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BROADBAND ADOPTION IN THE UK HOUSEHOLD: TOWARDS RELIABILTY AND CONSTRUCT VALIDITY OF A SURVEY INSTRUMENT

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Abstract

The aim of this paper is to develop a reliable and valid measurement of consumer adoption of broadband in the UK households. The paper validated the survey instrument in order to confirm the reliability of items and construct validity by employing a survey data randomly collected from 358 UK household consumers. Data analysis based on factor analysis and reliability test demonstrated that survey measures for all constructs were possess recommended level of construct validity and reliability. The final outcome of the instrument development process that culminated from the field test was a parsimonious, 39-item instrument, consisting of 10 scales, all with acceptable levels of reliability and construct validity. Therefore the most conspicuous contribution of this research paper is to provide a reliable instrument to measure the household consumer's perceptions of adopting broadband Internet. The developed instrument is relevant to both academic and practitioner communities who hold a particular interest in the study and management of broadband diffusion and adoption from the household consumer perspective.

Keywords: Broadband Adoption, Survey Instrument, Reliability, Construct Validity, Method Bias

1 INTRODUCTION

Since the emergence of the Internet, broadband is being considered as the most significant evolutionary step. It is considered to be a technology that will offer end users with fast and always-on access to new services, applications and content with real lifestyle and productivity benefits (Sawyer et al. 2003). International organisations such as the Organisation for Economic Co-operation and Development (OECD) foresighted broadband to be a vital means of enhancing competitiveness in an economy and also of sustaining economic growth (BSG 2004, OECD 2001, Oh et al. 2003). According to a report from the United Kingdom Broadband Stakeholder Group, broadband provides a number of ways of enhancing a national economy and quality of a citizen's life, as it stated that:

> "*…Full exploitation of broadband-enabled ICT, content, applications and services can help the UK to become a truly competitive knowledge-based economy and can be leveraged to help the UK's citizens become healthier, better educated and more engaged in their communities and society. ...Societies that adopt, adapt, and absorb the benefits of broadband enabled ICT, services and applications quickly and deeply will achieve significant benefits in terms of productivity, innovation, growth and quality of life as well as significant competitive advantage over societies that don't…*(BSG 2004)".

In order to appreciate the socio-economic benefits that broadband offers, governments of many countries including the United Kingdom (UK) have established ambitious targets for the deployment and diffusion of broadband services to the consumers and end users (National Broadband Task Force 2001, Office of Technology Policy 2002, Office of the e-Envoy 2001). Nationwide efforts from the UK government and competition amongst the Internet Service Providers (ISPs) have made broadband access widely available at affordable prices (Choudrie & Lee 2004). However consumers' demand for it has not yet increased as expected (OECD 2001, Crabtree 2003). This suggests that the current growth and diffusion of broadband are 'demand constrained' and not 'supply constrained' (Crabtree 2003). The issue of demand constraints provides researchers with a motivation to investigate the issues related with broadband adoption and diffusion. Studies on adoption and diffusion of broadband are just beginning to emerge (Anderson et al. 2002, Oh et al. 2003, Stanton 2004) and are exploratory in nature (Choudrie & Dwivedi 2005a, 2004b). Progress has been made in developing conceptual models to understand diffusion (Choudrie & Dwivedi 2004a) of broadband. However, in order to test the conceptual model of broadband adoption and diffusion a reliable survey instrument has yet to be developed and validated.

From the aforementioned analysis of broadband adoption studies, it appears that although researchers have begun to investigate broadband adoption from the consumer perspective, the conducted studies are still in exploratory in nature. Without employing the validity measures, including, content validity, reliability and construct validity to develop a reliable survey instruments, the findings and interpretations may or may not correspond to an actual situation (Straub et al. 2004). Therefore, validating the data collection instrument is a critical step before testing the conceptual model. Following aforementioned reasoning Choudrie and Dwivedi (2005b) have performed content validity and pre-test which validated the content of initial survey instrument and concluded that the 41 items scale were important for inclusion to examine broadband adoption. Since the number of experts who validated the content was few in numbers, the generalisability of finding of aforementioned study needed further investigation. It was recommended that conducting confirmatory study help to overcome this problem and will provide opportunity to do further analysis on findings such as examining the reliability and construct validity of newly developed scale (Choudrie & Dwivedi 2005b). *Therefore, building upon previous study, aim of this paper is to develop a reliable and valid measurement of consumer adoption of broadband in the UK households*. By achieving the proposed aim, the contribution of this research paper is to provide a reliable and valid measure to the academic and practitioner communities who hold a particular interest in the study and management of broadband adoption from the household consumer perspective. The survey instrument developed in this research paper is expected to provide assistance to practitioners from the telecommunications industry that is interested in determining how to improve its current strategies for increasing consumer base. This can also help policy makers in minimising the digital divide by understanding the reasons of non-adoption and accelerating the diffusion process.

Having introduced the topic of interest, this paper now proceeds to offer an introduction of broadband adoption constructs in Section 2. Section 3 presents a brief discussion of the research methodology followed to conduct this study. The findings are then presented in Section 4 and discussed in Section 5. Finally, Section 6 provides conclusions drawn from this research.

2 BROADBAND ADOPTION CONSTRUCTS

The constructs included in this study were adopted from the conceptual model of broadband adoption proposed by Dwivedi (2005). The model of broadband adoption is derived from the model of adoption of technology in households (Venkatesh & Browns 2001) and innovations characteristics (Rogers 1995). Although a detailed discussion on each construct is not possible within the scope of this paper, a brief description of overall conceptual model is provided here. The proposed conceptual model assumed that the dependent variable 'behavioural intentions' towards broadband adoption is influenced by several independent variables that include the attitudinal (relative advantage, utilitarian outcomes, service quality and hedonic outcomes), normative (primary influence and secondary influence) and control factors (knowledge, self-efficacy and facilitating conditions resources). Detailed discussion on each construct is not possible to provide within the scope of this paper. However, interested readers may refer Dwivedi (2005) for detail discussion and justification for including the aforementioned constructs.

3 RESEARCH METHODOLOGY

Survey instrument for broadband adoption study was developed in number of stages comprising exploratory survey, content validity, pre-test, pilot test and confirmatory survey (Moore & Benbasat 1991). This paper only discusses the methodology of pilot and confirmatory study and presents the findings from them. The research approach and findings from exploratory study, content validity and pre-test was not possible to describe within this paper. However, the full methodological details and findings of the aforementioned stages are available in Choudrie and Dwivedi (2004b, 2005b). Also, in order to provide complete picture of instrument development a recent study has combined aforementioned stages with confirmatory study (Dwivedi et al. 2006). Nationwide data on the adoption of broadband was randomly collected from the citizens of the UK. The UK-Info Disk V11 that contained 31 Million Electoral Register records, i.e. addresses of UK citizens was considered to be sample frame of this research. This is because it possesses the characteristics of a good sample frame such as comprehensiveness, accuracy, adequacy, and up-to-date and non-duplicated information (Fowler 2002, Rice 1997).

Prior to dissemination of the final questionnaire, a pilot study was conducted to determine the response rate and learn of any discrepancies within the questions, which included determining whether the format of the questionnaire and questions were suitable. Additionally, the duration that completion of the questionnaire would require was also established. The questions of pilot questionnaire were divided into four categories: (1) multiple type questions examining the demographics of the respondents (questions 1-6), Internet connection types, frequency and duration of Internet access on a daily basis (question 8-12); (2) Yes/No questions that determined the location of the Internet at home or elsewhere (question 7), accessibility to various (total of 41) online activities (question 16); (3) Likert scale questions to assess the perception of the adopters and non-adopters of broadband (Question 13) (See *Appendix* 1); and (4) to assess the impact of broadband upon individuals time allocation patterns, respondents were questioned about their use of the Internet. That is, whether usage of broadband had increased, decreased or had no impact, upon the amount of time spent on the 20 various daily life activities (Question 17). The pilot questionnaire was delivered via the postal service to a total of 200 randomly selected participants from UK-Info Disk V11 in December 2004. A total of 40 replies were obtained from the respondents within the specified duration. The majority of the respondents reported that the questionnaire was easily understandable and required 10 to 15 minutes for completion. Additionally, the majority of the respondents validated the content of the questionnaires, although minor changes to the final design of the questionnaire were undertaken based upon the received feedback, and a final questionnaire was developed. The purpose of the pilot test was also to confirm the reliability of the items. The findings obtained from the pilot test demonstrated an acceptable level of reliability for all the constructs.

Fowler (2002) has suggested that a prerequisite for determining a sample size should be an analysis plan. The analysis for this study required performing principal component analysis (PCA) and regression analysis. It has been suggested that in order to perform the aforementioned statistical analysis with rigour, the sample size should be above 300 (Stevens 1996). Therefore, keeping the statistical analysis plan in mind it was estimated that the total sample size of 1600 should be large enough to obtain a minimum of 300 responses. The final questionnaires were sent using the postal service. A covering letter and a self-addressed, prepaid return envelope were administered to a total of 1600 household consumers in the UK in the period between Jan and March 2005.

3.1 Response rate and nonresponse bias

Of the overall 1600 sent questionnaires, 358 usable replies were received within the specified periods, which was from Jan 2005 to March 2005. This implies that a response rate of 22.37 percent was obtained. To test whether the characteristics of the respondents from the original responses are similar to the non-respondents, a *t*-test was conducted for the demographics (i.e. age and gender), type of Internet connection at home, and a number of key constructs. The findings are illustrated in Table 1. The *t*-test on demographics and all key constructs showed no significant differences between the respondents and non-respondents (Table 1). Since, all variables produced non-significant results in terms of non-response bias; this suggests that it is less likely that the findings were affected due to non-response bias.

Variables	***t***	**df**	***p***
Age	.766	355	.444
Gender	.557	353	.578
Type of connection	-1.609	306	.109
BI	-.547	356	.585
RA	.377	356	.707
UO	-.996	356	.320
HO	.845	356	.398
SE	.072	356	.942
FCR	-1.079	356	.281

Table 1. t -test to examine non-response bias

3.2 Data analysis

Straub et al. (2004) recommended that a new survey instrument should be validated employing statistical techniques such as a reliability test in order to confirm the internal consistency of measures and factor analysis in order to confirm the construct validity, including both convergent and discriminant validity (Straub et al 2004). According to the recommended guidelines, a survey instrument possesses a high internal consistency (i.e. it is reliable) if the estimated Cronbach's alpha is above 0.70. Construct validity (both discriminant and convergent) exists if the latent root criterion (i.e.

eigenvalue) is equal to or above 1, with a loading of at least 0.40; and no cross loading of items above 0.40. (Straub et al 2004). Following the above guidelines, the aforementioned statistical techniques were employed to validate the survey instrument of this research.

4 FINDINGS

Of the 358 respondents, 308 (86%) had Internet access at home and 50 (14%) did not. Of the 308 (86%) respondents who possessed Internet access at home, 101 (32.8%) had a narrowband connection and the remaining 207 (67.2%) respondents had a broadband connection. The following section illustrates reliability, Section 4.2 shows the construct validity and Section 4.3 presents the computed values that demonstrate the absence of a method bias.

4.1 Reliability test

Table 2 illustrates the Cronbach's coefficient alpha values that were estimated to examine the internal consistency of the measure. Cronbach's α varied between 0.91 for the utilitarian construct and 0.79 for both hedonic outcomes and service quality constructs. Both secondary influence and self-efficacy possessed a reliability value of 0.90. Cronbach's α for the remaining five constructs varied between 0.80 and 0.90. Two constructs, namely facilitating conditions resources and knowledge, had Cronbach's α at 0.81 and for relative advantage and primary influence there were values of alpha at 0.84. The dependent construct behavioural intention possessed an alpha of 0.87. Hinton et al. (2004) have suggested four cut-off points for reliability, which includes excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70) and low reliability (0.50 and below) (Hinton et al 2004). The aforementioned values suggest that of the ten constructs, three possess excellent reliability and the remaining seven illustrate high reliability. None of the constructs demonstrated a moderate or low reliability (Table 2). The high Cronbach's α values for all constructs imply that they are internally consistent. That means all items of each constructs are measuring the same content universe (i.e. construct). For example, both the items of BI are measuring the same content universe of behavioural intention. Similarly, all ten items of UO are measuring the content universe of utilitarian outcomes construct. In brief, the higher the Cronbach's α value of a construct, the higher the reliability is of measuring the same construct.

Constructs	***N***	**Number of Items**	**Cronbach's Alpha (α)**	**Type**
Behavioural Intentions (BI)	358	2	.8790	High Reliability
Relative Advantage (RA)	358	4	.8481	High Reliability
Utilitarian Outcomes (UO)	358	10	.9131	**Excellent Reliability**
Hedonic Outcomes (HO)	358	4	.7968	High Reliability
Service Quality (SQ)	308	4	.7912	High Reliability
Primary Influence (PI)	358	3	.8420	High Reliability
Secondary Influence (SI)	358	2	.9034	**Excellent Reliability**
Facilitating Conditions Resources (FCR)	358	4	.8114	High Reliability
Knowledge (K)	358	3	.8193	High Reliability
Self-efficacy (SE)	358	3	.9026	**Excellent Reliability**

Table 2. Reliability of measurements

4.2 Factor analysis

In order to verify the construct validity (convergent and discriminant validity), a factor analysis was conducted utilising Principal Component Analysis (PCA) with Varimax rotation method. The results of the PCA are presented in Tables 3 and 4. Before conducting a factor analysis, it is essential to perform a test for sampling adequacy and sphericity. These two tests confirm whether it is worth proceeding with factor analysis (Hinton et al. 2004).

4.2.1 Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) test and Bartlett's test of sphericity

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was first computed to determine the suitability of employing factor analysis. The KMO is estimated using correlations and partial correlations in order to test whether the variables in a given sample are adequate to correlate. A general 'rule of thumb' is that as a measure of factorability, a KMO value of 0.5 is poor, 0.6 is acceptable and a value closer to 1 is better (Hinton et al 2004). The results suggest that the KMO is well above the recommended acceptable level of 0.6 as the obtained value is 0.85. The aforementioned results confirm that the KMO test supports the sampling adequacy and it is worth conducting a factor analysis. This means that higher KMO values indicate the possibility of factor existence in data as it was assumed in the conceptual model. Bartlett's test of sphericity is conducted for the purpose of confirming the relationship between the variables. If there is no relationship then it is irrelevant to undertake factor analysis. As a general rule, a p value <0.05 indicates that it is appropriate to continue with the factor analysis (Hinton et al 2004). The results suggest that the calculated p value is < 0.001, which means that there are relationships between the constructs in question. Therefore, it was considered appropriate to continue with the factor analysis.

4.2.2 Eigenvalues

As mentioned above, factor analysis was conducted utilising Principal Component Analysis as an extraction method and Varimax with Kaiser normalisation as a rotation method. Table 3 summarises the eigenvalues and explained total variance for the extracted components. According to a general rule of thumb, only those factors with eigenvalues greater than 1 should be considered important for analysis purposes (Hinton et al 2004, Straub et al 2004). The results presented in Table 3 suggest that all nine constructs included in the factor analysis possess eigenvalues greater than 1. Results from the analysis also suggest that no extracted new factor consisted of an eigenvalues greater than 1.

C	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	**% of V**	**Cumulative %**	**Total**	**% of V**	**Cumulative %**	**Total**	**% of V**	**Cumulative %**
1	9.766	26.395	26.395	9.766	26.395	26.395	5.358	14.482	14.482
2	3.324	8.984	35.379	3.324	8.984	35.379	2.677	7.236	21.718
3	2.551	6.894	42.273	2.551	6.894	42.273	2.675	7.229	28.947
4	2.189	5.916	48.189	2.189	5.916	48.189	2.616	7.071	36.018
5	1.632	4.411	52.600	1.632	4.411	52.600	2.568	6.940	42.958
6	1.536	4.151	56.751	1.536	4.151	56.751	2.540	6.865	49.823
7	1.458	3.941	60.692	1.458	3.941	60.692	2.354	6.361	56.184
8	1.290	3.487	64.179	1.290	3.487	64.179	2.188	5.915	62.098
9	1.115	3.014	67.193	1.115	3.014	67.193	1.885	5.095	67.193
Extraction Method: Principal Component Analysis; **Legend:** C = Components; % of V= Percentage of Variance									

Table 3. Eigenvalues and Total Variance Explained

4.2.3 Factor loadings

The rotated component matrix presented in Table 4 shows the factor loadings for all nine constructs. The statistics presented in Table 4 clearly suggest that the nine components loaded. All the items loaded above 0.40, which is the minimum recommended value in IS research (Straub et al 2004). Also, cross loading of the items was not found above 0.40. All ten items of the utilitarian outcomes construct loaded on component 1. Therefore, the first component represents the underlying constructs of utilitarian outcomes. For this construct, coefficients varied between 0.51 and 0.78. All four items of the facilitating conditions resources construct loaded on component 2. Therefore, the second component represents the underlying constructs of facilitating conditions resources. The coefficient for this extracted component varies between 0.64 and 0.78. All four items of the service quality construct loaded on component 3. Therefore, the third component represents the underlying constructs of service quality. Coefficients for this component varied between 0.65 and 0.85. All four of the relative advantage related items loaded on the fourth component and loadings for this component varied between 0.58 and 0.72. Hence, this confirms that the fourth component represents the underlying constructs of relative advantage (Table 4). All three items of the control construct self-efficacy loaded on component 5 with loadings that vary between 0.77 and 0.84. Hence, the fifth component represents the underlying constructs of self-efficacy. All four items related to the hedonic outcomes were loaded on component 6. The coefficients values for this component range between 0.60 and 0.85, and so the sixth component represents the underlying constructs of hedonic outcomes. All three items related to the primary influence construct loaded on the seventh component. The coefficients value was obtained from 0.65 and 0.89. This means that the seventh component represents the primary influence construct (Table 4). The three items related to the control construct knowledge were loaded on the eighth component and the loadings range between 0.61 and 0.75. This means that the eighth component represents the underlying constructs of hedonic outcomes (Table 4). Finally, all items related with the secondary influence construct loaded on the ninth component. This construct comprised only two items and the coefficients of these two items were 0.91 and 0.90. Therefore, the ninth component represents the secondary influence construct. There were no cross loading above 0.40 for any of the nine aforementioned components (Table 4).

The factor analysis results satisfied the criteria of construct validity including both the discriminant validity (loading of at least 0.40, no cross-loading of items above 0.40) and convergent validity (eigenvalues of 1, loading of at least 0.40, items that load on posited constructs) (Straub et al 2004). This confirms the existence of the construct validity (both discriminant validity and convergent validity) in the instrument measures of this research that were utilised for data collection (Table 4). This means that the collected data and findings that were obtained from this instrument are reliable. Stevens (1996) provided the following three recommendations regarding the reliable factors. First, the components with four or more loadings above 0.60 in absolute value are reliable, regardless of the sample size. Second, components with about ten or more with 0.40 loadings are reliable as long as the sample size is greater than about 150. Third, components with only a few loadings should not be interpreted unless the sample size is at least 300 (Stevens 1996). The results that are illustrated in Table 4 and presented above satisfied all the three criteria recommended by Stevens (1996). Therefore, it confirms that the extracted components are reliable and that the construct validity exists (Table 4).

4.2.4 Total variance explained

Table 3 summarises the explained total variance for the extracted components that shown in Table 4. As mentioned in Section 4.2.2, all constructs had eigenvalues greater than 1 and in combination accounted for a total of 67.13% variance in data. Variance contributed by each construct varies before and after rotation. Values presented hereafter represent before-rotation variance and after-rotation values and are illustrated in Table 3. Within this category, the maximum variance of 26.39% was explained by the utilitarian outcomes construct. Amongst the attitudinal constructs, service quality had the second largest variance in data (6.89%). The relative advantage construct followed this with a variance of 5.91%. The hedonic outcomes contribute to a variance of 4.15% (Table 3). The minimum variation of 3.01% was accounted for by the normative construct 'secondary influence' . The other normative construct (primary influence) accounted for only a 3.94% variance in data (Table 3). The first control construct, self-efficacy, accounted for a total variance of 4.44%. The second control construct, knowledge, accounted for a total of 3.48% variance. The third control construct, facilitating conditions resources, accounted for 8.98% variance in the data (Table 3). Findings from both the reliability test and factor analysis, which respectively confirms internal consistency of measures and construct validities (i.e. convergent and discriminant validity), suggest that it is appropriate to create aggregated measures by averaging the means of all items of each construct.

Items	Component								
	1(UO)	2 (FCR)	3 (SQ)	4 (RA)	5 (SE)	6 (HO)	7 (PI)	8 (K)	9 (SI)
UO1	**.788**	.094	.102	.041	.070	.025	.087	-.021	-.069
UO6	**.783**	.116	.060	.095	.086	.057	-.016	.136	-.051
UO8	**.758**	.106	.054	.053	.035	.062	.121	-.038	.093
UO5	**.740**	.079	.025	.041	.070	.146	-.034	.077	.118
UO4	**.682**	.121	.094	.194	.027	.084	.041	.153	.014
UO2	**.679**	.041	.028	.107	.019	-.071	.079	.174	.168
UO3	**.663**	.124	.035	.188	.261	.096	.132	.028	-.063
UO10	**.564**	.240	.179	.347	.143	.100	.227	.184	-.006
UO7	**.520**	-.002	-.078	.368	.169	-.038	.134	.109	.021
UO9	**.519**	.309	.139	.246	.058	.021	.227	.227	.096
FCR3	.171	**.780**	.190	.079	.130	.103	.024	.022	.020
FCR1	.133	**.768**	.133	.073	.228	-.037	.084	.201	.020
FCR4	.107	**.687**	.029	.056	.238	-.026	.067	.212	.102
FCR2	.234	**.649**	.016	.206	-.089	.058	.042	-.016	-.070
SQ4	.087	.068	**.858**	.053	.134	.017	.041	.014	-.048
SQ1	.057	.132	**.794**	.063	-.083	.024	.011	.024	.007
SQ3	.041	.017	**.769**	.013	.225	.068	.183	.094	.032
SQ2	.111	.081	**.650**	-.047	-.027	.089	.097	.038	.102
RA4	.137	.153	.038	**.728**	.125	.022	.001	-.073	.105
RA2	.197	.124	.053	**.706**	.129	.118	.017	.308	.022
RA1	.222	.026	-.039	**.683**	.165	-.054	.048	.256	.017
RA3	.373	.175	.054	**.589**	.112	.022	-.013	.196	-.080
S2	.120	.115	.095	.117	**.844**	.055	-.035	.178	.003
S3	.230	.188	.088	.179	**.795**	.013	.016	.262	.032
S1	.172	.183	.045	.241	**.771**	-.005	.095	.139	-.023
HO2	.048	.010	.024	.135	.099	**.853**	.111	-.063	-.011
HO3	.081	.030	.109	-.151	-.049	**.793**	.133	.099	.135
HO1	.226	.090	.038	.116	.148	**.767**	.187	-.057	.047
HO4	-.028	-.013	.060	-.015	-.138	**.600**	-.055	.208	.268
PI1	.092	-.010	.093	.036	.005	.132	**.897**	.063	.108
PI2	.123	.067	.065	-.017	.058	.163	**.864**	.015	.117
PI3	.298	.216	.271	.077	-.008	.064	**.654**	.033	.036
K3	.215	.123	.115	.255	.192	.054	.011	**.758**	-.021
K2	.182	.064	.067	.163	.311	.020	-.025	**.754**	-.010
K1	.173	.314	.015	.147	.130	.108	.177	**.615**	.033
SI1	.065	.034	.034	.112	.011	.143	.160	-.049	**.910**
SI2	.108	.026	.061	-.021	.005	.193	.091	.039	**.903**
Extraction Method: Principal Component Analysis. **Rotation Method**: Varimax with Kaiser Normalisation.									

Table 4. Rotated component matrix

4.3 Test for ordering of questionnaire items

Straub et al. (2004) argued that as a result of the lack of randomisation of items for a particular construct, respondents may sense the inherent constructs via the ordering of questionnaire items and therefore their response may introduce a bias, which is termed as a methods bias. This type of bias is considered to be threat to construct validity (Straub et al. 2004). To examine if any method bias exists within this study, a *t*-test was conducted for two samples, one with randomisation of questionnaire items and one without it. The findings showed no significant difference between the obtained responses from the randomised and non-randomised questionnaire. Therefore, it is unlikely that a method bias exists in the collected data, or more specifically, that the questionnaire items ordering in this particular instance contributed to the pattern of responses; instead the findings presented the 'true scores'. In brief, there is no threat to the construct validity due to a method bias in the data.

4.4 Test for predictive ability

A regression analysis was performed with behavioural intention as the dependent variable and relative advantage, utilitarian outcomes, hedonic outcomes, primary influence, facilitating conditions resources, knowledge and self-efficacy as the predictor variables. A total of 358 cases were analysed. From the analysis, a significant model emerged (F (6, 358) = 46.749, $p < .001$). The adjusted R square was 0.435. Except knowledge, all other six predictor variables included in the study were found to be significant. These include FCR (□ = .169, $p < .001$), HO (□ = .100, $p = .018$), PI (□ = .195, $p < .001$), SE (□ = .165, $p < .001$), RA (□ = .255, $p < .001$) and UO (□ = .113, $p = .035$).

5 DISCUSSIONS

To establish and demonstrate rigour in the findings of positivist research, validity should be undertaken both prior to and after final data collection (Straub et al 2004). The validation process suggested for application to the cases is one where research either utilises previously validated instruments or creates new instruments (Straub et al 2004). Although application of validation is recommended in both the aforementioned situations, it is essential in the latter case where a study employs newly created instruments for data collection (Straub et al 2004). Since this study created a new research instrument for examining broadband adoption, the utmost care was taken to validate a newly created instrument. This section provides an overall picture of the validation process and also briefly discusses if the undertaken validity measures and their outcomes are on a par with the recommendations made in IS research. The recommended validities include content validity, construct validity, reliability, manipulation validity and the common method bias (Straub et al 2004). Amongst the aforementioned validities, this research examined all the suggestions except for manipulation validity. Manipulation validity that forms an essential component of experimental research was not employed in this research, as it was suggested to be inappropriate in the context of survey research (Straub et al 2004). The stages involved in the validation process comprised an exploratory survey, content validation, pre and pilot tests and finally the confirmatory study. Validities that are exercised in this research included reliability and construct validity.

Construct validity was performed utilising PCA. Oh et al.'s (2003) study also employed the PCA to confirm construct validity in a previous broadband adoption study. The standard recommendation (Straub et al 2004) suggested that items should not be cross loaded over 0.40, but Oh et al.'s (2003) study suppressed the value below 0.50. Therefore, in this study it was not possible to consider whether any items cross loaded on any other constructs, and so it created a sense of doubt as to whether the construct validity existed in Oh et al.'s (2003) study. This study did not suppress values and findings demonstrate that this study meets the standard criteria (Straub et al 2004) of all types of validities, namely convergent validity, discriminant validity and method bias. This implies that the validated instrument provides an effective measure of the theoretical constructs included in the conceptual model. Regression analysis findings suggest that majority of predictor variables included in this study were reasonably explained depended variable ‘behavioural intention’ which suggest that included constructs illustrate appropriate level of predictive ability. Finally, the internal consistency of measures was assessed utilising a reliability test (i.e. Cronbach's α). Straub et al (2004) suggested that, for a confirmatory study, reliability should be equal to or above 0.70. The reliability values reported in Oh et al.’s (2003) study varies between 0.70 and 0.89 for various constructs. Reliability or the Cronbach's α value of various constructs in this research varies between 0.79 and 0.91, which means that all the constructs possessed reliability values above the minimum recommended level. This suggests that measures of this study demonstrate an appropriate level of internal consistency.

6 CONCLUSIONS

This paper described the development and validation process for an instrument that aims to measure the broadband adoption in the household context. There are several contributions that this research offers, the most important one being the creation of an overall instrument to measure the household consumer’s perceptions when adopting broadband. The development process was achieved in two main stages that included the pilot and confirmatory survey. The processes and contributions of each stage are summarised below. The purpose of the pilot test was to obtain feedback on instrument from the respondents, to improve the wording of items and also to examine if the newly developed scale demonstrates an acceptable level of reliability. Utilising the pilot responses it was found that all the scales, demonstrated an acceptable level of reliability. The outcome of the pilot provided an instrument that was subjected to a confirmatory survey. The purpose of the confirmatory survey was to confirm the reliability of items and to perform the construct validity. The findings obtained from the confirmatory survey demonstrated an acceptable level of reliability for all the constructs. This confirmatory survey also demonstrated the construct validity of the broadband adoption measurement. The final output of the three-stage instrument development process that culminated from the confirmatory study is a parsimonious, 39-item instrument, consisting of 10 scales, all with a high level of reliability. The final instrument can be utilised to investigate the adoption of broadband from the household consumer perspective. Since this is a current concern of ISPs this research paper also contributes to practice by assisting the professionals from the telecommunications industry. This can also provide assistance to policy makers by minimising the digital divide. By understanding the reasons for non-adoption and accelerating the diffusion process will achieve this. The final survey instrument will also help researchers interested in examining the diffusion of new electronic services such as e-government and other emerging communication technologies such as mobile Internet and wireless within household context.

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Appendix 1: List of constructs and items to examine broadband adoption

Variables / Items	Description
BEHAVIOURAL INTENTION (BI) TO ADOPT BROADBAND	
BI1	I intend to subscribe to (or continue my current subscription) broadband in the future
BI2	I intend to use (or intend to continue use) broadband Internet service in the future
RELATIVE ADVANTAGE (RA)	
RA1	Broadband has an advantage over dial-up because it offers faster access to Internet
RA2	Broadband has an advantage over dial-up because it provides faster download of files from Internet
RA3	Broadband has an advantage over dial-up because it offers an always-on access to Internet
RA4	Broadband has an advantage over dial-up because it frees up the phone line whilst connected to the Internet
UTILITARIAN OUTCOMES (UO)	
UO1	Broadband can be useful to find educational materials and accessing library resources at home
UO2	Broadband can be useful for distance learning
UO3	Broadband can be helpful to perform work/job-related tasks at home
UO4	Broadband will help me communicate better via email, chat, Web cam
UO5	Broadband can help in performing personal and household activities i.e. *online shopping*
UO6	Broadband can help in performing personal and household activities i.e. *information search*
UO7	Broadband can be helpful to establish and operate a home business
UO8	Broadband can help children to do their homework
UO9	Subscribing to broadband is compatible with most aspects of my everyday life
UO10	Overall broadband will be useful to me and other members in the family
HEDONIC OUTCOMES (HO)	
HO1	I will enjoy using broadband to listen to and download music
HO2	I will enjoy using broadband to watch to and download movies
HO3	I will enjoy using broadband to play online games
HO4	I will enjoy using broadband to play online gambling/casino
SERVICE QUALITY (SQ)	
SQ1	I am satisfied with the speed of Internet access obtained from my current service providers
SQ2	I am satisfied with the security measures provided with Internet access obtained from my current service providers
SQ3	I obtained satisfactory customer/technical support from my current service providers
SQ4	The overall service quality of my current Internet connection is satisfactory
PRIMARY INFLUENCE (PI)	
PI1	My friends think that I should subscribe to (or continue the current subscription) broadband at home
PI2	My colleagues think that I should subscribe to (or continue the current subscription) broadband
PI3	My family members think that I should subscribe to (or continue the current subscription) to broadband
SECONDARY INFLUENCE (SI)	
SI1	TV and radio advertising encourages me to try broadband
SI2	Newspaper advertising encourages me to try broadband
FACILITATING CONDITIONS RESOURCES (FCR)	
FCR1	My annual household income level is enough to afford subscribing to broadband
FCR2	It is not too costly to purchase a new computer or to upgrade my old computer
FCR3	It is not too costly for me to subscribe to broadband at its current subscription fee
FCR4	I would be able to subscribe to broadband if I wanted to
KNOWLEDGE (K)	
K1	I do not have difficulty in explaining why adopting broadband may be beneficial
K2	I know how broadband is different from dial-up/narrowband Internet
K3	I know the benefits that broadband offer and cannot be obtained by dial-up/narrowband

SELF-EFFICACY (SE)	
SE1	I would feel comfortable using the Internet on my own
SE2	Learning to operate the Internet is easy for me
SE3	I clearly understand how to use the Internet