



**Design and evaluation of Library SMS Services –
a case study of the OIT Library in Taiwan**

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Abstract:

Purpose –This study uses the Oriental Institute of Technology Library (the OIT Library) in Taiwan as a case to introduce a few mobile Web services which can be provided by a library, as well as to evaluate the library SMS (short messaging service) services offered by the OIT Library.

Design/methodology/approach – The research method involved survey questionnaires based on Technology Acceptance Model (TAM) to understand users' satisfaction and acceptance of library SMS services. Through Pearson-product moment correlation and linear regression, the correlation and causal relationships between factors which influence the acceptance of library SMS services were identified.

Findings –About three quarters of the respondents learned of library SMS services from librarians at the circulation desk and instructions. The due-day reminder and renewal-request service was the most favorite service of a majority of the respondents. Overall, respondents were positive regarding five constructs of TAM, i.e. advertisement (AD), perceived ease of use (PEOU), perceived usefulness (PU), attitude (AT), and behavioral intention (BI).On the

contrary, respondents did not achieve consensus on the charge (CH) construct. The interconnections among the above six constructs were all within an acceptable range, and all of the hypotheses postulated were supported.

Practical implications –As a case study, this study sheds light on the design of mobile Web services in a library. In addition, it points out how to evaluate patron satisfaction and acceptance of mobile Web services through survey questionnaires.

Originality/value –This study increases the understanding of what mobile Web services can be offered by a library. In addition, many previous studies only described certain kinds of mobile Web services implemented in libraries without showing their efficacy; however, this study evaluates patron satisfaction and acceptance of library SMS services in the OIT Library on the basis of a well-adopted framework, Technology Acceptance Model (TAM).

Keywords: Mobile Web, Library SMS Services, Technology Acceptance Model (TAM), Taiwan

1. Introduction

The mobile Web is defined as the access of Internet- and/or browser-based applications through a mobile device, such as a smart phone or a tablet PC, connected to a wireless network (Kroski, 2008c; Wikipedia, 2010). Mobile Web owns several benefits, including constant connectivity, location-aware, limitless access, and interactive capability (Kroski, 2008c); therefore, mobile devices and the associated applications have become an indivisible part of people's daily lives. Twenty more activities (Kroski, 2008b) in which mobile Web users are currently engaged have been identified and can be divided into three categories (Kroski, 2008c): communication, information and resources download and/or play, and information search.

An increasing number of libraries have adopted existing mobile technologies to provide innovative services. Many kinds of mobile Web applications in libraries have been developed, including mobile library websites and MOPACs (Mobile OPACs), mobile collections, mobile library instruction, mobile databases, mobile library tours, mobile learning, library SMS services, mobile library circulation, QR codes, access to services (such as reserving study rooms and checking out laptops and E-book readers), and SMS reference (Berk et al., 2007; Bridges et al., 2010; Cao et al., 2006; Herman, 2007; Kroski, 2008a; Karim et al., 2006; Lippincott, 2008; Murray, 2010; Pin et al., 2009; Vila et al., 2010; Vromans et al., 2009; West et al., 2006; Wilson and McCarthy, 2010). A good resource to know the implementation of mobile Web applications in libraries is *Library Success: A Best Practice Wiki*, which has an "M-Libraries" entry listing a lot of libraries offering different kinds of mobile interfaces or applications (Library Success, 2010).

In recent years, Taiwan has seen a surge in the number of mobile phone users. In the fourth quarter of 2010, the mobile phone penetration rate in Taiwan reached 120.2% (with approximately 120.2 mobile phone numbers for every 100 people). Among those mobile communication users, 67.3% were 3G users, and 70.0% enabled the functionality of mobile Web access (III, 2011). According to a survey on US cell phone owners, 90% of college students owned a cell phone, and early mobile Web adopters were significantly represented by Generation Y, or users whose ages ranged from 18 to 27 (Golvin, 2008). Although there is no such a survey in Taiwan, it is believed that Taiwan has a similar trend.

Viewing the popularity of mobile communication in Taiwan and believing that libraries should offer services with the technology which their patrons are familiar with and frequently used in their daily lives, the Library of the Oriental Institute of Technology (the OIT Library) has started the provision of mobile Web services. This study aims at introducing the mobile Web services implemented by the OIT Library. Additionally, the study also examines patron

satisfaction and acceptance of the OIT Library’s SMS services, on the basis of a well-adopted framework, Technology Acceptance Model (TAM).The rest of the article is organized as follows: Section 2briefly introduces mobile Web services provided by the OIT Library. Section 3describes the research model and hypotheses. Sections 4and 5 present the research methodology, and analyze patron satisfaction and acceptance of the library SMS services, respectively. The final section concludes this article.

2. Mobile Web Services in the OIT Library

Founded in 1969, Oriental Institute of Technology (OIT) is an urban university located at the core of New Taipei City, Taiwan. OIT consists of twelve departments covering areas of engineering, management and nursing. As of spring2011OIT has approximately 5,421 students including 61 Master and PhD students. The OIT Library has a collection of approximately 250,916 volumes of books, 800 periodical titles, 50,000 e-journal titles, 140,000 e-books, 70 electronic databases, and 12,000 non-book materials including CD ROMs, audiocassettes and videos etc. Due to her limited six librarians, the OIT Library exerts herself in incorporating technology into the technical and patron services.

In order to facilitate ubiquitous library access for her patrons, the OIT Library endeavors to systematically build mobile Web services. Currently, the OIT library has implemented four mobile Web services, including various library SMS services, mobile video on demand (MVOD) system, preview and reservation service of new titles, and service for positioning and navigation of holdings (See Table I).

Table I. OIT Library's mobile Web services

Services	Start-up Time
Library SMS Services	2008/1
MVOD System	2009/2
New Title Preview and Reservation Service	2009/10
Service for Positioning of holdings	2010/10

2.1. Library SMS Services

Text message alerts are entry-level mobile Web services for a library to offer her patrons speedy news announcement, event reminders, and other requested information. The OIT Library makes the following SMS services available to her patrons:

1. **News and event reminder service:** This service sends reminders to patrons about important news, exhibitions, instructions, and so on.

2. **Due-day reminder and renewal-request service:** This service sends reminders to patrons when their borrowed items are coming due. Furthermore, if a patron receives a due-day reminder and wants to renew the item, the patron can click a renewal-request hyperlink embedded in the text message to renew a borrowed item.
3. **New title notification service:** This service lets patrons get informed of newly acquired titles. This service accompanies the preview and reservation of new titles introduced in Section 2.3.
4. **Multimedia borrowing notification service:** The OIT Library stores her multimedia collection (including CD, VCD, and DVD) in a CD/DVD management system. After entering his/her PIN ID and password, a patron can discover and check-out any discs they want from the CD/DVD management system. At the same time, an SMS alert will be sent to the patron so as to prevent from account compromise.
5. **Request arrival notification service:** This service reminds patrons about the availability of reserved items.
6. **Overdue notification service:** This service reminds patrons about overdue items.

All the above SMS services are opt-in. Patrons only need to login to the library website and fill in their mobile phone numbers to avail of these services. Currently, patrons can use these services free of charge. This study aims at evaluating patrons' acceptance of the first five services.

2.2. Mobile VOD system

The mobile VOD system (MVOD) enables patrons to play streaming videos of the library's VOD system on their mobile devices through Wi-Fi or 3G. The MVOD system has about 1,000 licensed videos, including *Discovery Channel*, *National Geographic Channel*, English learning programs, and lectures/speech delivered in the campus. Users can search for the videos they want via simple metadata fields such as title and creator.

2.3. Preview and reservation service of new titles

As mentioned in Section 2.1, the OIT Library has developed a notification service for newly acquired titles. Normally, if a patron is interested in a new title, he/she must visit the library to borrow it. However, if the title is popular, before the patron reaches the library, it may have been checked out. In view of this, the OIT Library designs a service that allows patrons to preview and reserve new titles via their mobile devices.

Regarding the preview functionality, the OIT Library allows eligible patrons to view digitalized covers, author introduction, and table of contents of all newly acquired titles through their mobile devices. When a patron is interested in a new title, he/she can follow a hyperlink shown in his/her mobile device to reserve it. If a new title has been reserved by a patron, it can only be read by other patrons inside the library in the following three days; thus, the patron can arrange a convenient time to check out the title.

2.4. Service for Positioning of holdings

An average patron often encounters the difficulty in locating a book on shelf via its call number. The purpose of the service for positioning of holdings is to guide a patron to reach the shelf position of a book they want from his/her current position. When a patron looks into the holding information of a book through Web PAC, the service will convert its call number into a shelf-map with a red blinking circle which indicates the shelf position of the book. If the patron enters the call number of a nearby shelf, a blue blinking circle which indicates the position of the nearby shelf will appear on the shelf-map. In this manner, the patron can have an idea about how to reach the shelf of the book from the current position.

3. Research Model and Hypotheses

Whenever a library implements a new service, she should evaluate the service's effectiveness and patrons' satisfaction of the service. A previous study employed unobtrusive system log analysis and patron questionnaires to show that the due-day reminder and renewal-request service effectively reduced the amount of overdue fines and overdue rates, as well as indirectly increasing users' willingness to borrow books and thus leading to a higher rate of book circulation (Wang et al., 2012)

This study uses the technology acceptance model (TAM) as the basic framework for evaluating the OIT Library's SMS services, especially the first five services mentioned in Section 2.1.

TAM is a widely-adopted model for explaining user acceptance of a technology based on user perceptions (Davis, 1989; Davis et al., 1989). TAM postulates that two specific behavioral beliefs, perceived ease of use (PEOU) and perceived usefulness (PU), determine an individual's attitude (AT) toward using a technology. TAM posits that the actual usage of a technology is determined by behavioral intention (BI), which is jointly affected by an individual's attitude (AT) and perceived usefulness (PU). Furthermore, it is suggested that PEOU and PU can be affected by various external variables.

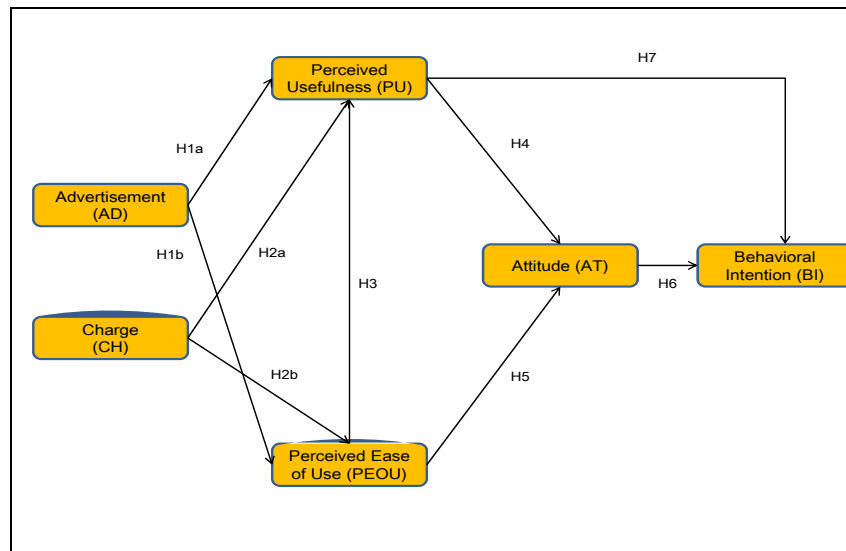


Figure 1 Research model and hypotheses

This study adopts TAM to investigate users' satisfaction and acceptance of library SMS services. The research model is illustrated in Figure 1, and the hypotheses which this study would like to test are described in the following.

External Variables

Two external variables, advertisement and charge, are proposed in this study. A library should advertise any newly provided services so that patrons can be informed and encouraged to use these new services; therefore, advertisement may improve the usefulness and ease of use for users to use a system. Thus, it is hypothesized that:

- H1a. Advertisement (AD) positively affects perceived usefulness of the library SMS services.
- H1b. Advertisement positively affects perceived ease of use of the library SMS services.

Although the OIT Library provides the SMS services free of charge, the OIT Library has to shoulder the SMS expense. If the OIT Library cannot afford the SMS expense, she may charge users for the SMS services. Therefore, if a patron is willing to pay for the SMS services, even a minimum amount like NT\$1, he/she may consider the services are useful and/or easy to use; thus, it is hypothesized that:

- H2a. The willingness to pay for the services (CH for charge) positively affects perceived usefulness of the library SMS services.
- H2b. The willingness to pay for the services positively affects perceived ease of use of the library SMS services.

Perceived ease of use

Perceived ease of use is the degree to which a user believes that using a technology will be free of effort (Davis et al., 1989). TAM suggests that perceived ease of use has a direct effect on positive attitude; therefore, this study will test the following hypothesis:

- H5. Perceived ease of use (PEOU) positively affects attitude(AT) toward using the library SMS services.

Perceived usefulness

Perceived usefulness is the degree to which a person believes that using a technology will enhance his/her performance (Davis et al., 1989). According to TAM, perceived usefulness is expected to have a direct effect on positive attitude. On the other hand, TAM suggests that perceived usefulness is directly influenced by perceived ease of use; therefore, this study will test the following hypothesis:

- H3 Perceived ease of use positively affects perceived usefulness of the library SMS services.
- H4 Perceived usefulness (PU) positively affects attitude toward using the library SMS services.

Attitude

Attitude is defined as an individual's favorable or unfavorable feeling on using a given technology (Ajzen and Fishbein, 1980), and it is suggested that attitude has positive effect on behavioral intention; hence, it is hypothesized that:

- H6. Attitude positively affects the behavioral intention (BI) of using the library SMS services.

Behavioral Intention

TAM suggests that an individual's actual use of a given technology is determined by the individual's behavioral intention to use that technology, which provides the most accurate prediction of behavior (Davis et al., 1989). The behavioral intention is jointly determined by attitude (H6) and perceived usefulness; therefore, it is hypothesized that:

- H7. Perceived usefulness positively affects the behavioral intention of using the library SMS services.

4. Methodology

This study took a quantitative approach and used a survey questionnaire as the data collection instrument.

4.1. Questionnaire Design

The questionnaire consisted of three parts. The first part asked demographic questions. The second part comprised several questions on users' perceived usage behavior, such as library SMS services experiences, the number of library SMS services activated, the channel through which a user gets aware of library SMS services, and the favorite library SMS services. The third part focused on the TAM constructs, as shown in Table II.

Table II Questionnaire design (For CH, PEOU, PU, AT, and BI, respective questions were asked for each library SMS service)

Constructs	Questions
Advertisement (AD)	I understand the functionality of the library SMS services.
	I think the library should use posters to advertise the library SMS services.
	I think the library should advertise the library SMS services through the library Web site.
	I think the library should advertise the library SMS services through Email.
Charge (CH)	I am willing to pay NT\$1 for the library SMS services.
	I think it is reasonable for the library to charge me for the library SMS services.
Perceived Ease of Use (PEOU)	I think it is easy to get the library SMS services to do what I want to do.
	I think the library SMS services are easy to operate.
	I think it does not take a long time to learn how to use the library SMS services.
Perceived Usefulness (PU)	I think using the library SMS services enhance the effectiveness to do what I want to do.
	I find the library SMS services useful.
Attitude (AT)	I think it is wise for me to use the library SMS services.
	I think it is good for the library to provide the library SMS services.
	I think it is worthwhile to use the library SMS services.
Behavioral Intention (BI)	I think I will keep using the library SMS services in the future.
	I think I rely on the library SMS services to do what I want to do.
	I think I will recommend my friends to use the library SMS services.

4.2. Study Context and Sample

The survey questionnaire was administered to the entire population to be served by the OIT Library. The electronic survey was publicized on the institute and library websites. The survey period was between 20March and 20April2011. The number of valid responses of this questionnaire was 400; therefore, sampling error for a 95% confidence interval of this questionnaire is $\pm 4.73\%$.

5. Data Analysis and Findings

Internal reliability is validated through Cronbach's α . Cronbach's α in Table III shows the internal reliabilities of the constructs were all greater than 0.7, which is the threshold normally considered acceptable.

Table III Cronbach's α

Constructs	Items	Cronbach's α
AD	4	0.764
Charge	6	0.888
PEOU	7	0.832
PU	6	0.866
AT	7	0.887
BI	3	0.701

Error! Reference source not found. lists the respondents' demographic profile, including gender, patron type, experiences in using the library SMS services, and the number of the library SMS services activated. As presented in **Error! Reference source not found.**, around 60% of the respondents have experiences in using OIT Library's SMS services for one or more years; three quarters of the respondents have enabled three or more library SMS services.

Table IV Demographic characteristics of respondents

Characteristics	Frequency	Percentage
<i>Gender</i>		
Female	151	37.8%
Male	249	62.3%
<i>Patron Type</i>		
Freshman	156	39.0%
Sophomore	112	28.0%
Junior	66	16.5%
Senior	30	7.5%
Teacher/Staff	10	2.5%
Alumni/Community	26	6.5%
<i>Library SMS services Experience</i>		
Below 0.5 year	50	12.5%
0.5-1 year	110	27.5%
1-1.5 years	81	20.3%
1.5-2 years	106	26.5%
Over 2 years	53	13.3%

Characteristics	Frequency	Percentage
<i>Activated Library SMS Services</i>		
1 service	20	5.0%
2 services	68	17.0%
3 services	146	36.5%
4 services	88	22.0%
5 services	78	19.5%
Total	400	

Regarding how respondents get aware of the OIT Library's SMS services, as shown in Table V, 60% and 13.0% of the respondents learned of library SMS services from librarians at the circulation desk and instructions, respectively. It indicates that librarians of the OIT Library are good at promoting library services when they get in touch with patrons. 36.0% of the respondents got aware of the library SMS services from library's Web site; on the other hand, only 6.8% from posters. It is worth investigating whether patrons of the OIT Library get used to receive library news/information from electronic media like library's Web site or the OIT Library should strengthen the promotion through posters. Furthermore, World-of-mouth promotion through schoolmates (18.3%) and teachers (4.5%) was another advertisement channel.

Table V Advertisement channels (multiple choices)

Advertisement Channels	Count	Percentage of Responses	Percentage of Cases
Circulation Desk	240	42.4%	60.0%
Schoolmates	73	12.9%	18.3%
Library Web Site	144	25.4%	36.0%
Library Posters	27	4.8%	6.8%
Library Instructions	52	9.2%	13.0%
Teachers	18	3.2%	4.5%
Others	12	2.1%	3.0

With respect to the favorite SMS services, as shown in

Table VI, 88.25% of the respondents voted for due-day reminder and renewal-request service. It is reasonable because overdue may lead to fines or depriving of borrowing privilege.

Table VII presents the library SMS services which need improvement. 59% and 29.5% of the respondents considered that the functionality of news and event reminder service, and new title notification service have to be improved, respectively. A follow-up investigation by interview will be conducted to understand defects of these services.

Table VI Favorite library SMS services (multiple choices)

Library SMS Services	Count	Percentage of Responses	Percentage of Cases
News and event reminder service	193	20.25%	48.25%
Due-day reminder and renewal-request service	353	37.04%	88.25%
New title notification service	185	19.41%	46.25%
Multimedia borrowing notification service	58	6.09%	14.50%
Request arrival notification service	164	17.21%	41.00%

Table VII Library SMS services which need improvement (multiple choices)

Library SMS Services	Count	Percentage of Responses	Percentage of Cases
News and event reminder service	236	41.40%	59.00%
Due-day reminder and renewal-request service	77	13.51%	19.25%
New title notification service	118	20.70%	29.50%
Multimedia borrowing notification service	74	12.98%	18.50%
Request arrival notification service	65	11.40%	16.25%

Table VIII shows the descriptive analysis of the six TAM constructs. As reflected from these figures, respondents in general were positive regarding AD, PEOU, PU, AT and BI. On the contrary, respondents did not achieve consensus on the issue of charge. Approximately 60.3% to 69.8% of the respondents had negative (disagree, strongly disagree) or neutral responses.

Table VIII Descriptive analysis

Construct	Items	Average	Standard Deviation
Advertisement (AD)	I understand the functionality of the library SMS services.	3.83	0.869
	I think the library should use posters to advertise the library SMS services.	3.99	0.832
	I think the library should advertise the library SMS services through the library Web site.	3.96	0.779
	I think the library should advertise the library SMS services through Email.	3.95	0.776
Charge (CH)	News and event reminder service	3.07	1.149
	Due-day reminder and renewal-request service	3.02	1.061
	New title notification service	2.92	1.082
	Multimedia borrowing notification service	3.15	1.138
	Request arrival notification service	2.97	1.134
	I think it is reasonable for the library to charge me for the library SMS services.	3.18	1.122
Perceived Ease of Use (PEOU)	News and event reminder service	3.82	0.773
	Due-day reminder and renewal-request service	4.07	0.766
	New title notification service	3.79	0.950
	Multimedia borrowing notification service	3.76	0.803
	Request arrival notification service	3.86	0.784
	I think the library SMS services are easy to operate.	3.90	0.818
	I think it does not take a long time to learn how to use the library SMS services.	3.84	0.833
Perceived Usefulness (PU)	News and event reminder service	3.99	0.796
	Due-day reminder and renewal-request service	3.93	0.746
	New title notification service	3.85	0.772
	Multimedia borrowing notification service	3.75	0.820
	Request arrival notification service	3.94	0.770
	I find the library SMS services useful.	3.97	0.819
Attitude (AT)	News and event reminder service	3.93	0.725
	Due-day reminder and renewal-request service	3.94	0.705
	New title notification service	3.93	0.726
	Multimedia borrowing notification service	3.87	0.768
	Request arrival notification service	4.04	0.731
	I think it is good for the library to provide the library SMS services.	4.07	0.766
	I think it is worthwhile to use the library SMS services.	3.99	0.785
Behavioral Intention (BI)	I think I will keep using the library SMS services in the future.	3.99	0.741
	I think I rely on the library SMS services to do what I want to do.	3.82	0.914
	I think I will recommend my friends to use the library SMS services.	3.87	0.740

Table IX Inter-correlations

	AD	CH	PEOU	PU	AT	BI
AD	1	.124(*)	.514(**)	.679(**)	.711(**)	.659(**)
CH	.124(*)	1	.247(**)	.169(**)	.196(**)	.193(**)
PEOU	.514(**)	.247(**)	1	.815(**)	.741(**)	.651(**)
PU	.679(**)	.169(**)	.815(**)	1	.843(**)	.755(**)
AT	.711(**)	.196(**)	.741(**)	.843(**)	1	.726(**)
BI	.659(**)	.193(**)	.651(**)	.755(**)	.726(**)	1

* $p < .05$; ** $p < .01$

The next part of the analysis employed Pearson-product moment correlations to examine the relationships between the six constructs, AD, CH, PEOU, PU, AT, and BI. The interconnections among the various constructs are provided in

Table IX and are all within an acceptable range. Furthermore, it revealed that perceived usefulness (PU) and attitude (AT) had the strongest inter-correlation, and the inter-correlation between perceived usefulness (PU) and perceived ease of use (PEOU) ranked the next.

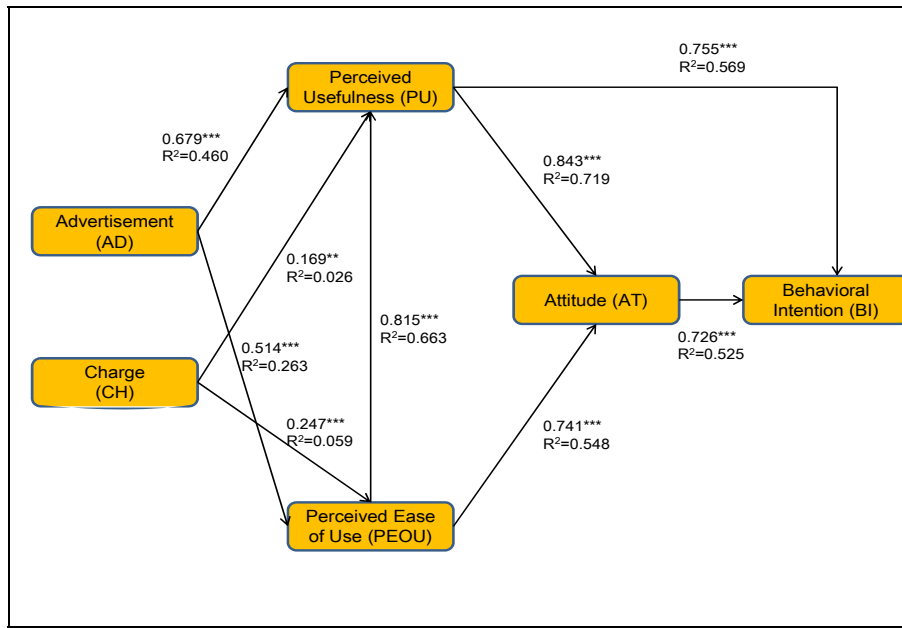
This study employed linear regression to test the model. Table X and Figure 2 show that all hypotheses were supported. This study postulates that two external variables, advertisement and charge, have direct impact on perceived usefulness and perceived ease of use. The regression model revealed that the two postulations were supported; however, CH had a small direct impact on PU ($\beta = 0.169$) and PEOU ($\beta = 0.247$); furthermore, the strength of linear association between CH and PU ($R^2 = 0.026$) and PEOU ($R^2 = 0.059$) was very weak. It indicates that patrons do not rely heavily on the charge to determine whether the library SMS services are useful and easy to use. On the other hand, advertisement had moderate direct impact on PU and PEOU, which suggests that advertisement is useful for attracting patrons to activate library SMS services.

As in most TAM model, PU and PEOU had direct significant impact on AT; similarly, PEOU had a direct significant impact on PU; likewise, AT and PU had direct significant impact on BI.

Table X Regression Analysis

Regression Equation	Adjusted R^2	β	t-value	Significant	Hypothesis
AD → PU	0.460	0.679***	18.455	.000	H1a(supported)
AD → PEOU	0.263	0.514***	11.968	.000	H1b(supported)
CH → PU	0.026	0.169**	3.415	.001	H2a (supported)
CH → PEOU	0.059	0.247***	5.079	.000	H2b (supported)
PEOU → PU	0.663	0.815***	28.028	.000	H3 (supported)
PU → AT	0.710	0.843***	31.292	.000	H4 (supported)
PEOU → AT	0.548	0.741***	22.019	.000	H5 (supported)
AT → BI	0.525	0.726***	21.036	.000	H6 (supported)
PU → BI	0.569	0.755***	22.996	.000	H7 (supported)

Note: Standard β s are reported: * $p < .05$; ** $p < .01$; *** $p < .001$



Note: Standard β s are reported: * $p < .05$; ** $p < .01$; *** $p < .001$

Figure 2 The Regression Model

6. Conclusion

This study introduces the mobile Web services offered by the OIT Library, including library SMS services, mobile VOD system, new title preview and reservation service, and service for Positioning of holdings. In order to evaluate patrons' satisfaction and acceptance of the library SMS services, TAM model was employed to develop a survey questionnaire. The results revealed that advertisement was a significant and positive factor for perceived usefulness and perceived ease of use; on the other hand, charge was not the main concern of patrons to use library SMS services. Furthermore, the relationships between PU, PEOU, AT, and BI were consistent with many previous TAM studies. Future research could be conducted on investigating into the relationship between behavioral intention and actual use, which can be measured by system logs.

Mobile Web library services transcend time restrictions, and free patrons from restrictions related to the opening and closing hours of the library. Now, they can enjoy services provided by the library 24 hours a day using their mobile phones. Mobile Web library services also help patrons transcend spatial limitations, allowing them to enjoy the services provided by the library without having to go to the library. The applications of mobile Web library services are only limited by imagination.

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