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Su Qian
ManagementFaculty,ChengduUniversityofInformationTechnology,China

Shao Peiji
SchoolofEconomicandManageme,UniversityofElectronicScienceandTechnology,China

Ye Quanfu
MarketingDepartment,ChinaUnicomSichuanBranch,China

Development and Validation a comprehensive instrument to measure customer perceived service quality of mobile data services

Qian Su[1]¯, *Peiji Shao*[2], *Quanfu Ye*[3]
[1]Management Faculty, Chengdu University of Information Technology, China
[2]School of Economic and Manageme, University of Electronic Science and Technology, China
[3]Marketing Department, China Unicom Sichuan Branch, China

Abstract: Following the rapid growth of mobile data services in China, the competition between mobile data service providers becomes more intensively. To gain advantage in the fierce competition, it's very critical to service providers managing their service quality effectively, thus a comprehensive measurement instrument of service quality is needed. However, there are few studies dedicated to mobile data services in this area. Our study proposes a conceptualization framework derived from Technical Acceptance Model. Based on the framework, we develop and validate an instrument to measure perceived service quality of mobile data services in rigorous process. Finally we have gotten a service quality instrument with six-dimensions: content quality, usability, reliability and speed, interaction, entertainment/ enjoyment, security/privacy. This scale provides a useful instrument for researchers who wish to measure the service quality of mobile data services and for marketing managers who want to improve their service performance.

Keywords: mobile data services, customer perceived service quality, conceptualization framework, scale development

1. INTRODUCTION

Mobile data services (MDS) are digital services added to mobile phone networks other than voice services, in which the contents included can be either self-produced by mobile telecom service providers or provided through strategic alliances with content providers[1]. Now these services include short message service (SMS), web browsing, ringtones, games, multimedia messages service (MMS), location based service (LBS), and electronic transaction, etc. They can bring five types of value to consumers: time-critical needs and arrangement, spontaneous needs and decisions, entertainment needs, efficiency needs and ambitions, and mobility-related needs[2]. Based on these brand new characteristics, MDS have gained more fast growth than traditional telecom voice business[3]. Following the adoption of 3G network (or xG) and penetration of smart phone, it's no doubt that MDS will dominate the future of mobile service market.

China is the most active and important mobile service market in the world. It holds the largest mobile user base, which was over 1.1 billion in December, 2012[4]. In China, three operators have licenses to provide mobile service. They are China mobile, China Unicom and China Telecom. Only China mobile, the biggest mobile operator in China have gained over 20 billion USD revenue on MDS in 2011, over the 30% of its whole revenue, and the increase rate is three times more than traditional voice business[5]. It's estimated that the whole market share of MDS will over 70 billion USD in 2012 in China.

The great opportunity attracts more and more players to take part in the game. Unlike mobile voice business, the competition of MDS market not only occurs between telecommunication service providers, but many new participants involved. The name list includes terminal manufactures (e.g., Apple), internet SPs (e.g., Tencent), etc[3]. Thus the competition becomes very tight than ever. This rivalry has resulted in an increasing

¯ Corresponding author. Email: slq@cuit.edu.cn (Qian Su) , pjshao@uestc.edu.cn (Peiji Shao)

need for mobile data service providers to pertain their customers. Researcher argued that service quality is the very important antecedent of customer loyalty[6], so how to measure the service quality of MDS is a critical issue for all the participants.

However, it's still lack of instruments to measure the service quality of mobile data services. Because mobile data services are innovative services that combine technologies and concepts from the domains of telecommunication, information technology, and consumer electronics[7], so the instruments for measuring service quality of telecommunication operators or web site can't be employed directly. Only a little research oriented to service quality of MDS, but these studies were based on a conceptual model of the traditional services (such as SERVQUAL)[8], which is difficult to accurately reflect the characteristics of the service quality of MDS. Furthermore, most of these studies only specified for one type of MDS (e.g., SMS)[9][10][11], so the generalization of their conclusions is limited. At last, few studies which employ a rigorous and systematic procedure to develop and validate an instrument have been conducted under China context.

Our research is aimed at developing and validating a comprehensive instrument to measure user perceived service quality of all kinds of MDS. The remainder of this paper is organized as follows: Section 2 reviews related literatures. Section 3 describes our research framework and study methodology. Section 4 presents the results of every step. Section 5 summarizes conclusions, points out the limitation and future of this research.

2. LITERATURES REVIEW

The conceptualization and measurement of service quality perception have been the most debated and controversial topics in the service marketing literature to date[12]. Parasuraman et al. developed the famous SERVQUAL model to measure service quality[13]. This model has been widely adopted by the academic and the practice. However, many scholars have questioned about the conceptual framework and measurement method of this model.

In measurement aspects, Cronin and Taylor proposed SERVPERF, scissored from SERVQUAL which only employ service quality performance to measure service quality[14]. They pointed out that using SERVPERF produces better results of reliability, validity, and predictive power than using SERVQUAL. Some other studies also maintained that SERVPERF is more accurate than SERVQUAL in the measurement of service quality[15][16][17]. Zeithaml, Parasuraman and Malhotra proposed that it is not necessary to use customers' expectation to measure the service quality of a website[18]. Many studies oriented to information quality adopted performance only method. Therefore, our study will directly use perceived service quality to measure the service quality of mobile data services. Many scholars also argued that the conceptualization model of SERVQUAL is only effective in traditional services[19]. It's not suitable to measure information service quality. So the researchers in information field often proposed their own conceptualization models[1][11].

Because MDS is the hybrid of mobile communication and information technology, so we looked for studies on service quality of mobile communication service area, plus service quality of information service domain. There are three categories of studies related with our objective. They are listed below.

- Mobile communication service quality.

Wang et al. used SERVQUAL as conceptualization framework to measure the quality of mobile networking services in China[20]. Kim, Park, and Jeong examined the service quality of mobile communication services in South Korea by call quality, value-added services, and customer support[21]. Because the voice business is the theme of these studies, service quality of MDS was only regarded as some attributes of total service. These researches emphasized factors that play key roles in mobile communication, such as system reliability, connection quality, etc. However, they ignored most of the information related attributes which is very important to service quality of MDS.

- Specified for one kind of MDS.

Chae et al. used content quality, connection quality, interaction quality and context quality to measure the service quality of mobile internet service[11]. Tung referenced the dimensions of SERVQUAL to measure the service quality of SMS in Singapore[9]. Zhang et al. studied mobile security transaction based on multiple hierarchical model[10]. Because these studies are too focused on specified type of MDS, it's difficult to spread to other MDS.

- All kinds of MDS oriented.

Guo et al. tried to develop a measurement instrument for all kinds of MDS[1]. They collected data from university students in Taiwan, China, and build a model with four dimensions: content quality, navigation and visual design, management and customer service, system reliability and connection quality. However, because of the absence of comprehensive conceptualization framework, this study neglected several important constructs which be recognized as key part of MDS service quality, for example, security and entertainment. So their model needed to be refined.

In sum, prior research developed some fundamental knowledge about MDS service quality. However, the lack in the comprehensive measurement resulted in our study.

3. RESEARCH FRAMEWORK AND METHODOLOGY

3.1 Conceptualization framework

There is currently no established conceptual foundation for developing and measuring the service quality of mobile data services. Because of the diversity of MDS, we integrated several conceptual methods to identity important service quality dimensions related to MDS.

Lu et al. argued that MDS is one kind of IT system or IT application[22]. So we can use technical acceptance model (TAM) to study the user adoption intention of MDS. TAM was developed by Davis[23]. It suggests that users' decision to adopt an IT is primarily determined by their attitudes toward: (1) perceived usefulness (PU) and (2) perceived ease of use (PEoU) The causal relationships have been widely investigated and verified in many studies[22].

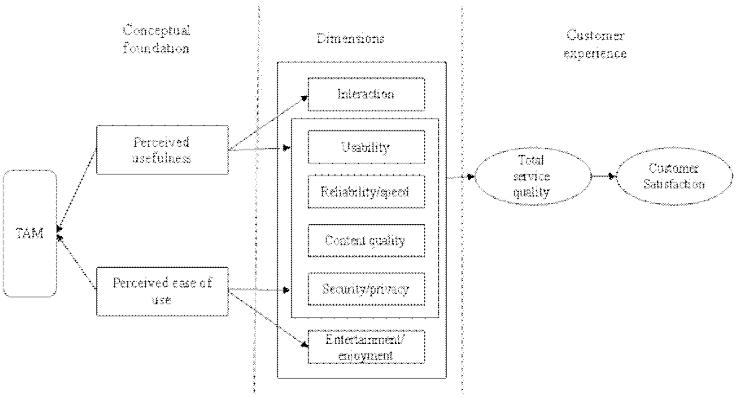

Figure 1. Conceptualization framework

If usefulness and ease of use of MDS do not outweigh customers' losses caused by impersonal experiences, technical difficulties, learning effort, etc., customers may simply switch back to traditional service. If we can determine what service related factors influence the PU and PEoU, we can define our conceptualization framework.

Lu et al. studied the determinants of IT adoption on China MDS[22]. They argued that technology and trust influence PU and PEoU, and the facilitating conditions influence PU. The technology includes functionality, interface design; Trust includes security, privacy and system reliability; Facilitating conditions include product training and technical support. Yang et al. argued that the two dimensions: information quality and system quality of can be derived from TAM when studied perceived service quality of internet information portal[24]. Loiacono et al. argued that TAM/TRA (Theory of Reasoned action) expanded model can be leveraged to derive web site service quality model[25]. Lee argued that enjoyment can influence PEou in mobile internet service[26].

Based on these studies, we proposed our conceptualization framework. Please see figure 1. We derived six dimensions of MDS service quality from our conceptualization framework. They are interaction, usability, reliability/speed, content quality, security/privacy and entertainment/enjoyment. Here below we described them one by one.

- Interaction

Parasuraman et al. defined interaction as "The service provider wish to help and support customers"[13]. This involves three types of communications between: users and service providers' employees, users and the system, and among peer users of similar MDS services[24]. Although using a MDS is primarily a self-served process, users may expect to receive personalized or customized services from a contact person, face to face or by call center. It may also be expected to be provided automatically, without human involvement or using email, message boards, chat rooms, and discussion forum. This reduces the burden of addressing some of the customer concerns, while grasping customers' comments and thoughts.

- Usability

Usability is related to user friendliness and accessibility[24]. Researchers have identified various factors about friendliness, primarily content layout and classification, appearance and visual design, and ease of navigation[1][11]. On one side, accessibility refers to the ability using MDS anytime, anywhere. On the other side, it means that user can take use of multiple channels to access MDS services.

- Reliability/speed

Compared with fix line communication, the reliability and speed are always major concerns of mobile communication[20][21]. One of the most important initiatives of evolution of mobile communication network is to solve these problems. Connection quality which refers to reliability is the most significant factors of mobile service quality[21]. Many MDS such as web browsing, online games require high speed[11].

- Content quality

Comparing with mobile voice service, the most valuable capability of MDS is content provided. Huizingh defined content quality as "the value and accessibility of information provided by service provider"[27], Chae and Kim argued that in mobile context, information relevance need to be considered[11]. Yang et al. argued that content quality includes usefulness of content and adequacy of content[24].

- Security/privacy

Mayer et al. argued that security significantly impacts on IT adoption[29]. One of the security related concern is that MDS depends on wireless Internet exposed to a more dangerous environment. The other is that the complexity of MDS enlarges the Asymmetry of information when a user faced with the service provider[22].

Privacy concerns often arise with new IT that support enhanced capabilities for collection, storage, use, and communication of personal information. It's a very serious issue especially in China.

- Entertainment/enjoyment

Many studies pointed out that user feel enjoyment or pleasure when using MDS[28]. Bauer et al. argued that enjoyment and pleasure are very important constructs to measure service under e-commerce context[30]. Chae and Kim argued that mobile internet is not only utilitarian, but hedonic[11]. Studies also found that using MDS as entertainment are more popular in Asia than other region[31].

3.2 Research methodology

In this study, we employed a rigorous scale development process proposed by Churchill[32]. Please check table 1 for the details.

Table 1. Research process, method and tools

Process	Description	Method and tools
Building questionnaire	To identify dimensions and corresponding items of MDS service quality	Literatures collection and analysis, Focus group, Expert interview
Pilot study	Small sample test to make sure the quality of questionnaire	Correlation analysis, Cronbach's alpha, interview of participants
Collecting data	Distribute questionnaire in several channel to collect data	Survey (paper and network)
Exploratory factor analysis	To explore the dimension structures based on data analysis method	Primary component factor analysis with varimax rotation, Barllet sphere test
Confirmatory factor analysis	To find out first-order and second-order measurement model	χ^2/df, GFI, RMSEA, CFI, NFI, TLI
Reliability and validity test	Theoretical meaningfulness of concept, content validity, reliability, Convergent validity, Discriminant validity, Convergent validity Nomological validity	Cronbach's alpha, composite reliability, AVE, SEM

There are many methods to test reliability and validity. We adopted suggestion from Bagozzi and Bagozzi & Phillips for its rigorousness[33][34]. Please check table 2 for details.

Table 2. Reliability and validity test method

Validity Issue	Concern
Theoretical meaningfulness of concept	Constructs well defined, Making theoretical sense
content validity	Measures correspond to theoretical constructs
Internal consistency	Maximally similar measures of the same construct agree (i.e. reliability)
Discriminant validity	Distinct constructs can be distinguished
Convergent validity	Maximally dissimilar measures of the same construct correlate (e.g. do a collection of questions on aquestionnaire correlate with an overview question, or with some objective measure)
nomological validity	Making sense in the larger theoretical framework

4. RESULTS AND FINDINGS

4.1 Qualitative research to identify major dimensions.

We conducted a focus group including eight experienced users of MDS and five experts of MDS operation. We asked them to discuss the service quality dimensions and check the items from their own perspective. They agreed that all the six dimensions should be involved. However, experts emphasized that content, and users concerned about privacy. The questionnaire was revised by them to make sure every items can be depicts clearly. Thus the content validity of questionnaire was confirmed.

Table 3. Constructs and items included in the questionnaire

Dimensions	Items	Measures	Reference
Interaction	CS1	I can access customer service in multiple ways	Yang et al[24].
	CS2	I can easily subscribe or cancel mobile data service	Kuo et al[1].
	CS3	I feel that the mobile data service provider is friendly when contact with them	Tung[9]
Usability	EQ1	This mobile data service is displayed in a harmonious way	Chae&Kim
	EQ2	I can easily use the mobile data service	
	EQ3	I can take use of the mobile data service from multiple channels	Yang et al[24].
	EQ4	I can use this mobile data service anywhere, anytime	
Content quality	CQ1	This mobile data service provides complete content	Chae et al[11].
	CQ2	This mobile data service provides appropriate content	Kuo[1]
	CQ3	This mobile data service provides important content	Kim et al.
	CQ4	This mobile data service provides fashionable content	Yang et al[24].
Reliability/speed	RQ1	Error seldom occurs to this value-added service system	Kuo et al.[1]
	RQ2	This value-added service system is stable	Chae&Kim[11]
	RQ3	It does not take too much time to download/upload the information I need	Kuo et al[1].
	RQ4	This value-added service system can instantly react to the data I input	Kuo et al[1].
Security/privacy	TR1	I believe in my mobile service provider	Tung[9]
	TR2	I believe that my service operator protecting my privacy	
	TR3	I believe that is safe to complete transaction by using mobile data service	Bauer et al[30].
	TR4	No mobile data service will be bound to me without my explicit permission	
Entertainment/enjoyment	EJ1	It's exciting to use mobile data service	Bauer et al[30].
	EJ2	Entertainment was provided by the mobile data service	Bauer et al[30].
	EJ3	It's fun to use mobile data service	Bauer et al[30].

4.2 Pilot study

The draft paper questionnaires were distributed to 40 graduate students in the same university to conduct pilot study. We have received 37 effective responses. Then we have correlation analysis and reliability test on each construct based these samples. 2 items were deleted because of low reliability, and 3 items were adjusted based on the feedback of participants. Finally, we got the scale including 6 dimensions which contains 22 items. Please refer to table 2.

4.3 Data

4.3.1 Data collection

A survey pointed out that most MDS customers are 18-30 young people (about 70.7%) in China mainland[3], similar results are found in Taiwan, Korea and Japan[31]. So in our study, we set the following sampling rules: age between 18-30 years old, have MDS usage experience in recent half year. We also have set the effective check rules, which include: repeat choice rate is too high, missing data on required items, inconsistency in answers.

Total 350 paper questionnaires were distributed in 3 colleges in Chengdu, China. The responses received are 321, so the response rate is about 91.71%. Another 170 paper questionnaires were distributed to two IT

company in Chengdu, and 168 responses are received, the response rate is about 94%. To make the data more general, we have put the questionnaire on a website and sent email to invite users to take part in. The email list was provided by a game website, including 500 email addresses. We have received 125 responses. Fang & Shao argue that both offline survey and online survey have the same effectiveness[35], so we combined all the samples. Finally, we have gotten 614 responses for our study. After the filtering out the non-effective responses, we got 422 effective samples, and the effective rate is 56.81%.

4.3.2 Sample profile

In our sample data, 54.21% are male. Seventy three percent of the samples are subscribers of China mobile, 19.26% are subscribers of China Unicom, and subscribers of China Telecom are about 8.73%. The characteristics of the sample data were similar to MDS user profiles gathered in other studies[3].

4.4 Exploratory factor analysis (EFA)

We randomly chose 200 rows to conduct exploratory analysis. We employed SPSS 17.0 as statistical tools. First, a Bartlett sphere test was conducted to judge if our sample data are suitable for EFA. The results are: KMO is 0.902, χ^2 is 2292.19, significant on 0.000. It shows that our samples are suitable for EFA[1].

Table 4. Results of EFA

		Factors						Variance explained
		1	2	3	4	5	6	
Content quality	CQ1	0.766						14.10%
	CQ2	0.827						
	CQ3	0.737						
	CQ4	0.675						
Security/ privacy	TR1		0.552					13.04%
	TR2		0.807					
	TR3		0.743					
	TR4		0.823					
Usability	EQ1			0.651				12.38%
	EQ2			0.706				
	EQ3			0.699				
	EQ4*			0.696				
Reliable/speed	RQ1				0.810			11.91%
	RQ2				0.848			
	RQ3				0.774			
Interaction	CS1					0.693		10.97%
	CS2					0.796		
	CS3					0.685		
Entertainment/ Enjoyment	EJ2						0.835	8.75%
	EJ3						0.803	

Note: (*) the item will be deleted after confirmatory factor analysis

Then the principal component factor analysis with a varimax rotation has been done. The initial factor analysis extracted six factors that had an eigenvalue greater than one. Then, we eliminated items that did not load strongly on any factor (values below 0.5) or had cross-loadings (values higher than 0.5)[1]. A total of 2 items were therefore deleted. The remaining 20 items were again factor analyzed. Each item was found to load strongly on only one factor. Six factors were generated and they accounted for 71.14% of the variance. They were labeled: (1) content quality, (2) security/privacy, (3) usability, (4) Reliability/speed, (5) interaction and (6) entertainment/enjoyment (see Table 4).

4.5 Confirmatory factor analysis (CFA)

In order to test the factor structure more rigorously, we carried out confirmatory factor analyses using the remaining 241 cases in the dataset. We first tested a first-order measurement model (see Fig. 2) using the AMOS 17.0. Following Byrne's suggestion[36], this model was specified in such a way that (1) the model included the identified six factors as first-order factors; (2) the six factors were correlated; (3) the six factors were one level away from the observed variables; (4) each observed variable had a nonzero loading on its corresponding factors and zero loadings on other factors; and (5) the measurement error terms associated with the observed variables were uncorrelated.

In the first test, the first-order measurement model showed a good model fit, with a ratio of Chi-square to degree of freedom of 1.92, RMSEA of 0.059, CFI of 0.94, GFI of 0.87. However, one item (EQ4) was found to be inappropriate by the CFA. It had an unacceptably small loading on its designated factor (0.271). Following the model improvement discipline, the item was deleted and only 19 items remained. The revised first-order measurement model showed an excellent model fit, with a ratio of Chi-square to degree of freedom of 1.89, RMSEA of 0.05, CFI of 0.94, GFI of 0.92, NFI of 0.93 (see Table 5). All items loaded on their designated constructs significantly. The item loadings on their corresponding dimensions ranged from 0.67 to 0.87 (see Table 6).

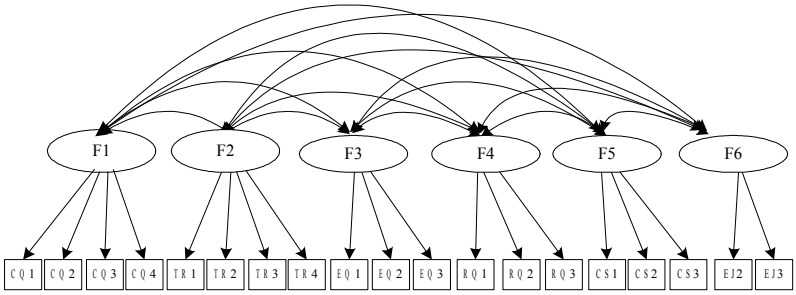

Figure 2. The first-order measurement model.

Table 5. Model fit indices of measurement models

	χ^2/df	RMSEA	CFI	TLI	GFI	NFI
Recommended value[37]	<3	<0.08	>0.9	>0.9	>0.9	>0.9
First-order measurement model	1.89	0.05	0.96	0.94	0.92	0.91
Second-order measurement model	1.95	0.056	0.95	0.94	0.91	0.9

Table 6. Results of CFA

Dimensions	Items	Loading	CR	Cronbach's α	AVE
Content quality	CQ1	0.78	0.85	0.85	0.58
	CQ2	0.81			

	CQ3	0.79			
	CQ4	0.67			
Security/privacy	TR1	0.77	0.84	0.84	0.57
	TR2	0.76			
	TR3	0.80			
	TR4	0.69			
Usability	EQ1	0.80	0.78	0.78	0.55
	EQ2	0.79			
	EQ3	0.61			
Reliability/ speed	RQ1	0.83	0.86	0.85	0.66
	RQ2	0.87			
	RQ3	0.74			
Interaction	CS1	0.74	0.78	0.79	0.55
	CS2	0.73			
	CS3	0.75			
Entertainment/ Enjoyment	EJ2	0.76	0.77	0.77	0.63
	EJ3	0.82			

Note: AVE is average variance extracted, CR is composite reliability

Based on the research of Parasuraman et al., we also assumed that there existed a second-order factors of overall service quality of MDS[13], which explained all the first-order factors. Therefore, a second-order factor measurement model was developed (see Fig. 3). Following Byrne[36], we constructed the model in a way that (1) the model included the six first-order factors and one second-order factor (overall service quality); (2) covariance among the six first-order factors were fully explained by their regression on the second-order factor; (3) each observed variable had a nonzero loading on its designated factors and zero loadings on other factors; and (4) the measurement error terms associated with the observed variables were uncorrelated.

The model exhibited an excellent model fit, with a ratio of Chi-square to degree of freedom of 1.95, RMSEA of 0.056, CFI of 0.94, GFI of 0.91, NFI of 0.9 (see Table 4). All six first-order factors loaded on the second-order factor strongly (>0.65) and significantly. This results confirmed that a second-order factor of overall service quality existed.

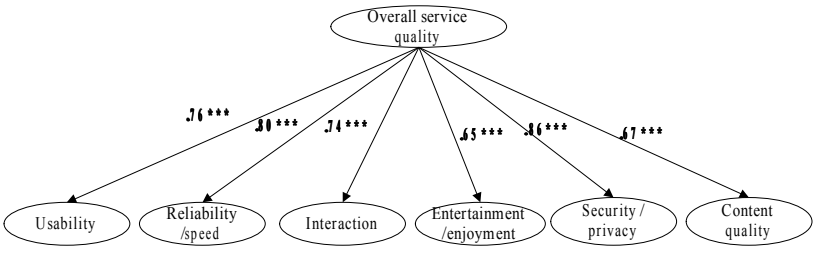

Figure 3. Second-order measurement model.

4.6 Reliability and Validity

The reliability of a measure is the extent to which it is free from random error. A common way to estimate reliabilty is Cronbach's alpha[37]. However, some researcher argued that Cronbach's alpha is only effective when the measures were Tau-equivalent[24]. So we employed composite reliability tests which examined the internal

consistency of the indicators that measured each CFA factor, along with Cronbach's alpha. The composite reliability for each factor was computed by using AMOS, and the Cronbach's alpha was computed by using SPSS. Either CR or Cronbach's alpha are not less than 0.77 (see Table 6). Thus, the reliability of the scales was totally acceptable[37].

Then we assessed convergent, discriminant, and nomological validity of the scales. Among them, the convergent and discriminant validity were required to establish construct validity, referring to the degree to which a scale measures what it is intended to measure. The nomological validity tests were critical in determining whether a scale behaved as expected in terms of its relationships with other theoretically related outcome variables and constructs.

To test the convergent validity of the six factors for the first-order measurement model, we calculated average variances extracted (AVE) for each construct. The results is in Table 6. The lowest AVE is 0.55 (interaction and usability). All met the recommended minimum level of 0.5[37], thus supporting the convergent validity for the first-order measurement model. Moreover, in the second-order measurement model, all the six first-order factors loaded significantly on the second-order factor, with the standardized loadings larger than 0.65. As in the case of the first-order measurement model, one could interpret this result as an indication of convergent validity for the second-order measurement model.

To test discriminant validity, We adopted the method of Fornell & Larcker, which compare the AVE with the squared correlation between each pair of constructs[39]. In our test, each construct's AVE was larger than the squared correlation between each pair of latent variables. Hence, the discriminant validity was adequate (see Table 7).

Table 7. AVE and squared correlation of construct pair matrix

	Content quality	Usability	Reliability/ speed	Interaction	Entertainment/enjoyment	Security/ privacy
Content quality	**0.58**					
Usability	0.44	**0.55**				
Reliability/speed	0.33	0.28	**0.66**			
Interaction	0.38	0.47	0.26	**0.55**		
Entertainment/Enjoyment	0.17	0.27	0.16	0.37	**0.63**	
Security/privacy	0.23	0.25	0.20	0.38	0.31	**0.57**

Previous marketing literatures argued that if users receive high quality service, they are likely to be satisfied[40][41]. Therefore, we tested a structural model that related overall MDS quality to user overall satisfaction (see Fig. 4). This was measured by three items: (1)''I am satisfied with the mobile data services provided by this company,'' and (2) ''I think this company has successfully provided mobile data services,'' and (3) "This mobile data service is better than expected"[40]. The structural model showed a good model fit, with a ratio of

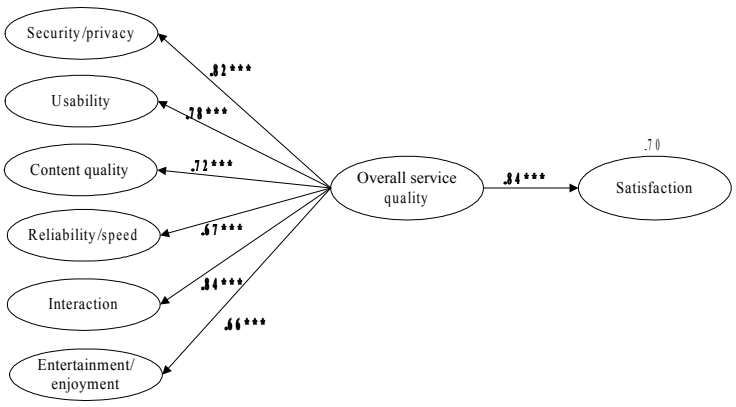

Figure 4. Structure model of service quality dimensions, overall service quality and sactisfaction

Chi-square to degree of freedom of 1.98, RMSEA of 0.057, CFI of 0.94, GFI of 0.89, NFI of 0.88, and TLI of 0.93. Moreover, as predicted, it showed that the overall service quality of MDS had a positive, significant influence on user satisfaction (parameter estimate: 0.84). It's about 70% variance of satisfaction can be explained by overall service quality. Therefore, the nomological validity of this instrument was demonstrated

5. CONCLUSIONS

This study employed a rigorous scale development procedure to establish an instrument that measures customers' perceived service quality of mobile data services. Firstly, the conceptualization framework derived from TAM was build, so all kinds of MDS can be covered. Then a measurement model was created with six dimensions: interaction, usability, reliability/speed, content quality, security/privacy and entertainment/ enjoyment. Each of the six identified and verified factors had a significant impact on overall service quality. Through understanding the service quality dimensions for MDS, a telecom operator or MDS service provider will stand a much better chance of gaining more business and serving its stakeholders. For managers, the 19 items across six factors can serve a useful diagnostic purpose. The managers can use the validated scale to measure and improve service. Furthermore, the six-dimension measurement scale adds to extant literature by establishing a basis for further theoretical advances on service quality related to mobile data service customer retention and loyalty.

The study has its limitations. Our data were collected from specified regions in China, and ignored the population older than 30 or younger than 18. So our six-dimension scale still needs to be verified with more data. This scale also needs to be test with different types of MDS to be verified.

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