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An empirical investigation of a modified technology acceptance model of IPTV

Dong Hee Shin*

College of Information Sciences and Technology, Pennsylvania State University, Reading, PA, USA

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This study explores the factors influencing the adoption of IPTV, and tests the applicability of the technology acceptance model (TAM) in a new convergent technology. The behavioural constructs from TAM were tested for predicting user acceptance of IPTV. Structural equation modelling was used to analyse data and to design a theoretical model predicting the individual's intention to adopt IPTV. A modified TAM for IPTV proposes that new constructs determine user-perceived usefulness and enjoyment of using IPTV. Although this study confirms the impact of information quality and system quality on consumers' technology experience, it specifically shows that the perceived quality of content and system were found to have a significant effect on users' perceived usefulness and perceived enjoyment. In addition, social influences had a positive effect on the intention to use IPTV. These findings suggest an extension of the TAM model for convergence technologies. This research advances theory and contributes to the foundation for future research aimed at improving the understanding of users' adoption behaviour of convergence technologies. Implications of these findings for practice and research are examined.

Keywords: user modelling; IPTV; structural equation model; technology acceptance model

1. Introduction

Despite the exorbitant amount of resources being invested in its development, IPTV is still not an influential threat to old-fashioned technologies. To date, IPTV's evolution has focused on overcoming three types of obstacles, relating to technology, business, and consumers. Technologically, a bandwidth limitation on simultaneous video streams, especially in an expanding high-definition TV environment that demands high bandwidth, remains a key challenge. On the business side, the battle among cable operators, broadcasters, phone companies, and the telecommunication industry has spurred cut-throat competition in the IPTV market. Many analysts, however, predict that the greatest barrier to the development of IPTV would be consumers. In the ever-changing technology environment, consumers must be convinced to adopt IPTV. Customers are questioning whether IPTV offers better features, such as content, price, interoperability, and search or other unique applications.

With the increased complexity of new technologies, and uncertainty about them, industries are now focusing on users' motivations and experiences: how users feel about new technologies and how they use them. As with any other technology, user acceptance of IPTV is tied directly to user experience, which is in turn related to the user motivation. The success factor seems clear: the higher the motivation, the better the experience, and the better the experience, the higher the user adoption rate.

From the user acceptance perspective, this study takes a micro-based approach focusing on customers' motivations to identify pulling forces driving the development of IPTV services. Diffusion of new technologies results from a series of individual decisions to begin using them, decisions which are often the result of a comparison of the uncertain benefits of the new invention with the uncertain costs of adopting it (Venkatesh *et al.* 2003). Understanding the factors affecting this choice is essential, both for researchers studying the user acceptance of convergence technologies and for the manufacturers of such technologies. This study provides a theoretical and empirical analysis to explain factors influencing a potential user's adoption of IPTV, which in turn suggests practical implications for the industry. The study has three objectives: (i) to propose and verify a modified technology acceptance model (TAM) specific to IPTV, (ii) to identify the factors that determine consumers' adoption of IPTV in terms of intrinsic and extrinsic motivations, and (iii) to investigate the success factors of IPTV development.

*Email: dshin@psu.edu

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2. Definition and current trends of IPTV

IPTV is an emerging and potentially disruptive technology. IPTV is a system of distributing television content over an internet protocol (IP) that enables a more customised and interactive user experience (Harris 2005). One advantage of an IP-based network is the opportunity for integration and convergence. Converged services imply interaction of existing services in a seamless manner to create new value-added services. Because of this potential, IPTV is predicted to become a common platform for systems where television and/or video signals are distributed to subscribers or viewers using a broadband connection over an IP. IPTV is in parallel with the subscriber's internet connection, supplied by a broadband operator using the same infrastructure over a dedicated bandwidth allocation. Development of interactive services on IPTV will allow it to incorporate e-commerce and television commerce (t-commerce) by combining Internet interactivity with high-quality interactive television video.

IPTV is expected to grow at a rapid pace in the coming years, as broadband is now available to more than 100 million households worldwide (Shin 2007). Many telco and cable operators around the world have already rolled out successful IPTV services to their customers and are benefiting from the increased revenues and reduced churn. The technology appears easy and comfortable for subscribers to adjust to, with the addition of television services now allowing telecom companies to target broadband adopters, while bundling new services in their offering.

IPTV services have been launched or trialled in 7 out of 13 Asia-Pacific economies (Yankee Group 2006). In particular, Korea has the world's highest broadband penetration, with 78%, or more than 11 million, subscribers (Gartner Group 2006). Because of the broadband, there has been a considerable growth in Website video content, both streaming and stored. For example, Major League Baseball and YouTube.com offer various forms of IPTV content. Large firms such as Korea Telecom and Hanaro Telecom were scheduled to launch IPTV (as part of their Triple Play service, an integrated Internet, telephone, and TV service) in 2006, but because of regulatory setbacks in Korea, the introduction has been delayed until 2008. By deploying IPTV services, providers can not only derive additional revenue through their subscriber access networks but do so in less time, at a lower cost, from a larger addressable market (Shin 2007). IPTV services give providers a new opportunity to bundle their services based on the same protocols as the internet. In addition to offering traditional cable-TV-like services, the IPTV platform gives providers an open platform for delivering a wide range of advanced entertainment services. This has the dual benefit of responding to the cable threat with a superior offering, while also opening new revenue opportunities not available on cable TV platforms.

Although these technological advantages shed light on the explosive growth, IPTV also poses several hurdles and challenges. The most serious concern for IPTV is its security issues in content, services, and infrastructure. Unlike traditional television services, though, IPTV is not a closed system and, as an IP-based service, is subject to the same threats from hackers and other vulnerabilities. New services, where security measures have not had time to mature and expand, are usually more vulnerable than established services.

3. Theoretical background

3.1. Customers' intentions to adopt convergence technologies

The TAM posits that behavioural intention is a significant determiner of actual system use, and that behavioural intention is determined by two salient beliefs: perceived usefulness and perceived ease of use. According to the TAM, individuals' beliefs determine their attitude toward using the system and, in turn, their attitude develops the intention to use. This intention influences the decision to actually use the technology. These causalities are broadly studied and accepted (Teo *et al*. 1999, Suh and Han 2003).

The motivational model that was adapted by Davis *et al*. (1992) employs two key constructs: *extrinsic* and *intrinsic motivation*. Shang *et al*. (2005) define extrinsic motivation as the performance of an activity; it is perceived to help achieve valued outcomes that are distinct from the activity itself, such as improving job performance, pay, etc. Intrinsic motivation refers to the performance of an activity for no reason other than the process of performing it (Shang *et al*. 2005). In the case of technology acceptance studies, perceived usefulness is an example of extrinsic motivation, whereas perceived fun, playfulness, and enjoyment are examples of intrinsic motivation. In the research on the usage intentions for information systems (IS), Heijden (2004) adds perceived enjoyment to the TAM model. Cheong and Park (2005) have developed a more comprehensive version of the TAM to better reflect the mobile Internet context. Their model employs perceived playfulness, content quality, system quality, internet experience and perceived price level, in addition to perceived usefulness and ease of use.

With the recent phenomenon of convergence (voice and data, fixed and mobile services), many studies are researching the TAM of convergence technologies. Nysveen *et al*. (2005) investigate the consumers' intention to use mobile internet and examine four overall

influences on usage intention: motivational influences, attitudinal influences, normative pressure, and perceived control. Similarly, Fogelgren-Pedersen (2005) found that connection stability and geographic coverage are significant variables of perceived relative advantage in wireless broadband. Also, Yu *et al*. (2005) found that the perceived enhanced utility of mobile services is a strong value motivating use of t-commerce. Although these studies found significant perceived variables, they still did not find variables specific to convergence technologies. In other words, with all the findings, a question remains, 'What peculiar variables in convergence technologies are different from those in other services?' Researchers are currently faced with the challenge of understanding user behaviour associated with multiple, synchronous, *ad hoc*, and even ubiquitous connections. One of the distinctive features of convergence is that it offers different content (voice, texts, video, broadcasts, etc.) in a simplified, convergent and computer-mediated communication system to enable individuals to interact, play, communicate, collaborate and share information in many new and different ways. In this aspect, it is worth investigating the factors of convergence technologies from a content and conduit framework. There is a need for the TAM to incorporate new factors to improve its explanatory utility for new convergence technologies (Lu *et al*. 2003). The present study proposes motivational variables specific to IPTV from a content and conduit framework. It is generally assumed that content factors are related to intrinsic motivations, which is about enjoying certain content, whereas conduit factors are related to extrinsic motivations, which is about usefulness. According to Davis *et al*. (1992), intrinsic factors include perceived enjoyment, along with perceived content quality, and extrinsic factors include perceived usefulness, possibly reinforced by perceived system quality. As these propositions reflect the current debate on the content and conduits of convergence, the findings of this study may shed light on the implications of such a debate.

Based on the literature review, it is projected that the general causalities found in the TAM are also applicable to the IPTV context.

H1: Attitude toward IPTV is positively related to the intention to use IPTV.

3.1.1. *Perceived usefulness*

The TAM uses two distinct but interrelated beliefs – perceived usefulness and perceived ease of use – as the basis for predicting end-user acceptance of computer technology. Of the two TAM variables, studies have found perceived usefulness to have the stronger influence (Davis *et al*. 1992, Igbaria *et al*. 1996, Heijden 2003). In the current study, the definition of perceived usefulness follows the classical definition of Davis (1989): 'the degree to which a person believes that using a particular system would enhance his or her job performance'. This study also highlights the factor 'capable of being used advantageously'.

H2: There is a positive relationship between perceived usefulness and intention to use IPTV.

H3: There is a positive relationship between perceived usefulness and attitude toward IPTV.

3.1.2. *Perceived enjoyment*

IPTV is a relatively simple system to use, and it is assumed that IPTV, as a variation of the Internet, presents little difficulty to users. In addition, because IPTV is a variety of television that provides enjoyment, interest, and pleasure, this study replaces the variable of perceived ease of use with perceived enjoyment from Heijden's (2004) study, as a variable more relevant to IPTV. As a hedonic system, IPTV can be better suited to enjoyment than to ease of use.

Although Davis *et al*. (1992) classify enjoyment as a type of intrinsic motivation, and perceived usefulness as a type of extrinsic motivation, they define enjoyment as the extent to which the activity of using a computer system is perceived to be personally enjoyable in its own right, aside from the instrumental value of the technology. On the other hand, Venkatesh (2000) conceptualised enjoyment as an antecedent of ease of use, whose effect increases over time as users gain more experience with the system. Moon and Kim (2001) examined a conceptually similar but distinct intrinsic motivation construct, playfulness, as an antecedent of Web usage, suggesting a significant effect of intrinsic motivation in determining the use of web-based IS. Most recently, Heijden (2003) researched the Web from utilitarian and hedonic purpose frameworks and found that perceived enjoyment as a hedonic purpose strongly influenced Web use for entertainment purposes. However, the specific effect of enjoyment on attitude has been largely overlooked in a convergence context.

IPTV, as a convergent technology, can be seen as a hedonic system, as it offers entertaining content and information services. Therefore, it can be hypothesised that people seek the hedonic IPTV services to satisfy their entertainment purposes.

H4: There is a positive relationship between perceived enjoyment and intention to use IPTV.

H5: There is a positive relationship between perceived enjoyment and attitude toward IPTV.

3.1.3. Perceived content quality

The notion of information quality was first proposed by DeLone and McLean (1992), who argued that information quality is a significant construct for building successful IS. Lin and Lu (2000) further developed information quality as part of a determinant of system quality and argue that information quality variables are useful predictors of perceived ease of use and perceived usefulness. As systems become complex enough to carry various content, many studies are using perceived content quality *in lieu* of perceived information quality. Beyah *et al*. (2003) measured perceived content quality along with other constructs in assessing Web-based reference systems. They found perceived content quality to be one of the significant determinants in the usage of the reference systems. Most recently, Cheong and Park (2005) applied perceived content quality to the acceptance model of mobile Internet. Their factor analyses showed content quality as a valid predictor and concluded that it is a significant factor in the adoption of that technology. The current study uses content quality as a possible factor for IPTV use and adoption. It is hypothesised that content quality has a positive impact on attitude, because better content can make individuals feel IPTV is more enjoyable and playful.

H6: There is a positive relationship between perceived content quality and perceived enjoyment.

H7: There is a positive relationship between perceived content quality and attitude toward IPTV.

3.1.4. Perceived system quality

System quality is especially important in the context of IS, because many people become reluctant to use IS when they experience frequent delays in response, frequent disconnection, lack of access, and poor security (Aladwani and Palvia 2002). In a study by DeLone and McLean (1992), information quality and system quality were found to be important constructs for the success of IS. Similarly, Lin and Lu (2000) examined information quality, response time, and system accessibility as IS qualities. They argue that these three variables are useful predictors of perceived ease of use and perceived usefulness. Because response time and system accessibility, and other factors such as system reliability and security, can be understood as attributes that explain system quality, IS quality can be comprehensively identified by system quality and information quality. Cheong and Park (2005) found positive causal relationships with perceived system quality and perceived usefulness. On the basis of these findings, the following hypotheses are proposed:

H8. There is a positive relationship between perceived system quality and perceived usefulness.

H9. There is a positive relationship between perceived system quality and attitude toward IPTV.

3.1.5. Social influences

Normative pressure is one of the components of the theory of reasoned action. Nysveen *et al*. (2005) define normative pressure as 'the person's perception that most people who are important to him think he should or should not perform the behavior in question'. Similarly, Rogers (1995) defines a norm as 'the most frequently occurring pattern of overt behavior for the members of a particular social system'. The importance of normative pressure on the intention to use mobile services is revealed in studies based on the IS perspective (Hung *et al*. 2003). As Nysveen *et al*. (2005) indicate, people often use technologies in a public social context in which they observe others' activities, and in which they must adapt to others' interactions. In addition, previous studies consistently show that social influence can determine an individual's behaviour (Lu *et al*. 2003).

H10: Normative pressure has a strong effect on intention to use IPTV.

3.1.6. Perceived cost level

This study adds a perceived cost variable as a significant factor in developing the intention to use IPTV. Cost variables have been widely studied in research on the adoption of technologies, and questions remain about how low a price consumers are willing to pay for technologies and, conversely, how high a price high-income consumers are willing to pay. In the development of behavioural intention, customers compare the benefit from the service to the cost of using the service. If the cost exceeds the benefit, they do not subscribe to the service. In the IPTV context, the cost of using IPTV includes the initial investment for the proper device (set-top box) and subscription charges. First, people pay for the set-top box, which enables them to connect to the internet network. Second, they pay for subscribing to the service, through fixed monthly charges, per-minute charges, per-packet charges or mixed charges. The main concern regarding the cost is to explore the impact of customer's perceived price level about the IPTV subscription (usage) charge in the development of the behavioural intention. The service cost used in most

previous research is not an objective term, but subjective, because it refers to the perceived level of value that individuals are willing to pay for the service. The behavioural intention of customers is influenced by their valuation of the service which significantly relates to the perceived cost level (Wu and Wang 2005). Cheong and Park (2005) found that the price has a significant impact in the development of initial willingness to use mobile Internet. Obviously, the perceived cost level is one of the critical factors in developing behavioural intention. As cost variables embody complexity, cost should be measured in relation to customers' perceptions (Teo *et al*. 2004).

H11: Perceived cost level has a significant influence in developing the intention to use IPTV.

3.1.7. Demographics

Since Davis's (1989) study, researchers have extended TAM by the inclusion of other external variables. These variables include prior use and experience (Venkatesh *et al*. 2003), gender (Gefen and Straub 1997), age and education (Pijpers *et al*. 2001), and knowledge about technology (Pijpers *et al*. 2001). Gefen and Straub (1997) find that gender predicts perceived usefulness. Venkatesh (2000) also examines gender differences in individual perceptions of information technology. His study concludes that men consider perceived usefulness to be more important than women in making their adoption decision, whereas women consider perceived ease of use to be more important than men. Pijpers *et al*. (2001) also find that demographic characteristics of senior executives are useful predictors of their acceptance of information technology. Based on the discussions about relationships between individual demographics and attitudes, the following hypotheses are postulated:

H12: Age negatively influences perceived usefulness of IPTV.

H13: Age negatively influences perceived enjoyment of IPTV.

H14: Gender influences perceived usefulness of IPTV.

H15: Gender influences perceived enjoyment of IPTV.

H16: Education influences perceived usefulness of IPTV.

H17: Education influences perceived enjoyment of IPTV.

4. Method

A pilot survey was administered to a pilot group of 22 people to revise and complement test survey questions. Several unclear questions and obscure wordings were revised. The survey questionnaire asked people whether they would adopt IPTV, with step-wise factors. Then with a revised survey questionnaire, telephone interviews of adult residents were conducted through a local university survey institute during July and August 2005. In the survey, interviewers placed calls, up to five times, to residential households whose telephone numbers were generated from a computerised random-digit dialling procedure. An adult house member between 18 and 74 years of age was selected from each household contacted, based on the last birthday method, for an interview. The final sample consists of 571 adults, which translates into a sampling error of $\pm 3\%$ at the 95% confidence level.

The ratio of male to female was almost equal, at 48.2% and 51.8%, respectively. Age groups consisted of teens (7.4%), twenties (24.9%), thirties (24.9%), over forties (32.8%), and occupational groups of students (20.1%), office workers (18.4%), self-employed workers (21.9%), and housewives (18.8%). SPSS 10.0 was used for the analysis of the basic statistics and analysis of variance.

4.1. Measurement

The scale items were developed from previously studied and validated measures and were carefully restated to reflect the characteristics of IPTV. The 10 variables are well founded in the IS literature. Prior to further study, a pilot test for measures was conducted. The wording of items was reviewed and modified, based on the pilot test outcomes, by experts in the quantitative research area. The participants indicated their agreement with a set of statements using a seven-point Likert-type scale that ranged from *strongly disagree* to *strongly agree*. One advantage of using the TAM is that it has a well-validated measurement inventory. The measures of behavioural intention to use were adapted from previous studies related to the TAM, mainly from the study of Davis *et al*. (1992).

To address the elements of enjoyment, this study used a four-item scale which was developed by Nysveen *et al*. (2005). The items are *entertainment*, *relaxation*, *excitement*, and *fun-seeking gratifications* ($\alpha = 0.946$). Perceived usefulness was measured with six items from Davis (1989), measuring the extent to which a person believed that IPTV was capable of being used advantageously and providing positive expected outcomes ($\alpha = 0.889$). Perceived content quality and perceived system quality were measured with the items used by Cheong and Park (2005) for mobile Internet service ($\alpha = 0.894$; $\alpha = 0.839$). The measures of items of perceived cost level ($\alpha = 0.732$) were adapted from Liao and Cheung (2001).

5. Data analysis

5.1. Discriminant validity using correlation

For discriminate validity, a test of correlation among the factors was performed to test for reciprocal relationship among them. Simple linear correlation (Pearson r) was used to determine the extent to which values of the variables are proportional to each other. Table 1 presents a correlation matrix of the variables. The generally modest inter-correlations among the variables indicate no significant multi-collinearity problem.

In addition to the correlation test, Cronbach's α was used to test the internal consistency reliability of each of the composite constructs (Table 2). Internal consistency measures estimate how consistently individuals respond to the items within a scale. All independent variables show acceptable values above 0.8 in Cronbach's α coefficients, which indicate the reliable measures of their respective constructs (Nunnally 1978).

5.2. Confirmatory analysis: LISREL measurement model

The goal of using confirmatory factor analysis is to improve convergent validity. The items with loading lower than 0.5 from the exploratory factor analysis were dropped for confirmatory factor analysis. Using the 571 data points from the initial sample, the three constructs and their indicators were subjected to confirmation through a measurement model in LISREL 8.12 (Joreskog and Sorbom 1993). This model provided evidence of trait validity in its component forms of discriminant validity and convergent validity (Peter 1981).

To test the hypotheses proposed above, multiple regression analyses are conducted on the demographics variables.

5.3. Model fit

The straightforward factor structure confirms that the model was a relatively uncomplicated one. The $X^2_{(509)}$ was 365 ($p = 0.000$). However, as the X^2 statistic is not always the best indication of model fit (Bagozzi and Yi 1988) a range of additional fit indices is reported. X^2 (df) is sensitive to sample size, and, thus, when all 571 complete responses are used, the fit indices AGFI,

Table 2. Convergent validity and internal consistency reliability.

Items	Factor loadings	Cronbach's α
Perceived usefulness		
PU1	0.869	0.8894
PU2	0.824	
PU3	0.822	
PU4	0.827	
Perceived enjoyment		
PE1	0.723	0.9467
PE2	0.932	
PE3	0.961	
PE4	0.901	
Perceived content quality		
PQ1	0.848	0.8941
PQ2	0.818	
PQ3	0.834	
Perceived system quality		
PA1	0.694	0.8389
PA2	0.759	
PA3	0.806	
PA4	0.794	
Social pressure		
SP1	0.693	0.8302
SP2	0.690	
SP3	0.889	
Perceived cost level		
PC1	0.738	0.7321
PC2	0.639	
PC3	0.729	

Table 1. Correlation matrix among factors.

	PU	PE	PA	PCQ	PSQ	SP	PC	Attitude	Intention
PU	0								
PE	0.38	0							
PA	0.39	0.38	0						
PCQ	0.38	0.20	0.47	0					
PSQ	0.41	0.40	0.39	0.67	0				
SP	0.38	0.22	0.41	0.24	0.34	0			
PC	0.24	0.33	0.34	0.39	0.40	0.28	0		
Attitude	0.34*	0.44	0.46*	0.21*	0.51	0.42	0.39	0	
Intention	0.48**	0.29*	0.26*	0.39*	0.37	0.23	0.31	0.49*	0

*$p < 0.05$; **$p < 0.01$.

PU, perceived usefulness; PE, perceived enjoyment; PA, perceived availability; PCQ: perceived content quality; PSQ, perceived system quality; SP, social pressure; PC, perceived cost level.

normed fit index (NFI), RMSEA, and comparative fit index (CFI) more correctly reflect model fit (Hair *et al.* 1988). The goodness-of-fit index (GFI) = 0.94 (AGFI = 0.92), the root mean square residual = 0.10 (SRMR = 0.05), NFI = 0.93, and CFI = 0.94. According to Browne and Cudeck (1993), an acceptable fit exists where AGFI > 0.80 and RMSEA < 0.10. Taken together, these figures provide evidence of a reasonably good fit, which is suggestive of trail-valid component measures in the form of the scales indicating each construct. Internal consistency for the three scales was also strong, as evidenced by a coefficient α of 0.82 for the scale indicating perceived enjoyment, 0.85 for perceived usefulness, 0.89 for perceived content quality, and 0.80 for perceived availability. Thus, it is concluded that the model fit is acceptable. Given a satisfactory measurement model fit, the structural model was assessed. Eleven structural paths were entered into the model. The fit indices again indicated good fit of the data (Table 3).

6. Hypotheses tests

6.1. Structural paths

To test the structural relationships, the hypothesised causal paths were estimated; eight hypotheses were supported and three hypotheses rejected. The results are reported in Table 4 and Figure 1. The overall fit of the model is acceptable because the goodness-of-fix/fit statistics (CFI = 0.912, GFI = 0.876, AGFI = 0.89, and RMSEA = 0.071) are satisfactory, with the X^2/df ratio close to 2.0.

The findings indicate that extrinsic and intrinsic motivations exhibit equally strong impacts on users' attitudes and intention to use IPTV. Perceived enjoyment had a significant effect on intention (**H4**, $\beta = 0.58$, $t = 3.01$), whereas perceived usefulness had a moderate effect on intention (**H2**, $\beta = 0.19$, $t = 3.31$). Perceived system quality and perceived content quality had statistically significant effects on perceived usefulness ($\beta = 0.57$, $t = 4.20$) and perceived enjoyment ($\beta = 0.39$, $t = 3.14$), supporting hypotheses 8 and 6, respectively. Perceived system quality and perceived content quality also had significant effects on attitude toward IPTV (**H9** = 0.61; **H7** = 0.39). These stand in contrast to the low effects of perceived usefulness and perceived enjoyment on attitudes toward IPTV (**H3**, $\beta = 0.17$; **H5**, $\beta = 0.11$).

Hypothesis 1 (attitude and intention) was supported with a statistically significant relationship ($\beta = 0.39$, $t = 5.12$), which corresponds to prior research findings in the literature. Social pressure (**H10**) was found to have a significant effect on intention ($\beta = 0.29$, $t = 1.92$). Finally, the cost hypothesis (**H11**) was rejected, implying that the IPTV cost factor is less of an issue if the users perceive the IPTV content and system to be valuable.

6.2. Multiple regression

The second section of the discussion investigates the effects of demographics (**H12**–**H17**) on IPTV adoption decision (Table 5). Age (**H12**, **H13**) and education (**H16**, **H17**) are consistently found to predict both perceived enjoyment and perceived usefulness. Although gender can predict perceived enjoyment (**H15**), it does not predict consumer's perceived usefulness (**H14**).

Table 3. Fit indices for the measurement model and structural model.

Fit statistics	Measurement model	Structural model	Recommended value
X^2 (df)	365 (509)	397 (509)	–
p-value	0.000	0.000	>0.05
AGFI (Adjusted goodness of fit)	0.89	0.81	>0.8
RMSEA (Root mean square error of approximation)	0.071	0.69	>0.06
CFI (Comparative fit index)	0.94	0.94	>0.90
NFI (Normed fit index)	0.93	0.92	>0.90
Incremental fit index	0.95	0.94	>0.90

Table 4. Summary of hypothesis tests.

Hypothesis	Path coefficient	*t*-value	Support
H1: Attitude → Intention	0.39**	5.691	Yes
H2: PU → Intention	0.22*	2.021	Yes
H3: PU → Attitude	0.17	6.717	No
H4: PE → Intention	0.58**	2.001	Yes
H5: PE → Attitude	0.11	2.459	No
H6: PCQ → PE	0.39*	3.143	Yes
H7: PCQ → Attitude	0.40**	4.423	Yes
H8: PSQ → PU	0.57**	4.204	Yes
H9: PSQ → Attitude	0.61**	2.123	Yes
H10: Soc. pres. → Intention	0.29*	1.923	Yes
H11: Cost → Intention	0.20	2.018	No
H12: Age → PU			Yes
H13: Age → PE			Yes
H14: Gender → PU			No
H15: Gender → PE			Yes
H16: Educ → PU			Yes
H17: Educ → PE			Yes

*$p < 0.05$; **$p < 0.001$.

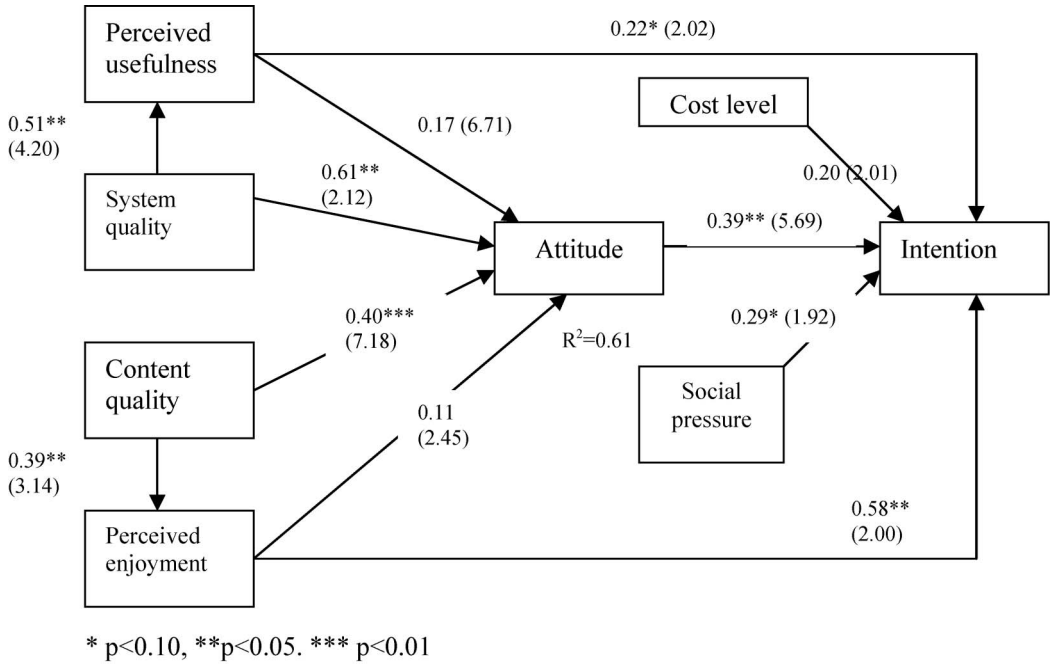

Figure 1. Result of the research model.

Table 5. Results of four regression tests.

Regression test	β	Result
Perceived usefulness ($R = 0.871$, $R_2 = 0.758$, Durbin–Watson = 1.274)		
Age	0.057**	H12 supported
Gender	0.015	H14 rejected
Education	−0.061**	H16 supported
Perceived enjoyment ($R = 0.808$, $R_2 = 0.652$, Durbin–Watson = 1.152)		
Age	−0.060***	H13 supported
Gender	0.024*	H15 supported
Education	0.239*	H17 supported

*$p < 0.001$; **$p < 0.005$; ***$p < 0.01$.
Gender coded as 0 = female, 1 = male.
Education coded as 0 = below college education, 1 = above college education.

7. Findings

The objective of this research was to develop a more comprehensive version of the TAM that can explain the development of individuals' behavioural intentions to adopt and use IPTV. For this purpose, new constructs modified from TAM were employed, and two additional motivations were introduced: intrinsic motivations, including perceived content quality and perceived enjoyment; and extrinsic motivations, including perceived usefulness and perceived system quality.

The measurement model was confirmed, displaying adequate convergent and discriminant validity with respect to the measurement of the constructs in the research model. Overall, the results show that the model demonstrates good predictive power and explains behavioural intentions to use IPTV. The structural model provided a good fit to the data, and most path coefficients in the research model were found statistically significant, except for the paths from perceived usefulness and perceived enjoyment to attitude. The two relative low significance paths contradict prior studies, implying unique features in the evaluation of the acceptance of convergence technologies. It can be inferred from these rejected factors that users may want clearer motivators of usefulness and enjoyment than those associated with traditional technologies. As various technologies rise and thrive, users may want to assure themselves about the degree of enjoyment provided by content and about the usefulness of the conduit. In addition, since IPTV tends to carry a content-based charge (per access, per usage time, or per song, etc.), users may be more cautious about usage and want to find more distinct usefulness and enjoyment. Customers become pickier than ever in using and adopting technologies, they may seek specific usefulness and novel enjoyment. For the discretionary use, customers may want a technology that targets their interests, rather than gives them lots of options.

The results highlight several implications for IPTV providers with regard to the development of new services over IPTV to increase users' intentions to use

the services. First, the empirical findings in this study demonstrate that employing perceived content quality and perceived system quality would be a worthwhile extension of the TAM, as both factors were found to be influential in predicting the behavioural intention to use IPTV. The results of SEM show that the perceived quality of content and system were found to have a more significant influence than any other variables in developing attitudes toward IPTV. The uniqueness of the technological features of IPTV derives more from the quality it offers users, rather than from an escalation along the quantity dimension. In the future, IPTV could also create and capture value through uniqueness on the units of content, which can be enabled by a quality of system capacity.

Interestingly, perceived usefulness and perceived enjoyment did not directly affect potential consumers' intention to adopt IPTV, although the two factors appear to be moderate antecedents for the intention to use IPTV. It can be inferred that IPTV itself is still in an early stage; consumers are not sure about its usefulness and enjoyment yet. Perceived quality of content and system may more clearly draw consumers' attentions and thus be more effective in influencing their intentions to use IPTV. This particular point can be a theoretical implication of the TAM in convergence technologies. Perceived enjoyment can be viewed as a specific utility/aspect of content, based on what is received and what is given; and perceived usefulness can be seen as an aspect of the specific conduit transmitting such content, based on the findings of this study that both perceived enjoyment and perceived usefulness are mediated by perceived content quality and perceived system quality, respectively.

Although it is widely known that usage behaviour is mediated by perceived usefulness and perceived ease of use, the question of how such TAM variables are augmented by what variables remains an under-researched area. Although past research has been valuable in explaining how such beliefs as perceived usefulness and perceived ease of use lead to system use, it has not explored extensively how and why these beliefs develop. In this regard, Zhang and Sun (2006) call for more research on moderating effects that can explain limited explanatory power and inconsistencies across studies. These moderating effects will be important for convergence technologies as they become more and more multi-tasking systems, and future research might productively investigate possible moderating factors in such complex systems. In this light, the framework of perceived content quality and perceived system quality can be a worthwhile extension to intrinsic and extrinsic motivations, respectively. The motivational aspects of the TAM (both intrinsic and extrinsic) have been widely approached and, thus, somewhat ambiguously defined. The TAM approach has long followed a dichotomy model, in which content and conduit have been cleanly separated because of the assumption that conduit defines content. However, the rules where conduit defines content have been rewritten by convergence technologies such as IPTV. Conduit no longer defines content, and therefore there is a need to approach content and conduit from an integrated perspective.

The findings of this study serve as one example of clear conceptualisation of such motivations and show the effects of content and conduit on attitude and intention. The two motivations reflect the current debate between/over content and conduit in convergence technologies (Shin 2006). As convergence technologies blur the line between content and conduit, the challenging question is: 'What will the killer application be for the next-generation Internet arena?' This question is being aggressively pursued by a number of industries that attempt to integrate the content and conduit of convergence technologies. Further studies should follow up on the validity of these new factors, as well as the moderating effects of the new motivations on attitude.

From the finding that perceived quality is a significant factor affecting attitude toward IPTV, practical implications can be drawn: IPTV providers should put significant resources into developing and delivering high-quality content, such as timely, up-to-date, and personalised services. In addition, IPTV providers should not only provide useful information to users, but offer quality content and a stable system by which users can enjoy various services via a new platform. As well, IPTV providers have to launch new and unique services on the platform to woo consumers. In TAM studies of the Internet, content has typically been represented by informational uses on a routine basis; IPTV content is often a combination of informational uses and synchronous entertainment, and it appears that much IPTV content serves both users' information and entertaining goals on an occasional basis.

This study also found that normative pressure is a significant predictor of intention to use IPTV. Together with the importance of content quality, the findings show that social norm-related influences have significant effects on the intention to use IPTV services. This is even truer in an environment where the market is remarkably favourable to technology, and consumers are highly sensitive to new trends. Users may be conscientious about what other users think about the technology service, asking their opinions and monitoring their behaviour. Trocchia and Janda (2003) show that Internet retail service users are influenced by positive word-of-mouth from their peers. This finding is similar to the nature of digital users, who are

influenced by word-of-mouth from other users, who may suggest that mobile devices provide a sense of status. A growing number of studies suggest that normative pressure is a significant factor in explaining the rapid adoption of technology services (Davis *et al.* 1992), and the findings of this study also confirm the positive effect of normative pressures on intention to use IPTV.

This social pressure can be seen in the network externalities that IPTV will have. IPTV will likely have indirect network externalities such that, when content attracts significant numbers of customers, the increase in popularity will draw more content providers to send over IPTV, and this will affect the intention of other customers to use IPTV. This reasoning has explanatory power with regard to the perceived quality of content and system identified by this study. The higher the quality of content and system, the more positive the attitude toward IPTV, a relation which can be correlated with the social pressure found in this study. This cycle of correlation may represent the reinforcing loop of the network externalities of IPTV.

As to the effects of demographic variables, age and education are found to positively predict consumers' perceived usefulness and perceived enjoyment. Gender is found to positively predict consumers' perceived usefulness, but not their perceived enjoyment. Gender has recently attracted researchers' attention to examine its effect on adoption decision (Venkatesh *et al.* 2003). Past TAM research has focused on gender-based perceptual differences and its effects. Pijpers *et al.*'s (2001) study thus hypothesises that males are more positive than females in their perception of technologies. Empirical data from this study confirm Pijpers *et al.*'s (2001) findings that gender does not affect perceived usefulness and perceived enjoyment.

In conclusion, considering the ever-changing nature of convergence technologies, this study offers help in understanding why and how people use IPTV in this new field of convergence and in understanding the implications for the development of effective IPTV applications and services. In this respect, the findings provide a good basis for the industry developing a service evaluation framework to determine the adoption potential of new IP-based services and convergence technologies in general. A TAM framework can be a good tool for understanding market potential through an analysis of users' needs and a prototyping of market profiles. The modified TAM model used in this study seems well suited for developing such a framework for services that are adopted for functional reasons, and services that are directed specifically at innovative user attitudes. In particular, the identified dimensions of intrinsic and extrinsic motivations imply that IPTV providers should develop new business models and should forge new ground in developing an IP platform to integrate various services and content.

8. Conclusion

As IPTV is emerging as the future of integrated system, discussions on how to guarantee the success of IPTV differ hugely. Some may argue that IPTV is unlikely to be perceived as an innovation, because IPTV is just another way to receive a TV signal. Some may argue that IPTV will be a killer application, as it is a new platform that not only allows consumers to customise their video programming experience but also empowers organisations of all types to directly and more inexpensively access new and targeted global audiences. This study investigated the issue from user perspectives and derived industrial implications of the IPTV determinants. This study examined several factors in explaining users' choices and found two noteworthy factors relating to content and conduit. Customers expect/anticipate IPTV as a content reservoir for enjoying various content and innovative services. At the same time, customers see IPTV as an advanced system offering a stable connection and accommodating numerous services. The two factors are in a reciprocal relationship that users interchangeably and complementarily seek. IPTV providers could use the findings to identify factors with favourable characteristics for adoption of IPTV services, which include reliability, security, quality, and usability.

Future IPTV providers should listen closely to the concerns of potential customers. No matter how good its underlying technologies are, if the core offering is insufficient or limited in scale and scope, IPTV may not win enough customers to make it a productive business, like the failed system t-commerce or, to a lesser extent, TiVo. Despite its innovative functionalities and ease of use, TiVo has had difficulty penetrating consumer markets and has remained a niche product. Some argue that this is because consumers are unfamiliar with the benefits of a system like TiVo. It may take a month of use to fully understand the magnitude of the change TiVo brings to television viewing. Users who are not comfortable with such technology tend to prefer less expensive, more familiar systems.

In short, the findings regarding consumers' demands illuminate several tasks for future IPTV providers. As well as customer demand, bandwidth availability, affordability of service, content, regulation, and piracy are the factors that could slow down the IPTV service roll-out from going forward. Once IPTV meets the technical and content requirements, and once customers get acclimatised, the market will tip in its favour.

9. Limitations and future studies

The results of this study should be interpreted and accepted with caution for several reasons. The user sample is a major drawback of the present study, as the sample was drawn only from the Korean market. This is particularly troubling in the study of technology acceptance because this possibly biased the findings; more research with samples from other countries is needed to validate the current results and provide pivotal implications for future convergence services. Customers' value perceptions and their influence on commitment and behaviour may differ from culture to culture, and results indicating the weights of the influence of different value dimensions should be interpreted with caution, at least with regard to the Asian markets, where the social influence of the group tends to be higher than in individualistic Western societies. Therefore, although these scales will be useful in both academic research and managerial applications, their generalisability may be limited. In addition, since IPTV is still in its early stage of development, there are limited data and experience in terms of service roll-out and awareness. Thus, consumer adoption behaviour identified in this study may only prove to be relevant for this early stage of rather premature understanding of IPTV services among the potential adopters.

Finally, regarding the à la carte pricing system, it is interesting to see that perceived cost level does not show significant influence. Future studies may follow up on this point.

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Appendix 1. Questionnaire items

Perceived usefulness

- I think that IPTV service is very useful to my life in general.
- I think that IPTV is helpful to improve my performance in general.
- I think that IPTV is helpful to enhance effectiveness of my life in general.
- I think that IPTV provides very useful service and information to me.

Perceived content quality

- I think that IPTV provides various information and services.
- I think that the services and information I can get from IPTV are valuable.
- IPTV provides the information and services that I need.

Perceived system quality

- I think that IPTV provides very reliable service.
- I think that the speed of IPTV is fast.
- I think that IPTV is secure to use.

Perceived enjoyment

- I find service entertaining.
- I find service pleasant.
- I find service exciting.
- I find service fun.

Normative pressures (social norms)

- People important to me think I should use service.
- It is expected that people like me use service.
- People I look up to expect me to use service.

Attitude

- I think that using IPTV is good idea.
- I think that using IPTV is beneficial to me.
- I have positive perception about using IPTV.

Intention to use/adopt

- I intend to use IPTV.
- I intend to use IPTV as much as possible.
- I recommend others to use IPTV.

Perceived cost level

- I think that using IPTV is expensive overall.
- I think that the price level of using IPTV is a burden to me.
- I think that the price level of using special service or information through IPTV is expensive to use.