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AN EVALUATION AND SELECTION OF 3G MOBILE VALUE-ADDED SERVICE

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ABSTRACT

As the wireless communication and mobile phone market develop rapidly, telecommunication dealers provide diverse mobile value-added services for consumers to choose from. However, which mobile value-added services are those consumers need have become a worthy issue for discussion. In this empirical study, cluster analyses and analytic hierarchy processes are used to investigate and understand the need for cognition in the young users (20-29 years old). The selected subjects' preferences for services, like mobile communication service, mobile entertainment service, mobile information service and mobile transaction service are evaluated. By surveying the subjects' need for recognition, cluster analysis can further be used to cluster diverse mobile value-added services. Furthermore, by means of the Analytic Hierarchy Process (AHP), services that subjects pay more attention to can be sifted out for the further development of service functions. The results of analysis indicate that the mobile value-added services young users pay most attention to are: wireless emergency services in the communications category, mobile mapping in the information category, mobile taxi services in the communication category, contact list in the communication category and short messaging service in the communications category.

Keywords: Mobile commerce, Third generation, Mobile value-added service, Analytic hierarchy process, Cluster analysis

INTRODUCTION

Because of the rapid development of the wireless communication and mobile communication industry, the issue of mobile commerce is getting more attention. Mobile commerce is derived from traditional e-commerce and realized by means of mobile devices like PDAs or Smart Phones. With the advances of information technology, the capabilities of mobile internet devices also expand.from original communication function into Data Acquisition, Data Transmission, Transaction Service and Entertainment Service, which influence more and more in our lives. The characteristic of "anywhere and any time" makes these functions be an indispensable part of our daily lives. Since NTT DoCoMo successfully promoted the i-Mode mobile value-added service, the whole world had paying its full attention to the development of this emerging commercial mode, and many manufactures start to follow this trend to increase their competitiveness. However, under the keen competition, the mobile value-added service market is gradually saturated. "Enterprises who plan to offer the m-commerce service must be aware of the primary concerns of customers to raise the adoption of mobile value-added services so as to raise the ARUP" [10]. To have a further understanding about this emerging mobile value-added service market, young consumers have been chosen as the subjects of this research. This empirical study is aimed at analyzing and understanding a users' preference in an attempt to serve as a reference for future system development. Firstly, the mobile value-added services provided by Taiwan's five 3G (Third Generation) communication service providers, including Chunghwa Telecom, Taiwan Cellular, FarEasTone, VIBO Telecom and Asia Pacific Broadband Wireless Communications, Inc., are gathered, and a Likert-scale questionnaire is used to sift out function items, and then categorize these items by means of a cluster analysis. After organizing related literatures, mobile value-added services are placed into four categories, including Mobile Communication Service, Mobile Entertainment Service, Mobile Transaction Service and Mobile Information Service. Finally, The Analytic Hierarchy Process (AHP) is used to observe the importance of each item to the users, and consumers' preference can be further learned.

MOTIVATION AND APPLICATION OF MOBILE VALUE-ADDED SERVICE

Compared to other media, the mobility of mobile phones is a unique feather that can break down the barriers of space and time and provide communication service anytime, anywhere. Mobile value-added services are, like other media, able to provide diverse services to the users. Consumers' motivations to use mobile value-added services claimed by Lin [6] are organized as followed:

- (1) For society evading: Consumers can find great pleasure in chatting, relaxing and wasting time using mobile phones [7]. Meanwhile, mobile value-added services provide diverse recreational services including on-line games, picture and music download or audio and video appreciation for users to get away from reality and to drive away feelings of loneliness.
- (2) For information: People surf online to search for information, discover new things and to do self-education, in an attempt to satisfy their needs and to get excitement and stimulation [9] [14]. Take the information services provided in mobile value-added services, for example, news & weather report, real-time traffic information and restaurant guide indeed satisfy users' needs for rapid and real-time information.

- (3) For social motivation: For social motivation means users increase interpersonal communications and activities by using mobile phones [9]. Leung and Wei [7] believe that mobile phones can help people get closer. For example, the relationships between user and families are improved, and also become closer to families. Besides, mobile phones make immediate contact possible when there is an emergency, which makes them stay in secure.
- (4) For the convenience of time and space: Leung and Wei [7] think that the mobility of mobile phones can address the trouble of finding a pay phone, which brings users' convenience. Except for this "anytime" service, some mobile value-added services even provide account transfer service so that users don't have to go to the certain places for it.
- (5) For fashion: Using mobile phones is a fashionable trend and even a symbol of status [7]. We can also know if one catches up with the trend by the usage of mobile value-added services. For example, whether one has ever downloaded screen savers, whether one has updated ring back tone or whether one can send messages all shows whether one catches up with the latest trend or not. As a result, mobile value-added services may also be something for the peers to compare.

"Wireless networks need to strengthen the 4C (convenience, customization, cost effectiveness, and cost iron security) characteristics of the customers [11]. And it must also provides timely information, enabled simple transaction, and location-base service" [4]. Combine related literatures, the definition of mobile value-added services goes as follows, mobile phone service operators decide the service contents themselves, or they cooperate with the service operators through strategic alliance, and they provide mobile phone users information service of mobile data other than general call service, such as games, pictures, ring back tone, coupon messages, electronic transaction and so on [5] [10] [17] [20].

Generally speaking, the applications of mobile value-added services can be divided into the following four categories in accordance with consumers' purposes [2] [10] [12] [13] [18] [19]:

- (1) *Mobile Communication Service:* To provide consumers with communication services like messages, e-mails and multimedia message exchanges. Mobile communication service is the most successful application among all the value-added services. As the 3G communication services grow mature, multi-media messages combining images, video & audio with messages encourage consumers to make use of the multi-media message service to entertain themselves and their friends.
- (2) *Mobile Entertainment Service:* To provide consumers with recreational application services, such as download of ring back tone, pictures and games. Currently, mobile recreational service is the second largest application of mobile value-added services, just second to mobile communication services. The combination of mobility and entertainment appears intuitively appealing for many customer segments due to the chance to waste time and have fun when wired entertainment appliances are inaccessible.
- (3) *Mobile Transaction Service:* To provide consumers with financial and commerce services, such as mobile shopping service, mobile banking service and mobile ticket booking service. Financial and commerce services are targeting at the buyers, namely individual users, and through the retail service, banking services and payment mechanism, users can buy things they want to buy easily.
- (4) *Mobile Information Service:* To provide real-time information services including news, weather report, stock information, map inquiry and parking space inquiry. The biggest characteristic of mobile information service is that it can provide real-time information that consumers need. Therefore, consumers make use of this type of mobile value-added service for their conveniences in their lives.

METHODOLOGY

Methodology Structure

Concerning the evaluation and filtration of mobile value-added service items, a questionnaire is used to see the consumers' preference for mobile value-added service, and suggestions are then presented. The research process is as shown in Figure 1.



Figure 1. Research Structure

The followings are the steps for AHP:

- (1) Define the attributive items of the matter.
- (2) Establish a pair-wise comparison matrix of the defined attributive items. If there are attributive items of Item1~Item n, then a matrix of $n \times n$ can be established.

$$A = \begin{bmatrix} 1 & A_{12} & \cdots & A_{1n} \\ 1/A_{12} & 1 & \cdots & A_{2n} \\ \vdots & \cdots & \ddots & M \\ 1/A_{1n} & 1/A_{2n} & \cdots & 1 \end{bmatrix}$$
(1)

(3) The pair-wise importance comparison of attributive items is made.

In the pair-wise comparison matrix of the defined attributive items, a pair-wise and directional comparison is made, and a specific value for comparison is then filled. A scale of values ranging from 1 (equally important) to 9 (extremely more important) was used to express the evaluators' preferences. The main diagonal element is the comparison of attributive items themselves, so the ratio is 1. This pair-wise comparison enabled the decision-maker to measure the contribution of each factor to the objective independently, thereby simplifying the decision-making process.

(4) Operations of comparison values of each attributive item. Numerical analysis is used to calculate the weight of each attributive item, and generally, the geometric mean is used. For example, there are *n* attributes of Attribute *L*: $L_1 L_2 L_3 \dots L_n$. The importance of sequence of the pair-wise comparison of Attribute L_1 and other attributes are: $L_{11} L_{12} L_{13} \dots L_n$. The geometric mean of the L_1 sequence can be calculated by means of the following equation:

$$\left(\prod_{i=1}^{n} L_{1i}\right)^{1/n} \quad i = 1, 2, 3, \dots, n$$
(2)

Geometric mean calculated from each attributive item has to be normalized, and W, the weight of each attributive item can be obtained. As a result, W can be calculated by means of the following equation:

$$W = \left\{ \left(\prod_{i=1}^{n} L_{1i} \right)^{1/n} \right\} / K ,$$

$$K = \sum_{j=1}^{n} \left(\prod_{i=1}^{n} L_{ij} \right)^{1/n} \qquad i, j = 1, 2, 3, ..., n$$
(3)

Cluster Analysis

Cluster analysis is a technique used for the classification of data, in which data elements are partitioned into groups called clusters that represent collections of data elements, which are proximately based on a distance or dissimilarity function [8]. The Hierarchical Method is the more commonly used method currently. By means of the correlation coefficient or distance between samples, two samples that are closest to each other form a cluster, and a new cluster will be formed by combining the sample nearest to it. This cluster-forming continues until all the samples are combined into one category. In this continuous combination process, a tree-shaped or hierarchical structure can be formed. The calculation of the Hierarchical Method is to cluster by means of minimum distance, namely, that the distance between two categories is the shortest distance between two samples, and its equation is as follows:

$$M_{ij} = \min\{r_{mn}\}, X_m \in r_i, X_n \in r_j$$
(4)

where r_{mn} is the distance between sample X_m and another sample X_n ; r_i represents Category i while r_j represents Category j. In addition, in this research, an Euclidean distance equation is used for the distance between attributes in each sample:

$$r^{2}_{ij} = (x_{i} - x_{j})^{2} + (y_{i} - y_{j})^{2}$$
⁽⁵⁾

where r_{ij}^2 represents the square distance of attribute *i* and *j* on the plane of geometry. x_i is the assessed value of attribute *i* on Index *x* while x_i represents the assessed value of attribute *j* on index *y*.

Experiment Design

According to the investigative report of the E-ICP [3], 45% of the mobile value-added service users in Taiwan spread from 20 to 29 years old. In terms of occupation, 34% of such users are students. Accordingly, college students were taken as the

subjects for this study. The subjects in this research were a group of youth aged 20 to 29, and there were 30 people in total for each phase.

This experiment was conducted in three phases. In the first phase, subjects tried every simulated mobile value-added service. After filtration and analysis of need for cognition, 38 items were decided. In the second phase, cluster analysis was conducted on the filtered mobile value-added services, concerning nine characteristics, including: Inquiry Function, Practical Function, Entertainment Function, Convenience, Real-time Character, Personalization, Business, Regional Character and Safety. Finally, the experts suggest to adjust the results into seven groups, and to be grouped under four categories including: Communication, Information, Transaction and Entertainment. Finally, an AHP was conducted in the third phase, and the ranking of group importance and function-item importance within one single group was obtained.

RESEARCH RESULTS

According to the demand analysis questionnaire in Phase 1, the function items are graded and listed in order by numbers, as shown in Table 1. In Table 1, since there is a larger gap between the grade of Item 38, "Mobile blog", and that of Item 39 "Mobile match-make", only Item 1 to Item 38 are intercepted and numbered.

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Ranking Number	Service item	Sum	Average	Ranking Number	Service item	Sum	Average
1	Wireless emergency services	135	4.5000	23	Mobile taxi services	110	3.6767
2	Contact list	133	4.4333	24	Memorandum	109	3.6333
3	Mobile mapping	130	4.3333	25	Medical consultation	108	3.6000
4	Transaction security	130	4.3333	26	Ringing tone and image download	108	3.6000
5	Call catcher	124	4.1333	27	Broadcast	108	3.6000
6	Short messaging service	124	4.1333	28	Receiving and sending e-mail	107	3.5767
7	Ticket booking	123	4.1000	29	Ring back tone	105	3.5000
8	Real-Time traffic information	122	4.0767	30	Push Mail	104	3.4767
9	Credit card transaction record inquiry	122	4.0767	31	Bookkeeping	103	3.4333
10	Popular music download	119	3.9767	32	Job-search information	102	3.4000
11	Mobile calendar	119	3.9767	33	Instant messaging	101	3.3767
12	Multimedia messaging service	118	3.9333	34	Mobile book	101	3.3767
13	On-line coupons	118	3.9333	35	Financial information	100	3.3333
14	Fee payment	117	3.9000	36	Electronic games	100	3.3333
15	Virus protection	116	3.8767	37	Video Conferencing	100	3.3333
16	Electronic dictionary	116	3.8767	38	Mobile Blog	97	3.2333
17	Real-Time weather information	115	3.8333	39	Mobile match-make	89	2.9767
18	Electronic transactions	114	3.8000	40	Mobile e-paper	86	2.8767
19	Mobile micro payment	113	3.7767	41	Mobile broker	83	2.7767
20	Mobile banking	112	3.7333	42	Horoscope	82	2.7333
21	Life information	111	3.7000	43	Chat rooms	77	2.5767
22	Mobile video streaming	111	3.7000				

Table 1	. Results	of Demand	Analysis
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Between-groups linkage is adopted in the cluster analysis on Phase 2. After clustering, in according to the tree diagram shown in Figure 2, these 38 function items are placed into nine clusters, with a merge level of six in this research. Experts suggested adjusting to seven clusters. Detailed items of the seven clusters are listed in Table 3. According to the natures of these function items, these seven clusters are categorized into four parts: (1) Communication, including General Communication Service, Life Communication Service and Application Communication Service, (2) Information, (3) Transaction and (4) Entertainment, including General Entertainment Service and Entertainment Application Service.



Figure 2. Hierarchical Cluster Tree

In Phase 3, the category of each cluster and every item in each cluster is transformed into pair-wise comparison matrix. This is then input into AHP software package (AHP maker) for importance ranking analysis.

Priority ranking	Service category	Weight
1	Communication	0.3478
2	Information	0.2163
3	Entertainment	0.1219
4	Transaction	0.1149

Table 2. Priority	^r Ranking of Mobile	Value-added Service	Categories
•/			

Table 2 indicates the importance weight of the 4 categories of mobile value-added services. Table 3 shows the importance weight of each service item in the 7 clusters. The importance rankings of the 4 mobile value-added service categories are: Communication, Information, Entertainment and Transaction. From the results, it is very obvious that the importance of Communication Category is higher than the other three categories. As a result, for future development of mobile value-added service and Entertainment Service should be enhanced to meet the consumers' differing needs. For Transaction Service, mechanism of safe transaction should be strengthened so that consumers will feel much safer to conduct transactions through their mobile device.

Table 3.	Weights	of Mobile	Value-added	Service Items

Cluster	Service item	Weight	Cluster	Service item	Weight
<u>Entertainment</u> General entertainment service	Pop music download	0.2063	<u>Communication</u> General communication service	Contact list	0.1714
	Electronic games	0.1629		Electronic dictionary	0.1528
	Ring back tone	0.1614		Call catcher	0.1302
	Mobile book	0.1393		Mobile calendar	0.1009
	Ringing tone and image download	0.1169		Memorandum	0.0895
<i>Entertainment</i> Entertainment application service	Broadcast	0.1923		Medical consultation	0.0875
	Life information	0.1453		Financial information	0.0604
	Mobile video streaming	0.1277		Bookkeeping	0.0554

	On-line coupons	0.1236	<u>Communication</u> Life communications service	Wireless emergency services	0.6013
	Ticket booking	0.1177		Mobile taxi services	0.1772
	Mobile blog	0.0761		Fee payment	0.1153
<u>Transaction</u>	Transaction security	0.3493	<u>Communication</u> Real-time communication service	SMS	0.1664
	Credit card transaction record inquiry	0.1680		MMS	0.1514
	Mobile banking	0.1456		Push Mail	0.1483
	Mobile micro payment	0.1051		Instant messaging	0.1230
	Electronic transaction	0.0846		Receiving and sending emails	0.1118
4. Information	Mobile mapping	0.4348		Video conference	0.1079
	Real-time traffic condition	0.2446			
	Real-time weather report	0.1941			

From the orders of the mobile value-added service items in Table 4, it is very clear that the top 5 services that consumers pay most attention to are: Wireless Emergency Services in the Communication Category, Mobile Mapping in the Information Category, Mobile Taxi Services in the Communication Category, Contact List of the Communication Category, and Short messaging service (SMS) in the Communication Category. To consumers, the 5 least important service items are: Ticket Booking in the Entertainment Category, Ringing Tone and Image Download in the Entertainment Category, Mobile Micro Payment in the Transaction Category, Electronic Transaction in Transaction Category, and Mobile Blog in the Entertainment Category.

Among all the mobile value-added services, Emergency applications are the most important items. Thus, we can see how people value unpredictable emergencies. When an emergency occurs, sending messages by mobile phone is a real-time guard that can protect us. As for Mobile mapping, the development of GPRS and LBS (Location-Based Service) made it possible to provide a real-time location of a moving object through a mobile communicative device, and through the notice and log-in function, the service center can provide positioning services, including road guides, restaurant guides, parking space information and traffic information. As to the contact list, it brings convenience to consumers to contact friends or to inquire about a friend's information, and therefore, it is also of high importance. It is very common that consumers receive and send messages to their relatives and friends. The application of messages also enables consumers to subscribe to some personalized messages like e-paper.

		0	0				
Ranking	Service item	Relative weight	Service category	Ranking	Service item	Relative weight	Service category
1	Wireless emergency services	0.20913	Communication	19	Medical consultation	0.03043	Communication
2	Mobile mapping	0.09405	Information	20	Pop music download	0.02515	Entertainment
3	Mobile taxi services	0.06163	Communication	21	Broadcast	0.02344	Entertainment
4	Contact list	0.05961	Communication	22	Finance information	0.02101	Communication
5	SMS	0.05787	Communication	23	Electronic games	0.01986	Entertainment
6	Electronic dictionary	0.05314	Communication	24	Ring back tone	0.01967	Entertainment
7	Real-time traffic information	0.05291	Information	25	Credit card transaction . record inquiry	0.01930	Transaction
8	MMS	0.02566	Communication	26	Bookkeeping	0.01927	Communication
9	Push Mail	0.05158	Communication	27	Life information	0.01771	Entertainment
10	Call catcher	0.04528	Communication	28	Mobile book	0.01698	Entertainment
11	Instant messaging	0.04278	Communication	29	Mobile banking	0.01673	Transaction
12	Real-time weather report	0.04198	Information	30	Mobile video streaming	0.01557	Entertainment
13	Transaction security	0.04013	Transaction	31	On-line coupons	0.01507	Entertainment
14	Fee payment	0.04010	Communication	32	Ticket booking	0.01435	Entertainment
15	Receiving and sending e-mails	0.03888	Communication	33	Ringing tone and I mage. download	0.01425	Entertainment
16	Video conference	0.03753	Communication	34	Mobile micro payment	0.01208	Transaction
17	Mobile calendar	0.03509	Communication	35	Electronic transaction	0.00972	Transaction
18	Memorandum	0.03113	Communication	36	Mobile blog	0.00928	Entertainment

 Table 4. Ranking and Weight of Mobile Value-added Service Items

CONCLUSIONS

The subjects in this research are a group of college and graduate students aged from 20 to 29. In the diffusion of innovation

theory, much research indicates that the demographic characteristics of innovative users are of higher income, from higher educational background, and are younger than the non-innovative users [1]; namely indicating that young people have a higher acceptance of new things than older people. Therefore, when introducing new services, service providers can target young people as their target group, and the focus of the service content should belong to the "Entertainment Category" [6].

- Concerning the ranking of service importance among mobile value-added services, suggestions are presented as followed:
- (1) Concerning the Life Communication Services, it is found in the research that subjects especially value personal safety services. Therefore, service providers can focus on users' needs to design the services, such as a reliable nighttime taxi-calling service.
- (2) Concerning the Information Service and Communication Service, real-time content and personalization are what consumers attach importance to. Thus, relating information about the basic necessities of life should be provided to meet the consumers' differing needs.
- (3) Concerning the Entertainment Service, epidemic and abundant contents are emphasized. Telecommunication companies can work together with many domestic service providers, in an attempt to provide interesting games or music to consumers.
- (4) In addition to the basic communicative nature of message services, practicability should also be noticed. As a result, message services can also combine with Web services to cope with the consumers' unique needs and provide customized message services, such as schedule-reminder messages or personal financial management services. Besides, the multi-media characteristics of multi-media messages (MMS) can be used to increase a users' interests. The application of it can also apply into other service categories and create innovative services like interactive message games or digital learning.
- (5) Safety is the most important element in the Transaction Service. It was found in this research that the subjects' preference was low. Thus, service providers should provide a safer transaction mechanism to enhance consumers' confidence.

Finally, though research is targeted at young people as research subjects, different age groups have different needs and preferences for mobile value-added services. Therefore, to enlarge other target markets, research on other age groups are still needed in the future, to establish innovative application services, and therefore, to enable the enterprises to have more competitiveness.

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