p < 0.05$; $\beta = 0.217$, $p < 0.01$; $\beta = 0.373$, $p < 0.001$, respectively). However, uncertainty costs, sunk costs and social norms were found to have no significant relationships with inertia ($\beta = 0.071$, $p > 0.05$; $\beta = -0.036$, $p > 0.05$; $\beta = -0.065$, $p > 0.05$, respectively). Thus, the results do not lend support to H8, H10, and H11a.

**Hypotheses 7.** b and 9b state that procedural switching costs and benefit loss costs have negative relationships with perceived need. Results show that procedural switching costs and benefit loss costs had significant negative relationships with perceived need ($\beta = -0.167$, $p < 0.05$ and $\beta = -0.174$, $p < 0.05$, respectively). Therefore, H7b

**Table 6**
Statistical results of the structural model.

| Dependent variable | Independent variable | Path coefficient | Standard error | *t* statistics | Results |
|---|---|---|---|---|---|
| BITU | (H1) PA | −0.011 | 0.037 | 0.290 | Not supported |
| | (H2) PN | 0.548 | 0.059 | 9.295 | Supported |
| | (H3) IN | −0.160 | 0.058 | 2.765 | Supported |
| | (H4) PA × IN | −0.117 | 0.072 | 1.617 | Not supported |
| | (H5) PN × IN | −0.132 | 0.065 | 2.011 | Supported |
| IN | (H6) ISH | 0.203 | 0.085 | 2.404 | Supported |
| | (H7a) PSC | 0.217 | 0.076 | 2.873 | Supported |
| | (H8) UC | 0.071 | 0.059 | 1.201 | Not supported |
| | (H9a) BLC | 0.373 | 0.073 | 5.119 | Supported |
| | (H10) SC | −0.036 | 0.038 | 0.952 | Not supported |
| | (H11a) SN | −0.065 | 0.051 | 1.286 | Not supported |
| PN | (H7b) PSC | −0.167 | 0.079 | 2.103 | Supported |
| | (H9b) BLC | −0.174 | 0.073 | 2.382 | Supported |
| | (H11b) SN | 0.554 | 0.053 | 10.519 | Supported |

*Notes*: BITU: behavioral intention to upgrade; PA: purchasability; PN: perceived need; IN: inertia; ISH: incumbent system habit; PSC: procedural switching costs; UC: uncertainty costs; BLC: benefit loss costs; SC: sunk costs; SN: social norms.

and H9b are supported. On the other hand, Hypotheses 11b states that social norms have a positive association with perceived need. The results demonstrate that the relationship existed and was significant ($\beta = 0.554$, $p < 0.001$). Thus, the results support H11b.

The final set of hypotheses predict that inertia (H3) has a negative relationship with the behavioral intention to upgrade to a new generation system. Table 6 shows that the relationship was significant ($\beta = -0.160$, $p < 0.01$), supporting H3. Among the moderating relationships, inertia was observed to moderate the relationship between perceived need and the behavioral intention to upgrade, with higher inertia leading to a lower positive relationship between perceived need and the behavioral intention to upgrade ($\beta = -0.132$, $p < 0.05$). This result supports H5. Fig. 2 shows how inertia moderated the relationship between perceived need and the behavioral intention to upgrade. However, inertia was unexpectedly found not to moderate the relationship between purchasability and behavioral intention to upgrade ($\beta = -0.117$, $p > 0.05$). Thus, the results fail to support H4.

Following Preacher and Hayes (2004, 2008), mediation was assessed using bootstrapping. Bootstrapping makes no assumptions of normal or sampling distributions of the indirect effect (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002), and it has more power and better control over type I error rates compared to the causal steps approach (Baron & Kenny, 1986); therefore, this technique is recommended for small sample sizes (Hoyle & Kenny, 1999; MacKinnon et al., 2002). To apply this approach, this study conducted the PROCESS macro for SPSS (model 4; Hayes, 2012) to examine the significance of the mediation effects of each eligible construct. The results for each antecedent construct via inertia and perceived need, respectively, are summarized in Table 7. The bootstrap estimates presented here are based on 5000 bootstrapping re-samples. The 95% confidence intervals (CIs) for the indirect effects from incumbent system habit [−0.585, −0.279], procedural switching costs [−0.584, −0.268], and benefit loss costs [−0.538, −0.215] on the behavioral intention to upgrade via inertia do not contain zero. These results indicate that inertia mediated the impact of incumbent system habit, procedural switching costs, and benefit loss costs on the behavioral intention to upgrade. Moreover, the 95% CIs for the indirect effects from procedural switching costs [−0.510, −0.232], benefit loss costs [−0.453, −0.239], and social norms [0.168, 0.423] on the behavioral intention to upgrade via perceived need also do not contain zero. The results show that perceived need mediated the impacts of procedural switching costs, benefit loss costs, and social norms on the behavioral intention to upgrade.

Altogether, about 56.3% of the variance in the behavioral intention to upgrade was accounted for by the research model, with perceived need having the strongest relationship with the behavioral intention to upgrade among the explanatory variables. In addition, about 57.8% of the variance in inertia was accounted for by the research model, with benefit loss costs having a strong effect. And about 50.5% of the variance in perceived need was accounted for by the research model, with social norms having a strong effect. Additionally, the goodness of fit (GoF) index, a global fit measure for PLS path modeling, has been defined as the geometric mean of the average communality and average $R^2$ values for all endogenous constructs (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). The GoF index is bounded between 0 and 1 (Vinzi, Trinchera, & Amato, 2010). Prior researchers have suggested that using the cut-off value of 0.5 for communality (Fornell & Larcker, 1981) and different effect sizes of $R^2$ (Cohen, 1988) to determine GoFsmall = 0.1, GoFmedium = 0.25 and GoFlarge = 0.36. In this study, the research model obtained a GoF value of 0.640, which exceeds the cut-off value of 0.36 for large effect sizes of $R^2$; therefore, the model can be said to provide good predictive power.

As for the control variables, PIIT was found to have a significant effect on the behavioral intention to upgrade ($\beta = 0.110$, $p < 0.05$). More specifically, users who had high PIIT scored higher on upgrading intentions (*Mean* = 4.107, *S.D.* = 1.511) then did their low PIIT counterparts (*Mean* = 3.339, *S.D.* = 1.293). However, income and age did not significantly affect the behavioral intention to upgrade. Table 6 summarizes the hypotheses testing results. Fig. 3 is a visual representation of the standardized path coefficients of the research model.

## 6. Discussion

IT innovation includes paying attention to users' upgrading behaviors. Companies that have a greater understanding and comprehension of clients' decision-making processes can better promote their products/services (Huh & Kim, 2008; Kim & Srinivasan,2009). Unlike previous studies (e.g., Bhattacherjee et al., 2012; Tseng & Lo, 2011) that focused on either users' satisfaction with prior usage or perceived usefulness and perceived ease of use of a new system, the current study considered a broader range of factors associated with PIM and SQB theory that influence users' behavioral intentions to upgrade. Moreover, this research examined the interaction effect between inertia and two PIM factors (purchasability and perceived need), which may have different impacts on the behavioral intention to upgrade.

Most of the proposed hypotheses were supported, but several results were especially interesting and unexpected. First, compared to nonmotivational factors (i.e., purchasability), motivational factors (i.e., perceived need) contributed more to the behavioral intention to upgrade. This finding is same as the notion proposed by Tseng & Lo (2011), who stated that users' perceived performances, qualities, and values are clearly reflected in meeting their needs. Jeong et al. (2009) also showed that users' perceived need ($\beta = 0.521$) can be used as a better predictor of their behavioral intention (e.g., purchase intention of mobile-RFID services) than purchasability ($\beta = 0.250$). Purchasability for paid or free versions has no direct impact on users' upgrading intentions. The results obtained in the current study suggest that system vendors should focus on the pace of innovations in terms of users' perception of needs. This finding contributes to the IS literature by showing that perceived need plays a part in determining users' upgrading intentions. Future research can validate the PIM model on different IT products/services.

Second, this study further distinguished two paths from social norms to perceived need and from social norms to inertia; in doing so, the findings suggest that users with high levels of social norms are more likely to have higher perceived needs. This finding is consistent with PIM theory, which proposes that social norms are an important driving force of perceived need. Moreover, procedural switching costs and

**Table 7**
Results of the mediation analysis ($n = 213$).

| IN as mediator: | | | | | |
|---|---|---|---|---|---|
| Effect | *B* | *SE* | *p* | $CI_{lower}$ | $CI_{upper}$ |
| *ISH as independent variable* | | | | | |
| ISH → BITU (*c*) | −0.580 | 0.090 | < 0.001 | −0.758 | −0.403 |
| ISH → IN (*a*) | 0.776 | 0.065 | < 0.001 | 0.647 | 0.905 |
| IN → BITU (*b*) | −0.555 | 0.095 | < 0.001 | −0.742 | −0.369 |
| ISH → BITU (*c′*) | −0.150 | 0.102 | > 0.05 | −0.350 | 0.051 |
| Indirect effects ($a \times b$) | −0.431 | 0.077 | | −0.585 | −0.279 |
| *PSC as independent variable* | | | | | |
| PSC → BITU (*c*) | −0.517 | 0.107 | < 0.001 | −0.727 | −0.307 |
| PSC → IN (*a*) | 0.715 | 0.074 | < 0.001 | 0.570 | 0.860 |
| IN → BITU (*b*) | −0.562 | 0.104 | < 0.001 | −0.767 | −0.358 |
| PSC → BITU (*c′*) | −0.116 | 0.127 | > 0.05 | −0.366 | 0.135 |
| Indirect effects ($a \times b$) | −0.402 | 0.079 | | −0.584 | −0.268 |
| *BLC as independent variable* | | | | | |
| BLC → BITU (*c*) | −0.494 | 0.090 | < 0.001 | −0.671 | −0.317 |
| BLC → IN (*a*) | 0.691 | 0.057 | < 0.001 | 0.579 | 0.803 |
| IN → BITU (*b*) | −0.544 | 0.113 | < 0.001 | −0.767 | −0.322 |
| BLC → BITU (*c′*) | −0.118 | 0.117 | > 0.05 | −0.347 | 0.112 |
| Indirect effects ($a \times b$) | −0.376 | 0.082 | | −0.538 | −0.215 |
| PN as mediator: | | | | | |
| *PSC as independent variable* | | | | | |
| PSC → BITU (*c*) | −0.517 | 0.107 | < 0.001 | −0.727 | −0.307 |
| PSC → PN (*a*) | −0.519 | 0.100 | < 0.001 | −0.716 | −0.321 |
| PN → BITU (*b*) | 0.708 | 0.066 | < 0.001 | 0.579 | 0.837 |
| PSC → BITU (*c′*) | −0.150 | 0.083 | > 0.05 | −0.314 | 0.014 |
| Indirect effects ($a \times b$) | −0.367 | 0.070 | | −0.510 | −0.232 |
| *BLC as independent variable* | | | | | |
| BLC → BITU (*c*) | −0.494 | 0.090 | < 0.001 | −0.671 | −0.317 |
| BLC → PN (*a*) | −0.480 | 0.074 | < 0.001 | −0.626 | −0.334 |
| PN → BITU (*b*) | 0.694 | 0.065 | < 0.001 | 0.566 | 0.822 |
| BLC → BITU (*c′*) | −0.161 | 0.077 | < 0.05 | −0.312 | −0.010 |
| Indirect effects ($a \times b$) | −0.333 | 0.054 | | −0.453 | −0.239 |
| *SN as independent variable* | | | | | |
| SN → BITU (*c*) | 0.647 | 0.050 | < 0.001 | 0.547 | 0.746 |
| SN → PN (*a*) | 0.585 | 0.058 | < 0.001 | 0.470 | 0.699 |
| PN → BITU (*b*) | 0.517 | 0.099 | < 0.001 | 0.323 | 0.712 |
| SN → BITU (*c′*) | 0.344 | 0.096 | < 0.001 | 0.156 | 0.533 |
| Indirect effects ($a \times b$) | 0.302 | 0.067 | | 0.168 | 0.423 |

*Notes*: 1. CI: confidence interval. 2. IN: inertia; ISH: incumbent system habit; BITU: behavioral intention to upgrade; PSC: procedural switching costs; BLC: benefit loss costs; PN: perceived need; SN: social norms. 2. The 95% CI for $a \times b$ is obtained by the bias-corrected bootstrap with 5000 re-samples.

benefit loss costs have negative significant effects on perceived need. This finding is consistent with the argument from SQB theory, which identified rational decision making and loss aversion as two of causes of user resistance to change. Users worry about the time and effort they have to invest in the upgrading process, the loss of some benefits (e.g., skills and familiarity with the current system) that they enjoy with the current system and the loss of task performance (e.g., efficiency, quality and compatibility) results in perceived need reduction. This study contributes to the IS literature by finding that, in terms of direction and magnitude, the proposed antecedents of perceived need (i.e., social norms, procedural switching costs and benefit loss costs) have crucial influences on users' behavioral intentions to upgrade.

However, results of this study indicate that social norms have an insignificant impact on inertia. This could be due to the source of social norms, which are mostly informational social influences (e.g., from colleagues, friends, or family members). According to Kim and Kankanhalli's (2009) research, different referents generate different degrees of user resistance (i.e., inertia). In their findings, informational social influence also had no significant impact on user resistance. Since the current study only measured the perceived amount of social norms, future researcher could examine the effect of different sources of social norms (e.g., normative social influences such as superiors) on upgrading intentions.

Inertia was found to have a negative impact on users' behavioral intentions to upgrade and a negative moderating effect between perceived need and the behavioral intention to upgrade. However, it is interesting to note that inertia did not significantly moderate the relationship between purchasability and the behavioral intention to upgrade: inertia contributed more to motivational factors (i.e., perceived need) than non-motivational factors (i.e., purchasability). This concept is similar to prior studies (e.g., Colgate & Lang, 2001; Ye, 2005) that indicated inert acts can be strong predictors of users' upgrading intentions. The current findings broaden the existing IS literature by showing that inertia and perceived need play important roles in determining users' upgrading intentions. Moreover, the extant literature (e.g., Polites & Karahanna, 2012) on inertia has suggested various ways of reinforcing the status quo in user inertia, and these also apply to all forms of inertia (specifically, in this case, upgrading intentions). Sources of inertia, including users' incumbent system habits, procedural switching costs, and benefit loss costs, can be used to boost users' resistance in terms of their motivation to upgrade to a new generation system. Future studies can reexamine this finding in different environments or organizational levels.

Although users' perceived uncertainty costs and sunk costs had no positive impact on inertia, the descriptive statistics show that both costs are noteworthy because each corresponding mean value exceeded 5.0. This result could have been due to the regressions explaining not much variance in the dependent variable. For this reason, users might have perceived high levels of uncertainty costs and sunk costs in the upgrading process. This result is similar to Perera and Kim's (2007) findings, which indicated that uncertainty costs and sunk costs contribute less to user resistance to change. A valuable and interesting future study would be an examination of the effects of both costs on other individual level influences, the results of which would certainly increase understanding in this domain.

## 7. Implications

### 7.1. Theoretical implications

Considering the innovative developments associated with popular technological systems, few studies have investigated relevant factors that affect users' upgrading behaviors. Traditional IS theories/models of user decision making and IT adoption behavior have focused on first-time use and repeat use. A main contention in this study is that system upgrading behavior is quite unlike these behaviors because of involved conscious (i.e., upgrading costs) and subconscious factors (i.e., incumbent system habit). In fact, the upgrade decision making process is more complex because it focuses on user comparisons of the current system version in satisfying needs with the enhanced benefits of the upgrade. Thus, this study presents and validates an integrated model that elicits a better understanding of the key factors that contribute to users' upgrading intentions and behaviors. The authors assert a theoretical connection between PIM and SQB theory that is able to predict users' upgrading intentions, which contrasts with prior studies that were mainly based on either TAM (Davis, 1989; Davis et al., 1989) or ECM (Bhattacherjee, 2001). Specifically, this study proposes a theoretical framework consisting of the technology upgrade model (TUM) based on PIM (which includes perceived need and behavioral intention to upgrade) and SQB theory (which includes benefit loss costs, procedural switching costs, incumbent system habit, inertia, and social norms) to capture the multidimensional and interdependent nature of users' upgrading intention measures (see Fig. 4). The TUM applies a conceptual framework (which consists of four classes of variables: motives to continue using incumbent system, attachment to and persistence of using incumbent system, beliefs, and intentions) proposed by previous researchers (i.e., Polites & Karahanna, 2012) to a technology upgrade context, and makes innovative and provocative contributions to IS theory applications, which the 2007 special issue of the Journal of the Association of Information Systems expected (Hirschheim, 2007).

Incumbent system constructs in the TUM refer to a set of constructs associated with the use of the incumbent system that serve as a source of resistance toward upgrade to a new generation system. This study uses the SQB theory to identify the incumbent system constructs and how they contribute to status quo bias, as well as to inform the relationships between the incumbent system constructs and new generation system constructs. Through the SQB theory, both conscious (i.e., upgrading costs, which include benefit loss costs and procedural switching costs) and subconscious determinants (i.e., incumbent system habit) of inertia are investigated with regard to user resistance to upgrade to a new generation system. Inertia serves as a salient inhibitor (mediator) in behavioral intention to upgrade to a new generation system, and the results show that the effects of benefit loss costs, procedural switching costs, and incumbent system habit on upgrading intention, while not direct, are all indirectly evident through inertia. These findings are consistent with those obtained in previous studies (e.g., Perera & Kim, 2007; Polites & Karahanna,2012), which also found that incumbent system habit and procedural switching costs (or transition costs) had significantly positive effects on inertia. Furthermore, benefit loss costs (or loss performance costs) are found to have a significant and positive relationship with inertia. However, in contrast to previous research findings regarding how social norms and sunk costs can weaken or strengthen a user's status quo inertia (e.g., Kim & Kankanhalli, 2009), the current results suggest that social norms and sunk costs have insignificant influences on inertia; this implies that users' inertia is mainly affected by automatic processes, rational decision making, and cognitive misperceptions. These findings are inconsistent with the arguments made in SQB theory, which identify psychological commitment as one of the causes of status quo bias. Therefore, the current study contributes new findings that future researchers should validate across various types of products/services (e.g., systems for mobile devices).

New generation system constructs in the TUM represents a user's salient beliefs and behavioral intentions toward upgrade to a new generation system. The new generation system constructs are based on the PIM to incorporate both attitudinal (i.e., perceived need) and normative beliefs (i.e., social norms) as important determinants of behavioral intention to upgrade. Perceived need is an important facilitator (as a mediator) in behavioral intention to upgrade to a new generation system. As expected, social norms are found to be mediated by perceived need. Users' perceptions of pressure to upgrade to a new generation system originate both internally (the personal desire to upgrade and the actual need to upgrade) and externally (social norms). This extends on previous research and demonstrates how SQB theory, with PIM, can be applied in IS research contexts to explain system upgrade intentions and perceived need. This study identifies and examines the effect of both benefit loss costs and procedural switching costs on perceived need. Applied more generally, these findings help explain user decision-making in specific areas such as version upgrades in mobile telephone services (Tseng & Lo, 2011). By integrating the PIM literature and adding relevant concepts from SQB theory, this study provides a deeper understanding of user upgrading behaviors.

Moreover, this study broadens the conceptual definitions of users' motivation for upgrading and emphasizes the motivational aspects, including users' perceptions of need and inertia. The empirical results indicate that the non-motivational factor of purchasability plays only a trivial role in users' upgrading decision-making process, and has no interactive relationship with inertia. The results also suggest that inertia has a negative relationship with upgrading intention and weakens the positive relationship between perceived need and behavioral intention. These findings not only indicate the moderating ability of inertia, but show that within an IS context, inertia may reduce users' intention to upgrade to a new generation system, and weaken the positive relationship between users' perception of need and behavioral intentions. As such, the current study contributes enormously to our existing understanding of user upgrading behaviors. Finally, in clearly recognizing the potential importance of control variables, PIIT is arguably among the salient individual differences shown in this study to positively affect technology upgrading intentions.

In summary, this study advances our understanding of the mechanisms that result in users upgrading to a more recent generation product. The nomological structure of TUM can serve as a reference framework for future researchers studying IS products/services and upgrading behaviors. Future studies can attempt to replicate the results across different upgrade situations (e.g., patches and updates). Also, while this study examined upgrade intentions, future research could focus on other dependent variables (e.g., past upgrade behavior) and other situations (e.g., mobile systems or enterprise systems). TUM may provide several insights to researchers interested in studying user behavior in other situations. Studies conducted in different environments/cultures and with different systems or applications would help establish the generalizability of this study's findings.

### 7.2. Practical implications

Based on the current findings, the authors suggest several specific recommendations for practitioners. First, system providers should be aware of the critical effect of perceived need on users' upgrading intentions. To increase or maintain competitive advantage, system providers must pay particularly close attention to the actual needs of users. Interviews with end users is one method to better understand user opinions (whether positive or negative) so that providers can develop products/services that are perceived as valuable. System providers can also strive to increase users' motivation with respect to feelings, wants, desires, and actual needs for a new generation system. For example, the user interface of a new generation system should be attractive and easy to set up according to users' needs. System qualities/performance must offer relative advantages (e.g., increased time-saving, efficiency, effectiveness, and less burdensome learning curves) that fit users' needs. In addition, there is a considerable need for system providers to increase user awareness of upgrades and convince users of the advantages of upgrading.

The new generation system's upgrade services should continue to improve the existing system's performance and avoid the potential loss of benefits (e.g., skills and familiarity with the current system) that occur when users upgrade from current systems. Users' loss aversion mentality should be an important consideration when providers are designing the upgrade process. Providers should focus on reducing users' potential switching costs, upgrading times, and system performance losses. For example, upgrade services should be painless experiences and include rapid installation, automatic backup of existing system settings, automatic version updates for continuous operation, retention of users' original software preferences, and retained compatibility with existing software and hardware. Simultaneously, an adequate balance must be maintained between system innovativeness and users' absorption capacity.

Moreover, system providers should aim to understand the importance of users' perceptions of social influence, which can increase users' need for the new generation system and affect upgrading behaviors. To increase social influence, system providers should use multiple channels to increase user awareness of a new generation system. Channel examples include network forums, online communities, word-of-mouth, and advertisements (physical or virtual). Increased awareness can influence users to a greater degree via surrounding referents' attitudes and usage experiences, which can increase perceived need to upgrade and lead to upgrading decisions. Also, the findings of this study suggest that users who perceive themselves as innovators may be a profitable target market. Thus, system marketers may have to expend greater effort convincing these innovators to upgrade.

Finally, most users consider systems to be routine tools, especially computer operating systems. The results of this study verify that inertia is an important and influential factor that determines users' motivations to upgrade. In other words, when users become familiar with an existing system's interface and environment through everyday usage (i.e., incumbent system habit), they are more likely to resist alternative upgrade options. Therefore, a new generation system's upgrade services should adopt continuous improvement and continuous innovation rather than discontinuous innovation (a.k.a. disruptive innovation). Therefore, system providers should have specific strategies and tactics to continuously implement and deploy system improvements to users. The benefits of the new version (including improved work processes, greater system integration, and free upgrades) need to be communicated clearly and effectively to users before the release of a new generation system. System marketers are well advised to introduce upgrades with substantive changes from previous versions to foster user perceptions of value. The positioning and promotion of upgrades would be most effective if users can be convinced that the upgrade's new features are worth the additional expense and inconvenience. Also, since very little is known about user adoption behavior with regard to upgrades, it would be fruitful to investigate how the results of this study could be applied in other IT situations (e.g., mobile applications or enterprise systems).

## 8. Conclusions

This study contributes to a more thorough understanding of users' behavioral intention to upgrade with respect to the impact of incumbent system habit, procedural switching costs, uncertainty costs, benefit loss costs, sunk costs, social norms, inertia, purchasability, and perceived need. The contributions of this study to the theoretical development of users' upgrading behavior are threefold. First, this study successfully integrates the PIM and SQB theory and simultaneously develops a TUM to explain users' behavioral intention to upgrade, which is uncommon in the existing literature. As such, this study represents a new direction for users' upgrading behavior research. Second, this study supports that incumbent system habit, procedural switching costs, and benefit loss costs significantly influence behavioral intention to upgrade through the mediation of inertia. Further, the empirical results indicate that inertia is not only negatively related to behavioral intention to upgrade, but also that inertia weakens the positive relationship between perceived need and behavioral intention to upgrade. This is a new finding, since the main, mediating, and moderating effects of inertia on behavioral intention to upgrade have rarely been explored until now. Third, this study provides empirical evidence to support that procedural switching costs, benefit loss costs, and social norms significantly influence upgrade intention through the mediation of perceived need. Importantly, perceived need is first tested and found to have a significant and positive relationship with behavioral intention to upgrade.

The results of this study should be interpreted in the context of a few limitations. First of all, the data was collected at the individual level for a particular system. It would be useful to replicate this study across other systems and organizational levels (e.g., upgrading of a firm's ERP system) in different influence situations (e.g., business needs or a need to support a new technical standard) to establish the robustness of the model. Second, statistical analysis with a nonparametric Chi-square test was used to check for representativeness. No statistically significant difference in gender was found ($\chi^2 = 0.117$, $p > 0.05$). Thus, the sample is representative of the population in terms of gender. However, the use of a nonrandom sample of volunteers in this study may have an associated risk of sampling bias. This sampling bias may also limit the generalizability of the study results beyond the study sample because of the potential lack of representativeness of the existing sample with respect to the size and geographical location of the population. Future researchers should first randomize their sample to include other nationalities and geographical areas besides Taiwan. Accordingly, continued research is needed to generalize the findings of this study and extend the discussion to include additional groups. Third, a few constructs (i.e., social norms and behavioral intention to upgrade) are measured with two indicator variables. Although previous research has noted that two are acceptable (Iacobucci, 2010), ideally each construct should be measured by at least three items. Future research is required to establish a valid and reliable measurement of these constructs and use it to retest the proposed model. Fourth, a cross-sectional study may not provide definite information about intention-behavior relationships. Additional research efforts are needed to evaluate the validity of the proposed model and the research findings. Accordingly, a longitudinal research has be recommended as a future research to investigate the effect of upgrade intention on upgrade behavior. Specifically, this study did not incorporate any actual upgrading behavior in the proposal model. This may be a minor limitation in that substantial empirical support for the causal link between intention and behavior exists (Liu et al., 2016; Malik, Mahmood, & Rizwan, 2014; Venkatesh et al., 2003). However, behavioral intentions are only partially useful, as their correlation with actual behavior is low and mediated/moderated by many other variables. Thus, future research is needed to investigate this more thoroughly. Longitudinal evidence would not only help predict beliefs and behavior over time, it would also enhance current understanding of the causality and interrelationships between the variables that are important to upgrading behavior. Finally, other predicting factors may exist. This study included only three key control variables (income, age, and PIIT). The results found that only PIIT had a significant relationship between these variables and the behavioral intention to upgrade. As such, a more detailed investigation or a different operationalization of each of the proposed antecedents may be necessary to answer questions that remain pertaining to the relationship between upgrading to a new generation system when purchasing a new computer, system advantages that accurately match users' actual needs, the sources of social influence that drive users to feel a need to upgrade, and the upgrade decision made by companies providing systems to its employees, and by system providers' tactics (e.g., unsupported versions). These were not included in the research scope of the current study, but future researchers can answer these important questions and provide specific recommendations related to upgrading behaviors.

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## Appendix A. Measurement items used in this study

*Behavioral intention to upgrade*

BITU1: I intend to upgrade to the new operating system on my current computer.
BITU2: I plan to upgrade to the new operating system on my current computer.

*Benefit loss costs*

BLC1: Upgrading to the new operating system would mean losing the system preferences that I have accumulated.
BLC2: Upgrading to the new operating system would require the reinstallation and reconfiguration of a variety of hardware and software for daily use.
BLC3: Upgrading to the new operating system would require a lot of time and energy to backup and transfer data.
BLC4: The software and hardware I am currently using may not be supported if I upgrade to the new operating system.

*Incumbent system habit*

ISH1: I use my current operating system as a matter of habit.
ISH2: Using my current operating system has become automatic to me.
ISH3: Using my current operating system is natural to me.
ISH4: When I need to use an operating system, my current version is an obvious choice for me.

*Inertia*

IN1: I never thought about switching to a new operating system.
IN2: I do not care about the functions of the new operating system.
IN3: I cannot be bothered to think about switching to a new operating system.
IN4: I will continue to use my existing operating system even though I know that it is somewhat inefficient.
IN5: I will continue to use my existing operating system even though I know that the system quality is somewhat unstable.
IN6: I will continue to use my existing operating system even though I know that the interface is not optimal.

*Purchasability*

PC1: It is very easy for me to purchase the new operating system.
PC2: I can afford the new operating system.
PC3: I am able to pay for the new operating system.
PC4: At this stage, the new operating system is easy for me to obtain.
PC5: It is not difficult for me to install the new operating system.
PC6: I think the new operating system is easily accessible.
PC7: Overall, I think the price of the new operating system is reasonable.

*Perceived need*

PN1: At present, I often need to use the new operating system.
PN2: The services offered by the new operating system are important to me.
PN3: I need the new operating system now.
PN4: I strongly desire to upgrade to the new operating system.
PN5: Because of the pressure I feel from others, I strongly desire to upgrade to the new operating system.
PN6: Because of my own desires, I strongly desire to upgrade to the new operating system.

*Procedural switching costs*

PSC1: If I switched to the new operating system, I might have to learn the new user interface.
PSC2: If I switched to the new operating system, it might be a real hassle.
PSC3: If I switched to the new operating system, I might have to spend a lot of time finding a new mode of operation.

*Sunk costs*

SC1: A lot of energy has gone into building and maintaining my current operating system.
SC2: I have put a considerable amount of time into building and maintaining my current operating system.
SC3: A lot of effort has gone into building and maintaining my current operating system.

*Social norms*

SN1: People who are important to me think that I should upgrade to the new operating system.
SN2: People who influence my behavior encourage me to upgrade to the new operating system.

*Uncertainty costs*

UC1: Switching to the new operating system will probably result in unexpected hassles.
UC2: I worry that the new operating system won't work as well as expected.
UC3: I am not sure what the level of operation would be if I switched to the new operating system.

*Personal innovativeness in the domain of IT*

PIIT1: If I heard about a new type of information technology, I would look for ways to experiment with it.
PIIT2: Among my peers, I am usually the first to try out new types of information technology.
PIIT3: I like to experiment with new types of information technology.

PIIT4: In general, I am not hesitant to try out new types of information technology.

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