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Application of Structural Equation Modeling to Evaluate Web-based Mobile CRM Quality of Chinese Commercial Banking Services

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Abstract: Since China has entered the age of web-based mobile communication, Mobile Instant Messengers are enjoying a rapid development. Therefore, this research explores the implementation of web-based mobile CRM (Customer Relationship Management, a system for managing a company's interactions with current and future customers) from customers' perspectives in the banking sectors of China. Most current studies of CRM implementation focus on traditional channel CRM services while few researches study the issue from the perspective of customers, so authors of this paper studied related literature, interviewed professional experts, collected 388 valid questionnaires from targeted customers and used SEM (Structural Equation Modeling) to analyze the collected data, illustrate the relationships among web-based mobile CRM, service attribute, relationship quality and customer intention and establish a new model of web-based mobile CRM. The results of this research may be used in academic studies and routine management.

Keywords: Web-based mobile CRM, service attribute, customer intention, relationship quality

1 Introduction

With the rapid development of China's economy, more and more Chinese people use mobile phones. On January 2014, Ministry of Industry and Information Technology of the People's Republic of China announced that the number of mobile phone users has reached 1.235 billion, among which 0.5 billion use Smartphones and 0.527 billion use mobile phones to surf the internet (CNNIC's report). Mobile phones have entered the lives of Chinese people and changed people's life styles. More and more netizens (a portmanteau of Internet and citizen) begin to use internet to deal with their business and personal matters (See Figure 1). On June 2014, over 0.4 billion people use mobile based banking service in China (Iresearch's report). Mobile banking has become one of the important channels for banks to provide services to customers.

In recent years, the mobile instant messaging is developing quite fast. WeChat and Fetion are the most popular instant messengers. First released in January 2011, WeChat, a mobile text and voice messaging communication service developed by Tencent in China, is the largest standalone messaging app by monthly active users. Developed by China Mobile, a Chinese telecommunication company, Fetion is an instant messaging (IM) client which allows users to send and receive SMS free of charge between PCs and mobile phones. The number of WeChat's users has exceeded 600 million on June 2014. Tencent Holdings Limited expects WeChat's customers to reach 1 billion people at the end of 2015 (Tencent official website). The number of fetion's users has also exceeded 100 million on January 2014 (China Mobile Limited official website). Therefore the web-based mobile customer services have become increasingly important for corporations. The banking industry finds this big opportunity and many banks start to enter the mobile internet service market and open the official WeChat accounts to serve mobile banking customers.

Another significant customer service channel is mobile based blog. China Internet Network Information Center announced that there are 0.275 billion mobile internet based blog users on June 2014 and the number is

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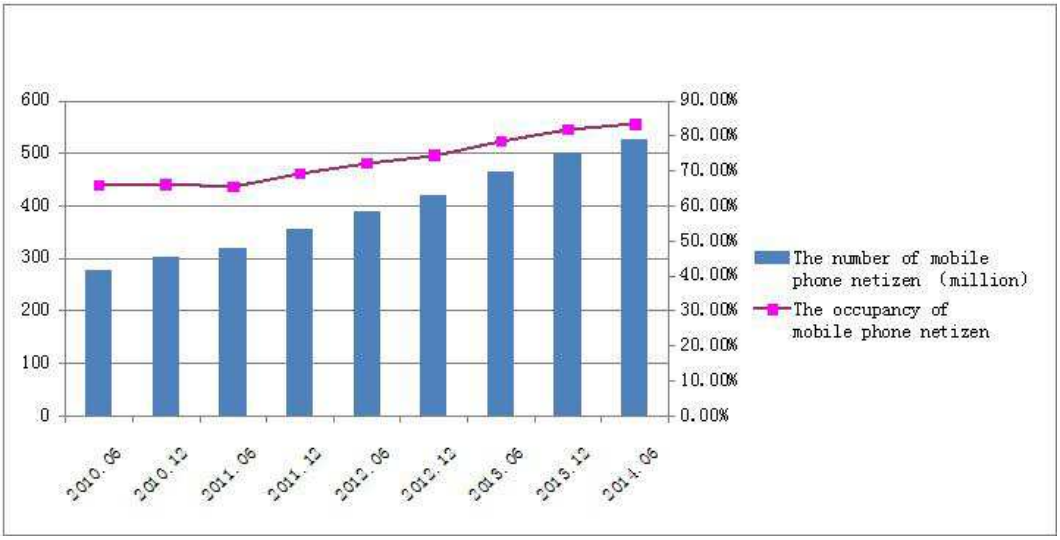

Fig. 1: Chinese mobile phone netizen

still increasing in China (CNNIC's report). Besides, 27 banks open the official blog accounts to serve mobile banking customers on June 2014 (www.blog.sina.com.cn). Official blog account can supply many different kinds of services, like recruitment information, promotion information, product introduction, product description, online customer service etc. So we can see the web-based mobile CRM in banking sector is becoming more and more important in China. Measuring mobile internet based CRM implementation in banking sectors is also a significant issue in China. Since few researches focus on web-based mobile CRM implementation, authors of this paper attempt to use Structural Equation Modeling (SEM) to establish a web-based mobile CRM performance model and illustrate the relationships among web-based mobile CRM, service attribute, customer intention and relationship quality.

SEM is a statistical technique for testing and estimating causal relations through the use of combination of statistical data and qualitative assumptions. SEM has been widely used in healthcare, logistics, information management, banking, psychology, marketing and tourism management. Structural equation model has become a preferred data analysis method for empirical research. Following the trend in empirical research, authors adopt SEM to analyze the first-hand data from survey.

2 Literature Review

2.1 Relationship quality

Following the early works of Hamilton [1] and Terman [2], many scholars have studied relationship quality in their researches such as Zeithaml [3], Roloff and Miller [4], Crosby et al. [5], Hennig-Thurau and Klee [6] The studies mentioned that relationship quality could be recognized as the level of adequate fulfillment of the needs of the customer associated with the relationship. Crosby et al. [5] considered that relationship quality was the overall assessment of the strength of a relationship between two parties, namely, the quality of the relationship between corporations and customers that determined the probability of continued interchange between the two parties in the future. In recent researches, Sivaraks et al. [7] confirmed that e-CRM system implementation had positive relationship with relationship quality. Therefore, authors think web-based mobile CRM may have an important relationship with relationship quality in banking industry.

Relationship quality comprises several key factors that reflect the overall nature of relationships between corporations and their customers [8]. Wong and Sohal [9] found trust was an important factor to affect the relationship stability and overall relationship quality. Storbacka et al. [10] defined customer satisfaction as customers cognitive and affective evaluation based on their personal experiences across all service episodes within the relationship. Gundlack et al. [11] illustrated that commitments by both parties were powerful indicators of relationship quality. Authors believe that relationship quality can reflect CRM system implementation. Through the thorough study of related literature, the major factors of relationship quality were selected as interactivity, trust, satisfaction, commitment, loyalty and recommendation.

2.2 Service attribute

There are many academic articles related to service attributes. The indicators of service attributes are different among different industries. In banking industry, Waite and Harisson [12] believed that it was essential for accurate information to be introduced into e-banking services since it is an important benchmark through which banking customers can judge the service quality. Another service attribute in web-based mobile banking service is convenience. Most banks' customers want to use bank services at their convenience. Web-based mobile banking services empower customers to meet their needs at any time, any place, in any way and even novices can have immediate access to vital internet banking functions 24 hours a day and 7 days a week [13]. Web-based mobile banking has changed the business of retail banks significantly in increased convenience for the customers [14]. Therefore, convenience is an important attribute for web-based mobile banking service. The third important attribute is communication in web-based mobile banking service. Communication involves increased credibility, timeliness and accuracy of information exchanged [15]. Good communication could help to resolve disputes and align perceptions and expectations [16]. In recent researches, Sivaraks et al. [7] confirmed that CRM system implementation had positive relationship with service attributes. By studying previous researches, service attribute indicators were listed as information, convenience and communication.

2.3 Customer Intention

With the rapid development of IT industry and web-based service, consumers can compare the services of different firms through the internet more easily, so customer intention related studies turn out to be really important. Davis [17] developed the Technology Acceptance Model (TAM) to measure web-based customer intention. Tan & Teo [18] and Cheng et al. [19] have extensively verified using factors that affect consumers' intentions toward using web-based mobile markets. In these studies, perceived ease of use and usefulness are two important factors used to measure customer intention. Another factor to measure customer intention is empathy, which focuses on individual customer's care and attention. Through the understanding of customers' care and attention, firms will know their intention more clearly. Fishbein et al. [20] specified that behavioral retention constitutes the most immediate representative of actual behavior. The studies of Garbarino and Johnson [21] regarded customer retention as surrogates for actual behavior. So authors could treat retention as a factor to represent customer intention. The major factors of customer intention are retention, empathy, ease of use and usefulness.

3 Construct and Hypothesis

Many researchers selected SEM to be the statistical tool for their studies. Cheng et al. [22] used SEM to understand customers' intention to adopt internet banking. Lu et al. [23] adopted SEM to reveal intention of shippers to use Internet services in liner shipping. Kelly [24] employed SEM to calculate the magnitude and significance of explanatory variables on residential energy consumption. So the SEM is a suitable statistical tool to reveal consumers' intention.

According to the possible connection among web-based mobile CRM, service attribute, customer intention and relationship quality in handling private data, a direct relationship might be established among the four concepts. Following prior studies, one construct is addressed in the present study involving web-based mobile CRM, service attribute, customer intention and relationship quality, all of which have been elaborated in previous paragraphs. The relationships among web-based mobile CRM, service attribute, customer intention and relationship quality, as embedded in the hypotheses, are now illustrated in Figure 2.

Taking into account the previous studies, the relationship among web-based mobile CRM, service attribute, customer intention and relationship quality are evident in personal data handling and should be examined in greater details. With the aim of testing these connections, the following hypotheses are proposed:

H1. There will be a positive relationship between web-based mobile CRM and service attribute.
H2. There will be a positive relationship between web-based mobile CRM and relationship quality.
H3. There will be a positive relationship between web-based mobile CRM and customer intention.
H4. There will be a positive relationship between service attribute and relationship quality.
H5. There will be a positive relationship between customer intention and relationship quality.

4 Materials and Methods

4.1 Data collection

The generation of the initial questionnaire was ascertained by interviews with experts and scholars in banking industry as well as in-depth discussions with web-based mobile banking customers. Pre-tests of the initial 22-item questionnaire were carried out with 40 targeted customers to improve the questionnaire. The resulting modified 16-item pool was presented to web-based mobile banking customers in drop survey. Respondents were asked about their attitudes towards web-based mobile banking CRM service in the questionnaire. Non-random method of collecting the data (volunteer sampling) generated 388 valid questionnaires.

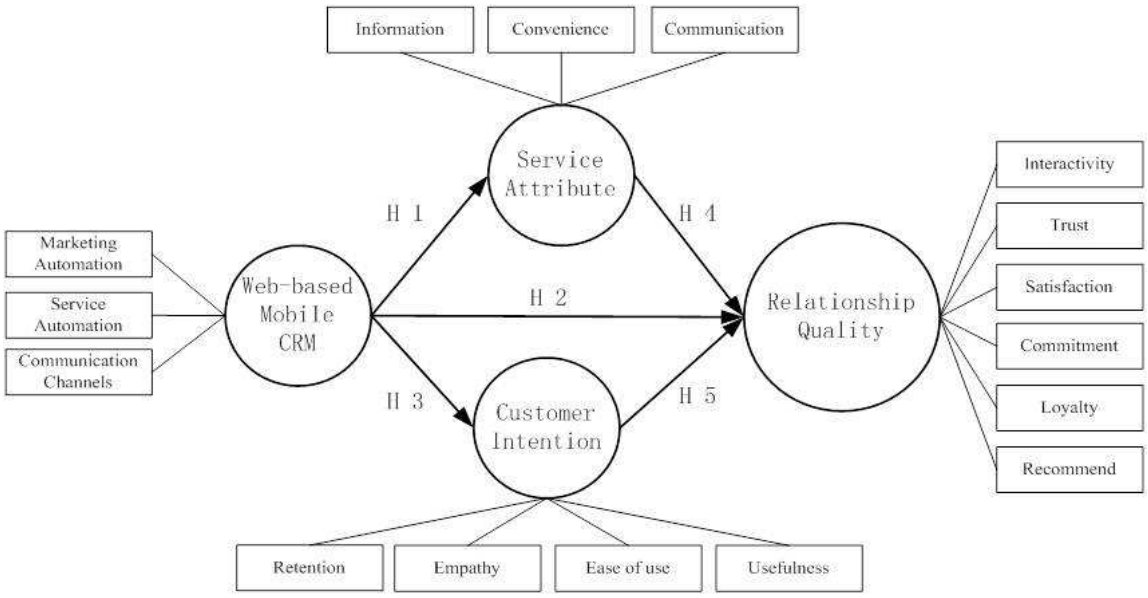

Fig. 2: Research Factors and Hypotheses in the Present Study

So authors compared some of the results in the survey with available information about the population and found that the results are very similar. As a consequence, authors may conclude that our sample represents the profile of the average mobile banking service.

4.2 Exploratory Factor Analysis

An exploratory factor analysis using SPSS 17 (SPSS is a software package used for statistical analysis produced by SPSS Inc. 17 means No. 17 version.) was conducted on all the data. The rotated factor matrix, resulting from a Direct Oblimin rotated principal axis factor extraction of the independent variables using the 1.0 eigenvalue cut-off criterion (see Table 1), indicates that sixteen factors emerged and reports their factor loadings.

The data were tested using the SPSS 17 Exploratory Factor Analysis to evaluate the Cronbach alpha, a coefficient of internal consistency commonly used as an estimate of the reliability of a psychometric test for a sample of examinees. Some scholars consider that it underestimates reliability (reliability in quantitative research can be translated into legitimate corresponding operations for qualitative research) [25]. Consequently, the use of composite reliability has been suggested [26] to adopt a cut-off value of 0.7. The results show the value for web-based mobile CRM's Cronbach alpha is 0.88; the value for service attribute's Cronbach alpha is 0.856; the value for customer intention's Cronbach alpha is 0.899; the value for relationship quality's Cronbach alpha is 0.932. This is satisfactory. Each item was evaluated individually to ensure convergent validity and item reliability. All factor loadings were larger than 0.5, representing an acceptable significant level of internal validity. The factor loadings ranged from 0.642 to 0.836 for web-based CRM; from 0.677 to 0.836 for service attribute; from 0.774 to 0.905 for customer intention; from 0.674 to 0.882 for relationship quality. All factor loadings were of an acceptable significant level, so all sixteen items were retained for further analysis (see Table 1).

4.3 Confirmatory Factor Analysis

Authors developed a Structural Equations Model (SEM) with the objective of testing the proposed hypotheses (Figure 3). Authors observed that the hypothesis was supported at the 0.05 level and, in a similar way. Model fit was acceptable (Chi-square =159.457 df=95, $p < 0.05$, normed Chi-Square=1.678) Through calculation, authors obtained Structural Equations Model (SEM) fit indexes, and listed the process in the coming paragraphs.

The GFI (goodness of fit index) was devised by Jöreskog and Sörbom [27] for MI and UI estimation, and generalized to other estimation criteria by Tanaka and Huba [28]. The GFI is given by

$$\mathrm{GFI} = 1 - \frac{\hat{F}}{\hat{F}_b} \tag{1}$$

Where $\hat{F}$ is the minimum value of the discrepancy function and $\hat{F}_b$ is obtained by evaluating F with $\sum^{(g)} = 0, g = 1, 2, \cdots, G$. An exception has to be made for maximum likelihood estimation, since (D2) is not defined

Table 1: Factor Loading

Factors	Factor loading	Cronbach alpha	Construct Reliability (CR)	AVE
WB CRM		0.880	0.8801	0.710
MA	0.836			
SA	0.714			
CC	0.642			
S-Attribute		0.856	0.8558	0.6643
IN	0.677			
CON	0.777			
COM	0.836			
C-Intention		0.899	0.8999	0.6922
RE	0.774			
EM	0.895			
EU	0.789			
US	0.905			
R-Quality		0.932	0.9303	0.6920
IN	0.674			
TR	0.686			
SA	0.769			
CO	0.820			
LO	0.706			
RE	0.882			

Used SPSS Principal Axis Factoring extraction with Direct Oblimin rotation method.

for $\sum^{(g)} = 0$. For the purpose of computing GFI in the case of maximum likelihood estimation, $f(\sum^{(g)}, S^{(g)})$ is calculated as:

$$f\left(\sum^{(g)}, S^{(g)}\right) = \frac{1}{2}\mathrm{tr}\left[K^{(g)^{(-1)}}(S^{(g)} - \sum^{(g)})\right]^2 \quad (2)$$

with $K^{(g)} = \sum^{(g)}(\hat{\gamma}_{\mathrm{ML}})$, where γ_{ML} is the maximum likelihood estimate of γ. By using the formula (1) and (2), authors calculated the Model's GFI as 0.951.

The AGFI (Adjusted Goodness of Fit Index) takes into account the degrees of freedom available for testing the model. It is given by

$$\mathrm{AGFI} = 1 - (1 - \mathrm{GFI})\frac{d_b}{d} \quad (3)$$

Where

$$d_b = \sum_{g=1}^{G} p^{*(g)} \quad (4)$$

Through the use of the formula (3) and (4), authors got that the model's AGFI value is 0.930.

The Bentler-Bonett normed [29] fit index (NFI), or Δ_1 in the notation of Bollen [30] can be written as

$$\mathrm{NFI} = \Delta_1 = 1 - \frac{\hat{C}}{\hat{C}_b} = 1 - \frac{\hat{F}}{\hat{F}_b} \quad (5)$$

Where $\hat{C} = n\hat{F}$ is the minimum discrepancy of the model being evaluated and $\hat{C}_b = n\hat{F}_b$ is the minimum discrepancy of the baseline model. By using the formula (5), authors calculated the Model's NFI as 0.970.

The comparative fit index (CFI; [31]) is given by

$$\mathrm{CFI} = 1 - \frac{\max(\hat{C} - d, 0)}{\max(\hat{C}_b - d_b, 0)} = 1 - \frac{\mathrm{NCP}}{\mathrm{NCP}_b} \quad (6)$$

Where $\hat{C}$, d and NCP are the discrepancy, the degrees of freedom and the noncentrality parameter estimate for the model being evaluated, and $\hat{C}_b d_b$ and NCP_b are the discrepancy, the degrees of freedom and the noncentrality parameter estimate for the baseline model. According to the formula (6), authors figured out that the Model of the study's CFI is 0.987.

F_0 incorporates no penalty for model complexity and tends to favor models with many parameters. In the comparison between the two nested models, F_0 will never favor the simpler model. Steiger and Lind [32] suggested compensating for the effect of model complexity by dividing F_0 by the number of degrees of freedom for testing the model. Taking the square root of the resulting ratio gives the population "root mean square error of approximation", called RMS by Steiger and Lind [32], and RMSEA by Browne and Cudeck [33].

$$\text{Population RMSEA} = \sqrt{\frac{\mathrm{F}_0}{d}} \quad (7)$$

$$\text{Estimated RMSEA} = \sqrt{\frac{\hat{\mathrm{F}}_0}{d}} \quad (8)$$

The results show that the RMSEA index is 0.042.

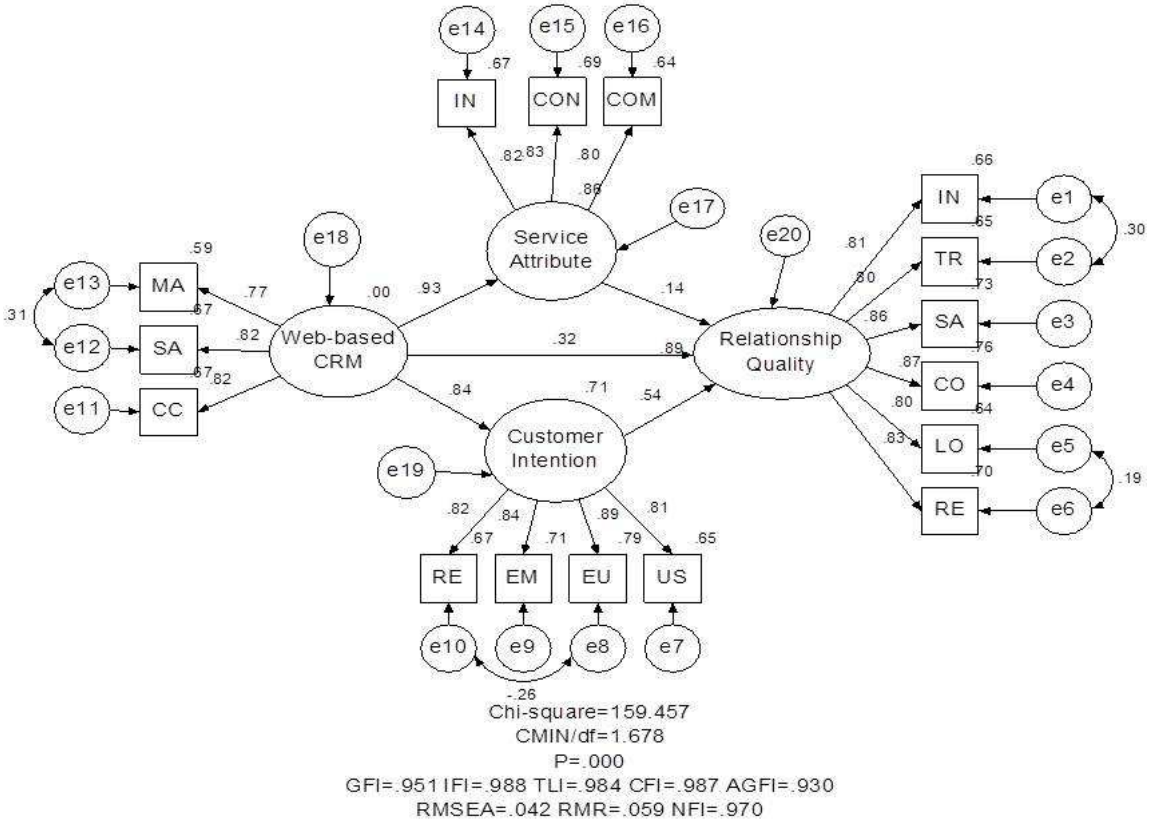

Fig. 3: The Structural Equation Model

In conclusion, our model exhibited a reasonable fit with the data collected. We assessed the model fit using other common fit indices: goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), comparative fit index (CFI), root mean square error of approximation (RMSEA) and root mean square residual (RMR). The model exhibited a fit value exceeding or close to the commonly recommended threshold for the respective indices and the commonly suggested valued would be listed in Table 2.

Table 2: Fit statistic of final model

Fit statistic	Suggested	Obtained
Chi-square		159.457
Df		95
Chi-square significance	$P \leq 0.05$	0.000
Chi-square/df	< 3	1.678
GFI	> 0.90	0.951
AGFI	> 0.90	0.930
NFI	> 0.90	0.970
CFI	> 0.90	0.987
RMSEA	< 0.05	0.042
RMR	< 0.1	0.059

4.4 Construct Reliability Analysis

The construct reliability of the latent variables is an evaluation standard for the inner quality in a structural equation model. If the construct reliability (CR) is higher than 0.7, the inner quality of the model is considered to be acceptable [34]. The authors will use the model standardized regression weights to calculate the Construct reliability, presented as ρ_c. Construct reliability of web-based mobile CRM, service attribute, customer intention and relationship quality were calculated at a suggested lower limit of 0.70 with equation (9). The results have been shown in the Table 1.

$$\rho_{c1} = [\frac{(\sum \lambda_1)^2}{(\sum \lambda_1)^2 + \sum \theta_1}] \tag{9}$$

Another index, similar to construct reliability, is "average variance extracted (AVE)," presented as ρ_v. This index can explain how much variance explained in the latent variable comes from the observed variables. The higher the average variance extracted, the better the observed variables could explain the latent variable. Generally speaking, the model's inner quality is considered to be good when the average variance extracted is higher than 0.5. The average variance extracted from web-based

mobile CRM, service attribute, customer intention and relationship quality were calculated at a suggested lower limit of 0.50 with equation (10). The results have been shown in the Table 1.

$$\rho_{v1} = [\frac{(\sum \lambda_1^2)}{(\sum \lambda_1^2) + \sum \theta_1}] \quad (10)$$

4.5 Results of hypothesis testing

After establishing an acceptable measurement model, authors evaluated the structural model shown in a path diagram in Figure 2. The Path coefficients and their significance values are reported in Table 3. The results of the SEM analysis show that H1, H2, H3 and H5 were supported, while H4 were not supported.

To test the statistical significance of the parameter estimates from SEM, the Critical Value (C.R.), which represents the parameter estimate divided by its standard error (S.E.), is used. Based on a significance level of 0.05, the C.R. needs to be $> \pm 1.96$. The factor loading between service attribute and relationship quality (Table 3) was 0.14 (with C.R.= 1.050, p=0.294), which was not significant. The first column in Table 3 expresses the influence degree of each independent variable for the dependent variable. And Figure 4 illustrates the significant structural relationships among the study variables.

The results of hypothesis testing express that the customer intention has the biggest influence compared to service attribute and web-based mobile CRM as well as relationship quality for consumers to adopt mobile commercial banking service. Since mobile commercial banking service is a new service of banks, most customers would like to have a try first. Therefore, customer intention is the preferential issue when adopting mobile commercial banking service. Besides, web-based mobile CRM to service attribute have high coefficient. The reason of this result is that web-based mobile CRM can improve customer service quality and service attribute.

The results from path analysis showed that the direct path coefficient of web-based mobile CRM to service attribute was positive and significant ($\rho = 0.93$); thus, H1 was supported. As shown in Fig.3, the path coefficient of Web-based mobile CRM to relationship quality was positive and significant ($\rho = 0.32$); thus, H2 was also supported. In additionthe path coefficient of web-based mobile CRM to customer intention was positive and significant ($\rho = 0.84$); thus, H3 was also supported. Moreover, the path coefficients, shown in Table 3, indicated that there were statistically significant direct effects of web-based mobile CRM on all of service attribute relationship quality and customer intention.

To test the mediating role of customer intention on the relationship paths between web-based mobile CRM and relationship quality, the indirect effect was analyzed. Not only was the direct effect of web-based mobile CRM on relationship quality significant, but also the indirect effect of web-based mobile CRM through customer intention was significant, with a path coefficient of 0.54. Therefore, H5 was supported. The conclusions of the indirect effect hypothesis testing and the indirect path coefficient are both shown in Table 3.

Therefore, this research study found that banks that implement web-based mobile CRM can make customers feel positive because web-based mobile CRM enables the banks to provide customers with complete information, greater convenience, empathy, ease of use and usefulness.

5 Conclusions and Implications

5.1 Academic implications

This study helps infilling researches on web-based mobile CRM measurement since it provides a measurement model of web-based mobile CRM from the perspective of customers. Service attribute and customer intention were developed into a construct to measure web-based mobile CRM's relationship quality from the consumers' viewpoints. The factor analysis results demonstrated that seven factors (information, convenience, communication, retention, empathy, ease of use and usefulness) are central to the evaluation of Chinese commercial banks' web-based mobile CRM implementation.

Path analysis found that customer intention plays an essential mediating role in the relationship between web-based mobile CRM and relationship quality. Relationship quality, which comprises interactivity, trust, satisfaction, commitment, loyalty and recommendation, is the result of customers' recognition of the major banks' web-based mobile CRM through information, convenience, communication, retention, empathy, ease of use and usefulness factors.

This research also described the mediating role of service attributes. The causal-effect results show that web-based mobile CRM has a direct effect and service attributes do not have a mediating effect on the relationship path between web-based mobile CRM and relationship quality.

5.2 Managerial implications

This study focused on customers' perspectives on the aspects of the major banks' web-based mobile CRM. The scope of the study is fundamentally characterized by the context of Chinese commercial banks. Findings from this study show that many Chinese commercial banks still have not put enough emphasis on web-based mobile CRM. Only ten banks have implemented web-based mobile CRM, one of which is WeChat banking account. That is to say, there is still enough room for the improvement of web-based mobile CRM in Chinese commercial banks.

Table 3: Path coefficients and their significance values

Path	Standardized coefficients	S.E.	C.R.	P
service attribute ← web-based mobile CRM (H1)	0.87	0.053	16.438	***
relationship quality ← web-based mobile CRM (H2)	0.32	0.162	1.976	0.048*
customer intention ← web-based mobile CRM (H3)	0.783	0.052	14.961	***
relationship quality ← service attribute(H4)	0.148	0.141	1.050	0.294
relationship quality ← customer intention(H5)	0.585	0.075	7.805	***

Note: *p< 0.05, **p< 0.01, ***p< 0.0001.

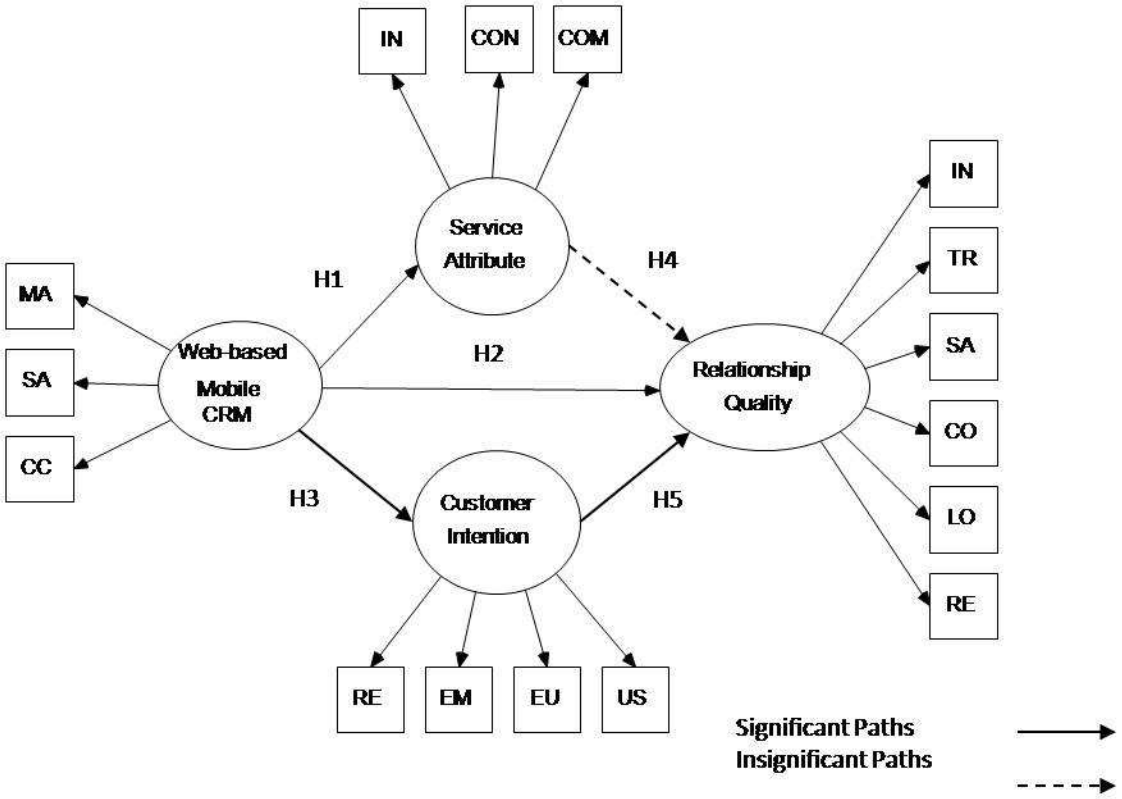

Fig. 4: Structural equation results model

When banks implement web-based mobile CRM, customers recognize that the major banks can provide them with (1) more convenience, like 24 hour banking service, (2) access to latest and accurate information, and (3) more communication channels that allow them to contact the major banks anywhere. One of the great benefits of web-based mobile CRM is that consumers can recognize the increase in convenience.

This study confirmed the important role of web-based mobile CRM in Chinese commercial banks. The results show that web-based mobile CRM has statistically significant effects, both direct and indirect, on relationship quality. The statistical results show that web-based mobile CRM is a viable means of increasing the bank-customer relationship quality, which comprises interactivity, trust, satisfaction, commitment, loyalty and recommendation. These results indicate that if banks implement web-based mobile CRM, the customers will recognize additional service attribute and customer intention and their relationship with the banks will be improved.

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Conflict of Interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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