Research on Bank APP User Experience Evaluation Model Based on Analytic Hierarchy Process

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Abstract—Bank APP is an important medium for the digital transformation of banking business. By building a bank APP user experience evaluation model, evaluate the user experience level of existing bank APP products, so that the bank APP is more in line with the needs of the bank's online customer groups. By analyzing the characteristics and trends of bank APP update iterations at the current stage, summarizing the bank APP experience quality evaluation criteria and demand elements, and constructing a bank APP user quality of experience (QoE) evaluation model. Using the fuzzy analytic hierarchy process (AHP), the judgment matrix of the QoE evaluation model is established, and the weight values of the evaluation indicators are calculated according to the judgment matrix, and the weight values obtained are sorted. On the basis of analyzing the development trend of bank APP at the present stage, the evaluation index of user experience quality of bank APP is determined, and a user experience evaluation model with detailed weight and more time-effectiveness is established. The validity of the model is verified by consistency test.

Keywords-bank APP; user experience; evaluation model; analytic hierarchy process

1 INTRODUCTION

With the rapid development and popularization of mobile Internet, and the catalysis of the COVID-19 epidemic, the scale of online customer groups of commercial banks has grown rapidly[1], drive the digital transformation of banking business. The bank APP is an important medium for the digital transformation of banking business. According to relevant statistics, in 2022, the number of active mobile banking APPs will reach an annual peak of 540 million in September. Retail business for individual users is the key business of commercial banks at this stage, and according to the "*2022 China Digital Finance Survey Report*", the proportion of personal mobile banking APP users will reach 86% in 2022, a year-on-year increase of 5%. Therefore, mobile banking apps have become an important factor that directly affects the reputation of banks. How to measure the level of user experience is an important issue faced by banks[2]. At the same time, individual users' demand for banking APPs is increasing day by day. Banking APPs are constantly updated and iterated to provide users with more comprehensive product functions and services[3]. The purpose of this paper is to build a bank APP user experience evaluation model based on the analytic hierarchy process, combined with the current characteristics and trends of bank APP upgrade iterations. The research can not only evaluate the user experience level of the existing bank APP, but also help the bank to accurately identify whether its APP meets the experience needs of the online banking customer group, so

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as to optimize the design scheme and increase the number of online customers.

2 LITERATURE REVIEW

2.1 User experience (UX)

User experience, referred to as UX, is a purely subjective feeling established by users in the process of using a product. The term UX was widely recognized in the mid-1990s and was proposed and promoted by *Donald Norman*. *Donald Norman* [4] believes that UX covers all aspects of human experience with the system, including industrial design, graphics, interface, physical interaction, etc. Since each researcher will add, delete or modify some concepts for UX according to his own background or interests when defining UX, there is no unique and universal concept of UX, but most researchers agree with UX can be summarized as two aspects of objective practicality (such as functionality, usability) and subjective feelings (such as pleasure, enjoyment, stimulation) [5].

Traditional approaches to user experience evaluation tend to focus on narrowly defined usability criteria, but recent approaches have increasingly focused on subjective responses, including the emotional aspects of user experience, often expressed as user satisfaction metrics[6]. Usability testing tends to focus on the performance of tasks, while UX focuses on the user's real experience, and user motivation and expectations play a more important role in UX[7].

2.2 Bank APP Development Trend

Many banks have created their own financial communities on the mobile banking platform, providing users with a variety of wealth information and open communication space, and by connecting private domain institutions and users, they can more accurately recommend financial products according to the needs of target user groups and service.

The community channel created on China Merchants Bank APP realizes the integration of social scenes and financial services, introduces senior financial experts and high-quality media, uses the China Merchants Bank APP to recommend the latest financial information to users in real time, and provides users with a window to discuss and express opinions, so that users Transform from a traditional bank "bystander" to a "participant" to facilitate the formation of a complete content ecological closed loop[8]。The circle tab of APP of Industrial Bank Co., Ltd. provides the function of connecting exclusive account managers and financial managers to provide users with professional financial information and advice. Bank of Communications mobile banking version 6.0 has added a community tab to provide wealth information and support user discussions and exchanges. Agricultural Bank of China mobile banking version 7.0 provides a wealth subscription account, and users can obtain expert analysis in real time.

In addition to "Finance + Community", the concept of "Finance + Life" is also constantly expanding. The service scenarios of mobile banking APP are constantly enriched, expanding from the initial payment of water, electricity, gas and other living expenses to medical care, travel, education, government affairs and other fields. For example, China Merchants Bank has cooperated with Alibaba's food delivery software and e-commerce software to provide users with discounts.

From the above bank APP examples, it can be found that in addition to traditional financial services, bank APPs also provide users with more high-quality and novel financial services in the form of communities, and some of them also provide social functions on the basis of communities. The provision of more and more comprehensive life services is also one of the development trends of banking APP.

3 CONSTRUCTION OF USER EXPERIENCE EVALUATION MODEL BASED ON AHP

Analytic Hierarchy Process, referred to as AHP, is a hierarchical weight decision-making analysis method proposed by American operations researcher Saaty.T.L. in the early 1970s. AHP is a method that combines qualitative and quantitative analysis to solve multi-indicator comprehensive problems, which can greatly weaken the intervention of subjective factors on evaluation to ensure the rationality of the evaluation model[9].

According to the above-mentioned development trends and characteristics of bank APPs, combined with relevant literature on user experience, the primary indexes of bank APP user experience quality are constructed into three levels: functionality (X), usability (Y), and ease of use (Z). The three levels are subdivided into nine secondary indexes, namely financial services (X_1), social service (X_2), life service (X_3), efficiency (Y_1), effectiveness (Y_2), user satisfaction (Y_3), ease of learning (Z_1), affordance (Z_2), operability (Z_3). Among them, affordance (Z_2) does not have a unified definition, and the term is used in various ways to explain the relationship between people and technology[10]. Here, affordance as a secondary index means the comprehensibility of specific function names and icons in the bank APP, that is, whether the user can understand that the function is available in the bank when seeing the function name or icon. The role of the APP or the tasks that can be completed.

Then compare the three primary indexes, and then compare the nine secondary indexes step by step to establish the evaluation index of bank APP user experience quality, as shown in Figure 1.

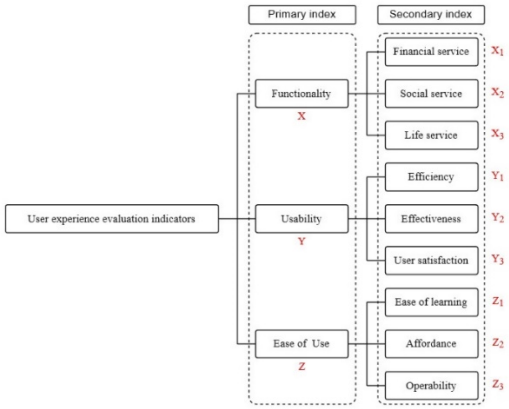

Figure 1. Bank APP user experience quality evaluation indexes

In the AHP, it is necessary to construct a judgment matrix for each level of indexes, and compare the importance of indexes in the same matrix in turn. The scale of the judgment matrix is defined by the fuzzy number 1 to 9 or the reciprocal of 1 to 9, and the value on the scale reflects the level of importance between the two indexes, so as to construct the judgment matrix.

Adopting the method of user questionnaire survey, let 5 postgraduates majoring in industrial design evaluate each index and submit their opinions. Gradually tend to concentrate, get consistent results, and then construct the judgment matrix of each index. Through the geometric mean method, calculate the scale value product M_i of each row in the judgment matrix, as shown in formula (1), then calculate the geometric mean a_i of M_i, as shown in formula (2), and finally normalize, as shown in formula (3). The weight ω of each index is obtained, as shown in Table 1, Table 2, Table 3, and Table 4.

$$M_i = \prod_{j=1}^{m} b_{ij} \qquad (i = 1,2,\dots,m) \tag{1}$$

$$a_i = \sqrt[m]{M_i} \qquad (i = 1,2,\dots,m) \tag{2}$$

$$\omega_i = \frac{a_i}{\sum_{i=1}^{m} a_i} \tag{3}$$

Table 1. Primary index matrix and weight calculation results

	X	Y	Z	ω
X	1	1	3	0.405
Y	1	1	5	0.481
Z	1/3	1/5	1	0.114

Table 2. Secondary index matrix of X and weight calculation results

	X_1	X_2	X_3	ω
X_1	1	9	2	0.639
X_2	1/9	1	1/3	0.081
X_3	1/2	3	1	0.279

Table 3. Secondary index matrix of Y and weight calculation results

	Y_1	Y_2	Y_3	ω
Y_1	1	1/5	1/3	0.114
Y_2	5	1	1	0.481
Y_3	3	1	1	0.405

Table 4. Secondary index matrix of Z and weight calculation results

	Z_1	Z_2	Z_3	ω
Z_1	1	5	3	0.637
Z_2	1/5	1	1/3	0.105
Z_3	1/3	3	1	0.258

According to the rules of AHP, it is also necessary to pass the consistency test to ensure the consistency and compatibility of the evaluation in the judgment matrix. The consistency ratio value CR is the standard for judging whether the consistency test is passed. When $CR \leq 0.1$, it is judged that the consistency of the judgment matrix is established. The calculation method of the consistency ratio value CR is shown in formula (4), and the calculation method of the consistency index CI is shown in the formula (5). The consistency index RI is a constant value. When the matrix order is 3, RI= 0.52.

$$CR = \frac{CI}{RI} \tag{4}$$

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{5}$$

After calculation, the consistency test results are obtained, as shown in Table 5.

Table 5. Consistency test results

	Primary index	Secondary index		
		X	Y	Z
λ_{max}	3.03	3.02	3.03	3.04
CI	0.015	0.010	0.015	0.020
RI	0.52	0.52	0.52	0.52
CR	0.029	0.019	0.029	0.038

It can be seen from Table 5 that the CR values of the consistency indicators of the primary index and the secondary index are all less than 0.1, which proves that the judgment matrices in Table 1, Table 2, Table 3, and Table 4 have passed the consistency test.

Summarize the weight values to form a bank APP user experience evaluation model, as shown in Table 6.

Table 6. Bank APP user experience evaluation model

Primary index	Weight	Secondary index	Relative weight	absolute weight
Functionality	0.405	Financial service	0.639	0.259
		Social service	0.081	0.033
		Life service	0.279	0.120
Usability	0.481	Efficiency	0.114	0.055
		Effectiveness	0.481	0.231
		User satisfaction	0.405	0.195
Ease of Use	0.114	Ease of learning	0.637	0.073
		Affordance	0.105	0.012
		Operability	0.258	0.029

In order to make the weight calculation results more intuitive, the pie charts of the primary indexes and the secondary indexes are drawn respectively, as shown in Figure 2 and Figure 3.

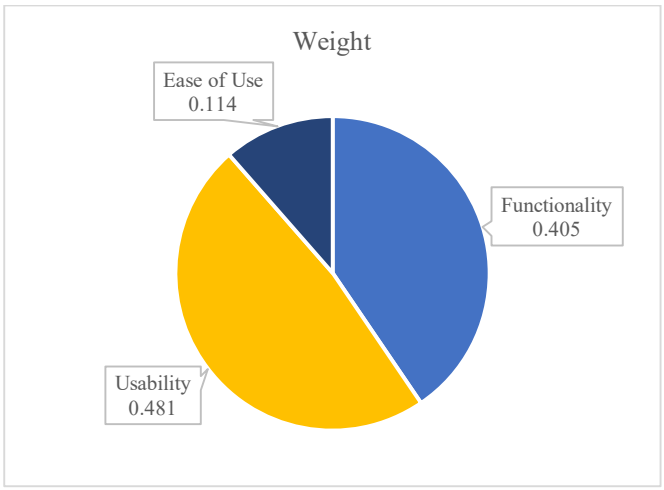

Figure 2. Pie chart of the primary indexes

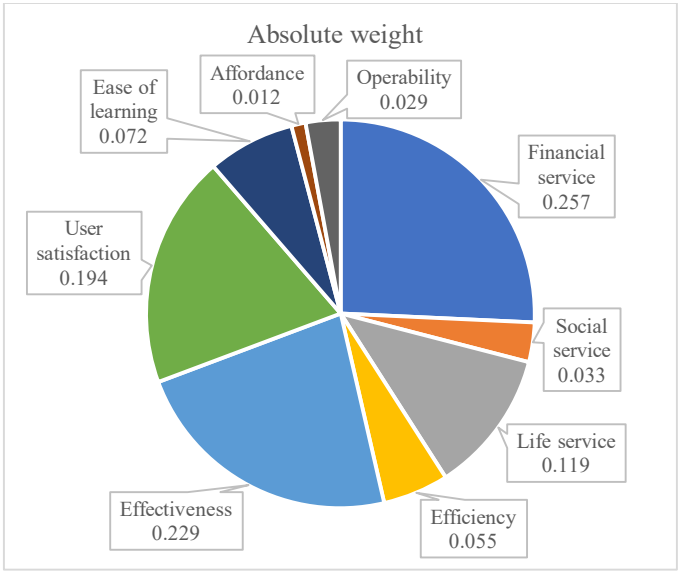

Figure 3. Pie chart of the secondary indexes

In the bank APP user experience quality model calculated according to the AHP, the primary index with the largest weight is usability, and the secondary index is biased towards financial services. According to the ranking results of indicator weights, banks should focus on the usability of APP. And in terms of functionality, in addition to providing financial services to users, APP of banks should also focus on meeting the life service needs of online customer groups.

4 CONCLUSIONS

This paper analyzes and summarizes the characteristics and trends of mobile banking App update iterations at the current stage, determines the user experience evaluation index, and then uses the AHP to determine the index weight, builds the user experience evaluation model of mobile banking App, and passes the consistency test. Evaluate the effectiveness of the model. The mobile banking App user experience evaluation model established in this paper is conducive to banks to control the update and iterative direction of App design, so that it conforms to the overall development trend at this stage, so as to better provide mobile financial services for users. The model constructed in this paper is applicable to mobile banking apps at this stage. The Internet is changing rapidly, and the development trend of banking apps will change in the future, and even the platform for digital transformation of banks will also be replaced. The user experience evaluation model of digital banks in the future needs further research.

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