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Integrating ISSM into TAM to enhance digital library services

A case study of the Taiwan Digital Meta-Library

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Abstract

Purpose – This study aims to propose a new model by incorporating information system success model (ISSM) into technology acceptance model (TAM) with an "attitude toward using" as the connection variable. The new model is then adopted to analyse and investigate empirical data and develop relevant factors, which affect the personal usage behaviour and net benefits for National Central Library in Taiwan to enhance digital library services. The research results can benefit future establishment and design of library information system or improvement of website service procedures.

Design/methodology/approach – This study selected National Central Library Taiwan Digital Meta-Library as the research theme, and used stratified convenience sampling to perform interviews in various colleges and universities in the southern Taiwan. A total of 264 valid questionnaires were returned, and this study used structural equation modelling (SEM) to perform analyses.

Findings – The results reveal that attitude toward using is significantly and positively affected by perceived usefulness, perceived ease of use and user satisfaction. However, service quality of information system and personal net benefits do not have a significant and positive effect on attitude toward using, while they have an indirect and significant effect on attitude toward using through user satisfaction. Based on the results above, "user satisfaction" is the critical factor affecting the attitude toward using. Therefore, to strengthen users' positive attitude toward using, the factor of user satisfaction is a key for enhancing digital library service.

Originality/value – This study constructed the "New Technology Information Assessment Model" as the reference for improving practical assessment. Moreover, this study also proposed the suggestions concerning digital library information services.

Keywords Technology acceptance model, Library information system, Information system success model

Paper type Research paper

Introduction

The rapid rise of Internet and digital technology has led to the development of electronic publications, which significantly affects the positioning and development of libraries. Traditional print holdings have been gradually replaced by the rapidly growing electronic publishing products. In response to the changes, the original printed publications have been scanned and digitized to facilitate their circulation. From the users' perspective, the definition provided by Trolley (1995), "Access to all information,

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anytime, anywhere", becomes what they are expecting. It is apparent that digital libraries should be accessible at any time and from any place. Providing digital libraries was one of the important programs promoted by the USA in 1992. Creation of digital libraries included high-speed and accurate data conversion technology and electronic data standards when various printed data were converted and stored in electronic formats. In addition, database management software was constructed to effectively provide accurate information inquiry and summarize tremendous amounts of data. Moreover, the development of library information services has been focused on developing visual technology, enhancing the speed for browsing a large number of image data and simplifying the use of network database.

In more recent years, owing to the inconvenient use of individual e-resources, digital library services started to introduce electronic information integration systems to enable users to access information more conveniently. Along the way, however, digital librarians faced new challenges in making digital libraries truly useful and fully accessible. Sreenivasulu (2000) noted that the digital librarian, in a sense, acts as a guardian of the information superhighway or the universal or global digital library and acts as a symbiotic human-machine guru. Thus, professional education and training specific to digital librarians in the management of digital information systems should be envisaged. He also discussed various digital librarian's roles, skills and competencies for the management of digital information systems in some important areas, such as imaging technologies, metadata creation and Web technology.

Electronic resource integration systems help users to access information from various databases through a single retrieval interface (Needleman, 2006). User satisfaction with library information systems and user benefits have always been important issues attracting attention away from more practical services. The development and application of digital content have also attracted much attention from the information industry. Both information providers and information service units have worked with these issues due to the fact that library information integration systems are an important intermediary tool in digital libraries (Tseng and Li, 2008). Seema (2013) claimed that the successful deployment of a digital library implementation may depend on a specific set of success factors. The identification of these factors has important implications on digital library development. It may help digital library start-ups to understand what sources and services they need to develop to make their applications succeed in an already very populated network. Both researchers and experts in the field of digital libraries may value the innovation and results of this study. Fatemeh *et al.* (2013) built the research framework to find critical success factors (CSFs) for digital libraries initiatives by collecting possible factors from literature on CSFs of information systems. The authors revealed six dimensions of CSFs and 36 potential success factor statements contributed by the study participants. The paper postulated that successful deployment of a digital library implementation was based on these CSFs and that these factors had important implications on digital library development. In Taiwan, the number of users using the National Central Library increased from two users per second in 2005 to 3.9 users per second in 2006 and 12 users per second by March 2014. This study used "attitude toward using" as the connection variable and integrated the information systems success model (ISSM) into the technology acceptance model (TAM) to propose a new model, the technology information system success model (TISSM). Moreover, the new model was utilized to analyse and

investigate empirical data. The relevant factors affecting personal usage behaviour and the identification of personal net benefits were developed for enhancing digital library services of National Central Library. The results can benefit the future establishment and design of other digital library information systems or the improvement of website service procedures.

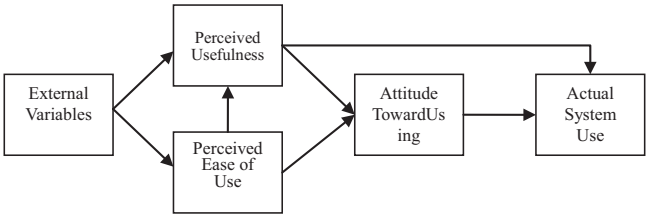
Theoretical background

Technology acceptance model (TAM)

Davis proposed TAM in 1986 mainly based on the theory of reasoned action (TRA) proposed by Fishbein and Ajzen (1975) in social psychology. The primary objective of the TAM model is to provide a basis to trace the effects of external variables on internal beliefs, attitudes and intentions, as well as to investigate and evaluate the relationship among actual behaviour, behavioural intentions, attitudes, subjective norms and beliefs.

Based on the TRA, Davis (1986) simplified the beliefs affecting attitude as "perceived usefulness" and "perceived ease of use", and excluded subjective norms to develop TAM. Davis' TAM indicated that external variables will affect both perceived ease of use and perceived usefulness and further affect attitude and behavioural intention. Adams *et al.* (1992) pointed out that researchers can use the TAM to understand factors affecting information system success. Davis (1993) re-proposed the TAM model in the empirical study on the use and acceptance of information systems, as shown in Figure 1. The results showed that, in addition to indirectly affecting actual usage behaviour through attitude toward using, perceived usefulness also directly, significantly and positively affects actual usage behaviour.

The TAM is widely applied to empirical studies on the use of various information technologies. In addition to applying the TAM to different models for verifying information systems, the follow-up studies also included external variables and certain dimensions in an attempt to better explain usage behaviours. For example, the results of the study by Igbaria *et al.* (1996) showed that individual computer use and training have a positive effect on perceived usefulness and perceived ease of use. Agarwal and Prasad (1999) investigated the effect of individual differences, such as level of education and participation in educational training on two beliefs: perceived usefulness and perceived ease of use. Venkatesh and Morris (2000) used TAM to investigate the effect of gender on the intention to use new technology. Hong *et al.* (2002) applied the TAM to the use of digital libraries. Van der Heijden (2003) used the TAM as the basic framework to investigate the factors affecting the use of portal websites. Hanho (2011) investigated students' understanding of e-library usage and e-library acceptance behaviours by using TAM for explaining the intentions of users to continue using the e-library. In fact,



Source: Davis (1986, 1993)

Figure 1.
Technology acceptance model

the adoption behaviour of students was affected by the perception on the system and ensured their willingness to continue to use the system. Fatemeh and Tahereh (2011) identified that the construction of the TAM, including its perceived usefulness, perceived ease of use, attitude toward using and the intention to use information technology (IT), were the independent variables that affected the dependent variable of IT. Their findings indicated that all independent variables in the TAM affected the acceptance of IT. Wallace and Sheetz (2014) indicated that both perceived usefulness and perceived ease of use had directly positive effects on measured usage. Perceived ease of use also had a direct positive effect on perceived usefulness.

Information system success model (IS success model)

In the 1980s to 1990s, there were numerous studies investigating the factors that affect the success of information systems. DeLone and McLean (1992) reviewed relevant studies and proposed six major dimensions for information system success, including system quality, information quality, use of the system, personal influence and organizational influence. These six major dimensions represented the process of an information system's success. Firstly, an information system possesses many features, namely, system quality and information quality. Then, after users use the system, they may be satisfied or dissatisfied with the information the system itself provides or output from it. These individual influences together will affect organizations. Moreover, there is a cause-and-effect relationship among these six major dimensions and they will affect one another. For example, good information or system quality will lead to higher satisfaction and a higher usage rate by users, and thus improve the productivity or operating performance of the entire organization.

However, Seddon (1997) suggested that the model proposed by DeLone and McLean includes certain processes and cause-and-effect relationships, which can lead to the confusion of meanings. Therefore, he amended the model and divided it into two models, "Information System Success Model" and "Partial Behavioral Model of IS use". In other words, he separated the net benefits perceived by the use of an information system from the expected benefits from the future use of the system. Compared with the perceived usefulness proposed by Davis (1989) in the Technology Acceptance Model (TAM), Seddon's perceived usefulness is an ex-post concept, which is based on the experiences and perceptions after use. However, the perceived usefulness in the technology acceptance model is the prediction of the perception of improvement in performance or productivity after the use of specific information technology. Hubona and Geitz (1997) reported that the main factor affecting beliefs is attitude which will further affect usage behaviour. Rai *et al.* (2002) performed empirical studies using the model proposed by DeLone and McLean and the amended model proposed by Seddon and compared them. They found that these two models both include five major dimensions: ease of use (which replaces system quality), information quality, perceived usefulness, satisfaction and use. The results showed that the goodness of fit of these two models is acceptable.

To respond to the applicability of the model in the era of e-commerce, as well as to respond to the investigation and criticism from previous relevant studies about the original model, DeLone and McLean (2003) proposed the updated model as shown in Figure 2. The updated model divided information system success into six major dimensions: system quality, information quality, service quality, user satisfaction, use (or intention to use) and net benefits. The results from Pitt *et al.* (1995) are adopted in the

new model to include the new dimension of "service quality". Moreover, DeLone and McLean (2003) suggested that this updated model is applicable to the assessment of the e-commerce success model and that its service quality mainly includes three dimensions: responsiveness, assurance and empathy.

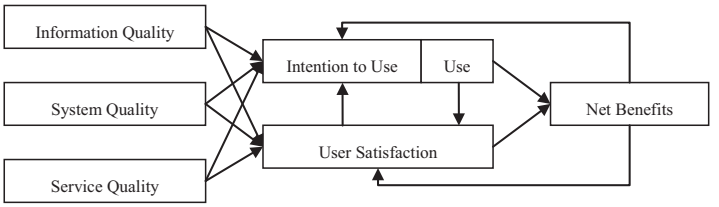
Lederer *et al.* (2000) indicated that information quality and system performance have a positive effect on users' perceived ease of use of websites. Based on the study by DeLone and McLean (2003), this study used three dimensions: responsiveness, assurance and empathy to assess service quality. Moreover, because it is difficult to use "use" to effectively assess service quality, this study replaced it by "intention to use" as an alternative dimension under certain conditions. Wixom and Todd (2005) suggested that there are two major issues in investigating information system success: user satisfaction and technology acceptance. Chen (2005a, 2005b) found that quality has a positive effect on perceived ease of use. Ahn *et al.* (2007) noted that information quality, system quality and service quality all have a significant effect on perceived ease of use and perceived usefulness. In the end, the two dimensions, individual influence and organizational influence, were also simplified, and a single dimension, "net benefits", was used to replace the influences or benefits of the use of information systems. By aggregating the results of 52 empirical studies that examined relationships within the IS success model at the individual level of analysis, the study found that service quality and user satisfaction was not significant and service quality and use also was not significant (Petter and McLean, 2009). The scholars of the follow-up empirical studies verified that the explanatory power and goodness of fit of the updated model proposed by DeLone and McLean (2003) were very high. As a result, this updated model is generally viewed as a model offering suitable construct indicators and cause-and-effect relationships for verifying whether a general information system is successful.

Research model and hypotheses

Research structure and hypotheses

Based on the aforementioned discussions, this study developed a research framework based on the amended Information System Success Model proposed by DeLone and McLean (2003) and adopted information quality, system quality, and service quality as external variables.

This current study developed a research framework based on the amended ISSM proposed by DeLone and McLean (2003). In the model, information quality, system quality, service quality, intention to use, user satisfaction, use and net benefits were included, and the model also adopted information quality, system quality and service quality as external variables. The external variables have a significant and positive



Source: DeLone and McLean (2003)

Figure 2.
Updated information system success model

effect on attitude toward using and user satisfaction. User satisfaction has a significant and positive effect on attitude toward using. Attitude toward using has a significant and positive effect on usage behaviour. Usage behaviour has a significant and positive effect on personal net benefits and user satisfaction. User satisfaction has a significant and positive effect on personal net benefits. Personal net benefits have a significant and positive effect on attitude toward using.

In addition, by referring to the amended TAM proposed by Davis (1993), four dimensions – perceived ease of use, perceived usefulness, attitude toward using and actual system use – are integrated into the proposed model. By the integration, the authors assumed that "usage behaviour" is affected by perceived usefulness. By the TAM, the fact that perceived ease of use has a significant and positive effect on perceived usefulness and attitude toward using was found so that perceived usefulness has a significant and positive effect on attitude toward using and actual system use. Moreover, this study also suggested that attitude is the antecedent affecting usage behaviour, and the intention to use still belongs to the construct of attitude and psychological dimension, rather than actual usage behaviour. Therefore, this study used "attitude toward using" as the variable and replaced "intention to use" to re-integrate the amended IS Success Model with the TAM. Moreover, this study proposed the following 14 research hypotheses:

H1. Service quality of an information system has a significant and positive effect on perceived ease of use.

H2. Perceived ease of use has a significant and positive effect on perceived usefulness.

H3. Perceived ease of use has a significant and positive effect on attitude toward using.

H4. Perceived usefulness has a significant and positive effect on attitude toward using.

H5. Perceived usefulness has a significant and positive effect on usage behaviour.

H6. Service quality of an information system has a significant and positive effect on attitude toward using.

H7. Service quality of an information system has a significant and positive effect on user satisfaction.

H8. User satisfaction has a significant and positive effect on attitude toward using.

H9. Attitude toward using has a significant and positive effect on usage behaviour.

H10. Usage behaviour has a significant and positive effect on personal net benefits.

H11. Usage behaviour has a significant and positive effect on user satisfaction.

H12. User satisfaction has a significant and positive effect on personal net benefits.

H13. Personal net benefits have a significant and positive effect on attitude toward using.

H14. Personal net benefits have a significant and positive effect on user satisfaction.

This study used structural equation modelling (SEM) to perform tests and used AMOS 18 as the analysis tool.

Definitions and assessment of research dimensions

This study developed a research framework based on the amended information system success model proposed by DeLone and McLean (2003). Characteristics include information quality, system quality, service quality, intention to use, user satisfaction, use and net benefits and adopted information quality, system quality and service quality as external variables. External variables have a significant and positive effect on attitude toward using and user satisfaction. User satisfaction has a significant and positive effect on attitude toward using. Attitude toward using has a significant and positive effect on usage behaviour. Usage behaviour has a significant and positive effect on personal net benefits. Usage behaviour has a significant and positive effect on user satisfaction. User satisfaction has a significant and positive effect on personal net benefits. Personal net benefits have a significant and positive effect on attitude toward using.

In addition, referring to the amended TAM proposed by Davis (1993), this study included four dimensions. These are perceived ease of use, perceived usefulness, attitude toward using and actual system use and an assumption that "usage behaviour" is affected by perceived usefulness. The TAM found that perceived ease of use has a significant and positive effect on perceived usefulness and attitude toward using. Perceived usefulness has a significant and positive effect on attitude toward using and actual system use.

This study referred to the previous relevant studies to provide the operational definitions to various dimensions. As for the items of "information quality", "system quality", "service quality", "user satisfaction" and "personal net benefits", this study amended the study by DeLone and McLean (2003). More specifically, the item of "usage behaviour" has been amended based on the studies by DeLone and McLean (2003), Ginzberg (1981) and Robey (1979). This study referred to the research items of the study by Davis (1989) to develop the items of "perceived ease of use" and "perceived usefulness". This study referred to the research items of the study by Ajzen and Fishbein (1980) to develop the item of "attitude toward using". The five-point Likert scale was applied to each item, where 1 denoted "strongly disagree" and 5 denoted "strongly agree". The research framework was developed according to the aforesaid theoretical bases and hypotheses, as shown in Figure 3.

Pre-test and sampling

After the questionnaire draft was completely developed, a pre-test on 30 professors in college and universities was conducted. The terms of some of the items were amended from the results of the pre-test and the suggestions on the interviews to enable the participants to better understand the content of questionnaire items. In addition, this study also analysed the reliability of various dimensions. According to SPSS analysis, the Cronbach's alpha for the various research dimensions were all greater than 0.82. The formal questionnaires were then distributed.

After using the randomized stratified convenience sampling to select participants in various colleges and universities in southern Taiwan, this study conducted the questionnaire survey. The participants were those who had used the National Central

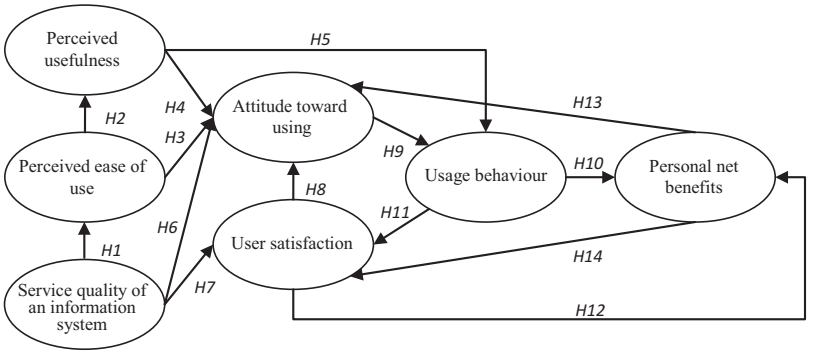


Figure 3.
Research framework

Library Taiwan Digital Meta-Library. This study selected instructors (professors, associate professors, assistant professors and lecturers) and PhD students in colleges and universities as respondents. During February 2013 to May 2013, a total of 400 questionnaires were distributed and 286 questionnaires were returned, with a return rate of 71.5 per cent. After the invalid questionnaires were excluded, a total of 264 valid questionnaires were obtained, providing a valid return rate of 66 per cent.

This study used SEM to test the research framework and used the Maximum Likelihood Estimation (MLE) to estimate parameters. Because the MLE model becomes overly sensitive with an increase in sample size, this study used 264 samples for data analysis according to the suggestion from Chen (2005a,b) that a sample size between 200 and 300 is optimum.

Data analysis and results

Respondent data and reliability analysis

This study selected teachers and PhD students in colleges and universities. The statistical results showed that 46.7 per cent of the respondents were male and 53.3 per cent were female. The average age was 43.7 years. Most were from research-oriented colleges and universities (62.1 per cent), while 32.9 per cent were from teaching-oriented colleges and universities (referred to as the vocational education system). Public colleges and universities comprised 62.4 per cent, while 37.6 per cent were private. As for the distribution of colleges, most respondents were from colleges of business and management (53.6 per cent), followed by colleges of science and technology (20.02 per cent). By job titles, the majority were assistant professors (65.6 per cent), followed by PhD students (15.7 per cent), associate professors (10.8 per cent), professors (4.2 per cent) and lecturers (3.7 per cent). For actual usage behaviour, on average, they used the National Central Library Taiwan Digital Meta-Library approximately 4.2 times per quarter and approximately 1.75 hours each time.

Findings

This study integrated the TAM with the ISSM to develop the research framework of investigating the behavioural model of accessing the National Central Library Taiwan Digital Meta-Library. The participants were requested to complete the questions according to their intuition about experience of use, perception and satisfaction. Furthermore, the authors adopted Structural Equation Modelling (SEM) for data

analysis. The package software, AMOS 18, was applied for the analysis to verify the cause-and-effect relationships among various dimensions in the research framework.

SEM analysis is the test on the relationship between goodness of fit to the overall model. This study used the goodness of fit of the overall model to test the goodness of fit of the observed data. Hair *et al.* (1998) proposed absolute fit measures, incremental fit measures and parsimonious fit measures. Various goodness of fit indices generated from the research data are shown in Table I.

For the absolute fit, the Chi-square value in Table I was 963.82 with a $p < 0.05$. However, because the Chi-square value may easily be affected by the sample size, Bagozzi and Yi (1988) suggested that sample size should be taken into consideration. In addition, the ratio of the Chi-square test value to Chi-square t test to degree of freedom is the Normed Chi-square, and it is used to test the goodness of fit of the model and data. The ratio should be less than 3. The Normed Chi-square of the research results was 2.86, which was less than the recommended standard value of 3, suggesting that the goodness of fit (GFI) of the data and model was acceptable. The GFI was 0.937, the RMR was 0.023, and the RMSEA was 0.041, which were all within the standard scope as recommended (Chen, 2005a, 2005b). For the incremental fit, the AGFI was 0.911, the NFI was 0.928, the CFI was 0.952, the IFI was 0.952, and the RFI was 0.905. All indices were greater than 0.9, meeting the ideal standard on GFI. In the end, for the parsimonious fit, the PNFI was 0.562. Although the PGFI was 0.453 and so failed to meet the standard, it was close to the ideal value of 0.5. According to various indices, the statistical values of the various goodness of fit measures of the overall model were quite ideal. Therefore, the goodness of fit of the original theoretical model of this study was acceptable. As a result, this study used the original model as the final theoretical model. The analysis results and framework of the overall model are further outlined in Figure 4.

As shown in Figure 4, path analysis was used to analyse the relationships among various latent variables. This study found that only the relationship between service quality of an information system, personal net benefits and attitude toward using was not significant, while the rest of the paths were significant. The standardized path coefficients were:

- service quality of an information system to perceived ease of use, 0.188;
- perceived ease of use to perceived usefulness, 0.146;

Fit	Goodness of fit indices	Research results	Standard	Compliance
Absolute fit	Chi-square	963.82 ($p = 0.000$)	$p > 0.05$	Non-compliance
	χ^2/df	2.86 (df = 336)	< 3	Compliance
	GFI	0.937	> 0.9	Compliance
	RMR	0.023	< 0.05	Compliance
	RMSEA	0.041	< 0.05	Compliance
Incremental fit	AGFI	0.911	> 0.9	Compliance
	NFI	0.928	> 0.9	Compliance
	CFI	0.952	> 0.9	Compliance
	IFI	0.952	> 0.9	Compliance
	RFI	0.905	> 0.9	Compliance
Parsimonious fit	PNFI	0.562	> 0.5	Compliance
	PGFI	0.453	> 0.5	Non-compliance

Table I.
Goodness of fit indices of the structural model

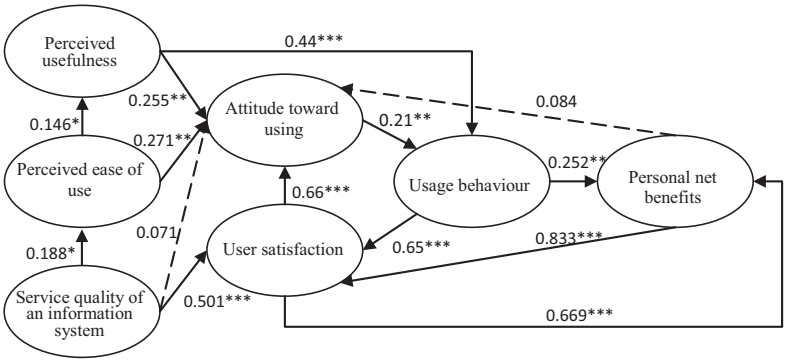


Figure 4.
LISREL path analysis

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

- perceived ease of use to attitude toward using, 0.271;
- perceived usefulness to attitude toward using, 0.255;
- perceived usefulness to usage behaviour, 0.44;
- service quality of information system to attitude toward using, 0.071;
- service quality of information system to user satisfaction, 0.501;
- user satisfaction to attitude toward using, 0.66;
- attitude toward using to usage behaviour, 0.21;
- usage behaviour to user satisfaction, 0.65;
- usage behaviour to personal net benefits, 0.252;
- user satisfaction to personal net benefits, 0.669;
- personal net benefits to attitude toward using, 0.084; and
- personal net benefits to user satisfaction, 0.833.

Based on the results above, all the hypotheses were supported, except for *H6* and *H13*.

Discussion

Service quality of information system has a direct, significant and positive effect on perceived ease of use. This finding is consistent with the research conclusion proposed by the scholars in the past (Lederer *et al.*, 2000; Ahn *et al.*, 2007). Perceived usefulness, perceived ease of use and user satisfaction all have a positive effect on attitude toward using. However, the effect of service quality of information system on attitude toward using is not significant. The reason may be that attitude is mainly a user's inner perception and opinion of the information system itself. It is less directly affected by external factors, such as information, system or service quality provided by the system's website. It is still mainly directly affected by perceived usefulness, perceived ease of use and user satisfaction. The effect of user satisfaction is the strongest.

Moreover, the effect of personal net benefits on attitude toward using is not significant, either. The reason may be that the current Internet search engine is quite

convenient. In addition, a library journal information system is also used in the libraries of various colleges and universities for users to rapidly search and download information. Moreover, physical or virtual interlibrary loan service is also integrated to meet the needs of users rapidly and accurately. In the competitive, information-overloaded and service satisfaction-oriented environment, the positive effect of personal net benefits of Taiwan's National Central Library Digital Meta-Library on attitude toward using is not significant. Perceived ease of use has a direct, significant and positive effect on perceived usefulness. Perceived usefulness and attitude toward using also have a direct, significant and positive effect on usage behaviour. The effect of perceived usefulness is the strongest. The result is consistent with that of the previous TAM studies of Davis (1986, 1993). Furthermore, service quality of an information system, usage behaviour and personal net benefits all have a direct, significant and positive effect on user satisfaction. Among them, the effect of personal net benefits is the strongest. Usage behaviour and user satisfaction also have a direct, significant and positive effect on personal net benefits. The effect of user satisfaction is the strongest. The finding is consistent with the conclusion proposed by DeLone and McLean (2003) in the amended ISSM.

In addition to direct effects, variables also have indirect effects through other variables. The direct, indirect, and total effects of various variables are shown in Table II. Although the service quality of an information system and personal net benefits do not have a direct, significant, and positive effect on attitude toward using, they have an indirect and significant effect on attitude toward using through "user satisfaction". The value of the indirect effect was 0.331 and 0.549, respectively. The value of total effect was 0.453 and 0.634, respectively. In other words, the higher the user satisfaction with the operation of a library information system is, the stronger the indirect effect on attitude toward using is, which further makes the users use the system again to generate the cycle of personal net benefits. Moreover, in addition to having a direct, significant and positive effect on user satisfaction, usage behaviour also has a significant and indirect effect through personal net benefits. The value of the indirect effect was 0.21 and that of total effect was 0.86. In addition to having a positive, significant and positive effect on personal net benefits, usage behaviour also has a significant and indirect effect through user satisfaction. The value of the indirect effect was 0.435 and that of the total effect was 0.687.

This study used the bootstrap method of repeated sampling provided by the Amos system to test the significance of path coefficient a. The data of the same group were repeatedly sampled for 2,000 times. The confidence interval of 95 per cent was used for test and analysis. Compared with the TAM, Table III shows that the TAM concentrates more on perceived usefulness, perceived ease of use and attitude toward using. However, it lacks the user satisfaction, usage behaviour and personal net benefits. On the other hand, compared with the ISSM, it has been found that the ISSM is mostly concerned with service quality of information system, user satisfaction, attitude toward using and personal net benefits, without tapping into perceived usefulness, perceived ease of use and usage behaviour. To improve digital library services, the proposed model comprehensively deliberates seven factors, including perceived usefulness, perceived ease of use, attitude toward using, information systems quality, user satisfaction, usage behaviour and personal net benefits.

Research hypotheses	Direct effect (Standardized path coefficients)	Indirect effect	Total effect	Verification result
H1. Service quality of information system → perceived ease of use	0.188*	NA	0.188	Supported
H2. Perceived ease of use → perceived usefulness	0.146*	NA	0.146	Supported
H3. Perceived ease of use → attitude toward using	0.271**	0.037	0.308	Supported
H4. Perceived usefulness → attitude toward using	0.255**	NA	0.255	Supported
H5. Perceived usefulness → usage behaviour	0.44***	0.053	0.494	Supported
H6. Service quality of an information system → attitude toward using	0.071	0.331**	0.453	Not supported
H7. Service quality of an information system → user satisfaction	0.501***	NA	0.501	Supported
H8. User satisfaction → attitude toward using	0.66***	NA	0.66	Supported
H9. Attitude toward using → usage behaviour	0.21**	NA	0.21	Supported
H10. Usage behaviour→ user satisfaction	0.65***	0.21**	0.86	Supported
H11. Usage behaviour→ personal net benefits	0.252**	0.435***	0.687	Supported
H12. User satisfaction → personal net benefits	0.669***	0.035	0.704	Supported
H13. Personal net benefits → attitude toward using	0.084	0.549***	0.634	Not supported
H14. Personal net benefits → user satisfaction	0.833***	NA	0.833	Supported

Notes: $*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Table II. Direct, indirect, and total effects of the research model

Factors \ Models	TAM	ISSM	TISSM
Perceived usefulness	V		V
Perceived ease of use	V		V
Service quality of an information system		V	V
Attitude toward using	V	V	V
User satisfaction		V	V
Usage behaviour			V
Personal net benefits		V	V

Table III. Comparison among the 3 models: TAM, ISSM, and TISSM

Based on the findings above, it revealed that attitude toward using is significantly and positively affected by perceived usefulness, perceived ease of use and user satisfaction. From the findings, "user satisfaction" is exposed as a critical factor in affecting attitude toward using. Moreover, this study found that attitude is the antecedent affecting usage behaviour. Therefore, to strengthen users' positive attitudes toward using, the factor of user satisfaction becomes a key for enhancing digital library services. It proves that the proposed model is more accurate than the TAM and ISSM separately.

Conclusions, contributions and suggestions

Conclusions

This study proposed a new technology information assessment model, TISSM, by incorporating ISSM into TAM with "attitude toward using" as the connection variable. This model can be used for the assessment of digital library services. Based on the research results, a variety of conclusions were obtained. Firstly, service quality of an information system is created as the exogenous variable of the overall model in this study, as well as the antecedent affecting the success of the introduction of a system. In addition, it is also the antecedent variable determining user acceptance of technology. The research verified that service quality of an information system has a positive effect on perceived ease of use. Therefore, functions, such as abundant and complete information, stable and efficient system efficacy, and online real-time interaction and response, indeed affect the perceived ease of use of the system. Furthermore, attitude toward using is significantly and positively affected by perceived usefulness, perceived ease of use and user satisfaction. Among them, effect of user satisfaction is the strongest. In other words, the higher the users' perceived usefulness and ease of use is the more positive the attitude toward using is. Likewise, the higher the users' satisfaction is, the more positive the effect on attitude toward using is. Although service quality of an information system and personal net benefits do not have a significant and positive effect on attitude toward using, they have an indirect and significant effect on attitude toward using through user satisfaction. Based on the results above, "user satisfaction" is the critical factor affecting the attitude toward using.

Therefore, to strengthen users' positive attitudes toward using, the primary objective of the National Central Library will be the improvement of user satisfaction. Then, perceived ease of use has a significant and positive effect on perceived usefulness. The performance of the empirical result is better than that of the previous model, TAM. In other words, when users suggest that it is easy-to-use the National Central Library Taiwan Digital Meta-Library, they are more likely to perceive the usefulness of the system, which further affects their attitude toward using and usage behaviour to develop personal net benefits. Moreover, usage behaviour is significantly and positively affected by perceived usefulness and attitude toward using. Among them, the effect of perceived usefulness is the strongest. Many studies applying the TAM also found that perceived usefulness plays a very important role during an individual's decision on whether or not to use a certain information technology (Venkatesh, 2000; Chau and Hu, 2001). In other words, when users suggest that the use of National Central Library Taiwan Digital Meta-Library can improve work performance, a more positive attitude toward using will be developed and the actual behaviour of using the system will be improved as well. Eventually, this will affect the cycle of personal net benefits.

Finally, service quality of the information system, usage behaviour and personal net benefit all have a significant and positive effect on user satisfaction. Among them, the effect of personal net benefits is the strongest. Usage behaviour and user satisfaction also have a significant and positive effect on personal net benefits and the effect of user satisfaction is the strongest. This result is consistent with that of the amended ISSM. In addition, user satisfaction and personal net benefits will affect each other. To improve user satisfaction, the National Central Library Taiwan Digital Meta-Library has to be able to improve the work performance of users and develop benefits. After the user

satisfaction is improved, personal net benefits will be increased as well to further affect user satisfaction.

Contributions

Information quality, system quality and service quality are the model's antecedents that are the key factors affecting the cognition for ease of use and user satisfaction. Library service departments and Web design administrators should regard them as crucial management considerations. One potential approach is to provide some services out of the expectations, increase user satisfaction and enhance work efficiency. The results reveal that attitude toward using is significantly and positively affected by perceived usefulness, perceived ease of use and user satisfaction. However, service quality of an information system and personal net benefits do not have a significant and positive effect on attitude toward using, while they have an indirect and significant effect on attitude toward using through user satisfaction. Based on the results above, "user satisfaction" is a critical factor in affecting the attitude toward using. Therefore, to strengthen the positive attitude toward using, the factor of user satisfaction becomes a key for enhancing digital library services. It proves that the proposed model is more accurate than the TAM and ISSM individually.

Suggestions

As for the future digital library services, some perspectives are illustrated, as follows:

- The demonstration of information pages should be concise and easy-to-use, which allows users to access information on demand. Accordingly, Web design should consider the needs of the users.
- Timely response service is another important factor of using a digital library for users. Thus, those interactions between users and the library should be handled promptly and in a friendly manner. It is suggested that libraries can provide electronic software information consulting services.
- The National Central Library should continue to coordinate libraries in Taiwan by employing the Internet of Things technology, such as QR code certification services on smartphones. Users can use the "online distance service" to borrow and electronically access documents of other library collections.
- In response to modern information technology trends, personalized information services need to be provided to users through smartphones or mobile devices to maintain ubiquitous service.

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