

CRM Mode Selecting for SMEs Based on Group Analytic Hierarchy Process and Fuzzy Comprehensive Evaluation



Wang Shengjin
Department of Business and Management
Henan Institute of Engineering
Zhengzhou, China, 451191
wsj228@126.com

ABSTRACT: This study presents a new selecting method of customer relationship management for Small and Medium Enterprises based on group analytic hierarchy process and fuzzy comprehensive evaluation. The method uses a group analytic hierarchy process to get the target's weight, and evaluate the importance of the schemes by the fuzzy comprehensive evaluation method. It not only embodies the decision maker's subjective intent, but also reflects the objectivity of the information. It is a conceptual and strategic breakthrough about the customer relationship management selection for small and medium enterprises.

Keywords: GAHP, Fuzzy Comprehensive Evaluation, CRM Mode Selecting, Small and Medium Enterprises

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1. Introduction

1.1 CRM

CRM (Customer Relationship Management) is a valuable marketing strategy and a powerful tool for enterprises to fight for market share and enhance the competitive power for SMEs (Small and Medium Enterprises). By selecting and managing the relationship between buyers and sellers, enterprises can organize and allocate resources more effectively according to the market segmentation, and can develop customer-centric activities and the related business processes. By this means the enterprise can enlarge their profitability, and improve customer satisfaction. So CRM is an effective weapon of competing for market shares for SMEs.

1.2 CRM Mode Selecting and Present Research

Generally speaking, there are three choices for enterprises to operate CRM: self-operating, outsourcing and buying. Large scale enterprises tend to CRM self operating mode, small and medium enterprises (SMEs) follow this mode also. But lots of data and cases show that the efficiency of CRM self-operating mode is not as attractive as it thought, especially for those small and medium enterprises, due to some constraints such as enterprise resources, human resources, operating skills, competitive situation operating cost, enterprises growing speed, customer satisfaction, enterprise strategy, and information.

Currently, evaluation methods related to CRM mode mainly comprise the Delphi method, linear weighting method, composite score, level of analysis, cost minimization and some other methods. However, all of the above evaluation methods have inevitably some degree of greater subjectivity and arbitrariness, because they are based on the decision-makers personal preference and experience to a large extent. In order to overcome the limitation of the above proposed method and make the

selection of CRM selecting mode more scientific and rational, this study integrates GAHP methods (group-level decision analysis) which are more objective than AHP and comprehensive fuzzy evaluation method to optimize the choice of the CRM operation model for small and medium enterprises. By means of combining qualitative analysis with quantitative analysis, the new method will make the CRM mode selecting more scientific.

2. GAHP and CRM mode select for SMEs

The optimal selection of CRM for SMEs means that we should get the best match and balance between the existing resources and the CRM mode. This is a multi-attribute and uncertain decision making process with some illegibility, so some comprehensive and objective evaluation indexes must be introduced in order to avoid the above limitations. So we introduce some fuzzy methods. In the application of fuzzy comprehensive evaluation process, the weight of each index plays a decisive role. But the weight of the fuzzy comprehensive evaluation method will have inevitably its subjective limitations because of expert's personal experience, and therefore we need to combine GAHP with the fuzzy comprehensive evaluation method.

GAHP (Group Analytic Hierarchy Process) is developed on the base of AHP (Analytic Hierarchy process), which was invented by Professor Saaty. It is an effective solution to multi-attribute decision making evaluation of the qualitative and quantitative analysis. It is mainly used for evaluation under uncertainty with multiple standards. But it can't resolve a number of decision-maker's decision problem. GAHP, however, can resolve this problem; it gathers the views of many experts and integrates multi-stakeholder preference information. It also inherited the advantage of the eigenvector method and the geometric means's method. All of these can make the decision-making tend to be more democratic and scientific.^{[1][3]}

GAHP mainly comprises the following 5 steps:^{[2][4]}

2.1 Determine the Factor Index Muster that Affect the Evaluation Objects

$$U = (U_1, U_2, \dots, U_n)$$

2.2 Determine the Weights by Means of GAHP method

Suppose the weight cluster that reflects the importance of every factor as: $W = (w_1, w_2, \dots, w_n)$. The weights can be calculated in the following way:

2.2.1 Structure the Pairwise Comparison Matrix A

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}. \text{ Thereinto, } a_{ij} > 0, a_{ij} = 1/a_{ji}, a_{ii} = 1;$$

2.2.2 Calculate the weight vector $W = (w_1, w_2, \dots, w_n)$

Eigenvectors W can be got from $AW = \lambda_{\max} W$, and then standardized it. It can be used as indicators of the corresponding weight vector, and

$$\lambda_{\max} = \sum_{i=1}^n (AW)_i / nw_i; w_i = (\sqrt[n]{\prod_{j=1}^n a_{ij}}) / (\sqrt[n]{\prod_{j=1}^n \prod_{i=1}^n a_{ij}}), (i, j = 1, 2, 3, \dots, n)$$

2.2.3 Consistency Testing Matrix A

Calculate the consistency index (CI): $CI = (\lambda_{\max} - n) / (n - 1)$

Random index (RI) can be found consulting table 1:

<i>n</i>	1	2	3	4	5	6	7	8
<i>RI</i>	0	0	0.58	0.90	1.21	1.24	1.32	1.41

Table 1. Random Index (R)

The consistency of judgment matrix is acceptable if: $CR = CI / RI < \varepsilon = 0.1$ Or else, the judgment matrix should be adjusted until it has the consistency until: $CR = CI / RI < 0.1$

2.3 Structure the Evaluation Cluster: $V = (V_1, V_2, V_3, \dots, V_n)$

2.4 Structure Single-Factor Evaluation Matrix [5][6]

The vector $R(u_i) = (r_{i1}, r_{i2}, \dots, r_{ij}, \dots, r_{in})$ from U to V is called a single-factor evaluation vector. $R(u_i)$ is a fuzzy sub-cluster from V , there into, $0 < r_{ij} < 1$. r_{ij} indicates the membership of V . Then juxtapose all the vectors from f and get the single-factor evaluation matrix R .

2.5 Structure the multi-factor comprehensive evaluation matrix [7][8]

$B = W \bar{R} = (b_1, b_2, \dots, b_m)$; Then CRM mode corresponding to $b_i = \max(b_1, b_2, \dots, b_m)$ is the best choice

$$\bar{R} = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{bmatrix}$$

3. Empirical Analysis

3.1 Structure the Evaluation Index System for CRM Mode Selecting

According to the above principle related to the mode choice of CRM, 6 indexes are selected as the evaluation cluster. $U = (u_1, u_2, u_3, u_4, u_5, u_6)$. Thereinto, $u_1, u_2, u_3, u_4, u_5, u_6$ means respectively enterprise resource, competitive situation, operating cost of CRM, enterprise growing speed, customer satisfaction, enterprise strategy and degree of information. According to the theory of GAHP, the analytic hierarchy model can be constructed as follows:

3.2 Judging Matrix, Index Weight and Consistency Testing

Calculate weight vector and eigenvectors by constructing a comparison matrix and running it under software MATLAB, according to the nine point's methods of Satty and the opinion of stakeholders and experts.

$$W = (0.082, 0.321, 0.168, 0.153, 0.039, 0.053), \lambda_{\max} = 8.132; CI = 0.121; RI = 1.41; CR = CI / RI = 0.086 < 0.1$$

This means the consistency testing can be accepted .

3.3 Construct Evaluation Cluster

Evaluation cluster V that the CRM mode the importance of CRM mode (self-operating, outsourcing and purchasing) for SMEs can be constructed according to the above 7 indexes

$U_{1 \sim 7}$ (enterprise resource, competitive situation, operating cost of CRM, enterprise growing speed, customer satisfaction, enterprise strategy and degree of information) $V = (v_1, v_2, v_3)$.

The number 1, 2, 3 respectively means 1- very important, 2- important, 3- not important.

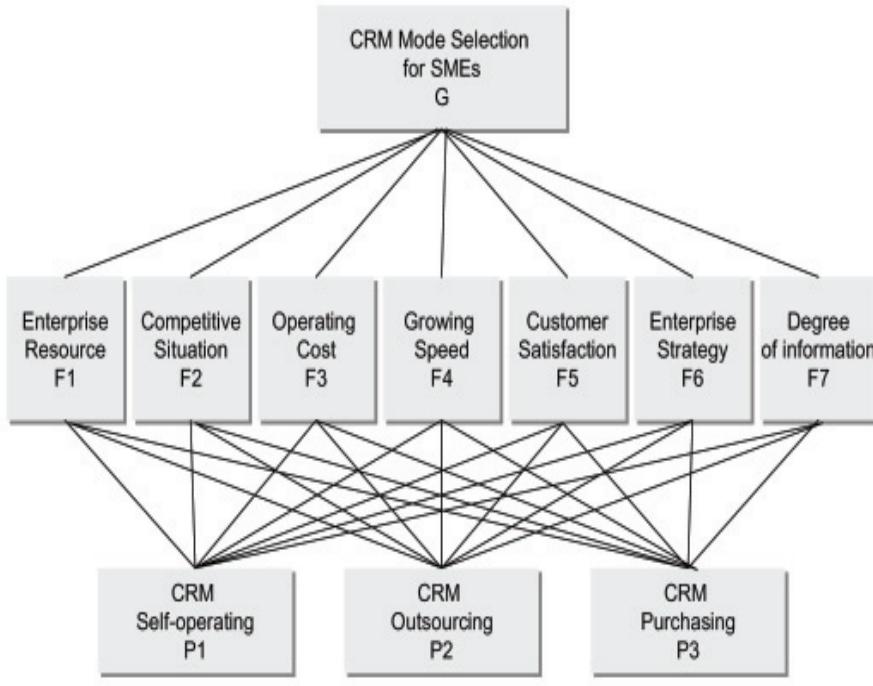


Figure 1. Analytic hierarchy mode for CRM mode

Index	V_1	V_2	V_3
U_1	1	3	1
U_2	2	2	3
U_3	2	3	1
U_4	2	3	3
U_5	1	2	2
U_6	1	3	2

Table 2. Indexes of $U_{1 \sim 7}$

3.4 Determine the Fuzzy Membership Matrix and Comprehensive Evaluation

Firstly, construct the membership function by means of hierarchy method:

$$\mu(\mu_i) = e^{\frac{2n-1}{10}} = \begin{cases} 0.90 & \text{not important} \\ 0.61 & \text{important} \\ 0.41 & \text{very important} \end{cases}$$

Secondly, calculate the fuzzy membership matrix \tilde{R} of CRM operating mode.

At last, calculate $M(\cdot \oplus)$ by means of combining the index weight vector W from method GAHP with a fuzzy membership matrix \tilde{R} of the 3 CRM mode, standardize it and get the fuzzy comprehensive weight vector:

$$B = (\omega_1, \omega_2, \omega_3) = (0.4336, 0.4128, 0.1536)$$

According to the above analysis, we can draw the conclusion that there is little difference between CRM outsourcing mode and self-operating mode for SMEs. This may be a conceptual and strategic breakthrough for small and medium enterprises to select and operate CRM.

4. Conclusion

This study proposed the method of CRM mode selection combining with fuzzy comprehensive evaluation directed by system engineering thought, and transferred the quantitative analysis into qualitative. It resolved the CRM mode selection problems that small and medium enterprises faced. This method combines the advantages of the group level analysis with fuzzy comprehensive evaluation. It helps SMEs to establish a scientific concept CRM mode selection.

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