Identifying the Quality Evaluation Indicator of CRM using an Extended DEMATEL Method

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Abstract: **The quality evaluation indicator system of CRM(Customer Relation Management) is the basis of understanding their business capacity for commercial banks. First, the quality evaluation indicator system is constructed; then, corresponding analysis model is suggested by the DEMATEL(Decision Making Trial Evaluation Laboratory) method based on interval scales. Finally, the total degrees of given and received influences, the degree of cause and the importance grade are analyzed.**

Keywords: CRM; quality evaluation indicator; DEMATEL; interval scales

I. INTRODUCTION

CRM is an innovation sales strategy with customer as the center, which receives more and more attentions in recent years. With Chinas accession to WTO, the managing strategy of commercial banks is changing from economy of scale to the customers' benefit. Many banks have currently realized the fact that the customer will be the critical resource[1].

Now the quality of CRM has been a major source to gain the competitive advantage[2]. Therefore, carrying out the quality evaluation for commercial banks is very important. In summary, the research on the CRM quality evaluation indicators of commercial banks has the essential practical signification for improving the business capacity and competitive advantage[3-4]. At present, many scholars have done many research works in the aspect of CRM quality evaluation form different standpoints. Sivaraks P/Krairit D/Tang J C (2011) examined and measured the outcomes of electronic customer relationship management (e-CRM) system implementation in the Thai banking industry from customers' perspectives[5]. Karahan M/ Kuzu Ö H (2014) made an attempt the CRM practices in the context of banking services, and surveying method has been used in order to collect data[6], etc. The analytic method of the CRM quality evaluation mainly take the fuzzy comprehensive evaluation, analytic hierarchy process and fuzzy DEMATEL based on triangular fuzzy number. However, there methods are so subjective as to render the results meaningless, and fuzzy DEMATEL based on triangular fuzzy number still exists operation difficult. Accordingly, this paper proposes an extended DEMATEL method based on interval scales, which is put forward for identifying the CRM quality evaluation indicator.

II. THE CONSTRUCTION OF CRM QUALITY EVALUATION INDICATOR SYSTEM

By analyses from related documents and visits some top - level and mid - level management staff in commercial banks, the CRM quality evaluation indicator system is constructed. It is divided into 4 first class criteria and the second criteria of 16(Fig .1)[7-8].

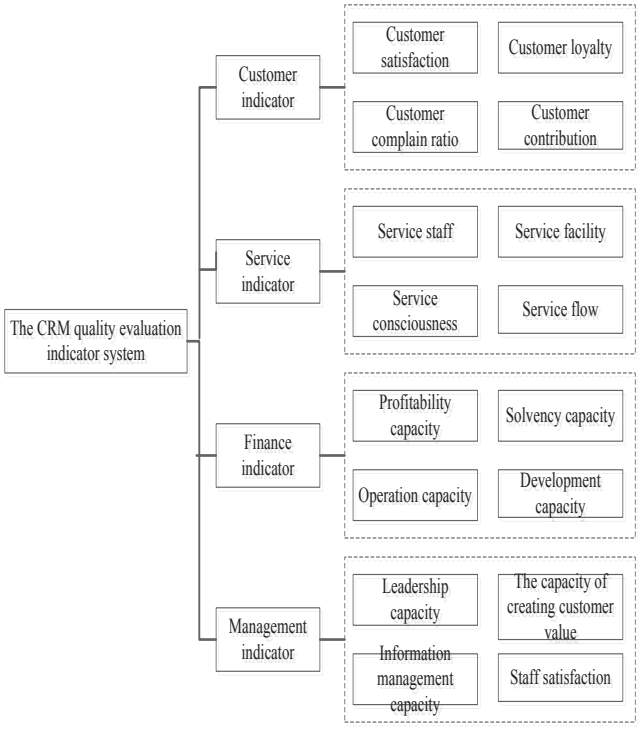

Figure. 1. The CRM quality evaluation indicator system of commercial banks

III. The Analytical Model of the Dematel Method Based on Interval Scales

A. The DEMATEL method

DEMATEL method is presented in 1973. It is a potent method that gathers collective knowledge for capturing the causal relationship between strategic criteria. The method is especially practical and useful for visualizing the structure of complicated causal relationship with matrices or digraphs[9]. In recent years, DEMATEL is becoming an attractive decision tool, and has been successfully applied in many situations, such as marketing strategies, control systems, group decision-making, and so on.

To establish a quality evaluation model of the CRM, experts' judgments for deciding the relationship between indicators are usually derived based on a process group decision making procedure. However, experts tend to give assessments according to their past experiences and knowledge, and their evaluating values are often expressed with actually crisp values in traditional DEMATEL. In fact, the crisp value could not reflect the ambiguities of human assessments. At present, to deal with the ambiguities of human assessments, Lin and Wu propose the extended DEMATEL based on triangular fuzzy number is proposed. But the initial fuzzy numbers has lost their original meaning as a result of defuzzification[10].

B. The DEMATEL method based on interval scales

1) Theoretical basis

Definition1. An interval number is defined as $[a^l, a^u] = \{x \mid a^l \le x \le a^u, a^l, a^u \in R\}$, where a^l is the lower bounded and a^u is the upper bounded.

Definition2. An interval matrix A is defined as $A = [a_{ij}^l, a_{ij}^u]_{n\times n} = \{x_{ij} \mid a_{ij}^l \le x \le a_{ij}^u, a_{ij}^l, a_{ij}^u \in R\}$, where $[a_{ij}^l]_{n\times n}$ is the lower bounded matrix and $[a_{ij}^u]_{n\times n}$ is the upper bounded matrix.

Definition 3. Let a and b be two interval numbers by the $[a^l, a^u]$ and $[b^l, b^u]$ respectively, then supposethat $L(a) = a^u - a^l, L(b) = b^u - b^l$, the possibility $a \ge b$ can be obtained through the following formula[11]:

$$p(a \ge b) = \frac{\min\{L(a) + L(b), \max(a^u - b^l, 0)\}}{L(a) + L(b)}. \quad (1)$$

Supposing the interval numbers $a_1, a_2, \cdots, a_n$, where $a_i = [a_i^l, a_i^u]$. For the interval numbers $a_1, a_2, \cdots, a_n$, where $a_i = [a_i^l, a_i^u]$, we can get the possibility order from the next three steps[12]:

***Step 1*:**Calculating the possibility $p(a_i \ge a_j)$ with (1).

Step2 : Building the possibility complementary matrix $P = (p_{ij})_{n\times n}$, where $p = P(a_i \ge a_j), i, j = 1, 2, \cdots, n.$

***Step3*:**Solving order vectors of the possibility complementary matrix $P = (p_{ij})_{n\times n}$. Calculating the order vectors $\omega = (\omega_1, \omega_2, \cdots, \omega_n)$ of the complementary Judgment Matrices, and sorting the interval numbers according to component size by using the formula(2):

$$\omega_i = \frac{\sum_{j=1}^{n} p_{ij} + \frac{n}{2} - 1}{n(n-1)}, i = 1, 2, \cdots, n. \quad (2)$$

2) The DEMATEL method based on interval scales

Due to the ambiguity and complexity, it is needed to build an extended DEMATEL method by applying interval numbers. The analytical procedure of the proposed method is described as follows:

***Step1*:** Calculating the initial relation matrix (A)

Suppose we have seven experts in this study and sixteen factors to consider. First, measuring the relationship between factors requires that comparison scale be designed into four levels, where scores of 1, 2, 3, and 4 represent "very low influence", "low influence", "high influence", and "very high influence" respectively. Next, each expert is asked to indicate the degree to which he or she believes the factor i affects the factor j. Considering that there is the uncertainly of subjective judgment and the simplicity of calculation, all evaluations are converted into interval number a_{ij}, where $a_{ij} = [a_{ij}^l, a_{ij}^u], a_{ij}^l \le a_{ij}^u (i, j = 1, 2, \cdots, 16)$ .Then, the form of the matrix is shown in (3).

$$A = \begin{bmatrix} 0 & a_{12} & \cdots & a_{1'16} \\ a_{16'1} & 0 & \vdots & a_{2'16} \\ \vdots & \cdots & 0 & \vdots \\ a_{16'1} & a_{16'2} & \cdots & 0 \end{bmatrix} = \begin{bmatrix} [0,0] & [a_{12}^l, a_{12}^u] & \cdots & [a_{1'16}^l, a_{1'16}^u] \\ [a_{21}^l, a_{21}^u] & [0,0] & \vdots & [a_{2'16}^l, a_{2'16}^u] \\ \vdots & \cdots & [0,0] & \vdots \\ [a_{16'1}^l, a_{16'1}^u] & [a_{2'16}^l, a_{2'16}^u] & \cdots & [0,0] \end{bmatrix}. \quad (3)$$

***Step2*:** Normalizing the direct relation matrix (M)

On the base of (A), the normalized direct relation matrix is obtained through (3).

$$M = A / \max_{1\le i\le 16} \sum_{j=1}^{16} a_{ij} = A / \max_{1\le i\le 16} \sum_{j=1}^{16} [a_{ij}^{l}, a_{ij}^{u}], \qquad (4)$$

where $M = (m_{ij})_{16\times 16} = (m_{ij}^{l}, m_{ij}^{u})_{16\times 16}$.

***Step3*:** Calculating the total relation matrix (T)

The total relation matrix (T) can be acquired by using for (5), in which I is denoted as the identity matrix.

$$T = M(I-M)^{-1} = (M^{l}(I-M)^{-1}, M^{u}(I-M)^{-1}) = [t_{ij}^{l}, t_{ij}^{u}]_{16\times 16}. \qquad (5)$$

Step4: Obtaining the sum of rows and columns

The sum of rows and the sum of columns are separately denote as F_j and E_j within the total-relation matrix.

$$F_i = \sum_{j=1}^{16} t_{ij} = \sum_{j=1}^{16} [t_{ij}^{l}, t_{ij}^{u}] = [\sum_{i=1}^{16} t_{ij}^{l}, \sum_{i=1}^{16} t_{ij}^{u}], i = 1,2,\cdots,16,$$
$$E_i = \sum_{j=1}^{16} t_{ij} = \sum_{j=1}^{16} [t_{ji}^{l}, t_{ji}^{u}] = [\sum_{j=1}^{16} t_{ji}^{l}, \sum_{j=1}^{16} t_{ji}^{u}], i = 1,2,\cdots,16. \qquad (6)$$

***Step5*:** Setting up degree of central role and relation

By producing matrix (T), then it is calculated $F_j + E_i$ and $F_j - E_i$ by (7)

$$F_i + E_i = [F_i^{l} + E_i^{l}, F_i^{u} + E_i^{u}], i = 1,2\cdots,16,$$
$$F_i - E_i = [F_i^{l} - E_i^{l}, F_i^{u} - E_i^{u}], i = 1,2\cdots,16. \qquad (7)$$

***Step6*:** Ranking the order about the degree of central role and relation with (1) and (2)

The ranking order of the degree of central represents how much importance the criterion has. Besides, when $(F_i - E_i)$ is positive, the criterion belongs to the cause group. Otherwise, the $(F_i - E_i)$ is negative, the criterion belongs to the effect group.

IV. ANALYSIS OF THE INDICATORS

Based on Fig. 1, seven decision-makers are asked to respond through a series of pairwise comparisons. The scale of measurement for the direct-relation matrix is a scalogram with 5, ranging from "0" as "no influence" to "4" as "very high influence". The initial direct-relation matrix and the total relation matrix are constructed with (3), (4) and (5). Next using (6) and (7), F_j, E_j, $F_j + E_i$, $F_i - E_i$ are acquired as TABLE1.

TABLE I: THE VALUES OF F_i, E_i, $F_i + E_i$, $F_i - E_i$

	F_i	E_i	F_i+E_i	F_i-E_i
S_1	[1.071, 1.698]	[1.208, 1.884]	[2.279, 3.582]	[-0.186, -0.137]
S_2	[0.309, 0.820]	[0.753, 1.269]	[1.062, 2.089]	[-0.449, -0.444]
S_3	[1.021, 1.683]	[1.284, 1.717]	[2.305, 3.400]	[-0.263, -0.034]
S_4	[0.507, 0.978]	[0.669, 1.064]	[1.176, 2.042]	[-0.162, -0.086]
S_5	[0.627, 0.874]	[1.177, 1.678]	[1.804, 2.552]	[-0.804, -0.550]
S_6	[0.316, 0.725]	[0.876, 1.455]	[1.192, 2.180]	[-0.730, -0.560]
S_7	[1.687, 2.224]	[0.629, 1.166]	[2.316, 3.290]	[1.058, 1.058]
S_8	[0.381, 0.840]	[0.187, 0.765]	[0.568, 1.605]	[0.075, 0.194]
S_9	[0.403, 0.772]	[0.588, 1.194]	[0.991, 1.866]	[-0.422, -0.185]
S_{10}	[0.192, 0.584]	[0.474, 0.706]	[0.666, 1.290]	[-0.282, -0.122]
S_{11}	[0.411, 1.001]	[0.487, 1.211]	[0.898, 2.212]	[-0.210, -0.076]
S_{12}	[0.795, 1.465]	[0.933, 1.923]	[1.728, 3.388]	[-0.458, -0.138]
S_{13}	[1.059, 1.720]	[0.061, 0.388]	[1.120, 2.108]	[0.998, 1.332]
S_{14}	[1.217, 2.016]	[0.641, 1.145]	[1.858, 3.161]	[0.576, 0.871]
S_{15}	[0.115, 0.621]	[0.091, 0.489]	[0.206, 1.110]	[0.024, 0.132]
S_{16}	[0.181, 0.516]	[0.118, 0.486]	[0.299, 1.002]	[0.030, 0.063]

According to (1) and (2), we acquire the possibility degree and scheduling vector.

$$\omega = (0.086, 0.058, 0.082, 0.063, 0.073, 0.061, 0.085, 0.046, 0.055, 0.042, 0.057, 0.079, 0.059, 0.080, 0.037, 0.036)$$

Based on the scheduling vector, the sorting of degree of central role as follows:

[2.279, 3.582]> [2.316, 3.290]> [2.305, 3.400]> [1.728, 3.388]> [1.804, 2.552]> [1.120, 2.108]> [1.062, 2.089]> [0.898, 2.212]> [0.991, 1.866]> [0.568, 1.605]> [0.666, 1.290] >[0.206, 1.110]> [0.299, 1.002].

Above all, according to the sorting of degree of central role, Customer satisfaction(s_1) has the highest $(F_i + E_i)$, showing that it is of the most important indicator for influencing CRM quality. That suggests that the crucial of improving CRM quality and sharpening competitive advantage is to cultivate the customer satisfaction.

Within the cause group, the evaluation indicators are visually divided into the cause group, including Leadership capacity(s_{13}), Service consciousness(s_7), The capacity of creating customer value(s_{14}), Service flow(s_8), Staff satisfaction(s_{16}), Information management capability(s_{15}), among (s_{13}) has the best effect on the other indicators. Further, the effect indicator group contains Customer contribution(s_4), Operation capacity(s_{11}), Customer complain ratio(s_3), Customer satisfaction(s_1), Solvency capacity(s_{10}), Development capacity(s_{12}), Profitability capacity(s_9), Customer loyalty(s_2), Service facility(s_6), service staff(s_5), in which (s_4) is the most readily influenced of the effect group indicators.

V. CONCLUSION

This paper applies the DEMATEL method based interval scales to evaluate the quality evaluation indicator of CRM. Such research raises awareness of enhancing CRM through improving customer satisfaction. Then, the paper proposes a DEMATEL method based interval scales in order to solve the problem of integrating group decision-making in fuzzy environmental segmentation. The proposed method successfully extends the DEMATEL method by applying interval numbers; hence it can rightly reflect the uncertainly of expert judgment, in comparison, the proposed method is more practical and eloquent than the traditional method. In addition, it is possible to deploy any other method for structural modeling frameworks, such as the AHP or ANP method.

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