A Study of Consumers' Upgrade Intention of High-technology Products

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Statement of Originality

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Synopsis

Consumers' upgrading of high-technology products rapidly grows in importance, but is still under-researched. This research aims to investigate the consumer upgrading intentions relating to high-technology products. It expands the prior research on technology acceptance and use in the information systems literature, and consumer upgrade behaviour in the marketing literature, to propose a technology upgrade model. The model extends the most recent extended unified theory of acceptance and use of technology model (UTAUT2) and incorporates two different concepts of satisfaction: satisfaction with a high-technology product, and satisfaction with the underlying technology of a high-technology product. Recency of purchase is hypothesized to moderate the effects of consumer beliefs about a high-technology product on consumer upgrade intentions. Results from a quantitative, cross-sectional study involving an anonymous questionnaire survey of a sample of 410 degree and sub-degree university students in Hong Kong provided empirical support for the model. The results showed that the model is more useful and powerful than the UTAUT2 model for explaining consumer upgrade intentions. The model explained 46.4% and 57.8% of the variation in upgrade intentions for consumers who had purchased a smartphone less than or equal to 12 months previously, and for consumers who had purchased a smartphone more than 12 months previously respectively. This research makes several significant theoretical contributions. Firstly, it extends the generalisability of the UTAUT2 from a consumer acceptance and use context to a consumer upgrade context. Secondly, it explains the contradictory result on the effect of satisfaction on consumer upgrade intentions in prior research. Most significantly, this research showed that the two different concepts of satisfaction regarding a high-technology product were two of the most significant

factors that explain consumers' upgrade of technology. Lastly, it reveals that a technology upgrade decision is similar to a technology acceptance decision when recency of purchase is old, but is more similar to a technology continued use decision when a purchase had been made recently (that is, 12 months or less). This research also indicates several practical implications for marketing managers. Marketers are advised to focus on hedoic motivation in order to attract consumers who made an earlier purchase to upgrade. Marketers should also focus less on price competition but more on product differentiation based on innovation and customer support services to promote upgrades.

Abstract

Consumers are adopting new technologies more readily and replacing high-technology products with improved versions more frequently. This phenomenon is most apparent regarding smartphone adoption and upgrading. Although substantial theoretical and empirical research has been undertaken to explain users' acceptance and use of technology, consumers' upgrading of high-technology products remains largely under-researched.

This research investigates the consumer upgrading intentions relating to high-technology products. The study will undertake this through formulating a technology upgrade model that expands the most recent extended unified theory of acceptance and use of technology model. This study will incorporate three different concepts: satisfaction with a high-technology product, satisfaction with the underlying technology of a high-technology product, and recency of purchase. A quantitative, cross-sectional study involving an anonymous questionnaire survey was conducted on a sample of 410 degree and sub-degree university students in Hong Kong. Confirmatory factor analysis was used to assess the measurement model validity of the technology upgrade model. Structural equation modelling analysis with multi-group analysis was used to assess the structural model validity of the technology upgrade model, the relationships between the constructs, and the moderating effect of recency of purchase. Empirical support is evident for the proposed technology upgrade model's applicability to the consumer upgrade context. The variance explained in consumer upgrade intentions was substantial. The model explained 46.4% of the variation in consumer upgrade intentions for consumers who had purchased a smartphone less than or equal to 12 months previously; this was 57.8% when the purchase had been made more than 12

months previously. This suggests that the proposed technology upgrade model is useful and powerful for explaining consumer upgrade intentions regarding high-technology products.

The major findings from testing the proposed technology upgrade model reveal the following:

1. The proposed technology upgrade model (as a development of the extended unified theory of acceptance and use of technology model, incorporating satisfaction and recency of purchase) is relevant and powerful for explaining consumer upgrade intentions relating to high-technology products.
2. Prior research on the extended unified theory of acceptance and use of technology model suggests that seven significant factors influence consumer acceptance and use intention (Venkatesh, Thong, & Xu, 2012). In contrast, this research shows that only four factors—effort expectancy, social influence, facilitating conditions and hedonic motivation—are significant in relation to consumer technology upgrades.
3. This research verifies that two different concepts of satisfaction relate to consumer technology upgrades. These are satisfaction with the current high-technology product, and satisfaction with the technology that supports the current high-technology product. While consumers who are dissatisfied with their current high-technology product are more likely to upgrade, satisfaction with the technology that supports the current high-technology product actually influences upgrading intentions. This research shows that these satisfaction-related concepts are two of the most significant factors that explain consumer technology upgrades.

4. This research also shows that consumers made significantly different considerations regarding upgrading decisions when recency of purchase was greater than 12 months and less than or equal to 12 months. When recency of purchase was greater than 12 months, consumers were driven to upgrade more strongly by effort expectancy, social influence and hedonic motivation. However, these consumers were not driven by facilitating conditions. When recency of purchase was less than or equal to 12 months, consumers who were satisfied with their current high-technology product were reluctant to upgrade. However, those who were more satisfied with the technology supporting their current high-technology product were more attracted to upgrades linked to gaining further benefits from the technology.

This research seeks to identify the significant factors that influence consumer upgrading intentions regarding high-technology products. This research reveals that the proposed technology upgrade model incorporating satisfaction and recency of purchase is more applicable and powerful than the extended unified theory of acceptance and use of technology model for explaining consumer upgrading intentions regarding high-technology products. Additionally, the research results suggest that a technology upgrade decision is similar to a technology acceptance decision when recency of purchase is greater than 12 months, but is more similar to a technology continued use decision when recency of purchase is less than or equal to 12 months.

This research indicates several practical implications for marketing managers of consumer technology vendors in product design, promotion, pricing and customer support. The findings show that consumers who wait longer to make an upgrade perceive hedonic motivation as vital. Hence, marketers are advised to focus on the

development of new features or the ‘look and feel’ that will make the usage experience enjoyable for these customers. Consumers are increasingly regarding high-technology products as essential. Therefore, consumers may become insensitive to price when considering an upgrade. Marketing managers should focus less on price competition and more on product differentiation. Finally, only consumers who are satisfied with using a technology but are no longer satisfied with their current high-technology product will consider upgrading to an improved product. In evaluating consumer satisfaction and potential for an upgrade, marketing managers must measure not only consumer satisfaction with the current high-technology product, but also their satisfaction with the technology that supports the product.

Chapter 1 Introduction

High-technology products are highly complex and have a high product-development rate with frequent releases of successive versions and generations (Steenhuis & De Bruijn, 2006). Examples of high-technology products include video game consoles, smartphones, flat-screen high-definition televisions, three-dimensional (3D) printers and robots. Recently, the product-development rate of some high-technology products has increased. Consumers are more readily adopting new technologies and are also frequently replacing high-technology products with improved versions (Farago, 2012; Voorhees-Harmon, 2012). This phenomenon is particularly apparent regarding smartphone development (International Data Corporation, 2014; Lipsman, 2014; Perez, 2015).

A *technology upgrade* is defined as when consumers purchase the improved version of a high-technology product to replace their current high-technology product (Kim & Srinivasan, 2009). While consumers upgrade some improved high-technology products readily, other improved products fail to attract upgrading. Recent examples of this include Windows 8, the Nintendo Wii U game console and 3D television (Cass, 2014; Hahs-Vaughn & Lomax, 2013; MacDonald, 2014). Additionally, companies often fail to forecast the demand for improved high-technology products accurately; this situation arose with Apple's iPhones and Samsung's Galaxy new smartphones, resulting in product shortages (Garside & Correspondent, 2013; Lehman, 2014). Inadequate business understanding of the significant factors that influence a consumer's intention to upgrade high-technology products is considered a major cause of these problems (Lee & Stewart, 2015). Although substantial theoretical and empirical research has been

undertaken to explain users' acceptance and use of technology in organisational and consumer contexts (in particular with the technology acceptance model [TAM], and its extensions, such as the most recently extended unified theory of acceptance and use of technology [UTAUT2] model) the factors influencing consumer intentions to upgrade technology are under-researched (Tseng & Lo, 2011; Venkatesh et al., 2012).

This thesis expands the prior research on technology acceptance and use in the information systems literature, and consumer upgrade behaviour in the marketing literature, to propose a technology upgrade model that explains consumer upgrade intentions regarding high-technology products. Chapter 1 presents the research's background and introduces its aim. Describing the managerial problem to be addressed identifying research gaps in the literature provide a justification for the research. The research questions are then presented. This chapter also presents a conceptual framework, discussing the relationships between the constructs in that framework. The chapter concludes with an overview of the research methodology and a summary of the study's findings and implications. Finally, the thesis structure is described.

1.1. Background

High-technology products are defined as technology products that have a high product-development rate (Steenhuis & De Bruijn, 2006). As high-technology products are generally built using cutting-edge technology, which develops rapidly and evolves constantly, these products typically have short and volatile lives, with frequent releases of successive versions and generations (Gardner, Johnson, Lee, & Wilkinson, 2000). As technology develops quickly and only momentarily reaches maturity, the definition of a what is a high-technology product can shift over time (Mohr, Sengupta, & Slater, 2010).

High-technology products in the 1990s, such as dial-up modems, would be considered low-technology products by current standards.

The major high-technology include information technology, computer hardware and software, telecommunications and internet infrastructure, and consumer electronics. In addition, high-technology can encompass a range of other industries, including biotechnology, medical equipment, nanotechnology, robotics, and transportation and energy technologies (Mohr et al., 2010). Mobile communications are an example of a major and rapidly growing high-technology development for mobile communications infrastructure and mobile consumer electronics, as well as software application development (Danova, 2014).

The impact of high-technology products is pervasive. In contemporary society, high-technology products have already become an integral part of our personal lives. High-technology products affect how we communicate, evidenced by the approximately one in every five people globally who owned a smartphone in 2013 (Fitchard, 2013). These products also affect how humans acquire information. It is predicted that over 50% of the global population will have internet access by 2017; over 50% of the population of 77 countries were ‘online’ in 2014 (ITU, 2014). High-technology products also change how goods and services are purchased. Worldwide business-to-consumer (B2C) e-commerce sales reached $1.25 trillion in 2013 (eMarketer, 2014). Additionally, high-technology products have changed leisure-time behaviour. In an online poll of 28,000 Canadians, Canadian smartphone owners reported that they spent (on average) nearly 90% of their free time staring at one of their many screen-based devices, such as a TV, smartphone, personal computer or tablet (Oliveira, 2014).

High-technology products contain both promise and peril. Radical technological innovation can offer exciting possibilities and promising solutions to many seemingly intractable problems, such as global warming and minimal information accessibility in impoverished regions. An example of a more sustainable technology developed in response to global warming is the light-emitting diode (LED), which began as a general lighting technology in the 2000s (Energy.gov, 2013). After a decade of research and development, this technology is now commercially in large volumes and has become one of the most energy-efficient and rapidly developing lighting technologies. In comparison with incandescent bulbs, LED lighting bulbs can last 25 times longer and consume 75% less energy (Energy.gov, 2012a). Lighting consumption in the United States of America (US) accounted for 14% of all building electricity use in 2012 (Energy.gov, 2012b). Hence, changing to LED lighting could reduce electricity consumption and thus greenhouse gas emissions. Importantly, reducing greenhouse gas emissions is crucial in fighting global warming. Development of the internet is an example of technological advances regarding access to information. The internet has developed rapidly since its inception (Davidson, 2015). The number of global internet users reached 3.42 billion in 2016 (Kemp, 2016). According to the United Nations (UN) (2010), the internet brings information and knowledge to improvised areas, educating people and helping to eradicate poverty. The diverse range of new technologies (with just two examples given above) offers many potential advantages and apparently infinite possibilities for improving living standards, ensuring business operates more effectively and efficiently, and solving social problems.

However, high-technology products also pose a risk. The failure rates of high-technology products are usually well over 50% higher than those of other products

generally (Mohr et al., 2010). All too often, new high-technology products fail to achieve commercial success, as with Sirius XM's satellite radio, Segway's two-wheel personal transportation vehicle, Microsoft's Windows Vista operating system, and Google's Google Glass (Altman, 2015; McIntyre, 2009). While technological superiority is essential for the success, alone is insufficient. High-technology companies must complement their technological superiority with a set of marketing competencies to achieve success with these products. One important marketing competency is a solid understanding of how and why consumers decide to adopt and use high-technology products (Mohr et al., 2010).

Marketing high-technology products differs from more general product marketing. Notably, marketing high-technology products involves much market and technological uncertainty, as well as competitive volatility (Gardner et al., 2000; Moriarty & Kosnik, 1989). Market uncertainty refers to the ambiguity regarding what consumers want from new high-technology products. Market uncertainty arises as consumers often do not completely understand the possibilities offered by new technologies, due to the products' complexity and innovativeness (Chtourou & Souiden, 2010). At the same time, consumers generally are unable to articulate what they need from new high-technology products. As Apple's former Chief Executive Officer Steve Jobs has explained, 'People don't know what they want until you show it to them' (Mui, 2011, para. 4). Consumer needs may also change rapidly and unpredictably as they acquire knowledge about new high-technology products and particularly as new technologies further (Mohr et al., 2010). Thus, understanding the reasons for consumers' adoption and use of high-technology products requires specific research. In addition, the development of high-technology products is technologically uncertain, as it is unclear whether new

high-technology products are capable of delivering on their promises to meet consumer needs. Finally, competitive volatility is also high, due to the elevated degree of change and uncertainty present in the competitive landscape.

New high-technology products are normally original and rely on technological breakthroughs, whereas improved versions of high-technology products are more likely to be product-line extensions or product modifications. While consumer adoption intentions will involve a long cognitive process regarding both new high-technology products and improved versions of high-technology products, the considerations for each can be very different (Souiden, Pons, & Mayrand, 2011). Consumers' adoption intention is better researched in relation to the acceptance of new high-technology products. A variety of cognitive assessments and emotional perceptions have been identified as influencing consumers' intentions to adopt new high-technology products (Venkatesh, Morris, Davis, & Davis, 2003; Venkatesh et al., 2012). Empirical findings reveal that aspects of cognitive assessments and emotional perceptions can also affect consumers' intentions to upgrade to improved versions of a high-technology product (Tseng & Lo, 2011). Satisfaction with the use of the current high-technology product has a critical effect on a consumer's decision to upgrade decision to an improved version of the product; this differs from the adoption of a new high-technology product not used previously (Tseng & Lo, 2011; Yoon & Lilien, 1985). However, research on consumer upgrades of high-technology products is still preliminary, and the findings are inconclusive (Aldhaban, 2012; Bolton, Lemon, & Verhoef, 2008; Tseng & Lo, 2011).

1.2. Adoption and Upgrade of High-technology Products by Consumers

The recent development of high-technology products shows that consumer adoption of these products is pervasive; the use of high-technology products is now commonplace.

The International Data Corporation (2014) reports that smartphone devices accounted for 55.1% of all mobile phone shipments, reaching one billion units, in 2013. About one in every five people in the world owned a smartphone in 2013 (Fitchard, 2013). In that year, the adoption rate of smartphones was as high as 87% in Hong Kong (Magdirila, 2013). Regarding internet use, it is predicted that more than half of the global population will have internet access by 2017; already, 77 countries had internet access for more than half of their population in 2014 (ITU, 2014). After being available for only two years, one in every 17 people globally owned a tablet device in 2013 (Heggestuen, 2013).

Consumer adoption of high-technology products is also increasing. The fast rate of adoption has been unprecedented when compared with other technology products historically. The adoption rate of smartphone devices is estimated as being ten times faster than that of personal computers (PC) in the 1980s; two times faster than internet adoption in the 1990s; and three times faster than the uptake of social networks such as Facebook and LinkedIn (Farago, 2012). Tablets are showing an even faster adoption rate than smartphones. Smartphones took nearly four years to reach 6% penetration, while tablets accomplished this percentage in only two years (Heggestuen, 2013).

High-technology products are not only adopted widely by consumers, but have also become an indispensable part of their daily lives. Research by Google (2013) reports that smartphones have become an indispensable tool, transforming consumer behaviour, and changing the way that consumers shop. In the US, 67% of smartphone users access the internet with their smartphone daily and most will not leave home without it (Google, 2013). Smartphones are also used to purchase products and services. In the US, 77% of smartphone users have researched a product or service with their smartphone;

46% of smartphone users have made a purchase with their smartphone. Canadian smartphone owners report spending on average nearly 90% of their free time staring at one of the many screen-based devices they own, including TVs, smartphones, PCs and tablets (Oliveira, 2014).

In the near future, wearable technologies are expected to have as much, or an even greater, impact on consumers than smartphones. Although wearable technologies remain under-developed, some innovative products such as smartwatches have already shown rapid growth in market volume, revealing an enormous market potential. The global smartwatch industry reached a market volume of USD 700 million in 2013, which is ten times the size 2012 market size (Smartwatch Group, 2014). Smart fitness tracking devices (i.e., Fitbit trackers)—as either technology or fashion products—have attracted extensive market, as well as investor, attention (Gandel, 2015; Goode, 2016).

In addition, while improved versions of some high-technology products are introduced, consumers also upgrade to the improved versions of these products just as frequently (Voorhees-Harmon, 2012; Witkowski, 2013). This phenomenon is mostly apparent in relation to current smartphone developments. New smartphones are released regularly, with the average number of days between smartphone rollouts declining from about 380 days in 2008 to 100 days in 2012 (Witkowski, 2013). In 2012, consumers replaced their smartphones every 22 months in the US (Hoelzel & Ballve, 2013). Hong Kong consumers are reported as making increasingly frequent upgrades (Perez, 2015). Deloitte (2015) estimates that one billion of the 1.4 billion smartphones sold globally in 2015 were upgraded versions.

1.3. Research Justification

As this study posits that consumers embrace new technologies more readily and also upgrade their high-technology products frequently (Farago, 2012; Voorhees-Harmon, 2012), a thorough understanding of consumer reasons for adopting technology upgrades is essential for the marketing managers of consumer technology vendors. As two-thirds of smartphones sold globally are expected to be upgrades (Deloitte, 2015), this understanding is especially important for smartphone vendor marketing managers. However, marketing managers still face a number of challenges. For instance, while consumers upgrade some improved high-technology products readily, other improved products still fail to gain consumer acceptance. In addition, companies often fail to forecast demand for their improved high-technology products accurately. These problems can be attributed to an inadequate understanding of the significant factors that influence consumers' intentions to upgrade their high-technology products. With high-technology companies adopting increasingly rapid release cycles, understanding the factors that influence consumer intentions to upgrade high-technology products is increasingly vital.

A literature review has revealed that substantial theoretical and empirical research exists that explains users' acceptance and use of technology in organisational and consumer contexts. In particular, this relates to TAM and its extensions, such as the UTAUT2 model. However, consumer technology upgrades remains an under-researched area (Tseng & Lo, 2011; Venkatesh et al., 2012).

Technology upgrading is a recently developed research area related to technology acceptance and use. It focuses on examining consumers' decisions regarding upgrades to improved versions of high-technology products. While research related to consumer

high-technology product upgrades exits, in the literature this research is limited to particular product categories, such as PCs, palm personal digital assistants (PDAs) and mobile phones (Huh & Kim, 2008; Kim, Srivastava, & Han, 2001; Kim & Srinivasan, 2009; Tseng & Lo, 2011). This is becoming too outdated for understanding consumer upgrades of recent high-technology products, such as smartphones and wearable devices (Farber, 2014; Yang, Yu, Zo, & Choi, 2016). Tseng and Chiang (2013) and Tseng and Lo (2011) have expanded TAM to incorporate satisfaction and other psychological aspects relating to consumer choice (e.g., perceived enjoyment and perceived price). This is done to explain consumer upgrade intentions, although TAM only partially explains these intentions. Consumers who perceive the improved product as more useful and easier to use do not necessarily possess more intention to upgrade. This finding contrasts with most outcomes associated with TAM and UTAUT regarding consumer technology acceptance and use. Since this research was undertaken by Tseng and Chiang (2013) and Tseng and Lo (2011), no further studies on TAM or its extensions in relation to technology upgrades have appeared. Hence, new research is required to verify TAM's (and its extensions) relevance for explaining consumer upgrades of high-technology products.

Additionally, while Tseng and Chiang (2013) and Tseng and Lo (2011) extended TAM to incorporate perceived enjoyment and perceived price, they failed to consider other important factors relevant to consumer upgrade intentions, such as social influence and facilitating conditions (Venkatesh et al., 2012). UTAUT2 is a recent extension of TAM and UTAUT, adapted for use in consumer contexts. It captures several important beliefs held by consumers that Tseng and Chiang (2013) and Tseng and Lo (2011) do not consider. As such, UTAUT2 is expected to be more powerful and relevant than Tseng

and Chiang's (2013) and Tseng and Lo's (2011) extended TAM for explaining consumer upgrade intentions towards high-technology products (Venkatesh et al., 2012). However, no research is yet available regarding UTAUT2 in relation to consumers' intentions to upgrade their high-technology products.

Further, recent studies have revealed that consumer satisfaction with a high-technology product has an opposite effect on their use of and upgrade intentions towards high-technology products (Tseng & Chiang, 2013; Tseng & Lo, 2011). However, these results are inconclusive. In general, satisfied are more likely to continue using their current high-technology product (Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004). Tseng and Chiang (2013) and Tseng and Lo (2011) expected that satisfied consumers were also more likely to upgrade, based on the expectation that satisfied consumers were more engaged with high-technology products, However, their research reported the opposite. They explained that consumers might have no plan to upgrade if they were satisfied with their current high-technology product. Nevertheless, findings on the effect of satisfaction on consumer technology upgrades are limited and inconclusive. Further research is required to validate the effect of satisfaction.

Studies in the information systems and marketing literature on consumer upgrade behaviour regarding services suggest that two different concepts of satisfaction exist in relation to upgrade decisions (Bolton, Lemon, & Verhoef, 2008; Eriksson & Nilsson, 2007). These are satisfaction with the consumer's current product and satisfaction with the *source* that enables delivery of the current product, and higher performance and improvement in other aspects of the product upgrade (i.e., the service provider). While the first type of satisfaction will affect consumer upgrade intentions negatively, the second type of satisfaction will affect consumer upgrade intentions positively (Bolton et

al., 2008). As two different concepts of satisfaction are involved in consumer upgrade decisions regarding services, two different concepts of satisfaction may also exist in consumer upgrade decisions regarding high-technology products. However, no research has been conducted to verify that these two concepts of satisfaction exist in a way that could potentially influence consumer intentions to upgrade their technology.

In view of the identified research gaps, further examination is required regarding identification of the factors that influence consumer intentions to upgrade high-technology products. In particular, research is needed to verify the UTAUT2 model's relevance for explaining consumer upgrade intentions towards high-technology products. In addition, study is also required regarding the effect of consumers' satisfaction with their current high-technology products on their upgrade intentions towards high-technology products.

1.4. Aim of the Research

The aim of this research is to describe the relationships between high-technology product consumers' psychological factors and upgrade intention. An understanding of what psychological factors influence consumers to upgrade will provide a solid foundation for the development of a powerful technology upgrade model for explaining and predicting consumers' upgrade intention towards high-technology products.

1.5. Research Questions

The following research questions have been identified from a review of the literature relating to technology acceptance and use and consumers' upgrade behaviour (with an emphasis on technology upgrades):

- **RQ1:** What significant factors influence consumer upgrade intentions towards high-technology products, particularly with reference to the UTAUT2 model and consumer satisfaction?

The sub-questions include:

- **RQ1a:** What is the relative importance of each factor with respect to consumer upgrade intentions towards high-technology products?
- **RQ1b:** How relevant is UTAUT2 to explaining consumer upgrade intentions towards high-technology products?
- **RQ1c:** What is the effect of satisfaction with the current usage of high-technology products on consumer upgrade intentions towards high-technology products?

1.6. Proposed Conceptual Framework

A technology upgrade model and a set of hypotheses were developed to answer the research question relating to identifying the significant factors that influence consumer upgrade intentions towards high-technology products. This is based on prior research into technology acceptance and use in the information systems literature, and consumer upgrade intentions in the marketing literature. The technology upgrade model is proposed as an extension of the UTAUT2 model, incorporating the satisfaction and recency of purchase concepts. From the UTAUT2, six factors—performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value—in relation to consumer beliefs regarding using an improved version of a high-technology product are expected to influence consumer upgrade intentions positively. Two concepts of satisfaction are expected to both influence consumer

upgrade intentions, but with opposite effects. While satisfaction with a current high-technology product is expected to affect a consumer's upgrade intention negatively, satisfaction with the technology that supports the current high-technology product is expected to affect a consumer's upgrade intention positively. Recency of purchase (of the current high-technology product) is expected to moderate the effects of consumer beliefs about the improved product on upgrade intentions in a positive way. Additionally, recency of purchase is also expected to moderate the effect of satisfaction with the current high-technology product positively and to moderate the effect of satisfaction with the technology supporting the current high-technology products on consumer upgrade intentions in a negative way. The proposed conceptual framework is presented below in Figure 1.1.

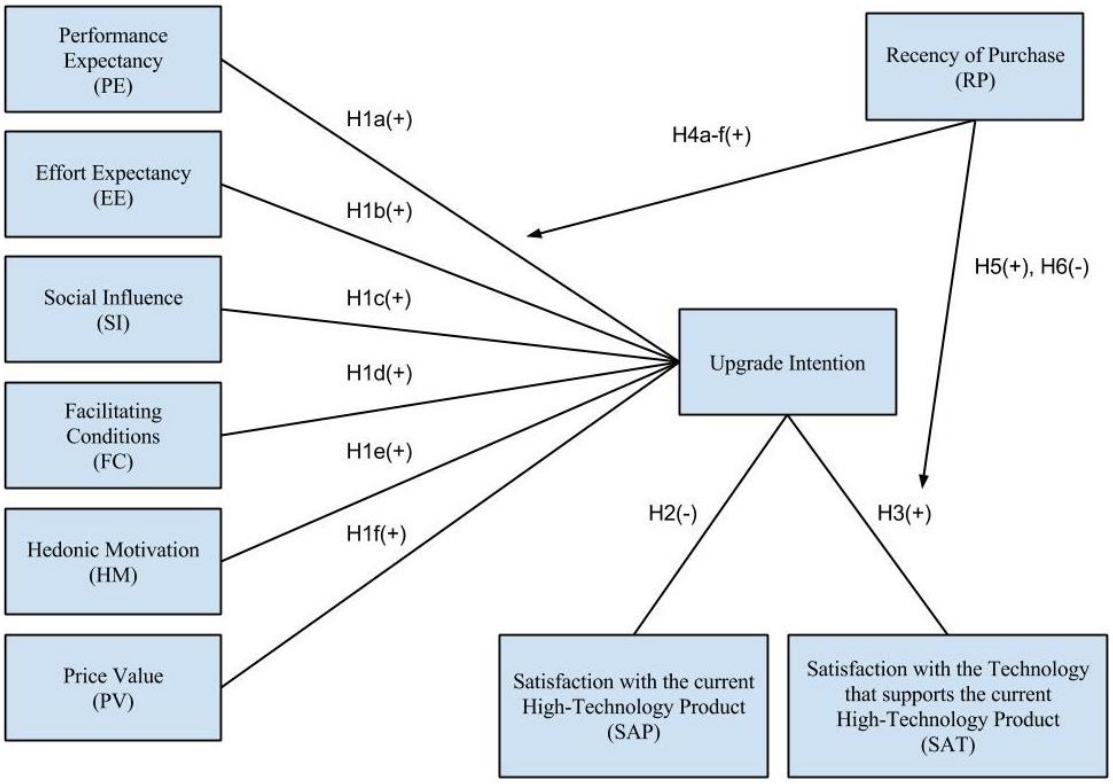


Figure 1.1 Proposed Technology Upgrade Model

1.7. Research Methodology

This study uses a quantitative, cross-sectional design, comprising an anonymous questionnaire survey collected from a sample of 410 degree and sub-degree university students in Hong Kong. Data were collected in two stages. Smartphones were chosen as the high-technology product for study. All scales for psychological factors and consumer upgrade intentions in the questionnaires were adapted from existing research proven as reliable and valid. A review of the scales was conducted before questionnaire administration to ensure the questionnaire items were understandable, worded clearly, and represented the concepts measured. Data collection was conducted safely in classrooms at the university and its affiliated institutions in Hong Kong over five weeks. The researcher administered to participants. The completed questionnaires were secured in a collection box. Implied participant consent was assumed when the anonymous questionnaires were completed and returned to this secure collection box.

1.8. Data Analysis

Descriptive statistics of the demographics were prepared to describe the sample. Data normality in the sample was assessed. Confirmatory factor analysis (CFA) was used to assess the measurement model validity of the technology upgrade model. Structural equation modelling (SEM) analysis (incorporating multi-group analysis) was then applied to assess the structural model validity of the technology upgrade model, the relationships between the constructs, and the moderating effect of recency of purchase. Finally, the research hypotheses were tested.

1.9. Research Findings

In this research, the six factors relating to using an improved version of a high-technology product, and the two concepts of satisfaction regarding the current high-technology product, were tested. The model's applicability for explaining consumer upgrade intentions was assessed. Additionally, the study tested the moderating effect of recency of purchase. Of the six UTAUT2 factors, four—effort expectancy, social influence, facilitating conditions, and hedonic motivation—were significant for influencing consumer upgrade intentions towards a high-technology product. However, contrary to expectations, the other two UTAUT2 factors—performance expectancy and price value—did not influence consumer upgrade intentions towards high-technology products. This suggests that consumers might be more concerned about hedonic motivation than task performance in the use and upgrade of consumer technologies, in particular for smartphones. In addition, consumers might become price insensitive in relation to upgrading a high-technology product when they are used to making frequent upgrades of that product. As hypothesised, satisfaction-related concepts in relation to using a current high-technology product (satisfaction with the current high-technology product and satisfaction with the technology supporting the current high-technology product) were significant factors that influenced consumer upgrade intentions. While satisfaction with the current high-technology product may result consumers being reluctant to upgrade, satisfaction with the technology that supports the current high-technology product could drive consumers to upgrade so that they benefit more from the technology.

In relation to the recency of purchase's moderating effect, consumers had significantly different considerations regarding upgrade decisions when recency of purchase was

greater than 12 months, and less than or equal to 12 months. When recency of purchase was greater than 12 months, consumers were driven to upgrade more strongly by effort expectancy, social influence, and hedonic motivation. However, these consumers were not driven to upgrade by facilitating conditions. When recency of purchase was less than or equal to 12 months, consumers were not only more affected by satisfaction with the current high-technology product, considering the upgrade unnecessary, but they were also more affected by satisfaction with the technology supporting the current high-technology product, increasing their interest in an upgrade.

The proposed technology upgrade model was determined as useful and powerful for explaining consumer upgrade intentions towards high-technology products. The variance explained in consumer upgrade intentions was substantial, with 46.4% when recency of purchase was less than or equal to 12 months, and 57.8% when recency of purchase was greater than 12 months.

1.10. Research Significance

The findings of this research have significant theoretical and practical implications. Therefore, this research has not only contributed to scholarly research, but it also has benefits for consumer technology vendor marketers.

1.10.1. Theoretical Contribution

This research makes significant theoretical contributions to understanding consumers' upgrade behaviour in relation to high-technology products. The contributions are related to a number of academic areas, including consumer behaviour, the marketing of high-technology products, technology acceptance, technology continued use, and technology upgrades. The details of these contributions are outlined below:

1. This research provides a theoretical model that is an extension of UTAUT2 for predicting and explaining consumer upgrade intentions towards high-technology products.
2. This research verifies the relevance of the UTAUT2 model for explaining consumer upgrade intentions towards high-technology products. The UTAUT2 model is a recent extension of TAM and UTAUT that applies to consumer use contexts and captures several important beliefs of consumers. Despite this, no research exists that uses UTAUT2 in relation to consumer upgrade intentions (Venkatesh et al., 2012).
3. Prior research on the UTAUT2 model suggests that seven factors are significant for influencing consumer acceptance and use intentions (Venkatesh et al., 2012). This research shows that only four factors—effort expectancy, social influence, facilitating conditions, and hedonic motivation—are significant in relation to consumer technology upgrades.
4. This research verifies that two different concepts of satisfaction apply to a consumer's technology upgrade decision. These are satisfaction with the current high-technology product, and satisfaction with the technology that supports the current high-technology product. While the former affects consumer upgrade intentions negatively, the second affects consumer upgrade intentions positively. Prior studies (in both the information systems and marketing literature) on consumer upgrade behaviour in relation to services suggest that two different concepts of satisfaction operate in consumer upgrade decisions (Bolton et al., 2008; Eriksson & Nilsson, 2007). However, no research has yet been conducted to verify that these concepts exist, and how they may influence consumer upgrade intentions towards high-technology products.

5. Most importantly, this research has determined that the concepts relating to satisfaction with a current high-technology product are two of the most significant factors that explain consumer technology upgrades.
6. This research has also investigated how recency of purchase moderates the effects of consumer beliefs about the use of an improved high-technology product, and the two concepts of satisfaction with current high-technology product use on consumer upgrade intentions.
7. This research shows that consumers perceive a technology upgrade decision is similar to a technology acceptance decision when recency of purchase is greater than 12 months, but is similar to a technology continued use decision when recency of purchase is less than or equal to 12 months.

1.10.2. Practical Contribution

This research has several practical implications for the marketing managers of consumer technology vendors in product design, promotion, pricing and customer support. The findings may help marketing managers to forecast the demand for new versions of high-technology products more accurately, as well as operate more successfully in marketing these products to consumers. The details of these contributions are outlined below:

1. Overall, this research provides marketing managers with a better understanding of consumers upgrade behaviour in relation to high-technology products. With this improved understanding, marketing managers can forecast the demand for new versions of high-technology products more accurately and devise highly effective marketing strategies.

2. This research suggests that consumers who wait for more than one year to make an upgrade will perceive hedonic motivation as a major reason for the upgrade. Hence, marketers should develop new features, or design products with a new look and feel that will make using the product more pleasurable (i.e., enhanced graphic support for playing of games or a more playful physical appearance) and encourage these consumers to upgrade.
3. This research suggests that effort expectancy is particularly essential for consumers who wait for more than one year to make an upgrade. These consumers demand the upgrade is easy to use. If an improved product is perceived as too complex to use, consumers may be deterred from making the upgrade.
4. Consumers are affected by social influence. They are more likely to make an upgrade if their relatives or close friends believe they should make the upgrade. Marketers should use mass media as well as social media to create a strong social influence that promotes new versions of high-technology products.
5. Customer support is important to consumers who make an upgrade within one year. These consumers are likely to expect effective support for their upgrade, as was available with their recently purchased high-technology product.
6. The results in relation to price value suggest that consumers do not consider price an important consideration when making an upgrade. As consumers become more used to making frequent upgrades, they are likely to perceive their high-technology products as necessities and become increasingly insensitive to price. Marketers are advised to focus less on price competition and more on product differentiation based on innovation and customer support to promote upgrades.

7. Satisfaction is also crucial in driving consumers to make an upgrade. Only consumers who are satisfied with the use of a technology (but are dissatisfied with the current high-technology product) will upgrade to an improved product. Hence, to evaluate consumer upgrade potential, marketing managers must measure consumer satisfaction with the current high-technology product, as well as their satisfaction with the technology that supports the product. In addition, marketing managers must also address consumer dissatisfaction with the current high-technology product by improving performance or introducing new features to encourage upgrades.
8. This research suggests that consumers who have owned their current high-technology product for less than or equal to one year behave significantly differently when considering an upgrade in comparison to consumers who have owned the current high-technology product for more than one year. Marketing managers should segment these two groups of consumers and target them with different marketing strategies.

1.11. Limitations and Directions for Future Research

This research has limitations and also provides several indications for future research in relation to the research design and methodology. The details of these limitations and indications are outlined below:

1. The finding's generalisability may be of concern. This study was conducted in Hong Kong. As Hong Kong residents show a very high adoption rate of smartphones, the findings may not be generalisable to other countries that are less technologically advanced. Additionally, this study only sampled students aged mainly between 18 and 26 years. Finally, only smartphone upgrades were

examined. Future research may use non-student samples and conduct research in other countries to validate the results of this research. Other high-technology products such as tablets and wearable smart devices can also be studied.

2. This research used a cross-sectional study design and ignored longitudinal observations. User behaviour can vary with time. However, any change in upgrade behaviour over time was not captured by this study. Future research may adopt a longitudinal design to study any changes in consumer upgrade behaviours over time.
3. This study used only self-reported measures of behaviour. However, users' self-reported upgrade intentions may not measure their actual upgrade behaviour. Future research could measure the actual upgrade behaviour directly, instead of the upgrade intention.
4. As a single questionnaire was used to collect data for all measures, the data might be susceptible to common method variance. Future research could adopt a more rigorous design to reduce measurement bias.
5. This study found that performance expectancy and price value were not significant determinants of consumer upgrade intentions. This result was contrary to the findings from research on consumer acceptance and use of technology (Venkatesh et al., 2012). Future research may validate the results, using the proposed technology upgrade model with different samples and high-technology products.
6. This study focused on the UTAUT2 model to examine consumer upgrade intentions towards high-technology products. Future research may study other consumer psychological factors such as desire for unique consumer products (Lynn & Harris, 1997) and affinity with brands (Lee, 2011).

7. This study examined the moderating effect of recency of purchase. A closely related measure—jump in improvement, which measures whether an improvement is a major innovation or simply a modification—is also expected to have a moderating effect on consumer upgrade intentions. Future research could study the moderating effect of jump in improvement and its relationship with recency of purchase.

1.12. Thesis Structure

This thesis is divided into five chapters. Chapter 1 (Introduction) has provided the study's background, justification and aims. It briefly introduced the information systems and marketing literature that have provided the theoretical foundation for developing the proposed technology upgrade model to explain and predict consumer upgrade intentions towards high-technology products. This chapter has also presented an overview of how the study was undertaken, along with a summary of the findings and the study's implications. Chapter 2 (Literature Review) will review high-technology products and the literature relating to technology acceptance and use, and consumer upgrade behaviour. In particular, this review will focus on consumer upgrades of technology, which comprises a recent stream of technology acceptance and use. The research questions will be identified, based on the discussion of the relevant literature. These will address gaps in the research on consumer technology upgrades. A conceptual framework and hypotheses will be developed to answer the identified research questions. Chapter 3 (Methodology) presents the study's research design and methodology. It describes how the study was developed using a quantitative, cross-sectional design, with an anonymous questionnaire survey answered by a sample of 410 degree and sub-degree students in Hong Kong. This was undertaken in two stages. The chapter will also

discuss the choice of smartphone as the high-technology product for study. The questionnaire scales for psychological factors and upgrade intentions of consumers are also presented here. The measures' reliability and validity are reviewed. The questionnaire administration procedures are explained. The data analysis methods, using CFA and SEM analysis (including multi-group analysis) are also presented. Chapter 4 (Data Analysis) presents the results of the analysis. A general picture of the participants is given through descriptive statistics on demographic and recency of purchase aspects. The CFA results for assessing the measurement model validity of the technology upgrade model are presented. The results of the SEM analysis (with multi-group analysis) for assessing the structural model validity of the technology upgrade model, the relationships between the constructs, and the moderating effect of recency of purchase are also discussed here. Finally, the chapter presents the tests of the research hypotheses. Chapter 5 (Discussion and Conclusion) interprets the findings and explains the results for each hypothesis test. After discussing the results of the hypothesis tests, the findings are then examined in relation to how they extend the prior knowledge and aid understanding of consumer technology upgrade behaviour. Practical implications for the marketing managers of consumer technology vendors (including product design and promotion strategies for high-technology products) are discussed. Research limitations are suggested to identify possible areas for future research.

Chapter 2 Literature Review

This chapter reviews high-technology products and the literature relating to technology acceptance and use and consumers' upgrade behaviour. The focus here is on technology upgrades. As the widely cited and tested TAM is highly influential in research on technology acceptance, the review will focus specifically on research relating to this model and its two notable extensions. These are the UTAUT and UTAUT2 models. The review also examines consumer technology upgrades, which is a recent stream of technology acceptance and use. Substantial theoretical and empirical research has been undertaken with TAM (and its extensions) to explain users' adoption of technology in organisational and consumer contexts. However, minimal research based on the TAM and its extensions exists in relation to consumer technology upgrades. In particular, the significant factors that influence consumer upgrade intentions towards high-technology products are under-researched. As a result, this study is interested in identifying the factors that influence consumer intentions to upgrade high-technology products. This study also focuses on the upgrade of smartphones, as an example of upgrading high-technology products. Based on a discussion of the relevant literature, research questions are identified here to address gaps in the research on consumer upgrades of technology. A conceptual framework and hypotheses are also developed to answer the identified research questions.

2.1. High-technology Products

High-technology products are generally built using cutting-edge technology and highly complex (Steenhuis & De Bruijn, 2006). They have short and volatile lives and undergo frequent releases of successive versions and generations (Gardner et al., 2000). Most

1990s high-technology products, such as dial-up modems, have reached their maturity and have been replaced by new generations of high-technology products, such as cable or fibre optic modems (Federal Communications Commission, 2014). Chapter 1 outlines some more recent examples of high-technology products.

With recent rapid advancements in technology and innovation, the product-development rate of some high-technology products has increased. New technologies, such as tablets and smartphones, have been developed rapidly and have also gained wide consumer acceptance more readily (Fitchard, 2013; Heggestuen, 2013). Consumers have also replaced high-technology products with their improved versions more frequently. This is particularly apparent with the current development of smartphones (Hoelzel & Ballve, 2013; International Data Corporation, 2014; Lipsman, 2014; Perez, 2015).

When consumers purchase an improved version of a high-technology product to replace their current high-technology product, this is defined as a technology upgrade (Kim & Srinivasan, 2009). Companies' understanding of the significant factors that influence consumers to upgrade their high-technology products is often inadequate (Lee & Stewart, 2015). For instance, many improved products (such as Windows 8, the Nintendo Wii U game console, and 3D TV) have been unsuccessful in encouraging consumers to upgrade (Cass, 2014; MacDonald, 2014; Vaughan-Nichols, 2013). In addition, companies often make inaccurate forecasts regarding the demand for improved high-technology products (i.e., Apple's iPhones and Samsung's Galaxy smartphones). As market competition is becoming fiercer and companies are adopting increasingly rapid release cycles, a solid understanding of the factors that influence consumer upgrades of high-technology products has also become increasingly important.

Tseng and Lo (2011) consider that a technology upgrade is the purchase of an improved version of a high-technology product that offers 'some innovative functions' and 'the same basic functions' (p. 74). This is because the improved version's basic functions are essentially the same as those of the current high-technology product. Based on Tseng and Lo's (2011) understanding of a technology upgrade, consumer upgrade decisions involve both acceptance of the innovative functions and continued use of the basic functions of the improved high-technology product. Hence, technology upgrades are related closely to technology acceptance and use. It is expected that the research on user acceptance and use of technology will provide a solid theoretical foundation for understanding consumer intentions towards upgrading high-technology products. A review of the research on user acceptance and use of technology is presented below.

2.2. Technology Acceptance and Use

Understanding users' acceptance and use of technology is an advanced research area related to information systems (Lee, Kozar, & Larsen, 2003). The literature contains several prominent acceptance models, developed primarily from theories in psychology and sociology, to explain technology acceptance in organisational contexts (Venkatesh et al., 2003). Most notably, TAM is widely cited and regarded by as the most influential theory to explain users' acceptance of technology (Lee et al., 2003). Davis (1986) devised TAM as an adaptation of the general and well-researched TRA (from social psychology). In most research, TAM is robust and powerful when explaining user acceptance of different technologies, including word processors, email and smartcards in different organisational settings and countries, such as the US, Canada and the UK (Adams, Nelson, & Todd, 1992; Davis, 1993; Horton, Buck, Waterson, & Clegg, 2001; Plouffe, Hulland, & Vandenbosch, 2001). Important work was conducted by Venkatesh

et al. (2003), who extended the model and synthesised the essential elements of seven other prominent acceptance models to formulate the UTAUT model. This model has proved more powerful than TAM. As both models were developed specifically to explain job-related performance, recent work by Venkatesh, Thong and Xu (2012) has developed the UTAUT2 model, extending TAM and UTAUT to consumer use contexts. A detailed review of TAM, UTAUT and UTAUT2 is presented in the following sections.

2.3. Technology Acceptance Model

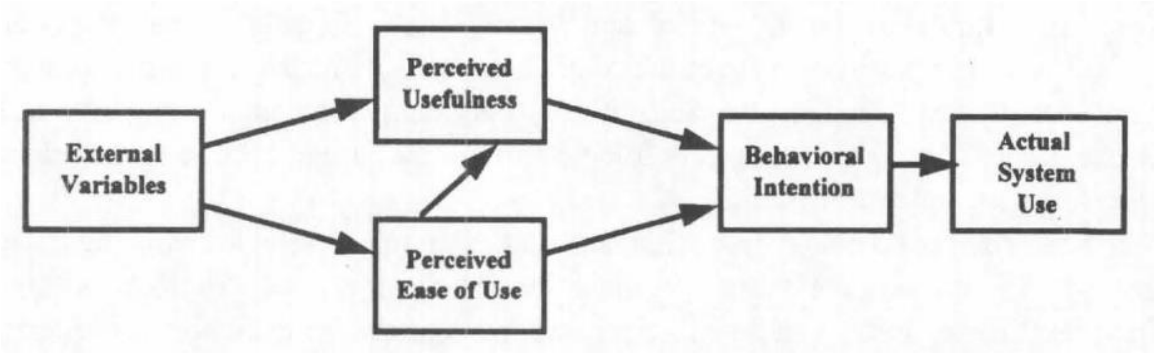
TAM was devised by Davis (1986) to explain and predict user acceptance of computer systems for job-related performance. In the 1980s, computer technology was rapidly, with computer power increasing tenfold each decade (Davis, Bagozzi, & Warshaw, 1989). As computer technology improved, using computer systems became economically feasible and showed great promise for improving organisational productivity. However, many companies found that their new computer systems failed to gain user acceptance. Heavy investments in computer systems often resulted in either under-use or rejection by employees. In response to the increasing failure of implementing computer systems, TAM was devised to explain user acceptance and the rejection of computer systems in organisations theoretically (Davis, 1986). In addition, the model addressed the practical prediction of user acceptance from simple measures taken after brief interactions with systems. Prior to TAM, research findings on the impact of user beliefs and attitudes on system usage behaviour were mixed and inconclusive (Fuerst & Cheney, 1982; Ginzberg, 1981; Ives, Olson, & Baroudi, 1983). Davis (1986) considered this might be due to the lack of adequate theoretical justification for the wide array of measures employed and the lack of conceptual model with a sound theoretical foundation. Hence, Davis adopted Fishbein and Ajzen's (1975)

TRA to form a sound theoretical foundation for TAM. This has contributed to its power as a model. Since its introduction, TAM has been widely cited and tested empirically in information systems research and has consistently been shown as robust (Chuttur, 2009). TAM is regarded by many scholars as the most influential theory to explain an individual's acceptance of technology in organisational contexts (Lee et al., 2003; Venkatesh et al., 2003).

TAM consists of two main components: perceived usefulness and perceived ease of use. These elements determine a user's acceptance of technology. TRA is a general behavioural intention theory, and is well-researched and successful at explaining and predicting human behaviour across many areas. According to the TRA model, the actual use of a particular technology is determined by users' behavioural intentions to use the technology; in turn, this is jointly influenced by users' attitudes and subjective norms in relation to using the technology. To adapt the TRA model to explain technology use behaviour at the initial acceptance stage specifically, TAM posits that two particular beliefs—perceived usefulness and perceived ease of use—are the primary determinants of users' attitudes. Consequently, the behavioural intention to accept a particular technology is affected by these elements. Perceived usefulness is defined as the degree to which a user believes that using the technology would enhance his or her performance of a task; perceived ease of use is defined as the degree to which a user believes that using the technology would be effortless (Davis, 1989). As the relationship between users' particular beliefs and behavioural intentions are not well explained by users' attitudes, and as the effect of users' subjective norms on their acceptance of technology was not well understood, TAM did not include users' attitudes and subjective norms as determinants. TAM is parsimonious; it only uses two particular

beliefs—perceived usefulness and perceived ease of use—as the determinants of users' acceptance of technology. Many later studies determined that perceived usefulness was the most significant determinant of users' behavioural intention to accept technology (Lee et al., 2003). When users gained more experience in using a particular technology, the perceived usefulness continued affect users' behavioural intention to accept the technology significantly, but perceived ease of use become less significant (Davis et al., 1989). Figure 2.1 illustrates the TAM.

Figure 2.1 TAM



Venkatesh and Davis (1996, p. 453)

TAM has been demonstrated across many replicated studies as robust and powerful when explaining user acceptance of different technologies. The model's measurements for perceived usefulness and perceived ease of use have also been validated extensively. Researchers have performed various replicated studies to verify TAM's proposals. These studies have examined a variety of technology, including word processors, email, spreadsheets and smartcards in different organisational settings and in different countries, such as the US, Canada and the UK (Adams et al., 1992; Davis, 1993; Horton et al., 2001; Plouffe et al., 2001). TAM is generally demonstrated as successful for explaining user acceptance of various technologies. When comparing TAM with the TRA model, TAM is superior at explaining users' behavioural intention to accept

technology (Davis et al., 1989). Additionally, TAM is more powerful at explaining users' acceptance of technology than the theory of planned behaviour (TPB). TPB is an extension of the TRA model (Hubona & Cheney, 1994). Most research, including meta-analysis studies, have reported that TAM measurements for perceived usefulness and perceived ease of use are valid and reliable (Adams et al., 1992; Hendrickson, Massey, & Cronan, 1993; King & He, 2006; Mathieson, 1991; Subramanian, 1994).

TAM is also generally shown to be robust and powerful in explaining the acceptance and use of consumer technology when applied to consumer contexts; however, in its original form it fails to capture some important consumer beliefs. TAM has been tested often in relation to global consumer internet adoption and use, online commerce and mobile commerce. This research includes studies from Taiwan, Hong Kong, the US, Canada, Finland, Singapore and China (Cheong & Park, 2005; Gefen, 2003; Khalifa & Shen, 2008; Kim, 2008; Mallat, Rossi, Tuunainen, & Öörni, 2009; Moon & Kim, 2001; Plouffe et al., 2001; Turel, Serenko, & Bontis, 2007; Wu & Wang, 2005). In many studies, perceived usefulness and perceived ease of use are significant determinants of users' behavioural intentions to adopt and use consumer technology. In turn, this determines actual usage significantly (Cheong & Park, 2005; Gefen, 2003; Kim, 2008; Moon & Kim, 2001; Plouffe et al., 2001). In particular, TAM is a valid and powerful tool to explain consumer use of the mobile internet (Hong, Thong, & Tam, 2006). In a meta-analysis of 58 relevant empirical studies, the TAM is also valid and powerful when explaining the adoption of mobile commerce (Zhang, Zhu, & Liu, 2012). However, the model fails to capture some important consumer beliefs, such as enjoyment and monetary cost; these elements are not relevant to technology for job-related performance in organisational contexts (Venkatesh et al., 2012). Hence,

while the model is still robust and powerful in consumer contexts, it cannot explain consumers' acceptance and use of technology fully.

Venkatesh et al. (2003) have conducted important work to extend the TAM and synthesise the essential elements of other prominent acceptance models. This has resulted in the formulation of UTAUT, which is more powerful than TAM for explaining user acceptance and use of technology in organisational contexts.

2.4. Unified Theory of Acceptance and Use of Technology

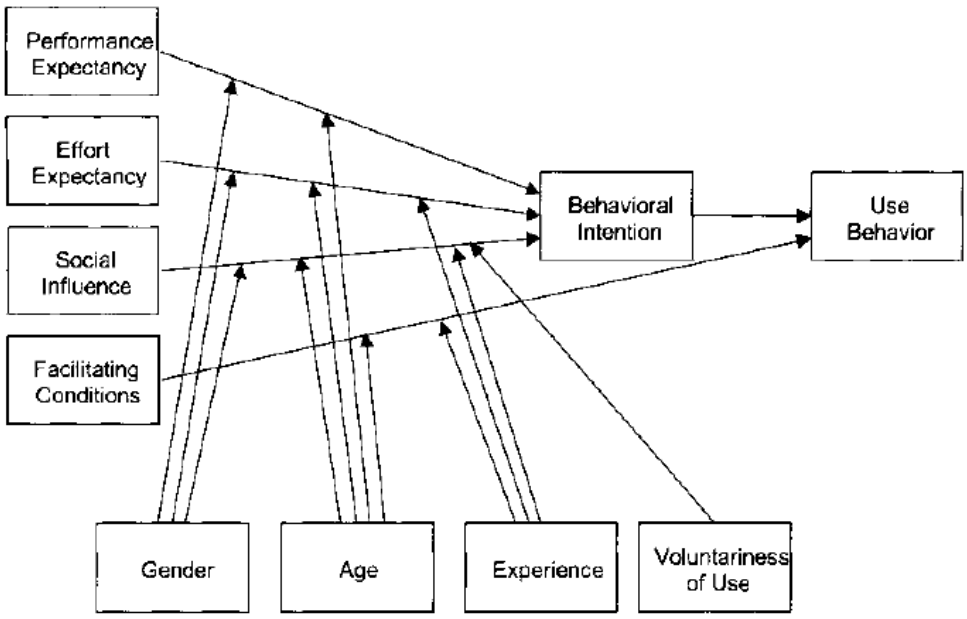
UTAUT was developed by Venkatesh et al. (2003) as a unified model to explain user acceptance and use of technology in organisational contexts. Apart from the TAM, seven other prominent acceptance models are reported to explain user acceptance of technology in organisational contexts. These are the TRA model (e.g., Davis et al., 1989), the TPB (e.g., Taylor & Todd, 1995), the motivational model (MM) (e.g., Davis, Bagozzi, & Warshaw, 1992), the combined TAM and TPB (C-TAM-TPB) (e.g., Taylor & Todd, 1995), the model of PC utilisation (MPCU) (e.g., Thompson, Higgins, & Howell, 1991), innovation diffusion theory (IDT) (e.g., Moore & Benbasat, 1991), and social cognitive theory (SCT) (e.g., Compeau & Higgins, 1995). In light of these various acceptance models, many scholars have argued for the formulation of a new theory incorporating all the essential elements of these models (Lee et al., 2003). In response to this, Venkatesh et al. (2003) formulated UTAUT by extending the TAM and synthesising the essential elements of the seven other models. This resulted in a more unified view of user acceptance and use of technology in organisational contexts.

The UTAUT was developed with two more factors than the TAM, and an additional four moderators to enhance its powerfulness. This development was achieved by comparing

the TAM empirically with the seven other prominent acceptance models. The TAM (and the other seven models) proposed 32 factors and four moderators that would influence user acceptance and use of technology in organisational contexts. After testing all the factors and moderators, Venkatesh et al. (2003) determined that three factors and four moderators had the strongest effect on users' behavioural intentions to accept and use technology. One factor had a direct effect on technology use. Out of the three factors, the two factors that the TAM proposed—perceived usefulness and perceived ease of use—were the strongest determinants of users' behavioural intentions. However, to unit several prominent acceptance models, Venkatesh et al. (2003) adopted performance expectancy and effort expectancy. This represented the constructs of perceived usefulness and perceived ease of use as posited in the TAM (along with similar factors from the other prominent models). Apart from the two TAM factors, one factor from the other models—social influence—was also highly significant in influencing users' behavioural intentions. Social influence represents the degree to which users perceive that other people who are important to them believe that they should use a particular technology (social influence is represented as a subjective norm in the TRA model). Venkatesh et al. (2003) suggested that social influence has an impact on individual behaviour mainly through compliance, which causes individuals to alter their behavioural intentions in response to social pressure. This is especially the case when technology use is mandatory. In addition, facilitating conditions (another particular belief in the models) had a direct effect on technology use. Facilitating conditions are the degree to which a user believes that technical infrastructure and support is available to support using a particular technology. Venkatesh (2000) suggests that facilitating conditions' influence on users' behavioural intentions is fully mediated by effort expectancy.

The UTAUT has four moderators. These are gender, age, experience and voluntariness of use. According to Venkatesh et al. (2003) and other studies, males and younger people were more task-oriented; as such, their behavioural intention to accept and use technology was affected more positively by performance expectancy (Gefen & Straub, 1997). Older users had less cognitive and memory ability and stronger affiliation needs (Rhodes, 1983). They were more concerned with effort expectancy and facilitating conditions, and were more affected by social influence (Morris & Venkatesh, 2000). Females appeared more concerned with effort expectancy and social influence; this is possibly related to gender roles and being more sensitive to the opinions of others (Lynott & McCandless, 2000). Experience is defined as the level of experience with the use of a particular technology. As experienced users are more knowledgeable and have a higher ability in using the technology, they are less concerned with effort expectancy and social influence. However, as users gain experience in using the technology in an organisation, they will identify help and support throughout the organisation and become more affected by facilitating conditions. Voluntariness of use is a measure of whether the use of a particular technology is voluntary. The use of a technology may be mandated by organisations (Venkatesh et al., 2003). Voluntariness of use moderates the effect of social influence on users' behavioural intentions, as compliance due to social pressures is stronger when the technology use is mandatory (Venkatesh & Davis, 2000). Figure 2.2 shows the UTAUT model.

Figure 2.2 UTAUT Model



Venkatesh et al. (2003, p. 447)

The UTUAT was validated by Venkatesh et al. (2003) and was shown as more powerful than the TAM and all other prominent acceptance models. In comparison with the TAM, Venkatesh et al. (2003) found that the UTAUT had a significant increase of 16% (from 53% to 69%) regarding its explanatory power for users' behavioural intentions to use new technologies in four organisations. This is despite the UTAUT doubling the number of factors and adding four moderators. Consistent with findings about the TAM, Venkatesh et al. (2003) found that performance expectancy was the strongest determinant of users' behavioural intention to accept and use technology in organisations. The UTAUT was verified by later studies as a robust and powerful technology acceptance and use model for different technologies, such as collaborative technology, mobile banking and internet services via mobile technology in both organisational and consumer use contexts (Chang, Hwang, Hung, & Li, 2007; Lu, Yao, & Yu, 2005; Zhou, Lu, & Wang, 2010). This related to different types of users, such as

health professionals and consumers (Yi, Jackson, Park, & Probst, 2006; Zhou et al., 2010) in different countries including China and India (Gupta, Dasgupta, & Gupta, 2008; Zhou et al., 2010).

Although the UTAUT unites the TAM and seven other prominent models (and is more powerful than all of them) it was still primarily to explain users' acceptance and use of technology for job-related performance in organisational contexts. As with the TAM, the UTAUT also fails to capture some significant consumer beliefs, such as enjoyment and monetary cost when using consumer technology (Venkatesh et al., 2012). In light of the limitations of the TAM and UTAUT, recent work by Venkatesh et al. (2012) has extended these models with three factors to explain consumer acceptance and use of technology more fully.

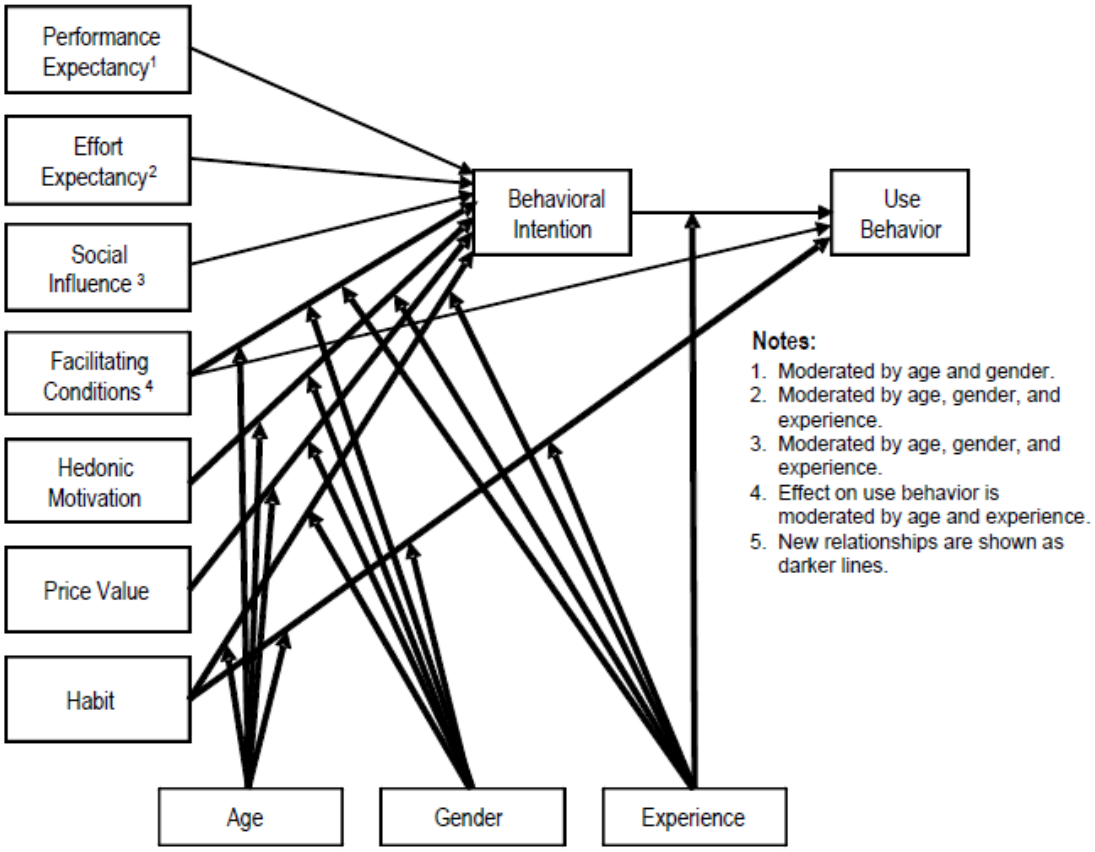
2.5. Extended Unified Theory of Acceptance and Use of Technology

The UTAUT2 was formulated by Venkatesh et al. (2012) to extend the TAM and UTAUT and thus explain the acceptance and use of technology in consumer use contexts. As the TAM and UTAUT were specifically to explain the acceptance and use of technology for job-related performance in organisations, both models were based on largely cognitive motivations; for instance, performance expectancy and effort expectancy (Davis, 1986; Venkatesh et al., 2003). While the TAM and UTAUT are robust and relevant in consumer use contexts, they are inept at capturing some important consumer beliefs (Yousafzai, Foxall, & Pallister, 2007; Zhang et al., 2012; Zhou et al., 2010). Consumers are influenced by affective, rather than cognitive, motivations. That is, the hedonic aspect of consumer technology use is particularly important. Consumers must pay for using technology and are offered less organisational support (Kim, Kim, & Wachter, 2013; Venkatesh et al., 2012). The monetary cost and

available technical support are important considerations. Regarding these inadequacies of the TAM and UTAUT in consumer use contexts and the growing use of consumer technologies, Venkatesh et al. (2012) reviewed and synthesised prior research on consumer technology use (Heijden, 2004), the continued use of technology (Kim & Malhotra, 2005) and habits (Limayem, Hirt, & Cheung, 2007) to extend the UTAUT. This new model—UTAUT2— explains consumers' acceptance and use of technology specifically.

The UTAUT2 extends the UTAUT to consumer use contexts by incorporating three consumer beliefs: hedonic motivation, price value and habit. The model posits that facilitating conditions are also a determinant of consumer behavioural intentions towards accepting and using technology (Venkatesh et al., 2012). Hedonic motivation is defined as the degree to which a user believes that using a particular technology would bring fun or pleasure. Price value is the degree to which a user perceives that the benefits are greater than the monetary cost of using a particular technology. Finally, habit is defined as the degree to which a user believes prior behaviour is automatic. In contrast with the UTAUT, the UTAUT2's facilitating conditions are considered to affect consumers' behavioural intentions (as well as the actual use of technology) directly. This is because consumers, with less organisational support than employees, consider available support a key factor in deciding whether to accept and use a particular technology. Figure 2.3 illustrates the UTAUT2 model.

Figure 2.3 UTAUT2 Model



Venkatesh et al. (2012, p. 160).

Hedonic motivation was incorporated into the UTAUT2 to capture the affective aspect of consumer technology use. Consumers had more diverse motivations than simple performance alone. Hedonic and social motivations were identified in consumer purchases of innovative products (Kim et al., 2013; Vandecasteele & Geuens, 2010). In many studies, hedonic motivation or enjoyment is an important determinant of the use of different consumer technologies (Brown & Venkatesh, 2005; Childers, Carr, Peck, & Carson, 2001; Chun, Lee, & Kim, 2012). Hedonic motivation has been incorporated into the UTAUT2 as a new consumer belief.

In addition, price value and habit are also incorporated into the UTAUT2 model, accounting for resource constraints and consumer use habits. As consumers face more

resource constraints than employees, a consumer's decision to use technology is influenced by the perceived value relative to the monetary cost of using a particular technology (Venkatesh et al., 2012). For instance, the popularity of short messaging services (SMS) in China was considered a result of the low pricing of SMS relative to other mobile applications (Chan, Gong, Xu, & Thong, 2008). In addition, when consumers establish habitual use of a particular technology, that habit will also determine the technology's continued use (Limayem et al., 2007). Hence, price value and habit have also been incorporated into the UTAUT2 as new consumer beliefs.

The UTAUT2 model has outperformed the UTAUT model. It is a more powerful technology acceptance and use model in consumer use contexts. The UTAUT2 was validated by Venkatesh et al. (2012) through mobile internet technology. Compared to the UTAUT model that explained 56% of the variance in consumers' behavioural intentions to use mobile internet technology, the UTAUT2 model provided a substantial improvement and explained 74% of the variance in consumer behavioural intentions. In contrast with the findings of the TAM and UTAUT models in organisational contexts, habit, and not performance expectancy, was the strongest determinant of consumer behavioural intentions (King & He, 2006; Venkatesh et al., 2003). In several studies, the UTATU2 has been generally valid and powerful with different types of consumer technologies, such as online purchasing of air tickets and smart mobile devices (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Huang, Kao, Wu, & Tzeng, 2013; Oechslein, Fleischmann, & Hess, 2014). These empirical findings support the contention that the UTAUT2 is more powerful and relevant when explaining consumer technology use. However, due to the relative early stages of the UTAUT2's use, empirical findings are still sparse.

Substantial theoretical and empirical findings explain users' acceptance and use of technology in organisational and consumer contexts. The TAM and UTAUT models are robust and powerful when explaining users' acceptance and use of technology in organisational contexts. The UTUAT2 is a recent powerful extension of these models to consumer use contexts. In technology upgrade contexts, these models provide a solid basis for understanding the factors that influence consumers' acceptance of new versions of high-technology products. However, these models fail to consider the effect of the usage experience with current high-technology products (particularly the satisfaction involved) on consumer intentions to upgrade. Additionally, only a few studies on the TAM exist, with no studies about the UTAUT and UTAUT2 in relation to consumer intentions to upgrade their high-technology products (Tseng & Chiang, 2013; Tseng & Lo, 2011). Although consumer technology upgrades are increasingly important and are attracting research attention, this area is still under-researched (Huh & Kim, 2008; Tseng & Lo, 2011).

2.6. Technology Upgrade

Technology upgrade is a recent stream of research related to technology acceptance and use. It focuses on consumers' decisions to upgrade to improved versions of high-technology products. Technology upgrade is defined as consumers purchasing an improved version of a high-technology product to replace their current high-technology product (Kim & Srinivasan, 2009). It is a rather new research area. Only a small amount of research exists in the literature that relates to consumer upgrades of high-technology products such as PCs, Palm PDAs and mobile phones (Huh & Kim, 2008; Kim et al., 2001; Kim & Srinivasan, 2009; Tseng & Lo, 2011).

Earlier studies on consumer upgrades of high-technology products mainly employed logit regression to study the upgrade probabilities and timing, and explained upgrade intentions using consumers' post-adoption behaviour. Kim et al. (2001) conducted some of the earliest research on consumer upgrades of high-technology products. Their study proposed a repeat purchase logit model for multi-generation products. This would enable estimation of the upgrade probabilities of consumers in relation to their purchase history, expectations of future generations and preferences for the currently available options. Huh and Kim (2008) also studied consumer upgrade intentions towards high-technology products in relation to consumers' post-adoption behaviour. According to these authors, using innovative features is a significant determinant of consumers' upgrade intentions. In a study on the upgrade timing of high-technology products, Kim and Srinivasan (2009) proposed an individual-level conjoint utility model with a hazard function specification and verified the proposed model with Palm PDAs. Higher upgrade costs and expectations of faster product improvement delayed consumers' upgrade decisions. Consumers who had made a recent purchase were also more reluctant to upgrade. However, these earlier studies mostly failed to consider consumers' cognitive and emotional assessments of high-technology products, despite these assessments being significant determinants of consumer technology use in many recent studies using TAM and UTAUT (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012).

Recently, Tseng and Chiang (2013) and Tseng and Lo (2011) have examined the effect of consumers' beliefs about 3G or 4G mobile phones on their upgrade intentions. According to Tseng and Chiang (2013) and Tseng and Lo (2011), consumers will assess the expected benefits of 3G or 4G mobile phones, and their experience with using

current 2G or 3G mobile phones, when deciding whether to upgrade. Compared to 2G or 3G mobile phones, 3G or 4G mobile phones offer some innovative functions, as well as the same basic functions. The assessment of these innovative functions was expected to be explained by a TAM extension, while the continued use intention towards the same basic functions was expected to be affected by satisfaction with the use of the current device. Accordingly, Tseng and Chiang (2013) and Tseng and Lo (2011) extended TAM with factors such as perceived enjoyment and perceived price and satisfaction to study consumers' upgrade intentions. In their research, the TAM was only partially supported as explaining consumers' upgrade intentions. Consumers who perceived the improved product as more useful and easier to use did not necessarily have a greater intention to upgrade. This finding contrasts with most findings using the TAM and UTAUT on consumers' technology acceptance and use. Since this research by Tseng and Chiang (2013) and Tseng and Lo (2011), no further examination of the TAM or its extensions have been undertaken in relation to technology upgrades. Further research is required to verify the TAM's relevance (and that of its extensions) for explaining consumer upgrades of high-technology products.

Additionally, while Tseng and Chiang (2013) and Tseng and Lo (2011) extended the TAM with some important consumer belief (perceived enjoyment and perceived price), they still failed to consider some other important factors, such as social influence and facilitating conditions (Venkatesh et al., 2012). The UTAUT2 is a recent extension of the TAM and UTAUT to consumer use contexts and captures several important beliefs of consumers not considered by Tseng and Chiang (2013) and Tseng and Lo (2011). As such, this model is expected to be more powerful and relevant than those authors' extended TAM for explaining consumer upgrade intentions towards high-technology

products (Venkatesh et al., 2012). However, no research exists that uses the UTAUT2 in relation to consumer upgrade intentions towards high-technology products.

Based on the above review of the relevant literature in relation to technology acceptance and use, as well as technology upgrades, the UTAUT2 is likely to be more powerful and relevant for explaining consumer upgrade intentions towards high-technology products. Hence, this study adopts the UTAUT2 as its conceptual framework. It then extends it to formulate a technology upgrade model that explains consumer intentions to upgrade technology. With this technology upgrade model, a set of hypotheses have been developed based on six of the factors. The details of these are presented below.

Research on the TAM, UTAUT and UTAUT2 has shown consistently that expectations regarding the performance and ease of use of a particular technology influence user intentions to enjoy various technologies (Lu et al., 2005; Venkatesh et al., 2003, 2012; Zhang et al., 2012; Zhou et al., 2010). In deciding whether to upgrade to an improved version of a high-technology product, consumers should consider whether to adopt the innovative or improved functions of the upgraded product. This assessment is expected to be influenced by expectations regarding performance and ease of use. In a study on mobile phone upgrades, consumers' upgrade intentions in relation to 3G or 4G mobile phones was affected positively by performance and effort expectations, with these effects mediated through the perceived value of the phone (Tseng & Chiang, 2013; Tseng & Lo, 2011). Thus, it is expected that performance and effort expectation regarding the use of an improved version of a high-technology product will affect a consumer's upgrade intentions positively.

Individuals are more likely to comply with the expectations of people whose opinions are important to them (Venkatesh et al., 2012; Warshaw, 1980). Several studies have

confirmed that social influence affects consumer use intentions towards technology positively (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012). When deciding whether to upgrade a high-technology product, consumers are also likely to be influenced by their social group (Hoyer, MacInnis, & Pieters, 2012). Thus, it is expected that social influence on the use of an improved version of a high-technology product will affect a consumer's upgrade intention positively.

Consumers are concerned about technical support when using a particular technology (Venkatesh et al., 2012). Several studies have also reported that facilitating conditions affect consumer use intentions towards technology positively (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012). Thus, it is expected that facilitating conditions relating to the use of an improved version of a high-technology product will affect a consumer upgrade intentions positively.

Consumers are also driven by hedonic motivation and price value when using technologies. As many studies show, hedonic motivation or enjoyment is an important determinant regarding the use of different consumer technologies (Brown & Venkatesh, 2005; Childers et al., 2001; Chun et al., 2012). In research on the continued engagement of smartphones, Kim, Kim and Wachter (2013) found that hedonic motivation was stronger than utilitarian motivation in influencing the continued engagement of smartphones. In contrast, utilitarian motivation had no effect on the perceived value of smartphones. Consumers have to pay for using technology, unlike the employees of an organisation. Consumers are unlikely to use a particular technology if the perceived value relative to the monetary cost of using the technology is low (Chan et al., 2008; Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012). In research conducted on mobile phone upgrades, consumer upgrade intentions towards 3G or 4G

mobile phones were affected by perceived enjoyment and perceived price positively (Tseng & Chiang, 2013; Tseng & Lo, 2011). Hence, it is expected that the hedonic motivation and price value related to using an improved version of a high-technology product will affect consumer upgrade intentions positively.

However, as consumers are unlikely to have developed the habit of upgrading their high-technology product through repeated upgrades, habit is not considered a factor that affects consumer upgrade intentions in this research.

As a result, apart from consumer beliefs on the establishment of a use habit, the other six factors of the UTAUT2 are posited to affect a consumer's upgrade intention positively.

Based on the above discussion of the six factors of the UTAUT2, it is hypothesized that:

H1 (a-f): The performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product affect consumer upgrade intentions positively.

Apart from using cognitive and emotional assessments of a particular technology to make a use decision, consumers are generally shown as more likely to continue using a technology when they are satisfied (Bhattacherjee, 2001; Park, Snell, Ha, & Chung, 2011). Based on the expectation that satisfied consumers are more engaged with a high-technology product, Tseng and Chiang (2013) and Tseng and Lo (2011) expected that satisfied consumers would also be more likely to upgrade. However, their research reported the opposite. Satisfied consumers were less likely to upgrade. No further research is available on the effect of satisfaction on consumer upgrade intentions

towards high-technology products. Thus, the effect of satisfaction on consumer upgrade intentions is still inconclusive. Further research is required to validate the effect of satisfaction.

2.7. Satisfaction

Satisfaction is widely studied; the behaviour literature reveals that it affects repurchase behaviour (Anderson & Sullivan, 1993). In addition, satisfaction has recently been posited as a significant determinant of consumers' use intention towards technology. Satisfaction, in the consumer behaviour literature, is defined by Oliver (1980) as 'the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience' (p. 29). This definition highlights that satisfaction is a psychological or affective state resulting from a cognitive appraisal of prior consumption experience. One well-researched and widely cited theories of satisfaction and consumer repurchase intention is expectation-confirmation theory (ECT) (Anderson & Sullivan, 1993; Oliver, 1980). This theory posits that repurchase intention is higher when consumers are satisfied with their prior consumption experience, while the intention is lower when they are dissatisfied. Bhattacherjee (2001) adapted ECT to study the use of consumer technology and devised the expectation-confirmation model in the context of information technology (ECM-IT). ECM-IT posits that perceived usefulness and satisfaction with the prior usage experience of a particular technology are significant determinants of consumer technology use. In Bhattacherjee's (2001) study, ECM-IT explained 41% of the variance in consumers' behavioural intentions to use online banking with satisfaction being the most significant factor that influenced consumers' behavioural intentions.

In several other studies using ECM-IT, satisfaction was found consistently as a significant determinant of consumers' behavioural intentions towards using technology. A hybrid model integrating TAM and ECM-IT was proposed for a study on consumer mobile internet use (Hong et al., 2006). In this study, when comparing TAM, ECM-IT and a hybrid TAM and ECM-IT model, the hybrid explained the most variation, with 67% of the variance in consumer behavioural intentions to use mobile internet services, followed by TAM with 63% and ECM-IT with 50%. For both the ECM-IT and hybrid models, satisfaction was a significant determinant of consumer behavioural intentions to use mobile internet services. A two-stage ECM-IT was later proposed for a study of temporal change on consumer beliefs and attitudes; subsequently, this was further extended to incorporate all UTAUT factors (Bhattacherjee & Premkumar, 2004; Venkatesh, Thong, Chan, Hu, & Brown, 2011). In two studies of the two-stage ECM-IT, satisfaction was also revealed as a significant determinant of consumers' behavioural intention to use technology.

Although it is still inconclusive, satisfaction with the use of a high-technology product has recently been found to have the opposite effect on consumer use of and upgrade intentions towards high-technology products. While improved versions of high-technology products have new functions, they also generally perform the same basic functions as those currently in use. Considering that a technology upgrade involves the continued use of basic functions in a current high-technology product, Tseng and Lo (2011) expected that consumer satisfaction with the prior usage experience of their current product would affect their upgrade intentions positively. However, the study found a contradictory result concerning the effect of satisfaction on consumers' upgrade intentions. In their study on consumers upgrading to 3G or 4G

mobile phones, when consumers were satisfied with their current mobile phones, they were unwilling, rather than willing, to upgrade their mobile phone. Although satisfaction was consistently shown to drive consumers' continued use of a technology, satisfaction with the prior usage experience of the current high-technology product influenced consumer upgrade intentions negatively. An explanation for this may be that satisfied consumers are pleased with their current high-technology product and thus find no need to upgrade to an improved product. Nevertheless, findings on the effect of satisfaction on consumer upgrade intentions are limited and inconclusive. Further research is required to validate the effect of satisfaction.

In addition, studies in both the information systems and marketing literature on consumer upgrade behaviours regarding services suggest that two different concepts of satisfaction operate in a consumer upgrade decision. In the information systems literature, Eriksson and Nilsson (2007) studied the use of internet banking and found that when consumers were satisfied with the traditional channels of doing banking, they were unwilling to use a new channel, such as internet banking. If internet banking was considered an upgrade of the traditional channels, this research suggests that consumers are unwilling to upgrade unless they are dissatisfied with the existing way of doing banking. In the marketing literature, Bolton et al. (2008) studied technology service contract upgrades in a business-to-business (B2B) relationship and found that customer satisfaction with the current level of computing system support service affected their upgrade intentions towards support services negatively. In contrast, customer satisfaction with the supplier of the computing system support service affected customer upgrade intentions towards support service positively. Bolton et al. (2008) suggested that two concepts of satisfaction exist in relation to customer technology service

contract upgrade decisions. First was satisfaction with the current level of support service. If customers were satisfied with the current level of support, they were unwilling to upgrade their support service. Second was the satisfaction with the support service supplier. If customers were satisfied with the support service supplier, they were more willing to upgrade their support service. Based on the available empirical evidence from these studies, two different concepts of satisfaction are evidently involved in consumer upgrade decisions. These are satisfaction with the current product and satisfaction with the *source* that enables delivery of the current product, along with higher performance and improvements in other aspects of the product upgrade (i.e., the provider of a service). While the first form of satisfaction will affect consumer upgrade intentions negatively, the second will affect consumer upgrade intentions positively.

Given that two different concepts of satisfaction are involved in a consumer upgrade decision relating to services, two different concepts of satisfaction may also relate to a consumer's upgrade decision about technology. A technology upgrade decision is a product upgrade decision. The source that enables delivery of a high-technology product, along with higher performance and improvement in other aspects, can be considered the *technology that supports the high-technology product* (i.e., the smartphone technology supporting a smartphone). Even though the performance and other aspects of the current high-technology product may be limited and unsatisfactory, the technology that supports the current high-technology product will continue to be developed and will enable delivery of higher performance and improvements in other aspects in the improved product. If consumers are very satisfied with the use of a technology, but not the performance and other aspects, they are likely to have high intentions of upgrading to an improved product to improve these aspects. Thus, they will benefit more from the

technology. In contrast, consumer satisfaction with performance and other aspects of the current high-technology product may make an upgrade unnecessary. Hence, satisfaction with the current high-technology product is expected to affect consumer upgrade intentions negatively, as shown in research on mobile phones by Tseng and Chiang (2013) and Tseng and Lo (2011). Satisfaction with the technology that supports the current high-technology product is expected to affect consumer upgrade intentions positively. However, no research has been conducted to verify the existence of the two different concepts of satisfaction that influence consumers' behavioural intentions to upgrade technology. As such, the following hypotheses are posited:

H2: Satisfaction with the current high-technology product affects consumer upgrade intentions negatively.

H3: Satisfaction with the technology that supports the current high-technology product affects consumer upgrade intentions positively.

Additionally, the effects of consumer beliefs about the improved product on their upgrade intentions are likely to be moderated by recency of purchase. Recency of purchase is defined as the time since the consumer's last purchase of a high-technology product (Kumar & Shah, 2009). In general, as consumers have to pay for an upgrade of high-technology products, consumers who have recently purchased a high-technology product may feel guilty in disposing of the recently purchased product and might be less willing to upgrade to an improved product (Kim & Srinivasan, 2009). Further, as high-technology products are improving continually and rapidly, the earlier a high-technology product was purchased, the bigger improvement a consumer is likely to find in an improved version of the high-technology product. For instance, the performance of smartphones is rapidly improved, with a three-fold increase in the past

three years (Triggs, 2015). Consumers using an older high-technology product that was purchased earlier are likely to perceive that a new and improved high-technology product can offer a larger gain in task performance. Thus, they are driven to upgrade more by performance expectancy. It is expected that recency of purchase will moderate the effect of performance expectancy positively. The effect of effort expectancy is more salient when more hurdles must be overcome in a new behaviour (Davis, 1989; Szajna, 1996; Venkatesh, 1999). Consumers using an older high-technology product are likely to find a new and improved high-technology product more different from the current product, demanding more effort to learn and use, and ensuring that effort expectancy is a stronger consideration. It is expected that recency of purchase will moderate the effect of effort expectancy positively. As the effect of social influence is more salient when a person's behaviour shows a large degree of deviance from social norms (Hoyer et al., 2012), consumers using an older high-technology product over a longer time are likely to be perceived by other people as more different from the 'upgraded' consumers and thus under a stronger social influence to upgrade. Hence, they are likely to consider social influence a more important consideration. It is expected that recency of purchase will moderate the effect of social influence positively. As these consumers are likely to require more effort to learn and use a new and improved high-technology product, they are also likely to be driven more by the availability of technical infrastructure and support to upgrade (Venkatesh, 2000; Venkatesh et al., 2003). It is expected that recency of purchase will moderate the effect of facilitating conditions positively. The effect of hedonic motivation is more prominent when the novelty of a target technology is high (Venkatesh et al., 2012). After using an older high-technology product for a longer time, these consumers are likely to find it less innovative and thus are more driven by hedonic motivations to upgrade. It is expected that recency of purchase will moderate the effect

of hedonic motivation positively. Finally, as consumers using an older high-technology product are likely to find that a new and improved high-technology product offers bigger improvements across various aspects, such as performance and innovativeness, they might also consider it better value for money. It is also expected that recency of purchase will moderate the effect of price value positively. Hence, it is argued that:

H4 (a-f): Recency of purchase moderates the effects of the performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product on consumer upgrade intentions positively.

Further, the recency of purchase of a high-technology product is expected to moderate the effects of satisfaction on consumer upgrade intentions. As high-technology products are improving continually and rapidly, a significant degree of development is likely to be found in a new and improved high-technology product—for instance computers and smartphones (Hachman, 2015; Triggs, 2015)—by consumers who made an earlier purchase. In the marketing literature, satisfaction is revealed as a determinant of repurchase intention, which concerns a repurchase of the same product (Szymanski & Henard, 2001). However, a new and improved high-technology is likely to be improved and to differ from the current high-technology product (not the same product for consumers who have purchased the current high-technology product a long time ago). As such, it is reasonable for consumers who made an earlier purchase to place less consideration on satisfaction regarding the current high-technology product, but more strongly driven by their beliefs regarding the new and improved high-technology product. This may involve performance expectancy and hedonic motivation, as explained earlier. Hence, consumers who made an earlier purchase are likely to be less

unwilling to upgrade, due to their satisfaction with the current high-technology product, and also less attracted to upgrading, due to their satisfaction with the technology supporting the current high-technology product. It is expected that recency of purchase will moderate the effect of satisfaction with the current high-technology product on consumer upgrade intentions positively, and moderate the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions negatively. Thus, the following hypotheses argue that:

H5: Recency of purchase moderates the effect of satisfaction with the current high-technology product on consumer upgrade intentions positively.

H6: Recency of purchase moderates the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions negatively.

2.8. Research Questions

Studies regarding consumer intentions to upgrade their high-technology products (such as smartphones) have been largely disregarded in the literature. The UTAUT2 is a recent extension of the TAM and UTAUT and proposes a number of factors that explain consumer intentions to accept and use technology. While the UTAUT2 is shown as more powerful and relevant for explaining consumers' use of technology, there is no research on the UTAUT2 in relation to consumer upgrade intentions. In addition, findings on the effects of satisfaction on consumer upgrade intentions are limited and inconclusive. Studies from the information systems and marketing literature suggest that two different concepts of satisfaction are present in consumer upgrade decisions. As a result, significant research gaps remain in relation to identifying the factors that

influence consumer intentions to upgrade high-technology products. This study is interested in addressing these research gaps by identifying the factors that influence consumer intentions to upgrade their high-technology products. This study also focuses on the upgrade of smartphones as an example of high-technology product upgrades.

Based on the discussion of the relevant literature, the main research question is identified as:

- **RQ1:** What significant factors influence consumer upgrade intentions towards high-technology products, particularly with reference to the UTAUT2 model and consumer satisfaction?

The sub-questions include:

- **RQ1a:** What is the relative importance of each factor with respect to consumer upgrade intentions towards high-technology products?
- **RQ1b:** How relevant is UTAUT2 to explaining consumer upgrade intentions towards high-technology products?
- **RQ1c:** What is the effect of satisfaction with the current usage of high-technology products on consumer upgrade intentions towards high-technology products?

2.9. Hypotheses

A technology upgrade model and a set of hypotheses have been developed to answer the research question regarding identifying the significant factors that influence consumer upgrade intentions of high-technology products. The proposed technology upgrade

model is an extension of the UTAUT2, with the incorporation of two different concepts of satisfaction and recency of purchase.

To summarise, the set of hypotheses is presented below.

Adopted from the UTAUT2, six factors—performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value in relation to consumer beliefs on the use of an improved version of a high-technology product—are expected to influence consumer upgrade intentions positively:

H1 (a-f): The performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product affect consumer upgrade intentions positively.

Two concepts of satisfaction are expected to influence consumer upgrade intentions directly, but with opposite effects:

H2: Satisfaction with the current high-technology product affects consumer upgrade intentions negatively.

H3: Satisfaction with the technology that supports the current high-technology product affects consumer upgrade intentions positively.

Recency of purchase of a high-technology product is expected to moderate the effects of consumer beliefs—the six factors of the UTAUT2—about an improved version of a high-technology product on their upgrade intentions positively:

H4 (a-f): Recency of purchase moderates the effects of the performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product on consumer upgrade intentions positively.

Further, recency of purchase of a high-technology product is expected to moderate the effect of satisfaction with the current high-technology product on consumer upgrade intentions positively and moderate the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions negatively.

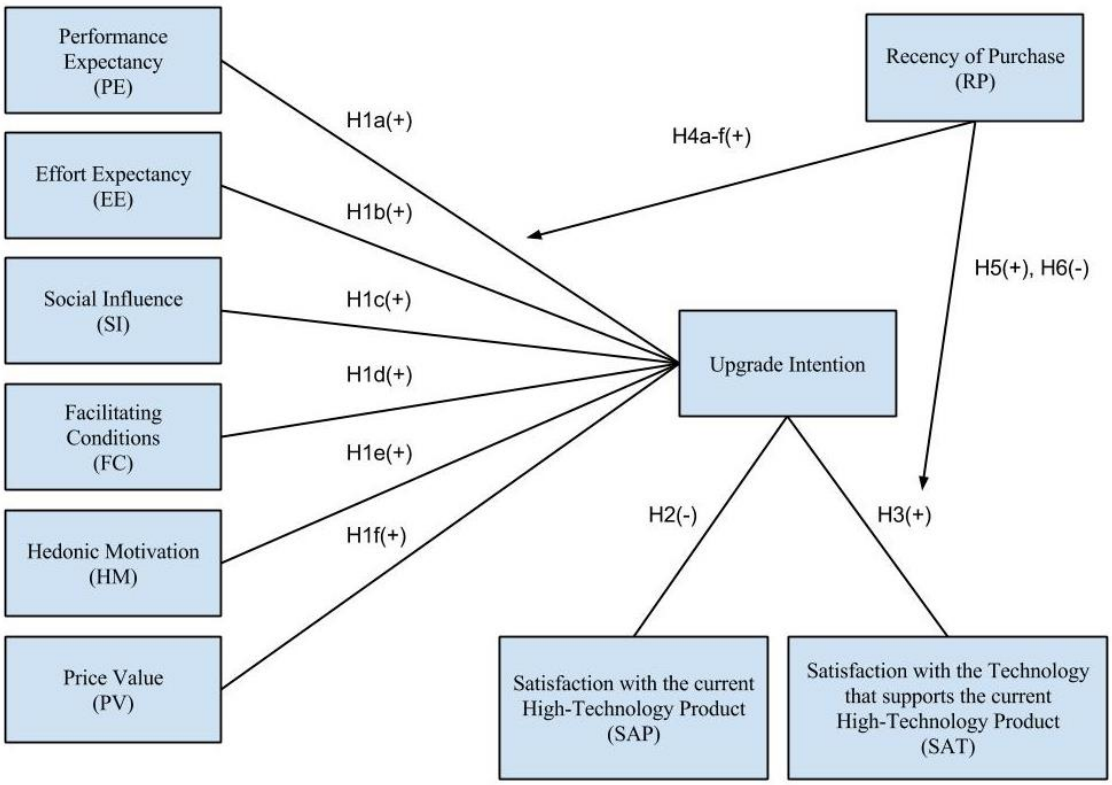
H5: Recency of purchase moderates the effect of satisfaction with the current high-technology product on consumer upgrade intentions positively.

H6: Recency of purchase moderates the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions negatively.

2.10. Conceptual Framework

The proposed conceptual framework is presented below. This is also the proposed technology upgrade model, an extension of the UTAUT2 to consumer upgrade contexts.

Figure 2.4 Proposed Technology Upgrade Model



Chapter 3 Methodology

Chapter 2 identified the research questions based on the literature review. Also in Chapter 2, the hypotheses were developed and a technology upgrade model was proposed. Chapter 3 presents the study's research design and methodology. This study aims to describe the relationships between the psychological factors involved in consumer upgrade intentions towards high-technology products. This study uses a quantitative, cross-sectional design, comprising an anonymous questionnaire survey, and a sample of 410 degree and sub-degree students in Hong Kong, collected over two stages. Smartphones were chosen as the high-technology product for study. All the scales for the psychological factors and upgrade intentions of consumers in the questionnaires were adapted from prior research with proven reliability and validity. The researcher administered questionnaires to participants. Descriptive statistics on the sample's demographics were prepared to depict the sample. CFA assessed the validity of the technology upgrade measurement model. SEM analysis (with multi-group analysis) was then applied to assess the technology upgrade structural model, the relationships between the constructs, and the moderating effect of recency of purchase.

3.1. Research Paradigm

This study proposes an extension of the UTAUT2 model to research the significant psychological factors that influence consumer upgrade intentions towards high-technology products. Based on a discussion of the relevant literature, further research on the significant factors that influence consumer upgrade intentions towards high-technology products is identified as necessary.

Regarding the study's research paradigm, objectivism is described as an ontological position, and positivism is described as an epistemology position. From an ontological perspective, objectivism asserts that social phenomena exists independent of social actors, while constructionism asserts that social phenomena and their meanings are being constructed continually by social actors (Bryman & Bell, 2011). For this research, consumer-related psychological factors and their upgrade intentions towards high-technology products were treated as independent of the consumers, and as similar to objects that can be examined. Thus, an objectivism position was adopted. Regarding epistemology, positivism advocates the use of scientific methods (from the natural sciences) to study social reality, while interpretivism respects the differences between social actors and the objects of the natural sciences; therefore, this approach requires an understanding of the subjective meaning of social actions (Bryman & Bell, 2011). Positivists assert that an objective truth exists about the world that can be discerned (Sekaran & Bougie, 2013). The rigour and replicability of research are significant here. For this research, the psychological factors of consumers and their upgrade intentions towards high-technology products are treated as objects appropriate for study with natural science methods. Additionally, the reliability of observations and the generalisability of findings are important for developing a generally applicable technology upgrade model to explain and forecast consumer upgrade behaviour. Therefore, a positivist position was adopted.

3.2. Research Method

This study involves quantitative research. This approach uses the quantification of observations and statistical analysis of the collected quantitative data. Qualitative research focuses on the rich description of observations and the social context, which is

usually expressed in words, along with an analysis of the deeper meanings of observations in terms of the social context (Bryman & Bell, 2011). To describe the relationships between consumers' psychological factors and their upgrade intentions towards high-technology products, this study undertook a quantitative approach to quantify the measurements of these psychological factors and upgrade intentions, expressing the relationships between them statistically.

Further, quantitative research entails a deductive approach to study the relationship between theory and research. Deductive reasoning is concerned with testing theories, while inductive reasoning applies to the generation of theories (Bryman & Bell, 2011). For this study, a key objective was to verify the proposed technology upgrade model. This entailed the development of hypotheses and testing of the proposed technology upgrade model. A quantitative and deductive approach was suitable. In addition, quantitative research focuses on reliability and generalisability, while qualitative research emphasises credibility and integrity. For the development of a general technology product upgrade model, this study emphasised the finding's reliability and generalisability. Quantitative research has been adopted in previous research on consumer acceptance and upgrading of technology (Tseng & Lo, 2011; Venkatesh et al., 2012). Hence, a quantitative study is appropriate here.

3.3. Research Design

This study is designed as a cross-sectional, correlational field study of smartphone users' upgrade intentions in Hong Kong. Smartphones have been chosen for this study as they are popular and are replaced by consumers every two years on average (Hoelzel & Ballve, 2013). Hong Kong was chosen as the place to carry out this study as it has a very high smartphone adoption rate; this was 87% in 2013 (Magdirila, 2013). In

addition, Hong Kong consumers are expected to make faster upgrades of their smartphones as Hong Kong mobile network operators continue to introduce "Unbundled Plans" to make it easy for subscribers to upgrade their smartphones, and "Flexi Pass" to allow subscribers to terminate their old contract and sign up for a fresh contract when purchasing a new smartphone (Perez, 2015). The unit of analysis is the individual level. A correlational field study of the relationship between smartphone users' psychological factors and upgrade intentions has been conducted. This study is cross-sectional, with data collected only at a single point in time.

This study is descriptive rather than exploratory and causal. Descriptive research is useful for solving a specific and well-defined problem. It clarifies the characteristics of certain social phenomena. Exploratory research is suitable for gathering more information about a loosely defined problem and causal research is needed to verify the causes of certain social phenomena (Sekaran & Bougie, 2013). Although consumer upgrades of technology is under-researched, substantial theoretical and empirical findings exist that explain users' acceptance and use of technology in organisational and consumer contexts. Specific and well-defined research questions have been identified in relation to consumer upgrades of technology, based on a literature review. A key research question identifies the significant psychological factors that influence consumer upgrade intentions towards high-technology products. This study is designed to investigate the research questions instead of being exploratory. As consumer upgrading of technology is under-researched, more research findings relating to the description of this process is needed to develop a general technology upgrade model. Therefore, this study is descriptive and designed to focus on the description of the relationships between consumers' psychological factors and their upgrade intentions

towards high-technology products. However, it is not designed to verify the causal links, even though the findings might shed light on the probable causal links. Correlational research describes relationships between variables (Sekaran & Bougie, 2013). This descriptive study is more specifically correlational.

This study is cross-sectional, with data collected only at a single point in time, over a period of weeks. A cross-sectional design collects data at one point in time, while a longitudinal design collects data at two or more points in time (Sekaran & Bougie, 2013). A cross-sectional design is sufficient and appropriate for correlational studies, which involve only descriptions of the relationships between variables (Avital, 2000). A longitudinal design is needed for causal studies as the collection of data at multiple time points is necessary to identify cause-and-effect relationships (Sekaran & Bougie, 2013). As this study is correlational and aimed at describing the relationships between consumers' psychological factors and their upgrade intentions towards high-technology products (but not aimed at identifying the causal relationships involved), a cross-sectional design is appropriate.

Smartphones are the technology product examined in this study. Smartphones have become an indispensable tool of consumers. The adoption rate of smartphone devices is unprecedentedly fast compared with other forms of consumer technology historically. Research reports that smartphones are indispensable to consumers (Google, 2013). They have transformed consumer behaviour and changed the way that consumers shop. More importantly, consumers are becoming used to replacing their smartphones and making frequent upgrades (Perez, 2015). Previous research on consumer upgrades of technology examine high-technology products such as PCs, Palm PDAs and mobile phones, but

there is still no research on smartphones (Huh & Kim, 2008; Kim et al., 2001; Kim & Srinivasan, 2009; Tseng & Lo, 2011). Hence, smartphones were chosen for this study.

Hong Kong is the study's location. Hong Kong is a major service economy and the world's eighth largest trading economy (Hong Kong Government, 2014b). It is a major gateway to China and has particularly strong links to the rest of the Asia-Pacific region. It is also one of the leading economies in using information communication technology to drive social and economic developments. In 2014, Hong Kong ranked eighth worldwide and second in Asia in the networked readiness index (World Economic Forum & INSEAD, 2014). Hong Kong has a very high household broadband penetration rate (83% in 2014) and mobile penetration rate (237% in 2014), among the highest in the world (Hong Kong Government, 2014a). Hong Kong also has a very high adoption rate of smartphones, 87% in 2013 (Magdirila, 2013). Hong Kong consumers also make frequent upgrades of their smartphones (Perez, 2015). Hong Kong has population of about 3 million people aged between 15 and 44 (Hong Kong Government, 2014b). Hence, approximately 2.6 million Hong Kong people who are aged 15 to 44 use smartphones.

3.4. Survey Method

Anonymous questionnaires were used to collect data and were administered by the researcher. Anonymous questionnaires are appropriate for correlational studies and allow collection of a large amount of quantitative data (Sekaran & Bougie, 2013). They are an efficient data collection mechanism and are generally less costly and time consuming than interviews. The administration of anonymous questionnaires also demands less skill from the researcher than administering interviews. Anonymous questionnaires are widely used in technology acceptance research (Escobar-Rodríguez

& Carvajal-Trujillo, 2014; Tseng & Lo, 2011). However, anonymous questionnaires introduce a high chance of non-responses, as well as non-response errors. Many potential participants are unwilling to participate as they assume great effort and much time is required to complete the questionnaire and will be not relevant or beneficial to them (Fröhlich & Pekruhl, 1996). The researcher administering the questionnaires can reduce the likelihood of non-responses (Sekaran & Bougie, 2013).

3.5. Sampling Design

For this study, full-time degree and sub-degree students at universities and their affiliated institutions in Hong Kong were sampled in two stages. First, a university was sampled with convenience sampling. Second, cluster sampling was used to sample the students.

Degree and sub-degree students were chosen, as they are a major group of youth and young adult smartphone users (Smith, 2013). Sub-degree programs include post-secondary education, encompassing associate degree and higher diploma programs in Hong Kong. These two-year programs are considered as partial degree programs; they are generally accepted as the first two years of a four-year degree program. According to a survey conducted by re:fuel (GlobeNewswire, 2013), 69% college students in the US owned a smartphone. A survey conducted by the Hong Kong Computer Society (2013), reports that 90% of Hong Kong students use smartphones. A major advantage of using student samples is that student samples are easily assessable. In addition, the value of using students as surrogates for professional young adults in technology acceptance research is confirmed by King and He (2006). Student samples are commonly used in technology upgrade research on consumers (Kim & Srinivasan, 2009; Tseng & Lo, 2011). However, subdegree and degree students are highly educated

and may not be effective surrogates for the general population in Hong Kong, particularly for those who are less educated and older.

3.6. Target Population

The target population of this study is defined as full-time degree and sub-degree students who are smartphone users at universities and their affiliated institutions in Hong Kong. About 150,000 degree and sub-degree students are enrolled at universities and their affiliated institutions in Hong Kong (Hong Kong Government, 2013, 2014b). As 90% of Hong Kong students use smartphones (Hong Kong Computer Society, 2013), the population size is approximately 135,000.

3.7. Sampling Frame

For sampling purposes, full-time degree and sub-degree students at universities and their affiliated institutions in Hong Kong were first grouped by their universities. The list of all universities formed the sampling frame at this first stage. Then, the degree and sub-degree students at a university and its affiliated institutions were further grouped by the classes in which they were enrolled. Classes were chosen such that each student was enrolled in only one class. The list of classes formed the sampling frame at this later stage.

3.8. Sampling Technique

A university was first sampled with convenience sampling from the sampling frame comprising all universities with full-time degree and sub-degree students in Hong Kong.

Convenience sampling was chosen to sample a university that permitted the researcher to perform the research, and provided the necessary class enrolment information for

degree and sub-degree students, for further sampling. This sampling method results in a sample that is able to provide information and is the best way of collecting data quickly and efficiently; however, it compromises the result's generalisability (Sekaran & Bougie, 2013). Convenience sampling is often the only practical sampling method for gaining access to sample organisations (Chan & Ngai, 2007). As degree and sub-degree students in different universities and their affiliated institutions should be more or less homogeneous in terms of consumer behaviour, using convenience sampling for the sampling of a university should not have a great effect on the generalisability of the result. Convenience sampling is commonly used for student samples in technology upgrade research on consumers (Kim & Srinivasan, 2009; Tseng & Lo, 2011).

Once a university was sampled, the available degree and sub-degree students at the university and its affiliated institutions were sampled with cluster sampling, using their enrolled classes as the natural grouping. Cluster sampling is one type of restricted or complex probability sampling design (Sekaran & Bougie, 2013). It divides the target population into clusters and then randomly selects some clusters as the sample. In our research, the degree and sub-degree students were first divided into clusters by their enrolled classes. A random sample of classes of students was drawn from the sampling frame with all the enrolled classes. The list of classes was chosen such that each student was enrolled in only one class. The classes included some common and mandatory courses that almost all students had to take. This arrangement ensured that the cluster sample offered more heterogeneity within groups and more homogeneity among groups. Cluster sampling usually suffers from the loss of generalisability when the conditions of intra-cluster heterogeneity and inter-cluster homogeneity are not met. Using classes as clusters allowed the researcher to visit the classes personally and collect data from

students during classes. This reduced the unit cost of sampling and improved efficiency. Using simple random sampling would have improved the generalisability of the results. However, it would also have required the identification of a sampling frame with all the degree and sub-degree students and collection of data from a random sample of individual students. The researcher would have had to contact the individual students and personally administer the collection of data with each of them. The sampling process would have become too cumbersome and expensive. Hence, cluster sampling is appropriate here.

3.9. Sample Size

The sample size is 410 students. SEM analysis using multi-group analysis was applied to analyse the data. The minimum sample size for SEM analysis depends on several factors, including the model complexity and the communalities in each factor (Hair, Black, Babin, & Anderson, 2009). In general, larger samples produce more stable and replicable results. However, as the sample size becomes too large (such as 500), the analysis will be very sensitive and detect almost any difference. Thus, sample sizes in the range of 200 to 400 are generally suggested. For this study, a sample size of 410 is appropriate.

As students were readily assessable at the sampled university and its affiliated institutions, the questionnaires were administered to students during classes by the researcher. Administering the questionnaires in this way reduced the likelihood of non-responses (Sekaran & Bougie, 2013). It also allowed clarification of any doubt on the questionnaires by the researcher and the collection of all completed responses within a short period. Data collection took place over five weeks.

Degree and sub-degree students at the university and its affiliated institutions were recruited as follows. A letter, together with the organisation consent form and organisation information sheet were sent to the university to request permission to conduct the study with their degree and sub-degree students. Upon obtaining the organisation's consent, participant information statements were distributed to 20 classes of students and the students were invited to participate in the study. Students were asked to read the participant information statement carefully so that they understood what the study was about, and their rights. The students were also reminded about the voluntary nature of the study. A week later, the researcher visited the 20 classes and explained the research objectives and contribution. The researcher also explained the questionnaire and context to be considered. The anonymous questionnaires were distributed to students. The students were asked to complete the questionnaires. The completed questionnaires were collected in a secure collection box. Implied consent from the students was assumed when they completed the anonymous questionnaires and returned them to the secure collection box.

Only degree and sub-degree students at the university and its affiliated institutions in Hong Kong were included in this research. The students were also required to be a smartphone user.

The purpose and contribution of this study and the rights of participants were clarified in the participant information statement. This also provided the contact details of the researcher, his supervisor and the human research ethics office at the University of Newcastle, in case participants had questions about the study.

No incentive was provided to the participants. A summary of the study's results will be provided to participants by the researcher after 30 September 2016 upon request by

email. The results can help participants gain a better understanding of the significant psychological factors that influence their upgrade intentions regarding smartphones.

3.10. Questionnaire Design

The questionnaire encompassed four sections and 34 items; this could be completed in about 15 to 20 minutes. All scales were adapted from prior research. Some basic demographic information, such as age and gender of the participants was requested for describing the sample's demographics. All scales had at least three items, as recommended by Nunnally and Bernstein (1994). All measuring items were measured with a seven-point Likert scale, with the anchors of 'strongly disagree' and 'strongly agree'.

3.10.1. Questionnaire Section 1

The first section asked participants for their assessments on various aspects connected with new and more advanced smartphones, using scales for UTAUT2 variables adapted from Venkatesh et al. (2012).

The assessments on various aspects connected with new and more advanced smartphones were independent factors in this study. The scales for the UTAUT2 variables—performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value—were adapted from Venkatesh et al. (2012). The tables below show the question IDs and measuring items of the independent factors.

Table 3.1 Measuring Items for Performance Expectancy
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
1	I find a new and more advanced smartphone useful in my daily life.
2	Using a new and more advanced smartphone helps me accomplish things more quickly.
3	Using a new and more advanced smartphone increases my productivity.

Table 3.2 Measuring Items for Effort Expectancy
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
4	Learning how to use a new and more advanced smartphone is easy for me.
5	My interaction with a new and more advanced smartphone is clear and understandable.
6	I find a new and more advanced smartphone easy to use.
7	It is easy for me to become skilful at using a new and more advanced smartphone.

Table 3.3 Measuring Items for Social Influence
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
8	People who are important to me think that I should use a new and more advanced smartphone.
9	People who influence my behaviour think that I should use a new and more advanced smartphone.
10	People whose opinions that I value prefer that I use a new and more advanced smartphone.

Table 3.4 Measuring Items for Facilitating Conditions
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
11	I have the resources necessary to use a new and more advanced smartphone.
12	I have the knowledge necessary to use a new and more advanced smartphone.
13	A new and more advanced smartphone is compatible with other technologies I use.
14	I can get help from others when I have difficulties using a new and more advanced smartphone.

Table 3.5 Measuring Items for Hedonic Motivation
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
15	Using a new and more advanced smartphone is fun.
16	Using a new and more advanced smartphone is enjoyable.
17	Using a new and more advanced smartphone is very entertaining.

Table 3.6 Measuring Items for Price Value
(Adapted from Venkatesh et al., 2012)

Question ID	***Questionnaire Items***
18	A new and more advanced smartphone is reasonably priced.
19	A new and more advanced smartphone is a good value for the money.
20	At the current price, a new and more advanced smartphone provides good value.

3.10.2. Questionnaire Section 2

The second section asked participants about their satisfaction with their current smartphone and the use of smartphone technology, using a scale for satisfaction adapted from Park et al. (2011) and reworded for the measures of the two satisfaction concepts.

Satisfaction with their current smartphone and the use of smartphone technology were independent factors in this study. The scales for satisfaction with the current smartphone and satisfaction with the use of smartphone technology were adapted from Park et al. (2011) and reworded for the measures of the two satisfaction. The tables below show the question IDs and measuring items of the independent factors.

Table 3.7 Measuring Items for Satisfaction with the Current High-Technology Product (Adapted from Park et al., 2011)

Question ID	***Questionnaire Items***
21	I am happy with my smartphone.
22	I am satisfied with my smartphone.
23	I am disappointed with my smartphone.
24	I truly enjoy my smartphone.

Table 3.8 Measuring Items for Satisfaction with the Technology That Supports a High-Technology Product
(Adapted from Park et al., 2011)

Question ID	*Questionnaire Items*
25	I am happy with the use of smartphone technology.
26	I am satisfied with the use of smartphone technology.
27	I am disappointed with the use of smartphone technology (reverse coded).
28	I truly enjoy the use of smartphone technology.

3.10.3. Questionnaire Section 3

The third section asked participants for their upgrade intention, using a scale for upgrade intention towards consumers adapted from Tseng and Lo (2011).

The upgrade intentions for a new and more advanced smartphone was a dependent factor of this study. The scale for upgrade intentions of consumers was adapted from Tseng and Lo (2011). The table below shows the question IDs and measuring items of the dependent factor.

Table 3.9 Measuring Items for Upgrade Intention
(Adapted from Tseng and Lo, 2011)

Question ID	*Questionnaire Items*
29	I intend to buy a new and more advanced smartphone.
30	I intend to replace my smartphone with a new and more advanced smartphone.
31	It is very possible that I will upgrade to a new and more advanced smartphone.

3.10.4. Questionnaire Section 4

The last section of the questionnaire collected some basic demographic information of the participants, such as gender, age and recency of purchase. The measure for recency of purchase was adapted from Kumar and Shah (2009).

The age and gender details of participants were collected to describe the sample's demographics. This basic demographic information is commonly collected in other similar research (Venkatesh et al., 2012). Recency of purchase is a moderator in this research. The measuring item for recency of purchase is adapted from Kumar and Shah (2009). The tables below show the question IDs and measuring items of the basic demographic information and moderator.

Table 3.10 Measuring Items for Demographic Information

Question ID	***Questionnaire Items***
32	What is your age?
33	What is your gender?

Table 3.11 Measuring Item for Recency of Purchase
(Adapted from Kumar and Shah, 2009)

Question ID	***Questionnaire Item***
34	What is the time (in months) since the last purchase of a smartphone?

3.11. Reliability and Validity

Reliability and validity are two key evaluation criteria for the goodness measures for the instruments of quantitative research. The reliability of a measure refers to the extent to which the measure is without bias and its measurement is stable and consistent across time and across various items in the measure's instrument (Sekaran & Bougie, 2013). The validity of a measure indicates whether the instrument measures the particular concept it is intended to measure. In other words, reliability concerns the stability and consistency of the measurement, while validity relates to whether the correct concept is measured.

Reliability of a measure is commonly evaluated by the measure's internal consistency (Sekaran & Bougie, 2013). The internal consistency of a measure indicates the homogeneity of the items in the instrument of the measure. In other words, it is concerned with whether the items form a set and if each item is capable of individually measuring the intended construct. For internal consistency to be high, the participants should attach the same overall meaning to each item. When using CFA to validate a measurement model, construct reliability is often used to measure the internal consistency of measures, indicating whether the measurement items all represent the same construct consistently (Hair et al., 2009). Construct reliability (CR) ≥ 0.7 suggests that reliability is good. For this study, the measures' reliability was primarily by adapting scales from prior research with proven reliability. Additionally, construct reliability was computed to validate the reliability of all the scales.

The validity of a measure can be categorised into three types of validity. These are content validity, criterion-related validity and construct validity (Sekaran & Bougie, 2013). Content validity refers to whether the instrument of the measure includes an

adequate and representative set of items to measure the construct. Criterion-related validity considers whether the measure differentiates between individuals on a criterion that the measure is expected to predict. Finally, construct validity evaluates whether the results obtained from using the measure are consistent with the theories for which the measure is designed. For this study, the validity of the measures is primarily by adapting scales from prior research with proven validity. In addition, content validity was confirmed with a review of the questionnaire items. The review was conducted to ensure that the questionnaire items were understandable, worded clearly and representative of the concepts to be measured. The construct validity of the scales was also examined with CFA in the validation of the measurement model.

3.12. Review of Questionnaire Items

A review of the scales was conducted before the questionnaires were administered to the degree and sub-degree students at the university and its affiliated institutions. The purpose of the review was to check the content validity of the scales, ensuring that the questionnaire items were understandable, worded clearly and representative of the concepts to be measured. The researcher and his supervisor first reviewed the wording of the questionnaire items. The questionnaire was then submitted to a group of senior academics at the Newcastle Business School for peer review. No revision of the questionnaire items was needed after the review.

3.13. Data Preparation

Of all the questionnaires collected, some had missing data for some questions. The complete case approach—listwise deletion—was used to deal with the missing data.

Only complete questionnaires were used for analysis. Traditionally, this approach is considered most appropriate for SEM (Hair et al., 2009).

3.14. Method of Analysis

The data analysis performed for this study included descriptive analysis, normality testing, CFA and SEM analysis, along with multi-group analysis. The statistics software package, SPSS, version 22, with AMOS, was used to perform the data analysis. The data collected from the questionnaires were entered into SPSS. The data were checked for entry mistakes and missing values manually and some descriptive statistics were reviewed.

3.15. Descriptive Analysis

Descriptive analysis was used to describe the basic characteristics and general distribution of the sample's responses. The total number of responses was reported. Descriptive statistics of the sample on the demographics and recency of purchase were computed.

Descriptive statistics on the sample's demographics were prepared to describe the sample. The purpose was to gain an overview of the characteristics and a profile of the sample. The basic demographic information included gender and age. Gender was measured with a nominal scale, while age was measured with an ordinal scale. A bar chart and histogram were plotted to show the sample's profile. Mean and standard deviation were used to measure the central tendency and dispersion of the sample's ages.

Recency of purchase of a smartphone was also requested from participants. Recency of purchase was measured with a numerical scale. A histogram was plotted to show the profile of the sample's responses. Mean and standard deviation were used to measure the central tendency and dispersion of the sample's responses.

3.16. Normality Testing

The normality of the data from the questionnaire items was assessed to prepare it for CFA and structural equation analysis. Multivariate normality was one of the assumptions of CFA and structural equation analysis (Hair et al., 2009). The Shapiro-Wilks test of normality was first used to assess the normality of the data from the questionnaire items (Coakes & Ong, 2013). In addition, the skewness and kurtosis values of the data from the questionnaire items were also examined. As a general rule, absolute values of skewness and kurtosis values less than two are considered a reasonable approximation to the normal curve (Hahs-Vaughn & Lomax, 2013).

3.17. Confirmatory Factor Analysis

CFA was used to assess the measurement model validity of the technology upgrade model. Measurement model validity depends on the establishment of acceptable levels of goodness-of-fit and construct validity, which includes convergent validity and discriminant validity (Hair et al., 2009). The measurement model for the technology upgrade model is shown in Figure 3.1 below. CFA was performed with the AMOS SEM program.

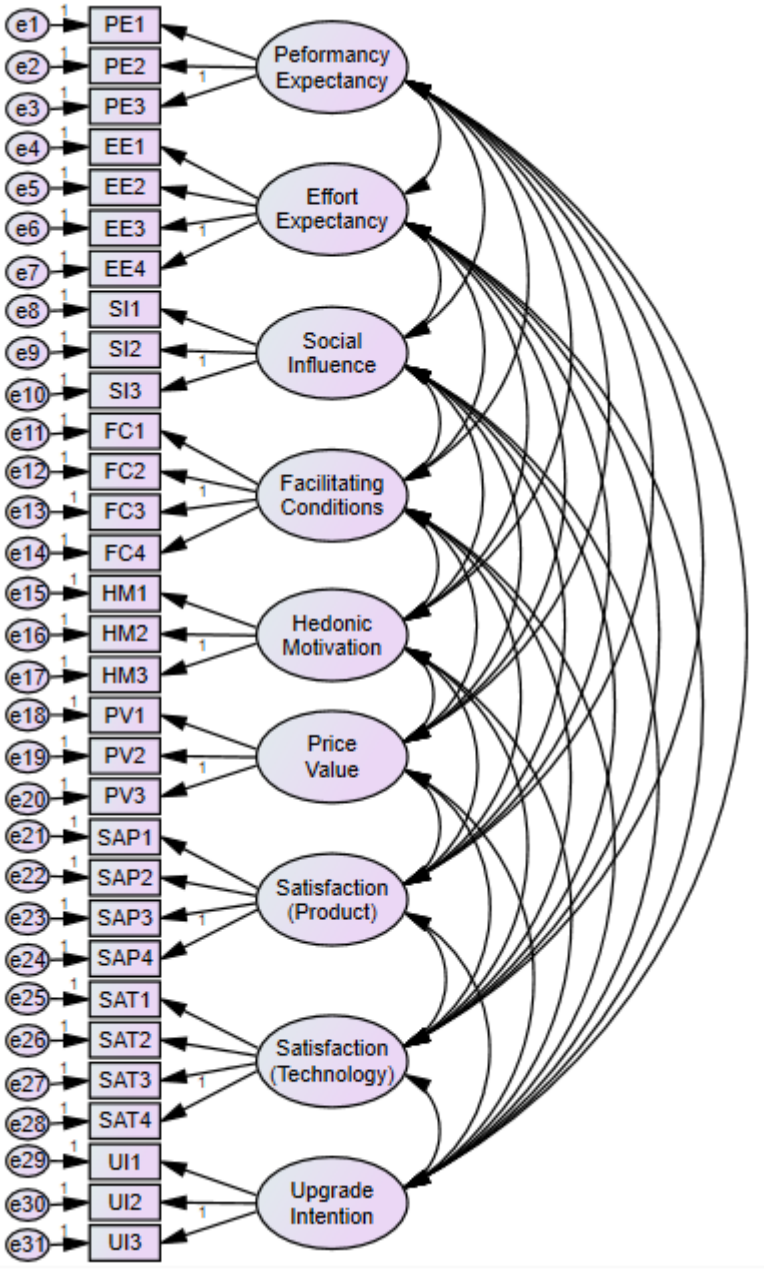


Figure 3.1 Measurement Model for the Technology Upgrade Model

3.17.1. Goodness-of-fit of the Measurement Model

The levels of goodness-of-fit of the measurement model for the technology upgrade model (with a sample size > 250 and the number of indicators about 30) were measured with five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR (Bollen & Long, 1993; Hair et al., 2009). CMIN/df is the normed chi-square, a simple

ratio of chi-square to the degrees of freedom for the measurement model and an absolute fit index. Generally, a CMIN/df in the order of 3:1 or less is associated with a good fit (Hair et al., 2009). CFI is an incremental fit index and an improved version of the normed fit index (NFI). A CFI above 0.9 is usually associated with a good fit. RMSEA is the root mean square error of approximation and an absolute fit index. It corrects for both model complexity and sample size. An RMSEA less than or equal to 0.07 is considered a good fit. PCLOSE is the *p* of Close Fit and tests whether the probability of RMSEA is less than or equal to 0.05. A PCLOSE larger than 0.05 suggests a good fit (Bollen & Long, 1993). SRMR is the standardised root mean residual and also an absolute fit index. It is a standardised measure of the overall residual value. As a rule, a SRMR less than 0.08 suggests a good fit (Hair et al., 2009). Table 3.12 summarises the standards and their sources used to assess the levels of goodness-of-fit of the measurement model.

Table 3.12 Goodness-of-fit Measures

Goodness-of-fit Measure	**Cut-off**	**Source**
CMIN/df	3:1 ratio	(Hair et al., 2009)
CFI	> 0.9	(Hair et al., 2009)
RMSEA	≤ 0.07	(Hair et al., 2009)
PCLOSE	> 0.05	(Bollen & Long, 1993)
SRMR	≤ 0.08	(Hair et al., 2009)

3.17.2. Construct Validity of the Measurement Model

The construct validity of the measurement model for the technology upgrade model (in terms of convergent validity and discriminant validity) was also examined. Convergent

validity indicates that the items share a high proportion of variance. Discriminant validity indicates that the factors are truly distinct from others.

To assess the convergent validity of the measurement model for the technology upgrade model, factor loadings, average variance extracted (AVE) and construct reliability were considered. The size of standardised factor loadings is an important consideration. High loadings on standardised factor loadings indicate that the measurement items converge on a common construct (Hair et al., 2009). As a good rule of thumb, standardised factor loadings should be 0.5 or higher, and ideally 0.7 or higher. AVE is a measure of the mean variance extracted for the measurement items loading on a construct. It is a summary indicator of convergence. An AVE equal to or higher than 0.5 suggests an adequate convergent validity. Reliability is also an indicator of convergent validity. Construct reliability is often used to measure the internal consistency of measures, indicating whether the measurement items all represent the same construct consistently. Construct reliability of ≥ 0.7 suggests that the reliability is good and thus represents good convergence.

To determine the discriminant validity of the measurement model for the technology upgrade model, the AVE for each construct was compared with the squared correlations of the other constructs. Discriminant validity is considered satisfactory if the AVEs of all constructs are higher than the squared correlations of other constructs (Hair et al., 2009). Table 3.13 summarises the standards and their sources used to assess the levels of the construct validity of the measurement model.

Table 3.13 Summary of the Standards and Their Sources to be Used for the Assessment of the Construct Validity of the Measurement Model

Component of Construct Validity	Measure	Cut-off	Source
Convergent validity	Standardised factor loadings	0.5 or higher, and ideally 0.7 or higher	(Hair et al., 2009)
	AVE	0.5 or higher	(Hair et al., 2009)
	CR	0.7 or higher	(Hair et al., 2009)
Discriminant validity	AVE for each construct and the square of the correlations of the other constructs	AVEs > the squared correlations of the other constructs	(Hair et al., 2009)

3.18. Update of the Measurement Model

The measurement model validity of the technology upgrade model was assessed based on the results of the CFA. To achieve adequate measurement model validity, constructs with more than three measurement items were examined. If the constructs had measurement items with a standardised factor loading less than 0.7, the measurement items were identified for deletion. Deletion of items is a common change to measurement models if the items do not perform well with respect to model integrity, model fit or construct validity (Hair et al., 2009). With the deletion of these items, an updated measurement model was proposed. The updated measurement model was then re-assessed for measurement model validity.

3.19. Structural Equation Modelling Analysis

SEM analysis was used to assess the structural model validity of the technology upgrade model. Structural model validity was evaluated based on a comparison of the structural model fit compared to the measurement model fit (Hair et al., 2009). The structural model for the technology upgrade model is shown in Figure 3.2 below.

Covariance-based SEM analysis was performed with the AMOS SEM program.

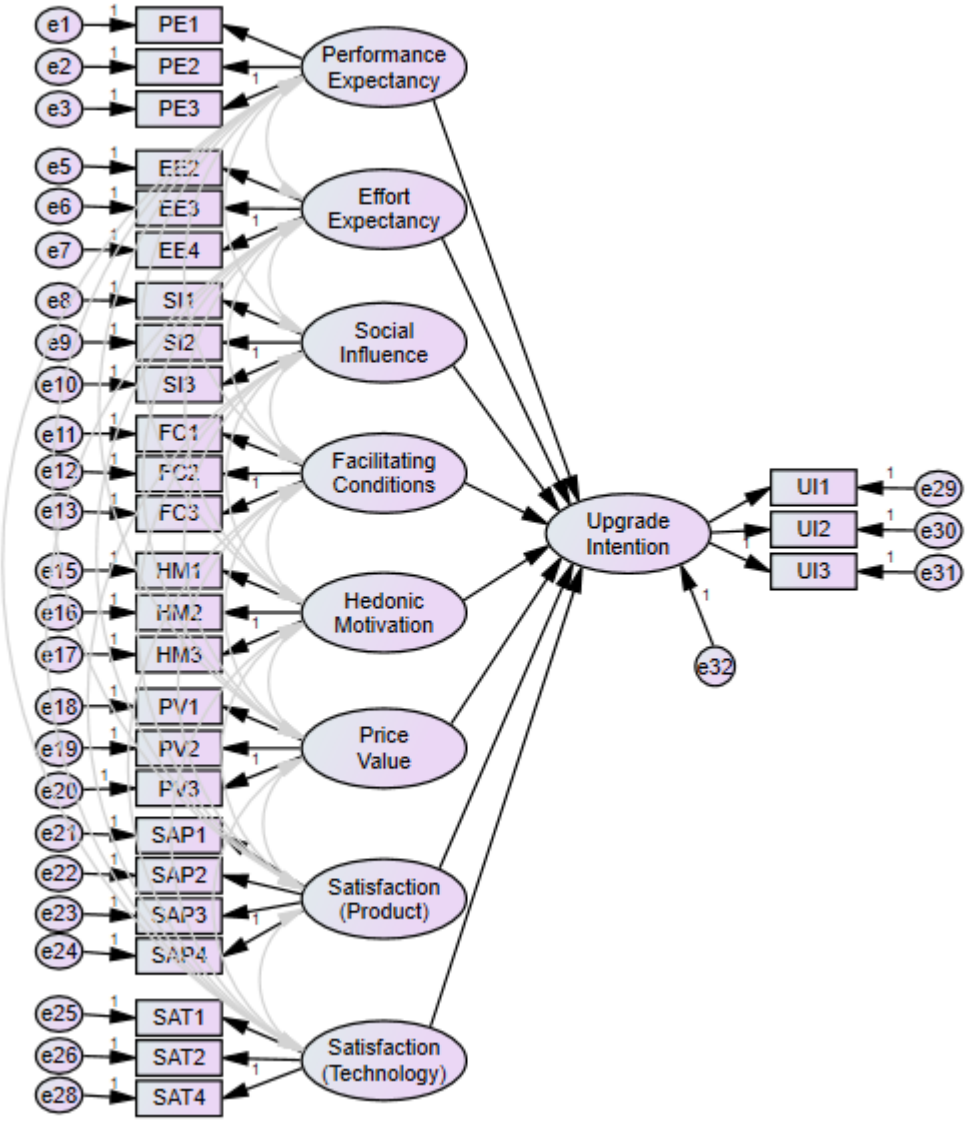


Figure 3.2 Structural Model for the Technology Upgrade Model

3.19.1. Goodness-of-fit of the Structural Model

The levels of goodness-of-fit of the structural model for the technology upgrade model (with a sample size > 250 and the number of indicators about 30) were measured with the same five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The same standards as used for the assessment of the levels of goodness-of-fit of the measurement model were applied for the assessment of the levels of goodness-of-fit of the structural model.

3.19.2. Relationships between the Constructs

After the structural model validity was validated, the relationships between constructs in the structural model were examined. The standardised path coefficients, along with their *t* values and significance, and the variance-explained estimates for the endogenous construct—upgrade intention—were examined. The standardised path coefficients between the constructs were inspected to determine the strength of the relationships between the constructs. To assess the explanatory power of the technology upgrade model, the variance-explained estimate for the endogenous construct—upgrade intention—was also presented.

3.20. Moderation

The moderating effect of recency of purchase was assessed using SEM analysis with multi-group analysis. Participants were separated into two groups based on their recency of purchase. Participants who had purchased their smartphone in the past 12 months were assigned to the RECENT group, while participants who had purchased their smartphone more than 12 months previously were assigned to the OLD group.

3.21. Multi-sample Confirmatory Factor Analysis

Before multi-group SEM analysis could be used to test the moderating effect of recency of purchase, multi-sample CFA was used to establish the measurement invariance of the updated measurement model for the technology upgrade model across the two groups.

Measurement invariance is made up of configural invariance and metric invariance (Hair et al., 2009). Configural invariance confirms that the same basic factor structure of the updated measurement model for the technology upgrade model exists in the two groups. Metric invariance establishes the equivalence of the factor loadings of the updated measurement model for the technology upgrade model across the two groups.

Multi-sample CFA, a form of multigroup analysis, was used to establish measurement invariance of the updated measurement model for the technology upgrade model across the two groups (Hair et al., 2009). MCFA was performed with the AMOS SEM program (Byrne, 2013).

To establish configural invariance, the model fit of the updated measurement model for the technology upgrade model (with all the factor loadings estimated separately for the two groups) was tested. This model (with all the factor loadings unconstrained for the two groups) is sometimes referred as the totally free multiple group model (Hair et al., 2009). The goodness-of-fit measures of the totally free multiple group model were examined.

3.21.1. Goodness-of-fit of the Totally Free Multiple Group Model

The levels of goodness-of-fit of the totally free multiple group model (with a sample size > 250 and the number of indicators about 30) were measured with the same five

goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The same standards were applied for assessing the levels of goodness-of-fit of the totally free multiple group model.

To establish metric invariance, the model fit of the updated measurement model for the technology upgrade model (with all the factor loadings constrained to be equal for the two groups) was tested and compared with that of the totally free multiple group model. The goodness-of-fit measures of this constrained model and the chi-square difference, $\Delta\chi^2$, between the totally free multiple group model and this constrained model were examined.

3.21.2. Goodness-of-fit Measures and $\Delta\chi^2$

The levels of goodness-of-fit of the constrained multiple group model (with a sample size > 250 and the number of indicators about 30), were measured with the same five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The same standards were applied for assessing the levels of goodness-of-fit of the constrained multiple group model.

The chi-square difference, $\Delta\chi^2$, between the totally free multiple group model and the constrained multiple group model was assessed to establish metric invariance.

3.22. Multi-group Structural Equation Modelling

With the measurement invariance established, multi-group SEM analysis was then applied to the structure model for the technology upgrade model to test for the moderating effect of recency of purchase. First, the model fit of the structural model for the technology upgrade model (with all the factor loadings estimated separately for the

two groups) was tested. Second, the model fit of the technology upgrade model (with all the factor loadings constrained to be equal for the two groups) was tested. Finally, a comparison of the differences between the two models with a chi-square difference, $\Delta\chi^2$, test was used to examine whether moderation existed.

The goodness-of-fit levels of the models were measured with the same five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The same standards were applied for assessing the models' levels of goodness-of-fit.

3.22.1. Relationships between the Constructs across the Two Groups

After moderation was shown to exist, the relationships between the constructs in the structural model were examined across the recency of purchase RECENT and OLD groups, with any differences identified. The standardised path coefficients, along with their *t* values and significance, and the variance-explained estimates for the endogenous construct—upgrade intention—of the two groups were examined.

3.23. Ethics

This study was conducted in accordance with the approved ethics protocol from the HREC, University of Newcastle, Australia. Ethical issues related to quantitative research with anonymous questionnaires, including questionnaire design, recruitment of participants and data storage and access were undertaken in strict compliance with the requirements of the National Statement on Ethical Conduct in Human Research (2007) and the University of Newcastle.

This research involved human participants. Ethics and safety applications were submitted to the University of Newcastle for approval. Data collection took place safely

in classrooms at a university and its affiliated institutions in Hong Kong. No personal data were requested, to ensure participant anonymity. No incentives were offered for participation. Participants' consent was indicated by their completion of the questionnaire.

All participants are degree and sub-degree students at a university and its affiliated institutions in Hong Kong. They are all proficient in English and have ready access to email. To protect participants' rights, they were handed a participant information sheet, which detailed how the participants might submit any concerns or complaints to the human research ethics office at the University of Newcastle.

All the data collected were safeguarded to ensure confidentiality. The collected data were stored securely (on a password protected computer/in a locked filing cabinet) by the researcher. The data will be retained for five years after the approval of the DBA thesis, as per University of Newcastle requirements and will then be discarded. As the questionnaire is anonymous, the data are non-identifiable. The collected data has contributed towards the researcher's DBA thesis. As such, it may be presented in academic publications or conferences. Non-identifiable data may also be shared with other parties to encourage scientific scrutiny and contribute to further research and public knowledge, or as required by law.

Chapter 4 Data Analysis

Chapter 3 outlined the study's research design and methodology, and described the data collection process and data analysis methods. This chapter presents the results of the analysis. Descriptive statistics on the participants' demographics of the recency of purchase were prepared to give a general description of the participants. CFA was used to assess the validity of the technology upgrade measurement model. SEM analysis with multi-group analysis was then applied to assess the technology upgrade structural model, the relationships between the constructs and the moderating effect of recency of purchase. Finally, the research hypotheses were tested.

4.1. Data Preparation

In total, 455 questionnaires were collected. Of these, 410 were complete questionnaires, while 45 had missing data on some questions. The questionnaires with missing data accounted for 9.89% of the total, which was marginally less than 10%. The complete case approach—listwise deletion—was used to deal with the missing data. Only the complete questionnaires were used for analysis. Traditionally, this approach is considered most appropriate for SEM (Hair et al., 2009).

4.2. Descriptive Analysis of the Participants

The respondents' profiles are presented first. The distribution of males and females was approximately even. Out of the 410 participants, 48.5% were male and 51.5% were female (see Figure 4.1).

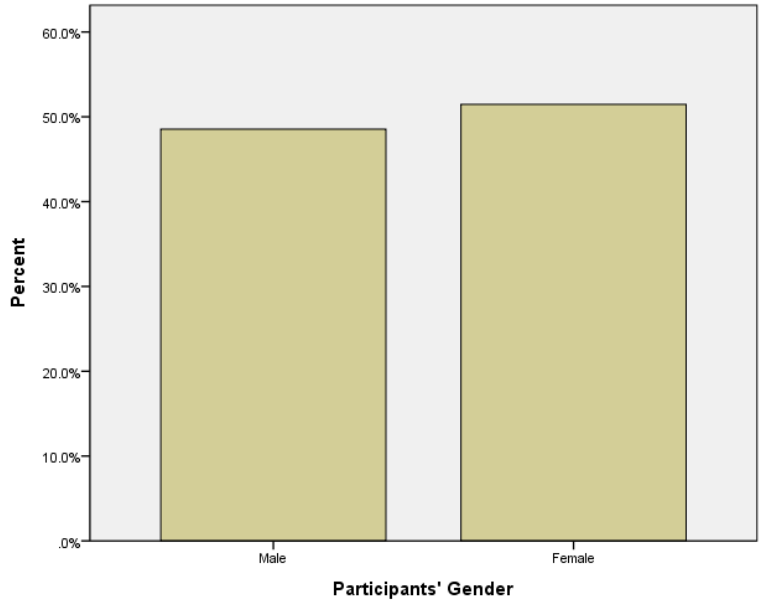


Figure 4.1 Participants' Gender

The age of respondents ranged from 18 to 43 years. The majority of participants (86.6%) were between 18 and 21 years old (see Figure 4.2). The average participant was 19.94 years of age, and there was very little variation in age among the sample, with a standard deviation of 1.99 years.

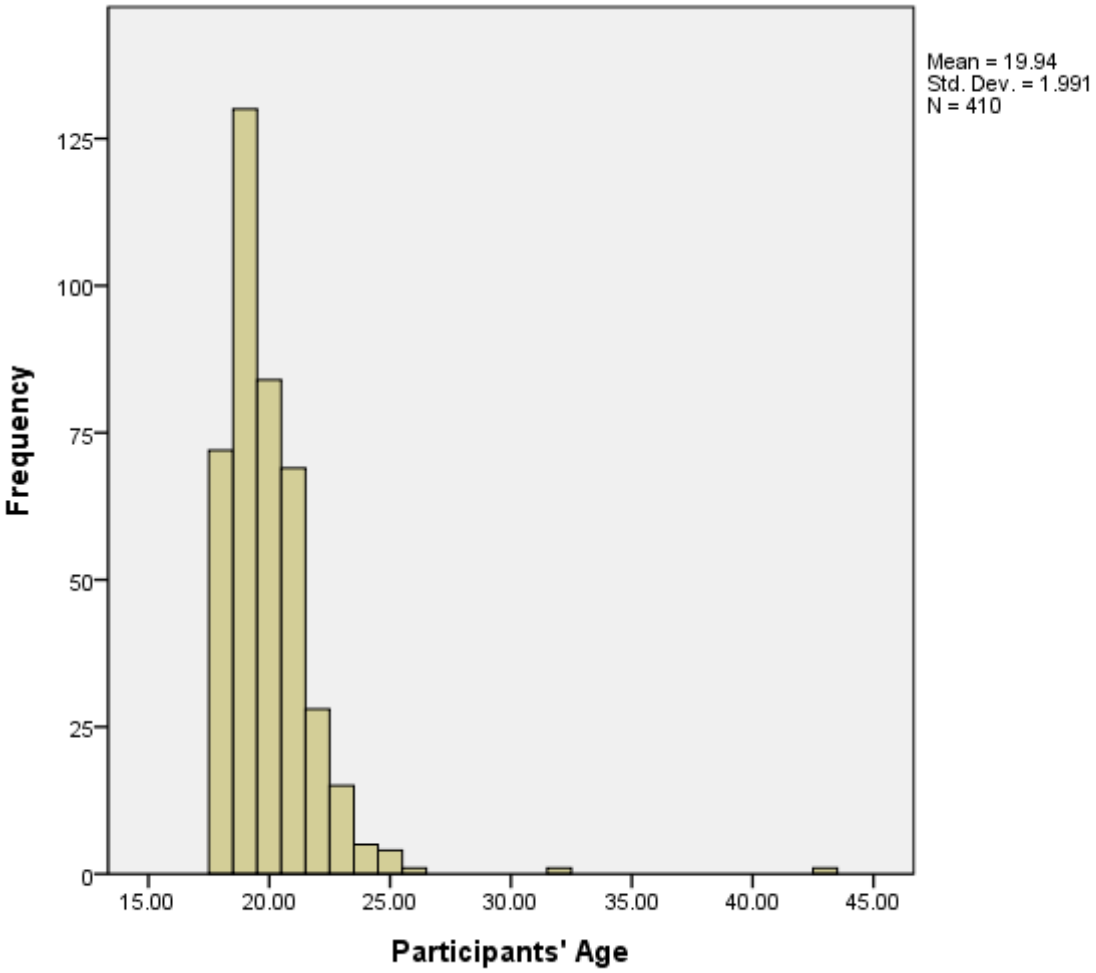


Figure 4.2 Participants' Age

Participants had purchased their smartphone between 1 month and 65 months ago (approximately 5.42 years) (see Figure 4.3). The majority of participants (61.7%) had purchased their smartphone in the past year, and 38.3% participants had purchased their smartphone more than one year ago. The average participant had purchased their smartphone a little over one year ago (mean of 13.77 months), although the recency of purchase was quite varied, with a standard deviation of 10.88 months.

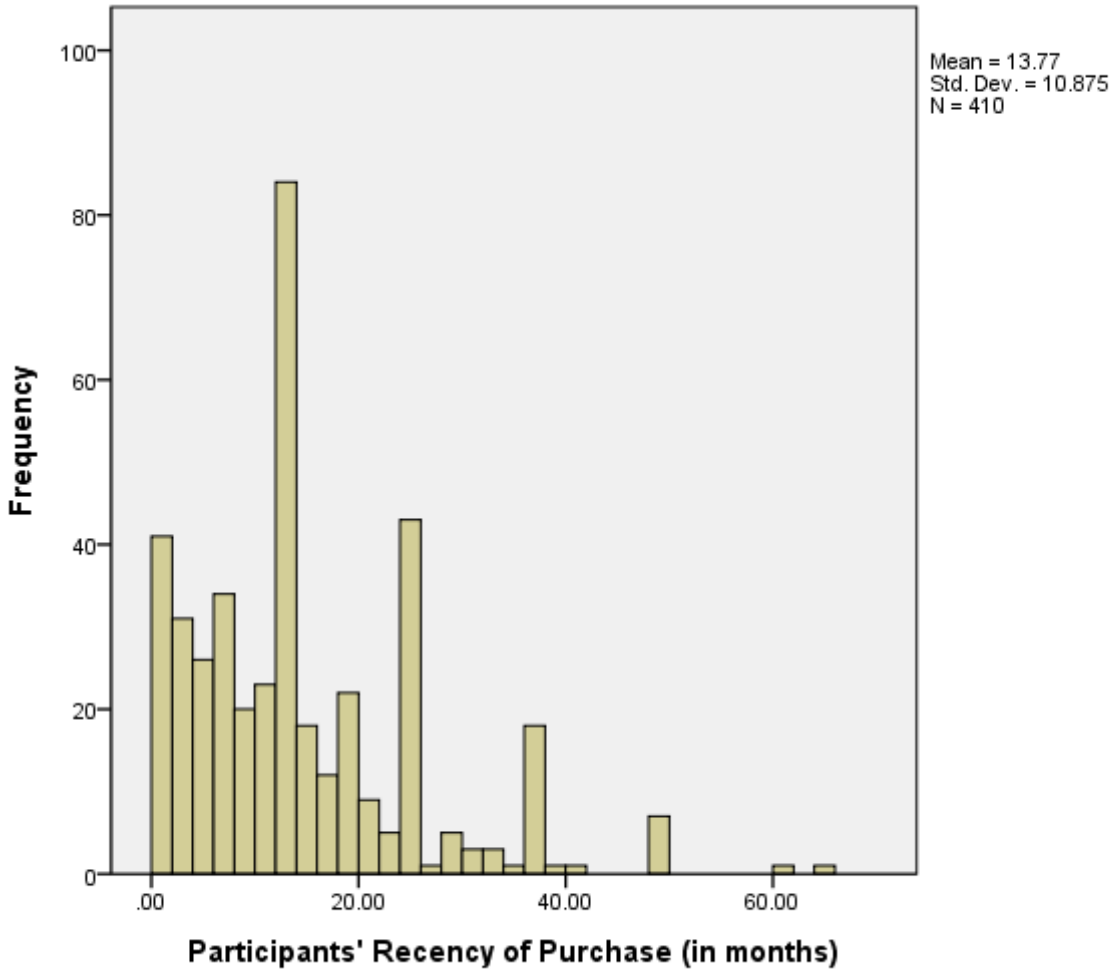


Figure 4.3 Participants' Recency of Purchase (in Months)

4.3. Normality Assessments

The normality of the data from the questionnaire items was assessed to prepare for CFA and SEM analysis. Multivariate normality is one assumption of CFA and SEM analysis (Hair et al., 2009). However, the Shapiro-Wilks test of normality showed that data from the questionnaire items might not be normally distributed (Coakes & Ong, 2013). Although this was not ideal, CFA is fairly robust against deviations from normality, and problems with deviations from normality for SEM analysis can be minimised with a sufficient sample size (Allen & Bennett, 2012; Hair et al., 2009). In addition, the absolute values of skewness and kurtosis of less than two are considered a reasonable

approximation to the normal curve (Hahs-Vaughn & Lomax, 2013). All data from the questionnaire items had skewness and kurtosis absolute values of less than two. Hence, all data from the questionnaire items were approximately normally distributed (see Appendix F).

4.4. Confirmatory Factor Analysis

CFA was used to assess the measurement model validity of the technology upgrade model. Measurement model validity depends on the establishment of acceptable levels of goodness-of-fit and construct validity, which includes convergent validity and discriminant validity (Hair et al., 2009). The measurement model of the technology upgrade model is shown in Figure 4.4 below.

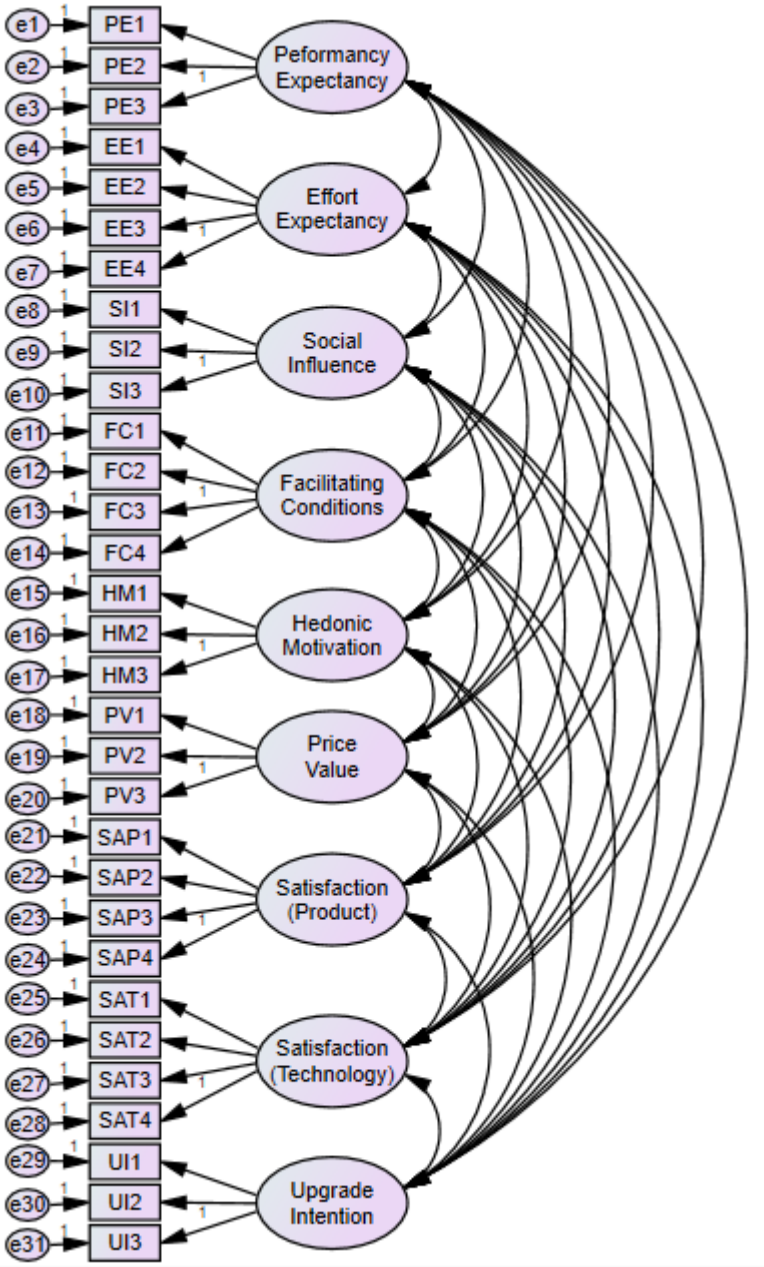


Figure 4.4 Measurement Model for the Technology Upgrade Model

CFA was performed with the AMOS SEM program. The standardised factor loadings and goodness-of-fit measures are presented below (Byrne, 2013).

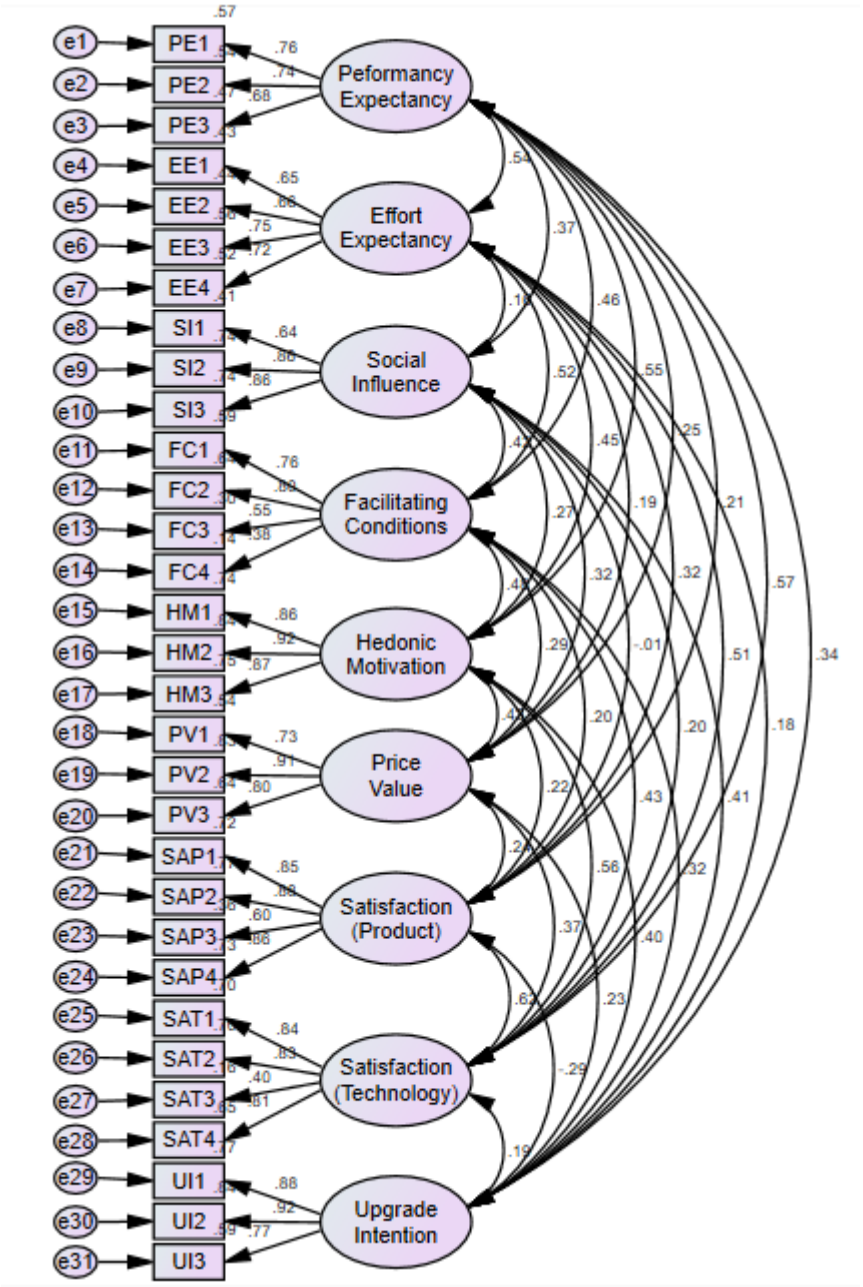


Figure 4.5 Standardised Factor Loadings and Squared Multiple Correlations of the Measurement Model for the Technology Upgrade Model

4.4.1. Overall Model Fit

To determine the strength of the relationships between the constructs and the variables, squared multiple correlations (SMC) were examined. Two of the 31 items had SMC values below 0.3 (FC4 and SAT3), which suggests these items should be dropped from

the model, as they are not a very good measure for the corresponding construct (see Figure 4.5).

4.4.2. Goodness-of-fit Measures

In terms of goodness-of-fit, the measurement model for the technology upgrade model demonstrated a good fit in four goodness-of-fit measures: CMIN/df, CFI, RMSEA and SRMR; however, the test for close fit (PCLOSE) was rejected (see Table 4.1). The chi-square statistic was significant (as expected with a large sample size), the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (2.404) and the CFI was above 0.9 (0.918). The RMSEA measures the number of errors in a model, and this was less than the recommended 0.07 level (0.059). SRMR was less than 0.08 (0.0621). These four goodness-of-fit measures were satisfactory. However, PCLOSE was not higher than 0.05 (0.002), indicating that the model fit of the measurement model was not as ideal as desired.

Table 4.1 Goodness-of-fit Measures of the Measurement Model for the Technology Upgrade Model

Goodness-of-fit Measure	**Cut-off**	**Result**
CMIN/df (*p* value)	3:1 ratio (significant) (Hair et al., 2009)	2.404 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.918
RMSEA	≤ 0.07 (Hair et al., 2009)	0.059
PCLOSE	> 0.05 (Bollen & Long, 1993)	***0.002***
SRMR	≤ 0.08 (Hair et al., 2009)	0.0621

4.4.3. Construct Validity

The construct validity of the measurement model for the technology upgrade model—in terms of convergent validity and discriminant validity—is presented below. The results

of convergent validity will be discussed first, followed by a discussion of discriminant validity.

4.4.3.1. *Convergent Validity*

Examination of the standardised factor loadings is one essential step for assessing convergent validity. Ideally, factor loadings should be 0.7 or higher, but are acceptable above the 0.5 mark (Hair et al, 2010). The majority of the standardised factor loadings were above 0.5; only two out of 31 (6.4%) standardised factor loadings were less than 0.5. These were the fourth item for 'facilitating conditions'—FC4 (0.376)—and the third item for 'satisfaction with the technology that supports the current high-technology product'—SAT3 (0.401). Six out of 31 (19.4%) standardised factor loadings were between 0.5 and 0.7. These were the third item for 'performance expectancy'—PE3 (0.683)—the first and second item for 'effort expectancy'—EE1 (0.653) and EE2 (0.662)—the first item for 'social influence'—SI1 (0.643)—the third item for 'facilitating conditions'—FC3 (0.547)—and the third item for 'satisfaction with the current high-technology product'—SAP3 (0.602). All other standardised factor loadings (74.2%) were higher than 0.7. As the standardised factor loadings of FC4 and SAT3 were less than 0.5, convergent validity was not satisfactory with respect to factor loadings. These items—FC4 and SAT3—were identified as problematic.

For convergent validity, AVEs should be 0.5 or higher. The AVEs for 'effort expectancy'—EE (0.485)—and 'facilitating conditions'—FC (0.417)—were less than 0.5, while the AVEs for all other constructs were greater than 0.5. Thus, convergent validity was also unsatisfactory with respect to AVE, due to problems with the constructs EE and FC. The CRs for all constructs were higher than 0.7 (see

Table 4.3). Convergent validity was satisfactory with respect to CR. Overall, the convergent validity was questionable with respect to the factor loadings and AVEs of the constructs EE, FC and SAT.

4.4.3.2. *Discriminant Validity*

To determine the discriminant validity of the measurement model for the technology upgrade model, the AVE for each construct was compared with the squared correlations of the other constructs. The AVEs of all constructs were higher than the squared correlations of other constructs (see Table 4.2). Hence, the discriminant validity was satisfactory.

Table 4.2 CR and Discriminant Validity (AVE and Squared Correlations) of the Measurement Model for the Technology Upgrade Model

Construct	CR	AVE	PE	EE	SI	FC	HM	PV	SAP	SAT	UI
PE	0.769	0.527	-								
EE	0.79	***0.485***	0.287	-							
SI	0.833	0.629	0.135	0.0259	-						
FC	0.726	***0.417***	0.215	0.2756	0.176	-					
HM	0.913	0.777	0.299	0.2034	0.075	0.228	-				
PV	0.856	0.667	0.064	0.0357	0.102	0.084	0.183	-			
SAP	0.879	0.648	0.045	0.0992	0.000	0.041	0.047	0.058	-		
SAT	0.822	0.552	0.324	0.2591	0.039	0.181	0.312	0.138	0.383	-	
UI	0.892	0.734	0.118	0.0342	0.166	0.101	0.158	0.055	0.084	0.036	-

Table 4.3 Construct Validity Measures of the Measurement Model for the Technology Upgrade Model

Component of Construct Validity	Measure	Cut-off	Result
Convergent validity	Standardised factor loadings	0.5 or higher, and ideally 0.7 or higher (Hair et al., 2009)	Two standardised factor loadings < 0.5, 6 standardised factor loadings between 0.5 and 0.7 and other standardised factor loadings > 0.7
	AVE	0.5 or higher (Hair et al., 2009)	AVE of EE (0.485) and AVE of FC (0.417) < 0.5 and AVEs of others > 0.5
	CR	0.7 or higher (Hair et al., 2009)	All CRs > 0.7
Discriminant validity	AVE for each construct and the square of the correlations of the other constructs	AVEs > the squared correlations of the other constructs (Hair et al., 2009)	For all constructs, AVEs > the squared correlations of the other constructs

4.5. Updated Measurement Model

As the model fit of the measurement model for the technology upgrade model was not as suitable as desired and the convergent validity was questionable with respect to the factor loadings and AVEs of the constructs EE, FC and SAT; modifications were needed to improve the model. Deleting items is common with measurement models if the items do not perform well with respect to model integrity, model fit or construct validity (Hair et al., 2009). As EE, FC and SAT had four items, with the deletion of one item, all could still satisfy the minimum requirement of having three items per construct (Hair et al., 2009). As EE1 had the smallest factor loading (0.653) and SMC (0.44) of all the EE items, and the standardised factor loadings and SMCs of FC4 (0.376 and 0.14,

respectively) and SAT3 (0.401 and 0.16, respectively) were unsatisfactory, items EE1, FC4 and SAT3 were chosen for deletion.

The updated measurement model of the technology upgrade model after deletion of the items EE1, FC4 and SAT3 is shown in Figure 4.6 below.

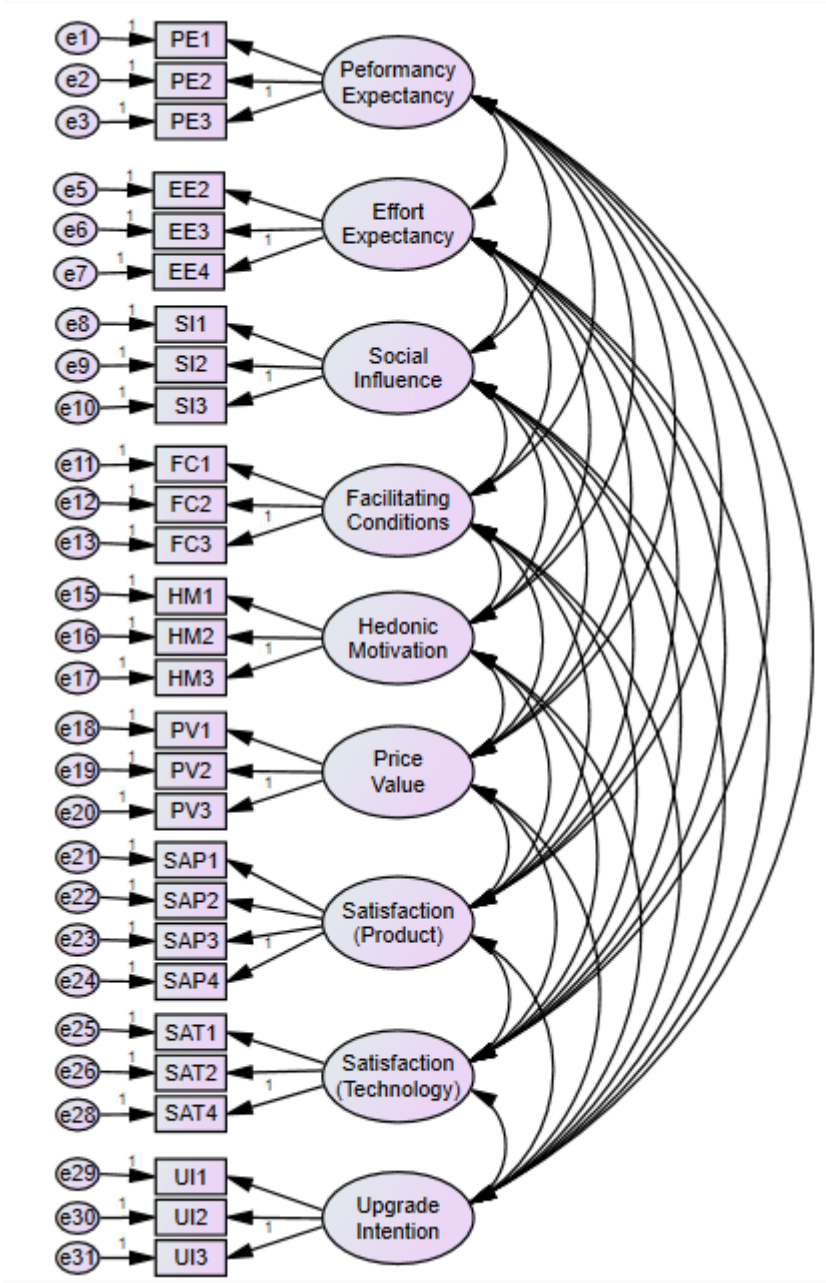


Figure 4.6 Updated Measurement Model for the Technology Upgrade Model with the Deletion of the Items EE1, FC4 and SAT3

CFA was then performed with the AMOS SEM program on the updated measurement model. The standardised factor loadings and goodness-of-fit measures are presented below.

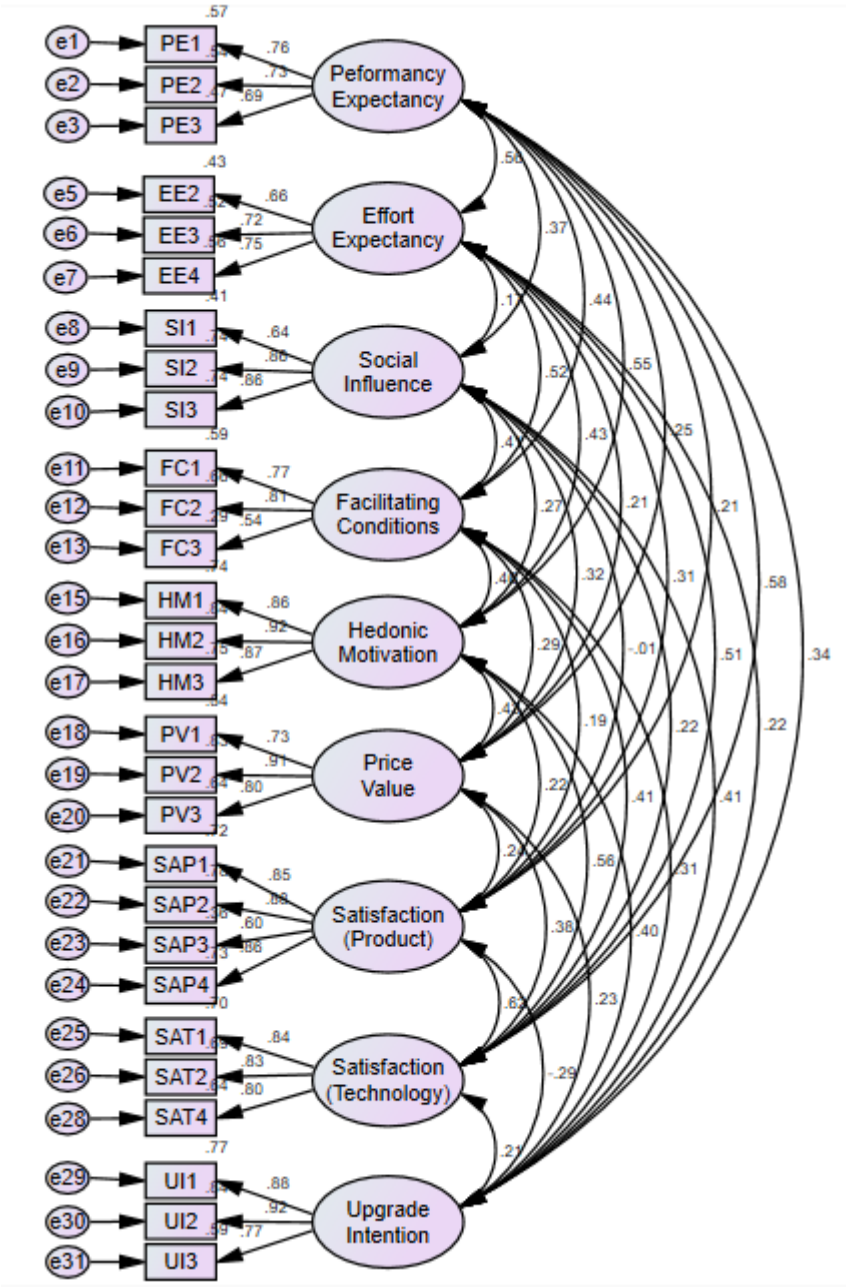


Figure 4.7 Standardised Factor Loadings of the Updated Measurement Model for the Technology Upgrade Model

4.5.1. Goodness-of-fit Measures

In terms of goodness-of-fit, the updated measurement model for the technology upgrade model demonstrated good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The chi-square statistic was significant as expected and the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio

(2.086). CFI was above 0.9 (0.946). RMSEA was less than 0.07 (0.052). PCLOSE was higher than 0.05 (0.317) and not rejected. SRMR was less than 0.08 (0.0533). As a result, the model fit of the updated measurement model was improved and satisfactory.

Table 4.4 Goodness-of-fit Measures of the Updated Measurement Model for the Technology Upgrade Model

Goodness-of-fit Measure	Cut-off	Result
CMIN/df (*p* value)	3:1 ratio (significant) (Hair et al., 2009)	2.086 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.946
RMSEA	≤ 0.07 (Hair et al., 2009)	0.052
PCLOSE	> 0.05 (Bollen & Long, 1993)	0.317
SRMR	≤ 0.08 (Hair et al., 2009)	0.0533

4.5.2. Construct Validity

The construct validity of the updated measurement model for the technology upgrade model, in terms of convergent validity and discriminant validity, is presented below.

4.5.2.1. Convergent Validity

For the updated measurement model for the technology upgrade model, no standardised factor loadings were less than 0.5. Five out of 28 (17.9%) standardised factor loadings were between 0.5 and 0.7. These were PE3 (0.685), EE2 (0.657), SI1 (0.643), FC3 (0.541) and SAP3 (0.599). All other standardised factor loadings (82.1%) were higher than 0.7. Therefore, the convergent validity of the updated measurement model for the technology upgrade model was improved and satisfactory. The AVEs of all constructs were also higher than 0.5. The CR of all constructs were higher than 0.7 (see Table 4.5).

4.5.2.2. Discriminant Validity

The discriminant validity of the updated measurement model for the technology upgrade model was also satisfactory. The AVEs of all constructs were higher than the squared correlations of other constructs (see Table 4.5).

As a result, the updated measurement model for the technology upgrade model demonstrated construct validity in terms of convergent validity and discriminant validity. The updated measurement model for the technology upgrade model was assessed as satisfactory and achieved measurement model validity.

Table 4.5 CR and Discriminant Validity (AVE and Squared Correlations) of the Updated Measurement Model for the Technology Upgrade Model

Construct	CR	AVE	PE	EE	SI	FC	HM	PV	SAP	SAT	UI
PE	0.769	0.527	-								
EE	0.752	0.503	0.319	-							
SI	0.834	0.629	0.135	0.0282	-						
FC	0.756	0.515	0.196	0.2746	0.171	-					
HM	0.913	0.777	0.298	0.1875	0.075	0.214	-				
PV	0.857	0.667	0.064	0.0458	0.102	0.085	0.183	-			
SAP	0.878	0.648	0.045	0.0942	0.000	0.036	0.048	0.058	-		
SAT	0.864	0.679	0.331	0.256	0.048	0.172	0.317	0.147	0.379	-	
UI	0.892	0.734	0.118	0.047	0.166	0.097	0.158	0.055	0.084	0.044	-

4.6. Structural Equation Modelling

SEM analysis was used to assess the structural model validity of the technology upgrade model. Structural model validity was evaluated based on a comparison of the structural model fit with the measurement model fit (Hair et al., 2009). The structural model of the technology upgrade model is shown in Figure 4.8 below.

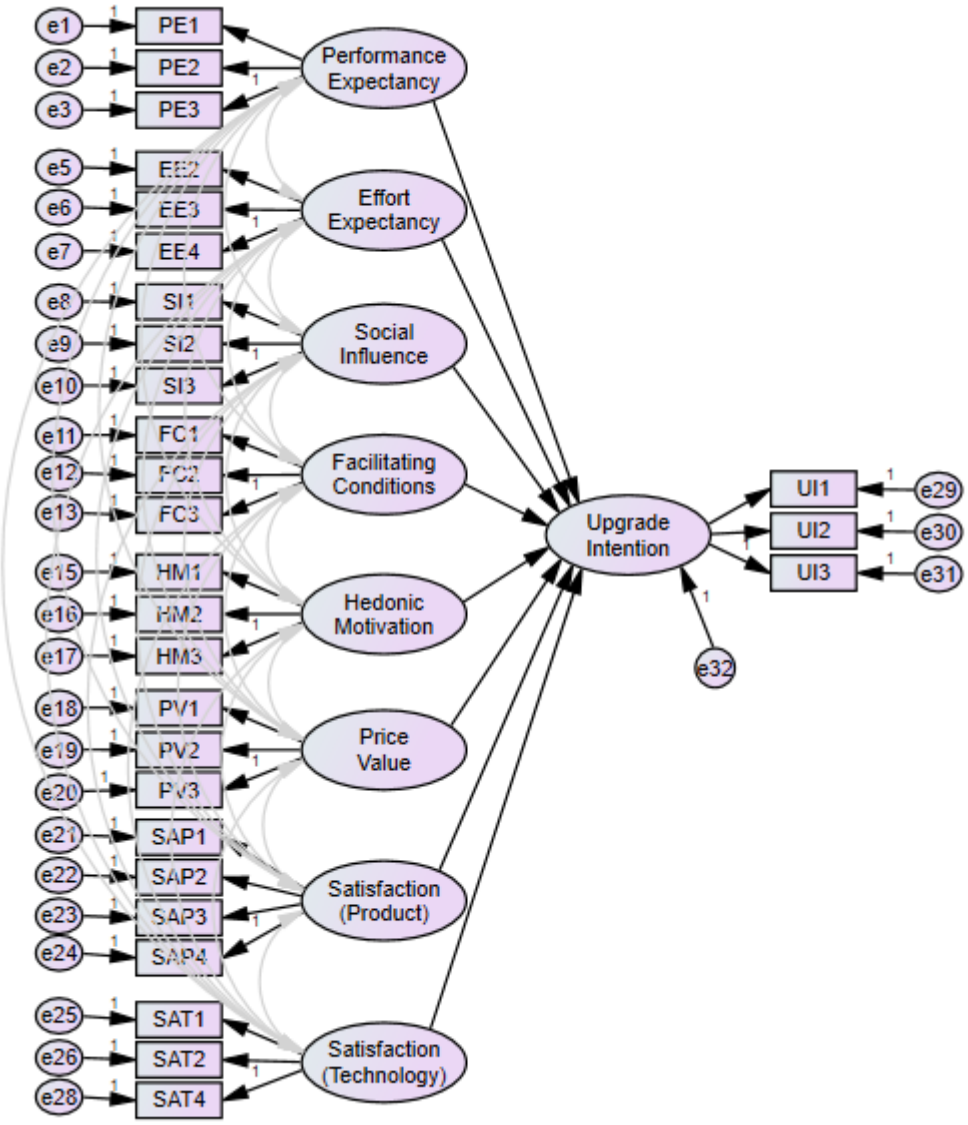


Figure 4.8 Structural Model for the Technology Upgrade Model

Covariance-based SEM analysis was performed with the AMOS SEM program. The standardised path coefficients and goodness-of-fit measures are presented below.

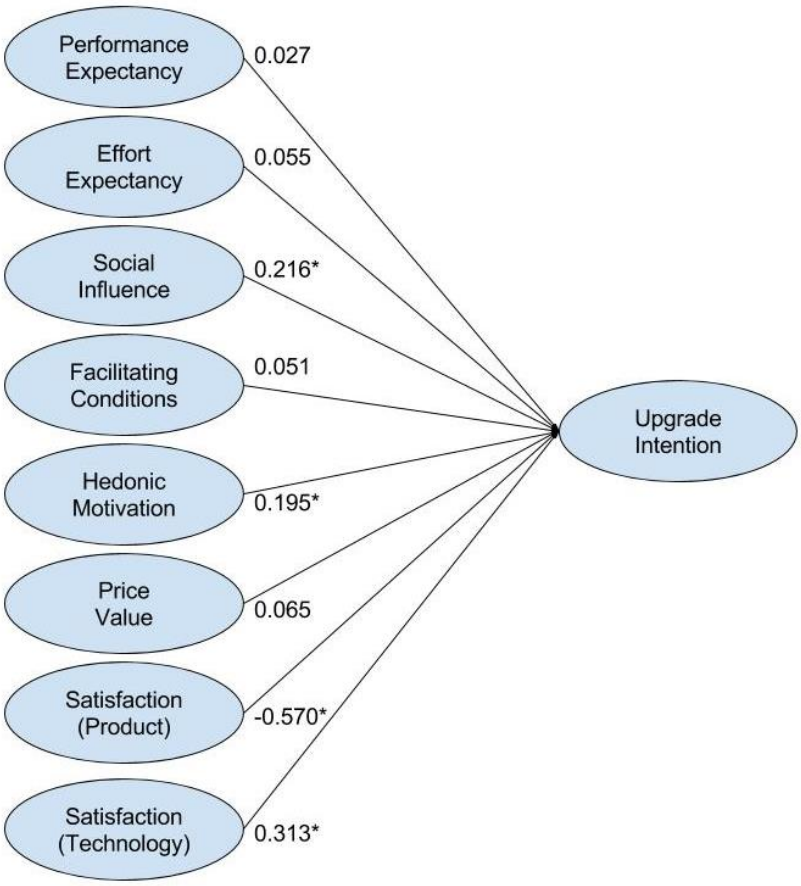


Figure 4.9 Standardised Path Coefficients of the Structural Model for the Technology Upgrade Model

4.6.1. Goodness-of-fit Measures

The structural model for the technology upgrade model demonstrated the same good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR, as the updated measurement model (see Table 4.6). The chi-square statistic was significant as expected, with a large sample size. The normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (2.086). CFI was above 0.9 (0.946). RMSEA was less than 0.07 (0.052). PCLOSE was higher than 0.05 (0.317). SRMR was less than 0.08 (0.0533). Thus, the structural model fitted the data well.

Table 4.6 Goodness-of-fit Measures of the Structural Model for the Technology Upgrade Model

Goodness-of-fit Measure	Cut-off	Result
CMIN/df	3:1 ratio (Hair et al., 2009)	2.086
CFI	> 0.9 (Hair et al., 2009)	0.946
RMSEA	≤ 0.07 (Hair et al., 2009)	0.052
PCLOSE	> 0.05 (Hair et al., 2009)	0.317
SRMR	≤ 0.08 (Hair et al., 2009)	0.0533

4.6.2. Relationships between the Constructs

The standardised path coefficients, along with their *t* values and significance, and the variance-explained estimate for the endogenous construct, upgrade intention (UI), are provided below.

Table 4.7 Standardised Path Coefficients, *t* Values, *p* Values and Variance-explained Estimate of Upgrade Intention

	Standardised Path Coefficients	***t* value**	***p* value**	**Variance-explained Estimate**
UI				0.448
PE → UI	.027	.337	.736	
EE → UI	.055	.736	.461	
SI → UI	.216	3.695	< 0.001	
FC → UI	.051	.739	.460	
HM → UI	.195	2.974	< 0.01	
PV → UI	.065	1.198	.231	
SAP → UI	-.570	-7.914	< 0.001	
SAT → UI	.313	3.394	< 0.001	

The standardised path coefficients between the constructs were inspected to determine the strength of the relationships between the constructs. The relationship between satisfaction with the current high-technology product and upgrade intention was the strongest, and most statistically significant result, with a standardised path coefficient of –0.570 ($p < 0.001$). This relationship was negative. The relationship between

satisfaction with the technology that supports the current high-technology product and UI was positive, representing the second strongest; this is a statistically significant result with a standardised path coefficient of 0.313 ($p < 0.001$). The relationships, HM → UI and SI → UI, were both positive and statistically significant and with similar strength, having standardised path coefficients of 0.195 ($p < 0.01$) and 0.216 ($p < 0.001$), respectively. Thus, SAT, HM and SI had a positive influence on the UI of the participants. However, no statistically significant relationship existed between PV → UI, FC → UI, EE → UI or PE → UI ($p > 0.05$).

The variance-explained estimate for the endogenous construct—UI—indicated that the technology upgrade model explained 44.8% of the variance in participants' upgrade intentions.

4.7. Moderation

The moderating effect of recency of purchase was assessed using SEM analysis and multi-group analysis. Participants were separated into two groups based on their recency of purchase. Participants who had purchased their smartphone within the past 12 months were assigned to the RECENT group, while participants who had purchased their smartphone more than 12 months previously were assigned to the OLD group. As a result, there were 252 participants in the RECENT group and 158 participants in the OLD group (see Table 4.8). The result of the technology upgrade model was compared across the two groups.

Table 4.8 Participants' Recency of Purchase

Group	Recency of Purchase	No. of Participants
RECENT	≤ 12 months	252
OLD	> 12 months	158

4.8. Multi-sample Confirmatory Factor Analysis

Before multi-group SEM analysis could be used to test the moderating effect of recency of purchase, the measurement invariance of the updated measurement model for the technology upgrade model across the two groups had to be established (see Figure 4.6).

Measurement invariance is made up of configural invariance and metric invariance (Hair et al., 2009). Configural invariance confirms that the same basic factor structure of the updated measurement model for the technology upgrade model that exists in the two groups. Metric invariance establishes the equivalence of the factor loadings of the updated measurement model for the technology upgrade model across the two groups.

MCFA, a form of multi-group analysis, was used to establish the measurement invariance of the updated measurement model for the technology upgrade model across the two groups (Hair et al., 2009). MCFA was performed with the AMOS SEM program (Byrne, 2013).

To establish configural invariance, the model fit of the updated measurement model for the technology upgrade model (with all factor loadings estimated separately for the two groups) was tested. This model is sometimes referred to as the totally free multiple group model (Hair et al., 2009). The goodness-of-fit measures of the totally free multiple group model are presented below.

4.8.1. Goodness-of-fit Measures of the Totally Free Multiple Group Model

The totally free multiple group model demonstrated a good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The chi-square statistic was significant, but the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (1.819). CFI was above 0.9 (0.921). RMSEA was less than 0.07 (0.045). PCLOSE was higher than 0.05 (0.982). SRMR was less than 0.08 (0.0632). Thus, the model fit of the totally free multiple group model was satisfactory and configural invariance was demonstrated.

Table 4.9 Goodness-of-fit Measures of the Totally Free Multiple Group Model

Goodness-of-fit Measure	Cut-off	Result
CMIN/df (p value)	3:1 ratio (significant) (Hair et al., 2009)	1.819 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.921
RMSEA	≤ 0.07 (Hair et al., 2009)	0.045
PCLOSE	> 0.05 (Hair et al., 2009)	0.982
SRMR	≤ 0.08 (Hair et al., 2009)	0.0632

To establish metric invariance, the model fit of the updated measurement model for the technology upgrade model (with all the factor loadings constrained to be equal for the two groups) was tested and compared with that of the totally free multiple group model. The goodness-of-fit measures of this constrained model and the chi-square difference, $\Delta\chi^2$, between the totally free multiple group model and this constrained model are presented below.

4.8.2. Goodness-of-fit Measures of the Constrained Model and $\Delta\chi^2$

The constrained model also demonstrated a good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The chi-square statistic was significant, but the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (1.791). CFI was above 0.9 (0.921). RMSEA was less than 0.07 (0.044). PCLOSE was higher than 0.05 (0.992). SRMR was less than 0.08 (0.0636). Thus, the model fit of the constrained model was satisfactory.

Table 4.10 Goodness-of-fit Measures of the Constrained Model

Goodness-of-fit Measure	**Cut-off**	**Result**
CMIN/df (*p* value)	3:1 ratio (significant) (Hair et al., 2009)	1.791 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.921
RMSEA	≤ 0.07 (Hair et al., 2009)	0.044
PCLOSE	> 0.05 (Hair et al., 2009)	0.992
SRMR	≤ 0.08 (Hair et al., 2009)	0.0636

The chi-square difference, $\Delta\chi^2$, between the totally free multiple group model and the constrained model was 16.893 with 19 degrees of freedom, which indicated no significant difference. Thus, the two models also exhibited full metric invariance.

Table 4.11 $\Delta\chi^2$ between the Totally Free Multiple Group Model and the Constrained Model

$\Delta\chi^2$	Δdf	***p* value**
16.893	19	0.597 > 0.1

As a result, the measurement invariance of the updated measurement model for the technology upgrade model across the two groups was established.

4.9. Multi-group Structural Equation Modelling

With the measurement invariance established, multi-group SEM analysis was then used to test the moderating effect of recency of purchase. First, the model fit of the structural model for the technology upgrade model (with all the path coefficients estimated separately for the two groups) was tested (see Figure 4.8). Second, the model fit of the technology upgrade model (with all the path coefficients constrained to be equal for the two groups) was tested. Finally, a comparison of the differences between the two models with a chi-square difference test, $\Delta\chi^2$, was used to test whether moderation existed. The goodness-of-fit measures of the two models and the chi-square difference, $\Delta\chi^2$, between the two models are presented below.

4.9.1. Goodness-of-fit Measures of the Unconstrained Model and $\Delta\chi^2$

The structural model for the technology upgrade model (with all the path coefficients estimated separately for the two groups) demonstrated a good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The chi-square statistic was significant, but the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (1.819). CFI was above 0.9 (0.921). RMSEA was less than 0.07 (0.045). PCLOSE was higher than 0.05 (0.982). SRMR was less than 0.08 (0.0632). Thus, the model fit of the unconstrained model was satisfactory.

Table 4.12 Goodness-of-fit Measures of the Structural Model with all the Path Coefficients Estimated Separately for the Two Groups

Goodness-of-fit Measure	Cut-off	Result
CMIN/df (p value)	3:1 ratio (significant) (Hair et al., 2009)	1.819 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.921
RMSEA	≤ 0.07 (Hair et al., 2009)	0.045
PCLOSE	> 0.05 (Hair et al., 2009)	0.982
SRMR	≤ 0.08 (Hair et al., 2009)	0.0632

The technology upgrade model (with all the path coefficients constrained to be equal for the two groups) also demonstrated good fit in all five goodness-of-fit measures: CMIN/df, CFI, RMSEA, PCLOSE and SRMR. The chi-square statistic was significant, but the normed chi-square measure—CMIN/df—was within the generally accepted 3:1 ratio (1.809). CFI was above 0.9 (0.918). RMSEA was less than 0.07 (0.045). PCLOSE was higher than 0.05 (0.988). SRMR was less than 0.08 (0.0657). Thus, the model fit of the constrained model was satisfactory.

Table 4.13 Goodness-of-fit Measures of the Structural Model with all the Path Coefficients Constrained to be Equal for the Two Groups

Goodness-of-fit Measure	Cut-off	Result
CMIN/df (p value)	3:1 ratio (significant) (Hair et al., 2009)	1.809 (< 0.001)
CFI	> 0.9 (Hair et al., 2009)	0.918
RMSEA	≤ 0.07 (Hair et al., 2009)	0.045
PCLOSE	> 0.05 (Hair et al., 2009)	0.988
SRMR	≤ 0.08 (Hair et al., 2009)	0.0657

Finally, the chi-square difference, $\Delta\chi^2$, between the two models was 42.557 with 27 degrees of freedom, which indicated a significant difference between the RECENT and OLD groups. As a result, moderation of recency of purchase existed for the technology upgrade model.

Table 4.14 $\Delta\chi^2$ between the Structural Model with Unconstrained Path Coefficients and the Structural Model with Constrained Path Coefficients

$\Delta\chi^2$	Δdf	*p* value
42.557	27	0.029 < 0.05

4.9.2. Relationships between the Constructs across the Two Groups

The standardised path coefficients, along with their *t* values and significance, and the variance-explained estimates for the endogenous construct (UI) for the two groups are provided below.

Table 4.15 Standardised Path Coefficients, *t* Values, *p* Values and Variance-explained Estimate of Upgrade Intention for the Recency of Purchase RECENT Group

	Standardised Path Coefficients	***t* value**	***p* value**	**Variance-explained Estimate**
UI				0.464
PE → UI	.155	1.491	.136	
EE → UI	-.005	-.045	.964	
SI → UI	.199	2.614	< 0.01	
FC → UI	.193	2.157	< 0.05	
HM → UI	.012	.129	.897	
PV → UI	-.049	-.687	.492	
SAP → UI	-.699	-6.111	< 0.001	
SAT → UI	.499	3.254	< 0.001	

An inspection of the standardised path coefficients for the recency of purchase RECENT group showed that the relationship SAP → UI was still negative and the strongest, most statistically significant result with a standardised path coefficient of -0.699 ($p < 0.001$). The relationship SAT → UI was also the second strongest, most positive and statistically significant with a standardised path coefficient of 0.499 ($p < 0.001$). The relationships SI → UI and FC → UI (instead of HM → UI, which were significant in the overall model), were both positive and statistically significant and with similar strengths. They had standardised path coefficients of 0.193 ($p < 0.05$) and 0.199

($p < 0.01$), respectively. There was no statistically significant relationship between PV → UI, HM → UI, EE → UI and PE → UI ($p > 0.05$).

The variance-explained estimate for the endogenous construct UI indicated that the technology upgrade model explained 46.4% (about 2% higher than that of the model with no consideration of moderation), of the variance in the upgrade intention towards the participants for the RECENT group.

Table 4.16 Standardised Path Coefficients, *t* Values, *p* Values and Variance-explained Estimate of Upgrade Intention for the Recency of Purchase OLD Group

	Standardised Path Coefficients	***t* value**	***p* value**	**Variance-explained Estimate**
UI				0.578
PE → UI	-.289	-1.814	.070	
EE → UI	.228	1.999	< 0.05	
SI → UI	.243	2.547	< 0.05	
FC → UI	-.189	-1.555	.120	
HM → UI	.422	3.801	< 0.001	
PV → UI	.144	1.631	.103	
SAP → UI	-.586	-5.374	< 0.001	
SAT → UI	.377	2.722	< 0.01	

For the recency of purchase OLD group, the relationships between the constructs showed greater difference from those of the model with no consideration of moderation. They also differed from those of the recency of purchase RECENT group. The relationship SAP → UI continued to be negative and the strongest, most statistically significant result with a standardised path coefficient of –0.586 ($p < 0.001$). However, the relationship between hedonic motivation and the upgrade intention, HM → UI, rather than SAT → UI, was the second strongest, positive and statistically significant result with a standardised path coefficient of 0.422 ($p < 0.001$). The relationship SAT → UI was only the third strongest, positive and statistically significant result with a

standardised path coefficient of 0.377 ($p < 0.001$). The relationships SI → UI and EE → UI (instead of HM → UI or FC → UI) were both positive and statistically significant and with similar strength, having standardised path coefficients of 0.243 ($p < 0.05$) and 0.228 ($p < 0.05$), respectively. There was no statistically significant relationship between PV → UI, FC → UI and PE → UI ($p > 0.05$).

The variance-explained estimate for the endogenous construct UI indicated that the technology upgrade model explained 57.8% (about 13% higher than that of the model with no consideration of moderation and 11% higher than that of the model of the recency of purchase RECENT group) of the variance in the upgrade intention towards the participants for the OLD group.

4.10. Results of Hypothesis Tests

Six hypotheses have been formulated to test the relationships hypothesised in the technology upgrade model. The proposed hypotheses and findings are presented below.

Table 4.17 Hypotheses 1–6 and a Summary of the Results

Number	Hypothesis	Supported
H1 (a-f)	The performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product affect consumer upgrade intentions positively.	Partially. Yes for (b) (only significant for OLD group), (c), (d) (only significant for RECENT group) and (e).
H2	Satisfaction with the current high-technology product affects consumer upgrade intentions negatively.	Yes
H3	Satisfaction with the technology that supports the current high-technology product affects consumer upgrade intentions positively.	Yes
H4 (a-f)	Recency of purchase moderates the effects of the performance expectancy (a), effort expectancy (b), social influence (c), facilitating conditions (d), hedonic motivation (e), and price value (f) of the use of an improved version of a high-technology product on consumer upgrade intentions positively.	Partially. Yes for (b), (c) and (e).

H5	Recency of purchase moderates the effect of satisfaction with the current high-technology product on consumer upgrade intentions positively.	Yes
H6	Recency of purchase moderates the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions negatively.	Yes

The majority of hypotheses were supported. Of the six UTAUT2 factors, four—effort expectancy (H1b), social influence (H1c), facilitating conditions (H1d), and hedonic motivation (H1e)—were found to positively affect a consumer's upgrade intention. Social influence (H1c) positively affected a consumer's upgrade intention no matter whether recency of purchase was RECENT or OLD. Facilitating conditions (H1d) positively affected a consumer's upgrade intention only when a purchase had been made recently, while effort expectancy (H1b) and hedonic motivation (H1e) positively affected a consumer's upgrade intention only when recency of purchase was OLD. However, the other two UTAUT2 factors—performance expectancy (H1a) and price value (H1f)—had no effect on a consumer's upgrade intention, providing partial support for H1 (a-f). Satisfaction with the current high-technology product negatively affected a consumer's upgrade intention, supporting H2. Satisfaction with the technology that supports the current high-technology product positively affected a consumer's upgrade intention; therefore H3 was also supported.

In relation to the moderating effect of recency of purchase, this positively moderated the effects of effort expectancy (H4b), social influence (H4c), and hedonic motivation (H4e) regarding the use of an improved version of a high-technology product on a consumer

upgrade intentions. Contrary to H4, recency of purchase negatively moderated the effect of facilitating conditions (H4d). Further, as performance expectancy and price value had no effect on a consumer's upgrade intentions, no moderation existed for the effect of performance expectancy (H4a) and price value (H4f), providing only partial support for H4 (a-f). Finally, recency of purchase negatively moderated both the effect of satisfaction with the current high-technology product and the effect of satisfaction with the technology that supports the current high-technology products on consumer upgrade intentions. Both H5 and H6 were supported. These results are discussed further in the next chapter.

Chapter 5 Discussion and Conclusion

This chapter interprets the findings from Chapter 4 and explains the results for each of the hypothesis tests. The influence of performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value of an improved version of a high-technology product on a consumer's upgrade intention is explained. The effect of satisfaction with the current high-technology product and satisfaction with the technology that supports the current high-technology product on a consumer's upgrade intention is also discussed. This is followed by details on the moderating role of recency of purchase on the factors that influence a consumer's upgrade intention towards high-technology products. After a discussion of the hypothesis tests, the findings are then deliberated in regard to how they extend prior knowledge of the significant factors that influence consumers' upgrade intention towards high-technology products, and how they aid the understanding of consumers' technology upgrade behaviour. Practical implications for marketing managers of consumer technology vendors, including product design and promotion strategies for high-technology products, are discussed. Limitations of the research are considered to identify areas for further research.

5.1. Discussion of Results

In this section, the results of the hypothesis tests are evaluated. An explanation is offered for the results of each hypothesis tested.

5.1.1. Performance Expectancy

In this research, performance expectancy of an improved version of a high-technology product was hypothesised to positively affect a consumer's upgrade intention (H1a), and recency of purchase was hypothesised to positively moderate the relationship between performance expectancy and upgrade intention (H3a).

Performance expectancy was defined as the degree to which a consumer believes that using an improved version of a high-technology product would increase task performance (adapted from Venkatesh et al., 2012). Recency of purchase was defined as the time since the last purchase of a high-technology product (Kumar & Shah, 2009). Results indicated that performance expectancy had no direct influence on a consumer's upgrade intention. Recency of purchase was also found to have no moderating effect on the relationship between performance expectancy and upgrade intention. This means that consumers did not consider task performance a significant factor in deciding whether to upgrade their high-technology product, which was their smartphone in this research. This result was contrary to the results of prior research. Performance expectancy was generally found to positively influence users' use intention towards varied types of technologies (Lu et al., 2005; Venkatesh et al., 2003, 2012; Zhang et al., 2012; Zhou et al., 2010) and was also found to positively influence consumers' upgrade intention towards mobile phones (Tseng & Chiang, 2013; Tseng & Lo, 2011). However, it is suggested that while performance expectancy is a cognitive motivation and of primary importance for job-related performance in organisations, consumers are strongly influenced by affective motivations, as opposed to cognitive motivations, particularly for the use of consumer technologies, such as smartphones (Kim et al., 2013; Venkatesh et al., 2012). This may explain why performance expectancy had no impact

on consumers' intention to upgrade their smartphone. In their research on the continued engagement of smartphones, Kim et al. (2013) showed that hedonic motivation was stronger than utilitarian motivation in influencing the continued engagement of smartphones; utilitarian motivation had no effect on the perceived value of smartphones. Further, as the performance of smartphones is rapidly improving with a three-fold increase in the past three years (Triggs, 2015), consumers are likely to have formed the expectation that a new and more advanced smartphone would deliver better performance than their current smartphone. Consumers who have experienced the current smartphone might not be concerned about performance expectancy in an upgrade, whereas consumers in an adoption situation have no prior usage experience to which to refer. In sum, this finding—that performance expectancy had no effect on a consumer's upgrade intention—suggests that consumers perceive task performance as an insignificant consideration when upgrading consumer technologies, particularly smartphones.

5.1.2. Effort Expectancy

Effort expectancy of the use of an improved version of a high-technology product was hypothesised to positively affect a consumer's upgrade intention (H1b), and recency of purchase was hypothesised to positively moderate the relationship between effort expectancy and upgrade intention (H3b).

Effort expectancy was defined as the degree to which a consumer believes that using an improved version of a high-technology product would be free of effort (adapted from Venkatesh et al., 2012). Results indicated that while effort expectancy had no direct influence on a consumer's upgrade intention when a purchase had been made recently, effort expectancy had a significant positive effect on a consumer's upgrade intention

when recency of purchase was old. This means that consumers only consider effort expectancy a significant factor in deciding whether to upgrade their high-technology product when the current high-technology product was purchased more than 12 months previously. As smartphones are rapidly improving (Triggs, 2015), the older the current smartphone is, the bigger improvement consumers are likely to find in a new and more advanced smartphone. The effect of effort expectancy is more salient when there are more hurdles to be overcome in a new behaviour (Davis, 1989; Szajna, 1996; Venkatesh, 1999). Hence, consumers who use an older smartphone that was purchased earlier are likely to find a new and more advanced smartphone demands more effort to learn and use, making effort expectancy an important consideration. This was found to be generally true in prior research on varied types of technology adoption (Lu et al., 2005; Venkatesh et al., 2012; Zhang et al., 2012; Zhou et al., 2010), and technology upgrades of mobile phones from 2G to 3G and 3G to 4G (Tseng & Chiang, 2013; Tseng & Lo, 2011). In contrast, consumers who use a recently purchased smartphone are likely to find a new and more advanced smartphone demands less effort to learn and use, due to a small number of upgrade differences, and therefore effort expectancy is not a significant consideration.

5.1.3. Social Influence

Social influence related to the use of an improved version of a high-technology product was hypothesised to positively affect a consumer's upgrade intention (H1c), and recency of purchase was hypothesised to positively moderate the relationship between social influence and upgrade intention (H3c).

Social influence was defined as the degree to which a consumer perceives that other people who are important to him or her believe that he or she should use an improved

version of a high-technology product (adapted from Venkatesh et al., 2012). Results indicated that social influence had a significant positive effect on a consumer's upgrade intention as hypothesised. Additionally, the influence of social influence on a consumer's upgrade intention was stronger when recency of purchase was old. This means that consumers consider social influence a significant factor in deciding whether to upgrade their high-technology product, particularly when the current high-technology product was purchased more than 12 months previously. While social influence has been found to positively affect consumers' use intention towards technology in general (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012), this research showed that consumers were also pressured by social influence when deciding whether to upgrade a high-technology product. As the effect of social influence is more salient when a person's behaviour shows a large degree of deviance from social norms (Hoyer et al., 2012), consumers who use an older smartphone over a longer time can be expected to be under stronger social influence to upgrade. Hence, it is reasonable to find consumers perceiving social influence a more significant consideration in an upgrade when recency of purchase was old.

5.1.4. Facilitating Conditions

Facilitating conditions were hypothesised to positively affect a consumer's upgrade intention (H1d), and recency of purchase was hypothesised to positively moderate the relationship between facilitating conditions and upgrade intention (H3d).

Facilitating conditions were defined as the degree to which a consumer believes that technical infrastructure and support is available to aid the use of an improved version of a high-technology product (adapted from Venkatesh et al., 2012). Results indicated that facilitating conditions had a significant positive effect on a consumer's upgrade

intention when a purchase had been made recently, but no effect when recency of purchase was old. This means that consumers only consider facilitating conditions an important factor in deciding whether to upgrade their high-technology product when the current high-technology product was purchased less than or equal to 12 months previously. Several studies have found that facilitating conditions positively affect consumers' intention to use technology (Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012). This research finds that facilitating conditions also have a positive influence on a consumer's upgrade intention, but, contrary to expectation, only for consumers who use a recently purchased high-technology product. An explanation may be that consumers who use a recently purchased high-technology product are more likely to spend time and effort to learn how to use the product, and thus identify a set of facilitating conditions available for help and support. The effect of facilitating conditions is more prominent as multiple avenues for help and support are found through learning and using a new product (Venkatesh et al., 2003). Therefore, it is reasonable that these consumers find facilitating conditions more important when deciding to upgrade. Conversely, consumers who use an older high-technology product that was purchased a long time ago are more than likely competent in using the features of their current product and thus perceive facilitating conditions a less significant consideration.

5.1.5. Hedonic Motivation

Hedonic motivation was hypothesised to positively affect a consumer's upgrade intention (H1e), and recency of purchase was hypothesised to positively moderate the relationship between hedonic motivation and upgrade intention (H3e).

Hedonic motivation was defined as the degree to which a consumer believes that using an improved high-technology product would bring fun or pleasure (adapted from Venkatesh et al., 2012). Results indicated that while hedonic motivation had no direct influence on a consumer's upgrade intention when a purchase had been made recently, hedonic motivation was the second strongest factor to positively influence a consumer's upgrade intention when recency of purchase was old. This means that consumers only consider hedonic motivation a strong and significant factor in deciding whether to upgrade their high-technology product when the current high-technology product was purchased more than 12 months previously. In many studies, hedonic motivation was shown to be an important determinant for the use of different consumer technologies (Brown & Venkatesh, 2005; Childers et al., 2001; Chun et al., 2012). Research regarding the upgrade of mobile phones indicates that perceived enjoyment is a factor shown to positively affect consumers' upgrade intention towards 3G or 4G mobile phones (Tseng & Chiang, 2013; Tseng & Lo, 2011). This research showed that consumers who used an older smartphone found hedonic motivation a significant consideration when deciding to upgrade. This result was expected, since the effect of hedonic motivation is more prominent when the novelty of a target technology is high (Venkatesh et al., 2012). After using an older smartphone for a long period, consumers are likely to find it no longer innovative and thus are more driven by hedonic motivation when deciding to upgrade. This is supported by prior research on the acceptance of consumer technologies (Brown & Venkatesh, 2005; Childers et al., 2001; Chun et al., 2012). In contrast, consumers who use a recently purchased smartphone are likely still enjoying using their smartphone. Hence, they might not perceive hedonic motivation as a significant consideration.

5.1.6. Price Value

Price value regarding the use of an improved version of a high-technology product was hypothesised to positively affect a consumer's upgrade intention (H1f), and recency of purchase was hypothesised to positively moderate the relationship between price value and upgrade intention (H3f).

Price value was defined as the degree to which a consumer perceives the benefits are greater than the monetary cost of using an improved high-technology product (adapted from Venkatesh et al., 2012). Results indicated that price value had no direct influence on a consumer's upgrade intention. Recency of purchase was also found to have no moderating effect on the relationship between price value and upgrade intention. This means that consumers did not consider value for money a significant factor in deciding whether to upgrade their smartphones. This result was contrary to the results of prior research regarding the use of and upgrade intention towards other types of products, measured with the TAM, UTAUT and UTAUT2. Price value was generally found to positively influence users' use intention towards consumer technologies (Chan et al., 2008; Escobar-Rodríguez & Carvajal-Trujillo, 2014; Venkatesh et al., 2012) and was also found to positively influence consumers' upgrade intention towards mobile phones (Tseng & Chiang, 2013; Tseng & Lo, 2011). However, as smartphones are widely adopted by consumers in Hong Kong, where the adoption rate of smartphones was 87% in 2013 (Magdirila, 2013), and consumers become more used to replacing their smartphones and making more frequent upgrades (Perez, 2015), consumers might view their smartphones as more of a necessity rather than luxury good (Pylayev, 2012). Necessities are goods that people cannot live without and will not likely reduce their use no matter the price (Mankiw, 2014). Whether a good is a necessity or luxury depends

mainly on the preferences of the buyers. Hence, if consumers view their smartphones as a necessity, it is reasonable to find that they are insensitive to price when considering an upgrade.

5.1.7. Satisfaction with the Current High-technology Product

Satisfaction with the current high-technology product was hypothesised to negatively affect a consumer's upgrade intention (H2), and recency of purchase was hypothesised to negatively moderate the relationship between satisfaction with the current high-technology product and upgrade intention (H4).

Satisfaction with the current high-technology product was defined as the degree to which a consumer is satisfied with the use of the current high-technology product (adapted from Park et al., 2011). Results indicated that satisfaction with the current high-technology product had a strong and significant negative effect on a consumer's upgrade intention. The influence of satisfaction with the current high-technology product on a consumer's upgrade intention was even stronger when a purchase had been made recently. This means that consumers who were satisfied with their current high-technology product were strongly unlikely to upgrade to an improved high-technology product, in particular when the current high-technology product was purchased less than or equal to 12 months previously. This result was predicted based on the research findings on consumers' upgrade behaviour for services in both the information systems and marketing literature (Bolton et al., 2008; Eriksson & Nilsson, 2007), that satisfied consumers are likely to consider an upgrade to an improved high-technology unnecessary. In their research on mobile phones, Tseng and Chiang (2013) and Tseng and Lo (2011) also found that satisfaction with their current mobile phone negatively affected consumers' upgrade intention. They explained that consumers

might have no plan to upgrade if consumers were satisfied with their current mobile phone. In this research, when recency of purchase was old, consumers were found to be strongly driven by hedonic motivation and effort expectancy regarding a new and more advanced smartphone when deciding on an upgrade. Hence, these consumers are more driven by the benefits brought by a new and more advanced high-technology product, and reasonably place less importance on satisfaction with the current high-technology product when making an upgrade decision. One noteworthy result was that satisfaction with the current high-technology product was found to be the most important, negative factor that influenced consumers' upgrade intention. This result was in contrast with Bhattacherjee's (2001) study on the continued use of consumer technology. In Bhattacherjee's (2001) study, satisfaction was found also to be the most important, but positive, factor that influenced consumers' behavioural intention towards the continued use of online banking.

5.1.8. Satisfaction with the Technology That Supports the Current High-technology Product

Satisfaction with the technology that supports the current high-technology product was hypothesised to positively affect a consumer's upgrade intention (H3), and recency of purchase was hypothesised to negatively moderate the relationship between satisfaction with the technology that supports the current high-technology product and upgrade intention (H5).

Satisfaction with the technology that supports the current high-technology product was defined as the degree to which a consumer is satisfied with the use of the technology that supports the current high-technology product (adapted from Park et al., 2011). Results indicated that satisfaction with the technology that supports the current

high-technology product had a significant, moderate, positive effect on a consumer's upgrade intention as hypothesised. Its influence was stronger, and it was the second most important factor influencing upgrade intention when a purchase had been made recently. This means that consumers who are satisfied with the technology that supports the current high-technology product are more likely to upgrade to an improved high-technology product, and even more so when the current high-technology product was purchased less than or equal to 12 months previously. This result was expected, since consumers who are satisfied with the use of a technology, but not the performance and other aspects of the current high-technology product, are likely to demand an upgrade to an improved product to enhance the performance and other aspects, and benefit more from the technology. This was shown in the research on consumers' upgrade behaviour for services in both the information systems and marketing literature (Bolton et al., 2008; Eriksson & Nilsson, 2007). In addition, similar to the discussion regarding satisfaction with the current high-technology product, consumers who use an older high-technology product that was purchased a long time ago are more driven by the benefits brought by a new and more advanced high-technology product. Thus, they reasonably place less importance on satisfaction with the technology that underlines the current high-technology product when making an upgrade decision. In contrast, as consumers who use a recently purchased high-technology product are less strongly affected by considerations regarding a new and more advanced high-technology product, they are likely to perceive satisfaction with the technology underlining the current high-technology product as a major consideration. Hence, it is reasonable to find that the influence of satisfaction with the technology that supports the current high-technology product was stronger when a purchase had been made recently. Additionally, satisfaction with the technology that supports the current high-technology

product was found to be the most important, positive factor that influenced consumers' upgrade intention.

5.2. Concluding Remarks

This research aimed to gain a greater understanding of consumers' upgrade behaviour concerning high-technology products, such as smartphones. In reference to this, a key research question and three sub-questions were ultimately addressed.

The key research question was:

- **RQ1:** What significant factors influence consumer upgrade intentions towards high-technology products, particularly with reference to the UTAUT2 model and consumer satisfaction?

The sub-questions were:

- **RQ1a:** What is the relative importance of each factor with respect to consumer upgrade intentions towards high-technology products?
- **RQ1b:** How relevant is UTAUT2 to explaining consumer upgrade intentions towards high-technology products?
- **RQ1c:** What is the effect of satisfaction with the current usage of high-technology products on consumer upgrade intentions towards high-technology products?

5.2.1. Factors for Consumers' Upgrade Intention Towards High-technology Products

This research proposed a technology upgrade model that extended the UTAUT2 with the incorporation of two concepts of satisfaction regarding a high-technology product and recency of purchase. Six factors of the UTAUT2 and two concepts of satisfaction were tested to explain consumers' upgrade intention. In addition, any differences in result between consumers whose recency of purchase was old and recent were tested.

Table 5.1 Summary of the Results

	Recency of Purchase OLD	**Recency of Purchase RECENT**
Performance expectancy	No effect	No effect
Effort expectancy	Positive influence	No effect
Social influence	Stronger positive influence	Positive influence
Facilitating conditions	No effect	Positive influence
Hedonic motivation	Positive influence, second most important factor	No effect
Price value	No effect	No effect
Satisfaction with the current high-technology product	Negative influence, most important factor	Stronger negative influence, most important factor
Satisfaction with the technology that supports the current high-technology product	Positive influence	Stronger positive influence, second most important factor

In sum, of the six factors of the UTAUT2, consumer upgrade intention was found to be influenced by four factors: effort expectancy, social influence, facilitating conditions, and hedonic motivation (see Table 5.1). However, contrary to expectation, consumers were not affected by performance expectancy and price value, neither when recency of

purchase was recent nor old. The two concepts of satisfaction regarding the use of the current high-technology product—namely, satisfaction with the current high-technology product and satisfaction with the technology that supports the current high-technology product—were found to strongly influence a consumer's upgrade intention. As expected, they exert opposite effects on consumers. On the one hand, consumers who are satisfied with the current high-technology product are likely to consider an upgrade unnecessary (Tseng & Chiang, 2013; Tseng & Lo, 2011). On the other hand, consumers who are satisfied with the use of a technology, but not the performance and other aspects of the current high-technology product, are likely to demand an upgrade to improve the performance and other aspects in order to benefit more from the technology (Bolton et al., 2008; Eriksson & Nilsson, 2007).

Regarding the differences in result when recency of purchase was old or recent, consumers were found to have significantly different considerations in an upgrade decision depending on the time since their current high-technology product was purchased. Consumers who used a high-technology product purchased some time ago (more than 12 months) were more strongly driven by effort expectancy, social influence, and hedonic motivation to upgrade. However, these consumers were not driven by facilitating conditions to upgrade. This result was not totally expected, but reasonable as explained in earlier sections.

Finally, consumers were also found to differ on the two concepts of satisfaction depending on the time since their current high-technology product was purchased. When consumers used a recently purchased high-technology product, they were more affected by satisfaction with the current high-technology product to consider an upgrade unnecessary. In addition, they were also more affected by satisfaction with the

technology that supports the current product, where satisfaction with the technology that supports the current product led to a higher inclination to upgrade. As these consumers usually find other considerations, such as effort expectancy and hedonic motivation, not as relevant and important, as shown in this research, it is reasonable for them to rely more heavily on the two satisfactions regarding the current high-technology product when deciding on an upgrade.

5.2.2. Relative Importance of Factors for Consumers' Upgrade Intention

Consumers whose recency of purchase was old and recent were found to place different relative importance on the factors of the technology upgrade model to decide on an upgrade (see Table 5.2).

Table 5.2 Relative Importance of Factors for Consumers' Upgrade Intention

Order of Importance	**Recency of Purchase OLD**	**Recency of Purchase RECENT**
1	Satisfaction with the current high-technology product (–)	Satisfaction with the current high-technology product (–)
2	Hedonic motivation (+)	Satisfaction with the technology that supports the current high-technology product (+)
3	Satisfaction with the technology that supports the current high-technology product (+)	Social influence (+)
4	Social influence (+)	Facilitating conditions (+)
5	Effort expectancy (+)	

Consumers perceived satisfaction with the current high-technology product was the most important factor that deterred them from making an upgrade both when recency of purchase was old and recent. This result was expected based on prior research findings

on continued use of technology. Satisfaction with the current high-technology product is generally shown to be one of the most important factors that drive consumers' continued use of a current high-technology product (Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004; Park et al., 2011). If satisfaction with the current high-technology product drives consumers to continue using the current high-technology product in a consumer use context, it can be expected to also make consumers continue using the current high-technology product and to make consumers consider replacing the current high-technology product with an upgrade unnecessary in a consumer upgrade context.

When recency of purchase was old, consumers perceived hedonic motivation as the second most important factor. Consumers are generally found to be strongly driven by hedonic motivation in the use of technologies (Brown & Venkatesh, 2005; Childers et al., 2001; Chun et al., 2012). In Venkatesh et al.'s (2012) study on consumers' acceptance and use of technology, hedonic motivation was also found to be the second most important factor that influenced a consumer's use intention. Satisfaction with the technology that supports the current high-technology product was the third most important factor. This satisfaction with the technology that supports the current high-technology product, and enables the delivery of higher performance and improvement in other aspects in an upgrade of the product, was first shown to be important in the upgrade of technologies. Social influence and effort expectancy were the fourth and fifth most important factors, respectively. Consumers were influenced by social influence and effort expectancy to a similar degree. Similar results on social influence and effort expectancy were reported in prior research on the UTAUT2 in consumers' use of technologies (Venkatesh et al., 2012).

When a purchase had been made recently, consumers perceived satisfaction with the technology that supports the current high-technology product as the second most significant factor. As hedonic motivation was not important to these consumers, as explained earlier, it was reasonable for them to rely more heavily on the two satisfactions regarding the high-technology product when deciding on an upgrade. Social influence and facilitating conditions were the third and fourth most significant factors, respectively, and were found to have similar strength. Similar results on social influence and facilitating conditions were reported in prior research on the UTAUT2 in consumers' use of technologies (Venkatesh et al., 2012).

5.2.3. Relevance of UTAUT2 for the Explanation of Consumers' Upgrade Intention

The UTAUT2 is a recent extension of the TAM and UTAUT, created to explain consumer use contexts and capture several important beliefs of consumers (Venkatesh et al., 2012). In this research, the UTAUT2 was found to be generally relevant for the explanation of consumers' upgrade intention (see Table 5.3).

Table 5.3 UTAUT2 for the Explanation of Consumers' Use and Upgrade

UTAUT2	**Consumers' Use** (Venkatesh et al., 2012)	**Consumers' Upgrade**
Performance expectancy	Yes	No effect
Effort expectancy	Yes	Yes (only when recency of purchase was OLD)
Social influence	Yes	Yes
Facilitating conditions	Yes	Yes (only when recency of purchase was RECENT)
Hedonic motivation	Yes	Yes (only when recency of purchase was OLD)
Price value	Yes	No effect

Habit	Yes	N/A

Habit, as a factor of the UTAUT2, was not incorporated in the technology upgrade model. Habit is defined as the degree to which a user believes prior behaviour to be automatic (Venkatesh et al., 2012). In this research, it was expected that consumers were unlikely to have developed a habit of upgrading their high-technology product through repeated upgrades, and thus habit was not incorporated in the technology upgrade model.

When recency of purchase was old, three factors of the UTAUT2— namely, effort expectancy, social influence, and hedonic motivation—of the use of an improved version of a high-technology product were found to significantly influence a consumer's upgrade intention. However, performance expectancy, facilitating conditions, and price value were found to have no significant influence on a consumer's upgrade intention. When a purchase had been made recently, only two factors of the UTAUT2—namely, social influence and facilitating conditions—were found to significantly influence a consumer's upgrade intention. Facilitating conditions became important to these consumers as they should have identified a set of facilitating conditions available for help and support through their use of the recently purchased product. Hedonic motivation and effort expectancy were found to no longer make a difference to these consumers who were using a recently purchased product. The other two factors—performance expectancy and price value—continued to have no significant effect on a consumer's upgrade intention.

The UTAUT2 failed to consider satisfaction regarding the current high-technology product. Satisfaction was reported to be a significant factor in consumers' continued use of technologies. This is supported in Bhattacherjee's (2001) study of ECM-IT, and

consumers' upgrade behaviour in the use of mobile phones and internet banking (Eriksson & Nilsson, 2007; Tseng & Lo, 2011) and technology service contract upgrades (Bolton et al., 2008) in both the information systems and marketing literature. In this research, satisfaction with the current high-technology product and satisfaction with the technology that supports the current high-technology product were found to be two highly important, negative and positive factors in explaining a consumer's upgrade intention, respectively. Their effects were even stronger when a purchase had been made recently.

In sum, the proposed technology upgrade model, which was formulated as an extension of the UTAUT2 with the incorporation of two different concepts of satisfaction and recency of purchase, was shown to be more relevant and powerful in explaining a consumer's upgrade intention.

5.3. Implications

This research makes significant contributions to the understanding of consumers' upgrade behaviour concerning high-technology products. The research findings also have a number of implications for further research in the area of technology upgrades, and practical implications for marketers of consumer technology vendors. The theoretical and managerial applications of the research findings are now discussed.

5.3.1. Theoretical Contributions

The major contribution this research makes to theory is in extending the UTAUT2 to formulate a technology upgrade model that explains consumers' upgrade intention towards high-technology products. The UTAUT2 is a recent extension of the TAM and UTAUT, and was theorised to be more powerful and relevant than these in explaining

consumers' acceptance and use of technologies (Venkatesh et al., 2012). By extending the UTAUT2, the generalisability of the UTAUT2 is extended from a consumer acceptance and use context to a consumer upgrade context. Prior technology upgrade research has extended the TAM from an organisational-acceptance context to a consumer upgrade context to investigate consumers' upgrade intention towards high-technology products, but no research had been conducted on the UTAUT2. Partial support was found for the TAM to explain consumers' upgrade intention (Tseng & Chiang, 2013; Tseng & Lo, 2011). The prior research on the UTAUT2 suggests that seven factors are significant in influencing consumers' acceptance and use intention (Venkatesh et al., 2012). From the UTAUT2, six factors—performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, and price value—in relation to consumers' beliefs on the use of an improved version of a high-technology product were incorporated into the proposed technology upgrade model. The empirical results suggest that out of the six factors of the UTAUT2, only four factors—effort expectancy, social influence, facilitating conditions, and hedonic motivation—are significant, while performance expectancy and price value are not significant. Prior research on consumers' use of technologies suggests that consumers perceive task performance a less significant consideration (Venkatesh et al., 2012). It is also proposed that since consumers are getting more used to making frequent upgrade of their high-technology products (such as smartphones) and perceiving them as more of a necessity, they may become increasingly price insensitive when considering a technology upgrade (Perez, 2015). Future work can further examine the six factors of the UTAUT2 and validate the results of this research by examining consumers' upgrades of other high-technology products.

Satisfaction regarding the current high-technology product was integrated into the proposed technology upgrade model, as the UTAUT2 fails to take into account the prior usage experience of consumers. Satisfaction is not only a main driver of consumers' continued use of technologies (see Bhattacherjee, (2001)), but also a key determinant of consumers' upgrade behaviour for services in the information systems literature (Eriksson & Nilsson, 2007; Tseng & Lo, 2011) and marketing literature (Bolton et al., 2008). Satisfaction was consistently reported to positively drive consumers' continued use of technologies (Bhattacherjee, 2001). However, contrary to expectation, Tseng and Chiang (2013) and Tseng and Lo (2011) found that satisfied consumers were less likely to upgrade their high-technology products. This research proposes that the concept of satisfaction in a consumer upgrade context needs to be further investigated. Based on the studies on consumers' upgrade behaviour for services in the information systems (Eriksson & Nilsson, 2007) and marketing (Bolton et al., 2008) literature, two different concepts of satisfaction regarding the current high-technology product were first incorporated into the proposed technology upgrade model. They are satisfaction with the current product and satisfaction with the source that enables the delivery of the current product, and higher performance and improvement in other aspects in an upgrade of the product. The empirical results support that while satisfaction with the current high-technology product negatively affects consumers' upgrade intention, satisfaction with the technology that supports the current high-technology product positively affects consumers' upgrade intention. This research verifies that consumers will only be more likely to upgrade when they are satisfied with the technology that underlines the current high-technology product, but dissatisfied with the current high-technology product. Hence, this research fills the gap and offers a theoretical explanation for the contradictory result on the effect of satisfaction on consumers'

upgrade intention reported by Tseng and Chiang (2013) and Tseng and Lo (2011). In addition, the empirical results showed that the two concepts of satisfaction regarding the current high-technology product were two of the most significant factors that explain consumers' upgrade of technology.

Finally, this research has contributed to our understanding of how recency of purchase of the current high-technology product moderates the effects of the factors of the UTATU2 and the two concepts of satisfaction regarding the current high-technology product on consumers' upgrade intention. Kim and Srinivasan (2009) studied the time until consumers' first adoption of a high-technology product and found that consumers who had recently purchased a high-technology product were less likely to make an upgrade. In this research, recency of purchase was incorporated as a moderator into the proposed technology upgrade model. An important result was that when a purchase had been made recently, consumers perceived an upgrade decision as more similar to a continued use decision than an acceptance decision. For these consumers, the empirical results showed that the two concepts of satisfaction were the main drivers of the consumers' upgrade of technology, while most factors in the UTAUT2 related to the utilitarian and affective aspects of an improved high-technology product were not significant. This result was similar to that of Bhattacherjee's (2001) study on the continued use of consumer technology. When recency of purchase was old, consumers perceived an upgrade decision as more similar to an acceptance decision than a continued use decision. For these consumers, the empirical results showed that although the two concepts of satisfaction were still two of the main drivers of the consumers' upgrade of technology, most factors in the UTAUT2—particularly hedonic motivation, which became the second most significant factor—had stronger influence on the

consumers' upgrade of technology. This result was more in line with most studies on the acceptance of consumer technology (Venkatesh et al., 2012; Zhang et al., 2012).

In sum, the extension of the UTAUT2 with the incorporation of two concepts of satisfaction and recency of purchase as a moderator are shown to be crucial in formulating a more relevant and powerful technology upgrade model to explain consumers' upgrade of technology. Thus, the research findings contributed significantly to our understanding of consumers' upgrade of technology. Additionally, this research provided empirical evidence that consumers perceive that a technology upgrade decision is more similar to a technology acceptance decision when recency of purchase is old, and more similar to a technology continued use decision when a purchase had been made recently.

5.3.2. Practical Implications

The empirical findings on consumers' upgrade of technology have practical implications for the product design of high-technology products for marketers of consumer technology vendors. The results of this research suggest that consumers who wait for more than one year to make an upgrade will perceive hedonic motivation to be highly important when considering an upgrade. Hence, marketers should focus on the development of new features or a look and feel that will make the usage experience more enjoyable—for instance, enhanced graphic support for the playing of games or a more stylish physical appearance—to attract these consumers to upgrade. However, consumer technology vendors mostly promote their latest smartphones as more powerful and faster, whereas the aesthetic and hedonic aspects are not emphasised as

much. In addition, the results suggest that effort expectancy is particularly essential for these consumers. They demand the upgrade to make the product not only more enjoyable, but also more easy to use. If some innovative functions are perceived to be too complex to use, consumers can be deterred from making an upgrade.

The empirical findings on consumers' upgrade of technology also have implications for marketing and customer support of high-technology products. Consumers are found to be driven by social influence. They are more likely to make an upgrade if their relatives or close friends consider that they should. Hence, marketers should promote new versions of high-technology products widely through mass media as well as social media to create strong social influence. The more people in society that consider an upgrade necessary, the more consumers will be likely to make an upgrade. Additionally, customer support is important to consumers who make an upgrade in under one year. These consumers are likely to have thoroughly learnt about the customer support services available through the use of their recently purchased high-technology product, thus expecting to be also well supported in their upgrade.

The result on price value suggests that consumers do not consider price an important consideration when making an upgrade. This has practical implications for the pricing strategy of marketers. If consumers are getting more used to replacing their high-technology products and making more frequent upgrades (Perez, 2015), consumers are likely to treat their high-technology products as necessities and become increasingly insensitive to price when considering an upgrade. Hence, marketers should focus less on price competition but more on product differentiation based on innovation and customer support services to promote upgrades. For instance, Apple not only develops new

iPhones with innovative functions, but also rolls out a new iPhone Upgrade Program to support consumers to upgrade to the latest iPhone every year (Weiss, 2015).

Apart from consumers' perception of the improved versions of the high-technology products, satisfaction regarding the current high-technology products is also crucial and even more important in driving consumers to make an upgrade. Only consumers who are satisfied with the use of a technology but are no longer satisfied with the current high-technology product will consider an upgrade to an improved product. Hence, in evaluating consumers' satisfaction and potential for an upgrade, it is essential for marketers to measure not only consumers' satisfaction with the current high-technology product, but also their satisfaction with the technology that underlines the product. Further, it is also important for marketers to understand what causes the dissatisfaction with the current high-technology product, and act accordingly to improve performance or introduce new features in a new product to attract consumers to upgrade. Empowered with information about consumers' satisfaction with both the current high-technology product and the technology, marketers will be able to more accurately forecast the demand for improved high-technology products and reduce the chance of product shortages (Garside & Correspondent, 2013; Lehman, 2014).

Finally, the results suggest that consumers who have purchased the current high-technology product less than one year previously behave significantly differently from consumers who have purchased the current high-technology product more than one year ago when considering an upgrade. Marketers may benefit from segmenting the two groups of consumers and targeting them with different marketing strategies. For instance, marketers should be more effective in marketing an upgrade to consumers who have purchased the current high-technology product less than one year previously with

the provision of better customer support services to support their upgrade. Conversely, marketers will be more effective in marketing an upgrade to consumers who have purchased the current high-technology product more than one year ago by promoting the fun and enjoyment as well as the ease of use of the new features of an upgrade.

5.4. Limitations and Directions for Future Research

First, the generalisability of the findings may be of concern. As this study was conducted in Hong Kong, a territory with a very high adoption rate of smartphones, the findings may not be generalisable to other countries that are less technologically advanced. Further, this study only sampled students, with the majority aged between 18 and 26 years. Although the value of using students as surrogates for professional young adults in technology acceptance research was confirmed by King and He (2006), the result may not be generalisable to general users, particularly older or less educated users. Finally, the only technology product studied was smartphones. The result may not be generalisable to other high-technology products such as video game consoles, 3D printers and smart fitness tracking devices. Future research may use samples other than students and samples in other countries to validate the results of this research. The moderating effect of gender, age and education may also be investigated. Further, different high-technology products, such as tablets and wearable smart devices, may also be studied.

This study was a cross-sectional study and ignored longitudinal observation. As user behaviour may vary over time, this study fails to capture any change in upgrade behaviour over time. Future research may consider adopting a longitudinal design to study any change in consumers' upgrade behaviour over time.

This study used only self-reported measures of behaviour. However, users' actual upgrade behaviour may differ from their upgrade intention. Future research may need to measure the actual upgrade behaviour instead of only the upgrade intention. Additionally, as all measures were collected using a single questionnaire, the data might be susceptible to common method variance (Lindell & Whitney, 2001). While Venkatesh et al. (2012) found that common method variance was not a serious concern with the UTAUT2, future research may adopt a more rigorous design to reduce the measurement bias.

This study focused on the UTAUT2 model to examine the significant factors that influence consumer upgrade intentions towards high-technology products. While UTAUT2 is a unified model of several prominent technology acceptance models developed to explain consumer acceptance and use of technology, future research may examine the effect of other consumer psychological factors such as desire for unique consumer products (Lynn & Harris, 1997) and brand loyalty (Lee, 2011).

Contrary to the findings from research on consumers' acceptance and use of technology, this study found that performance expectancy and price value were not significant determinants of consumers' upgrade intention. Future research may test the proposed technology upgrade model with different groups of consumers and different technologies in different countries to validate the results of this study.

Finally, this study examined the moderating effect of recency of purchase. A closely related measure, jump in improvement, is expected to also have a moderating effect on consumers' upgrade intention. High-technology products are continually and rapidly improving. The earlier the current high-technology product is purchased, the bigger a jump in improvement a consumer may find when considering an upgrade. Future

research may study the moderating effect of jump in improvement in an upgrade and its relationship with recency of purchase.

5.5. Conclusion

In conclusion, the proposed technology upgrade model extended the UTAUT2 to the consumer upgrade context with the incorporation of two different concepts of satisfaction, with the use of the current high-technology product and recency of purchase as a moderator. Empirical support was provided for the applicability of the proposed technology upgrade model to the consumer upgrade context through a quantitative, cross-sectional study, comprising an anonymous questionnaire survey, collected from a sample of 410 degree and sub-degree students in Hong Kong. SEM analysis with the use of multi-group analysis was applied. The variance explained in consumers' upgrade intention was substantial, at 46.4% when a purchase had been made recently and 57.8% when recency of purchase was old, respectively. This suggests that the proposed technology upgrade model is useful and powerful in explaining consumers' upgrade intention towards high-technology products.

To address the research questions identified, this study found that the UTAUT2 is generally relevant for the explanation of consumers' upgrade of technology, but fails to consider satisfaction regarding the current high-technology product. Four factors of the UTAUT2—effort expectancy, social influence, facilitating conditions and hedonic motivation of the use of an improved version of a high-technology product—significantly influenced a consumer's upgrade intention. However, contrary to expectation, the other two factors of the UTAUT2—performance expectancy and price value—were not significant. Two different concepts of satisfaction were incorporated into the proposed technology upgrade model. They were satisfaction with the current

high-technology product and satisfaction with the technology that underlines the current high-technology product. While the former negatively affected consumers' upgrade intention, the latter positively affected consumers' upgrade intention. More importantly, the two concepts of satisfaction were two of the most significant factors to explain consumers' upgrade of technology. Finally, it was found that consumers perceive that a technology upgrade decision is more similar to a technology acceptance decision when recency of purchase is old, but is more similar to a technology continued use decision when a purchase has been made recently.

All in all, this research extended the UTAUT2 from the consumer technology acceptance and use context to the consumer technology upgrade context. It adds significant theoretical contributions through the formulation and validation of a powerful technology upgrade model, which is an extension of the UTAUT2, with the incorporation of two different concepts of satisfaction and recency of purchase as a moderator.

Appendices

APPENDIX A: Participant Information Sheet

Dr Alicia Kulczynski
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Information Statement for the Research Project:
A Study of Consumers' Upgrade Intention of High-technology Products

Document Version 2.0; dated 25/7/2015

You are invited to participate in the research project identified above, which is being conducted by Mr Chow Wing-Yiu Winn, a DBA candidate from the Newcastle Business School at the University of Newcastle.

The research is part of Mr Chow Wing-Yiu Winn's studies at the University of Newcastle, supervised by Dr Alicia Kulczynski from the Newcastle Business School.

Why is the research being done?

The purpose of the research is to examine the significant factors that influence consumers' intention to upgrade high-technology products, such as smartphones. The information will aid in identifying ways to improve product offerings, service delivery, and communication campaigns aimed at increasing consumer satisfaction in relation to

technology upgrades.

Who can participate in the research?
Students who are at or above 18 years old, use a smartphone, and are enrolled in a sub-degree or degree programme offered by a university or affiliated institution in Hong Kong are being invited to participate.

What would you be asked to do?
If you agree to participate, you will be asked to complete an anonymous questionnaire about your assessment on various aspects of smartphone adoption, your satisfaction with your current smartphone and smartphone technology, and your intention to purchase a new and more advanced smartphone.

What choice do you have?
Participation in this research is entirely your choice. Only those people who give their informed consent will be included in the project. Whether or not you decide to participate, your decision will not disadvantage you.

If you do decide to participate, you may stop completing the questionnaire and withdraw from the project at any time prior to submitting your completed questionnaire, without giving reason. Please note that due to the anonymous nature of the questionnaire, you will not be able to withdraw your response after it has been submitted.

How much time will it take?
The questionnaire will take approximately 15 minutes to complete.

***What are the risks and benefits of participating*?**
There are no anticipated risks associated with participating in this research.

Whilst there are no anticipated benefits to you personally in participating in this research, a summary of the results will be provided to you upon your request. The results will help you to gain a better understanding of the significant factors that influence consumers' intention to upgrade smartphones.

You can access a summary of the research results by e-mailing Mr Chow Wing-Yiu Winn, after the 30th September, 2016.

How will your privacy be protected?

The collected anonymous data will be stored securely on a password protected computer by the student researcher. The raw data will be retained for a minimum of five years, and will be stored in the office of the Project Supervisor (SR119, University of Newcastle).

Due to the anonymous nature of the questionnaire, the responses you provide will not be identifiable.

How will the information collected be used?

The data will be reported and presented in a thesis to be submitted for Mr Chow Wing-Yiu Winn's degree, and for preparation of academic papers.

No participant will be identified.

***What do you need to do to participate*?**

Please read this information statement and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have questions, please contact the researchers.

If you would like to participate, please complete and return the attached anonymous questionnaire to the secure collection box. Completion and return of the paper questionnaire will be taken as your implied consent to participate.

Further information

If you would like further information please contact Mr Chow Wing-Yiu Winn by email (c3191059@uon.edu.au), or the Project Supervisor, Dr Alicia Kulczynski, by email or phone (alicia.kulczynski@newcastle.edu.au, +61 2 4921 6805).
Thank you for considering this invitation.

Mr Chow Wing-Yiu Winn
DBA Candidate

Dr Alicia Kulczynski
Project Supervisor

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. H-2015-0248.

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone +613 (02) 49216333, email Human-Ethics@newcastle.edu.au.

APPENDIX B: Organization Information Sheet

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Information Sheet for the Research Project:
A Study of Consumers' Upgrade Intention of High-technology Products

Document Version 2.0; dated 25/7/2015

Your students are invited to participate in the research project identified above, which is being conducted by Mr Chow Wing-Yiu Winn, a DBA candidate from the Newcastle Business School at the University of Newcastle.

The research is part of Mr Chow Wing-Yiu Winn's studies at the University of Newcastle, supervised by Dr Alicia Kulczynski from the Newcastle Business School.

Why is the research being done?
The purpose of the research is to examine the significant factors that influence consumers' intention to upgrade high-technology products, such as smartphones. The information will aid in identifying ways to improve product offerings, service delivery, and communication campaigns aimed at increasing consumer satisfaction in relation to technology upgrades.

Who can participate in the research?
Students who are at or above 18 years old, use a smartphone, and are enrolled in a sub-degree or degree programme offered by a university or affiliated institution in Hong Kong are being invited to participate.

What would your students be asked to do?
If your students agree to participate, your students will be asked to complete an anonymous questionnaire about their assessment on various aspects of smartphone adoption, their satisfaction with their current smartphone and smartphone technology, and their intention to purchase a new and more advanced smartphone. The information sheets and questionnaires will be distributed to your students by Mr Chow Wing-Yiu Winn.

What choice do your students have?
Participation in this research is entirely their choice. Only those people who give their informed consent will be included in the project. Whether or not your students decide to participate, their decision will not disadvantage them.

If your students do decide to participate, they may stop completing the questionnaire and withdraw from the project at any time prior to submitting their completed questionnaire, without giving reason. Please note that due to the anonymous nature of the questionnaire, they will not be able to withdraw their response after it has been submitted.

How much time will it take?
The questionnaire will take approximately 15 minutes to complete.

***What are the risks and benefits of participating*?**
There are no anticipated risks associated with participating in this research.

Whilst there are no anticipated benefits to them personally in participating in this research, a summary of the results will be provided to them upon their request. The results will help them to gain a better understanding of the significant factors that influence consumers' intention to upgrade smartphones.

You can also access a summary of the research results by e-mailing Mr Chow Wing-Yiu

Winn, after the 30th September, 2016.

How will their privacy be protected?

The collected anonymous data will be stored securely on a password protected computer by the student researcher. The raw data will be retained for a minimum of five years, and will be stored in the office of the Project Supervisor (SR119, University of Newcastle).

Due to the anonymous nature of the questionnaire, the responses they provide will not be identifiable.

How will the information collected be used?

The data will be reported and presented in a thesis to be submitted for Mr Chow Wing-Yiu Winn's degree, and for preparation of academic papers.

No participant will be identified.

***What is requested from you*?**

Please read this information statement and be sure you understand its contents before you consent to allow this research to be conducted at your university or institution. If there is anything you do not understand, or you have questions, please contact the researchers.

If you would allow this research to be conducted at your university or institution, please complete and return the attached consent form.

Further information

If you would like further information please contact Mr Chow Wing-Yiu Winn by email (c3191059@uon.edu.au), or the Project Supervisor, Dr Alicia Kulczynski, by email or phone (alicia.kulczynski@newcastle.edu.au, +61 2 4921 6805).
Thank you for considering this invitation.

Mr Chow Wing-Yiu Winn
DBA Candidate

Dr Alicia Kulczynski
Project Supervisor

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. H-2015-0248.

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone +613 (02) 49216333, email Human-Ethics@newcastle.edu.au.

APPENDIX C: Organization Consent Form

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Consent Form for the Research Project:
A Study of Consumers' Upgrade Intention of High-technology Products
Dr Alicia Kulczynski and Mr Chow Wing-Yiu Winn

Document Version 1.0; dated 2/7/2015

I agree to allow the above research project to be conducted at the Community College at Lingnan University (CCLU) and Lingnan Institute of Further Education (LIFE).

I understand that the project will be conducted as described in the Information Statement, a copy of which I have retained.

I have had the opportunity to have questions answered to my satisfaction.

Print Name: _____

Position: _____

Signature: _____ Date: _____

APPENDIX D: Questionnaire

Questionnaire for the Research Project:

A Study of Consumers' Upgrade Intention of High-technology Products

* Required

Section 1: Your Assessment of a New and More Advanced Smartphone

The following items ask for your assessment on various aspects connected with a new and more advanced smartphone. You can mark the most appropriate answer, using the scale below.

Your assessment on Performance

1. **I find a new and more advanced smartphone useful in my daily life.** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

2. **Using a new and more advanced smartphone helps me accomplish things more quickly.** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

3. **Using a new and more advanced smartphone increases my productivity.** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your assessment on Effort

4. **Learning how to use a new and more advanced smartphone is easy for me.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

5. **My interaction with a new and more advanced smartphone is clear and understandable.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

6. **I find a new and more advanced smartphone easy to use.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

7. **It is easy for me to become skillful at using a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your assessment on the Influence of Important Others

8. **People who are important to me think that I should use a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

9. **People who influence my behavior think that I should use a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

10. **People whose opinions that I value prefer that I use a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your assessment on Resources and Support

11. **I have the resources necessary to use a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

12. **I have the knowledge necessary to use a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

13. **A new and more advanced smartphone is compatible with other technologies I use.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

14. **I can get help from others when I have difficulties using a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your assessment on Enjoyment

15. **Using a new and more advanced smartphone is fun.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

16. **Using a new and more advanced smartphone is enjoyable.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

17. **Using a new and more advanced smartphone is very entertaining.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your assessment on Value for Money

18. **A new and more advanced smartphone is reasonably priced.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

19. **A new and more advanced smartphones is a good value for the money.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

20. **At the current price, a new and more advanced smartphone provides good value.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Section 2: Your Satisfaction with Your smartphone and Smartphone Technology

The following items ask for your satisfaction with your current smartphone and smartphone technology. You can mark the most appropriate answer, using the scale below.

Your Satisfaction with Your smartphone

21. **I am happy with my smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

22. **I am satisfied with my smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

23. **I am disappointed with my smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

24. **I truly enjoy my smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Your Satisfaction with Smartphone Technology

25. **I am happy with the use of smartphone technology.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

26. **I am satisfied with the use of smartphone technology.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

27. **I am disappointed with the use of smartphone technology.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

28. **I truly enjoy the use of smartphone technology.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Section 3: Your Upgrade Intention

The following items ask for your intention to buy a new and more advanced smartphone. You can mark the most appropriate answer, using the scale below.

Your Upgrade Intention

29. **I intend to buy a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

30. **I intend to replace my smartphone with a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

31. **It is very possible that I will upgrade to a new and more advanced smartphone.** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly Disagree	◯	◯	◯	◯	◯	◯	◯	Strongly Agree

Section 5: Some information about You

A few questions that seek information about yourself.

32. **What is your age?** *

_____

33. **What is your gender?** *
Mark only one oval.

◯ Male
◯ Female

34. **What is the time (in months) since the last purchase of a smartphone?** *

_____

APPENDIX E: Descriptive Statistics

Participants' Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	199	48.5	48.5	48.5
Female	211	51.5	51.5	100.0
Total	410	100.0	100.0	

Participants' Age

Age	Frequency	Percent	Valid Percent	Cumulative Percent
18.00	72	17.6	17.6	17.6
19.00	130	31.7	31.7	49.3
20.00	84	20.5	20.5	69.8
21.00	69	16.8	16.8	86.6
22.00	28	6.8	6.8	93.4
23.00	15	3.7	3.7	97.1
24.00	5	1.2	1.2	98.3
25.00	4	1.0	1.0	99.3
26.00	1	.2	.2	99.5
32.00	1	.2	.2	99.8
43.00	1	.2	.2	100.0
Total	410	100.0	100.0	

Descriptive Statistics of Participants' Age and Recency of Purchase

	N	Minimum	Maximum	Mean	Std. Deviation
Age	410	18.00	43.00	19.9439	1.99125
Recency of Purchase (in months)	410	1.00	65.00	13.7683	10.87526

Participants' Recency of Purchase (in months)

Recency of Purchase (in months)	Frequency	Percent	Valid Percent	Cumulative Percent
1.00	41	10.0	10.0	10.0
2.00	9	2.2	2.2	12.2
3.00	22	5.4	5.4	17.6
4.00	11	2.7	2.7	20.2
5.00	15	3.7	3.7	23.9
6.00	33	8.0	8.0	32.0
7.00	1	.2	.2	32.2
8.00	6	1.5	1.5	33.7
9.00	14	3.4	3.4	37.1
10.00	10	2.4	2.4	39.5
11.00	13	3.2	3.2	42.7
12.00	78	19.0	19.0	61.7
13.00	6	1.5	1.5	63.2
14.00	12	2.9	2.9	66.1
15.00	6	1.5	1.5	67.6
16.00	7	1.7	1.7	69.3
17.00	5	1.2	1.2	70.5
18.00	19	4.6	4.6	75.1
19.00	3	.7	.7	75.9
20.00	7	1.7	1.7	77.6
21.00	2	.5	.5	78.0
22.00	3	.7	.7	78.8
23.00	2	.5	.5	79.3
24.00	38	9.3	9.3	88.5
25.00	5	1.2	1.2	89.8
26.00	1	.2	.2	90.0
28.00	2	.5	.5	90.5
29.00	3	.7	.7	91.2
30.00	3	.7	.7	92.0
32.00	2	.5	.5	92.4
33.00	1	.2	.2	92.7
34.00	1	.2	.2	92.9
36.00	16	3.9	3.9	96.8
37.00	2	.5	.5	97.3
38.00	1	.2	.2	97.6
41.00	1	.2	.2	97.8
48.00	7	1.7	1.7	99.5
60.00	1	.2	.2	99.8
65.00	1	.2	.2	100.0
Total	410	100.0	100.0	

APPENDIX F: Normality Testing

Skewness and Kurtosis of the Questionnaire Items

Item	Skewness	Kurtosis
EE1	-1.029	1.174
EE2	-.602	.636
EE3	-.556	-.012
EE4	-.449	.050
FC1	-.273	-.255
FC2	-.409	-.086
FC3	-.498	.306
FC4	-.743	.325
HM1	-1.013	.914
HM2	-1.076	1.264
HM3	-.840	.611
PE1	-.687	.768
PE2	-.838	1.163
PE3	-.568	.380
PV1	-.156	-.541
PV2	-.107	-.312
PV3	-.277	-.052
SAP1	-.759	.581
SAP2	-.661	.217
SAP3 reversed	-.788	.026
SAP4	-.562	.101
SAT1	-.642	.469
SAT2	-.561	.664
SAT3 reversed	-.795	.324
SAT4	-.682	.561
SI1	-.115	-.452
SI2	-.111	-.390
SI3	-.211	-.240
UI1	-.118	-.578
UI2	-.039	-.842
UI3	-.188	-.647

APPENDIX G: Standardized Factor Loadings

Standardized Factor Loadings of the Measurement Model for the Technology Upgrade Model

			Standardized Factor Loadings
EE1	<---	EE	.653
EE2	<---	EE	.662
EE3	<---	EE	.748
EE4	<---	EE	.719
FC1	<---	FC	.765
FC2	<---	FC	.801
FC3	<---	FC	.547
FC4	<---	FC	.376
HM1	<---	HM	.858
HM2	<---	HM	.919
HM3	<---	HM	.867
PE1	<---	PE	.755
PE2	<---	PE	.738
PE3	<---	PE	.683
PV1	<---	PV	.732
PV2	<---	PV	.911
PV3	<---	PV	.797
SAP1	<---	SAP	.850
SAP2	<---	SAP	.880
SAP3 reversed	<---	SAP	.602
SAP4	<---	SAP	.857
SAT1	<---	SAT	.836
SAT2	<---	SAT	.835
SAT3 reversed	<---	SAT	.401
SAT4	<---	SAT	.806
SI1	<---	SI	.643
SI2	<---	SI	.858
SI3	<---	SI	.858
UI1	<---	UI	.878
UI2	<---	UI	.918
UI3	<---	UI	.767

Standardized Factor Loadings of the Updated Measurement Model for the Technology Upgrade Model

			Standardized Factor Loadings
EE2	<---	EE	.657
EE3	<---	EE	.721
EE4	<---	EE	.747
FC1	<---	FC	.771
FC2	<---	FC	.811
FC3	<---	FC	.541
HM1	<---	HM	.858
HM2	<---	HM	.919
HM3	<---	HM	.867
PE1	<---	PE	.757
PE2	<---	PE	.734
PE3	<---	PE	.685
PV1	<---	PV	.733
PV2	<---	PV	.910
PV3	<---	PV	.798
SAP1	<---	SAP	.851
SAP2	<---	SAP	.881
SAP3 reversed	<---	SAP	.599
SAP4	<---	SAP	.856
SAT1	<---	SAT	.838
SAT2	<---	SAT	.832
SAT4	<---	SAT	.802
SI1	<---	SI	.643
SI2	<---	SI	.858
SI3	<---	SI	.859
UI1	<---	UI	.878
UI2	<---	UI	.918
UI3	<---	UI	.767

Standardized Factor Loadings of the Structural Model for the Technology Upgrade Model

			Standardized Factor Loadings
UI	<---	EE	.055
UI	<---	FC	.051
UI	<---	HM	.195
UI	<---	PE	.027
UI	<---	PV	.065
UI	<---	SAP	-.570
UI	<---	SAT	.313
UI	<---	SI	.216
EE2	<---	EE	.657
EE3	<---	EE	.721
EE4	<---	EE	.747
FC1	<---	FC	.771
FC2	<---	FC	.811
FC3	<---	FC	.541
HM1	<---	HM	.858
HM2	<---	HM	.919
HM3	<---	HM	.867
PE1	<---	PE	.757
PE2	<---	PE	.734
PE3	<---	PE	.685
PV1	<---	PV	.733
PV2	<---	PV	.910
PV3	<---	PV	.798
SAP1	<---	SAP	.851
SAP2	<---	SAP	.881
r_SAP3x	<---	SAP	.599
SAP4	<---	SAP	.856
SAT1	<---	SAT	.838
SAT2	<---	SAT	.832
SAT4	<---	SAT	.802
SI1	<---	SI	.643
SI2	<---	SI	.858
SI3	<---	SI	.859
UI1	<---	UI	.878
UI2	<---	UI	.918
UI3	<---	UI	.767

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