International Journal of Innovation and Research in Educational Sciences
Volume 5, Issue 3, ISSN (Online) : 2349–5219

Research on Location Selection of International Offices of Large Multinational Service Companies Based on Analytic Hierarchy Process

Hanzeng Wang[1*], Chenglong Hu[1], Jinhan Sun and Hui Xu[*]
Yanbian university, Yanji 133002, P.R. China.
[*]Corresponding author email id: 945565817@qq.com

Date of publication (dd/mm/yyyy): 17/06/2018

Abstract – **At present, there are many large multinational service companies that are in the process of continuous development. In order to facilitate the expansion of the company's scale, it is necessary to set up some international offices in different countries and regions. How to assess the optimal location of international offices will directly affect the economic benefits of these companies. Employees in these international offices can speak English and use English as their second language. Through the selection of indicators and reasonable analysis, we have chosen government encouragement, immigration, and economy serve as three reference indicators. A simple and clear mathematical model is established using the Analytic Hierarchy Process, and a relatively perfect and reasonable optimal address evaluation system is constructed. Finally, we used this method to select six languages and set up international offices in the six major languages.**

Keywords – **AHP, Language, International Office, Location Selection, Evaluation System.**

I. Introduction

When we talk about the international office, we will first consider the distribution of regional languages set up by the office. Employees in the regions where these international offices are located are required to speak English. A large number of international office choices are for regions or countries that choose English as a second language, so these regions are the key considerations. Second, we must also consider the level of economic development in the region, whether government policies support it, and immigration. Then, we will focus on the economic level of the area where the office is located. The government encourages and immigrants to influence the local language environment. The first is the degree of economic development. The degree of economic development in a region is the key to the development of local businesses. Second, the government encourages it. Obviously, if the local government does not give policy encouragement and support, it is very difficult to set up an office in the region. The third is immigration. Immigrants will inflow and outflow a large number of people, and they will have the greatest influence on the local language environment. When these factors are met, the office can be more suitable for the company's quality development.

The Analytic Hierarchy Process (AHP) is a multi-objective decision-making method combining qualitative analysis and quantitative analysis proposed by Prof. T.L. Saaty, a famous American operational researcher and University of Pittsburgh in the early 1970s. The approximation method is used to calculate the maximum eigenvalues and eigenvectors of each judgment matrix. The eigenvectors are the relative weights of the factors. Then the consistency check of the judgment matrix is performed. When the relative weights of the factors at all levels are obtained, measures are taken. The combination weights of the layers are calculated, and then the relative rankings of the various measures can be obtained.

Nowadays, how to choose the best location for international offices is a major challenge for the global service industry, especially for large multinational service companies. This paper evaluates the best location of the international office. We use the Analytic Hierarchy Process (AHP) to extract the factors affecting the location of the international office and divide it into government incentives, immigration, and the economy. We use the analytic hierarchy process to calculate the consistency ratio. CR^F, if $\mathrm{CR}^F < 1$ then through the consistency test, using Matlab software to calculate the weight vector ω, to determine the weight of each item influencing the selection of the location of the international office, so as to reach the role of the assessment of the best location.

II. Symbol Description

In order to facilitate model understanding, before the model analysis, first set the corresponding variables, as seen in Table Ⅰ.

Table Ⅰ. Symbols and Meanings

Symbol	Meaning
$K_i(i = 1,2,\dots,9)$	English as Second Language
$Q1$	Government encourage
$Q2$	Migration
$Q3$	Economy
F	International office location
$CR^i(i = F, Q1, Q2, Q3)$	Consistency ratio
$CI^i(i = F, Q1, Q2, Q3)$	Consistency indicator
$\lambda_i(i = 0,1,2,3)$	Maximum eigenvalue

III. Model Establishment

A. *Level Analysis Chart*

Analytic Hierarchy Process (AHP) decomposes the decision-making problem into the different hierarchical structures according to the order of the overall goal, laminar target, and evaluation criteria until the specific preparation plan, then, by solving the eigenvector of the judgement matrix, the priority of each element of each level over a

International Journal of Innovation and Research in Educational Sciences
Volume 5, Issue 3, ISSN (Online) : 2349–5219

certain element of the previous level is solved.. Finally, the method of weighted summation is used to merge the final weights of the alternatives for the total goal. The ultimate weight is the optimal solution. Our goal is to assess the location of the international office. It is divided into three levels to study the weight of the influencing factors in the lowest level countries, and then to assess the site selection through the weights of the three factors. We can see from Figure 1.

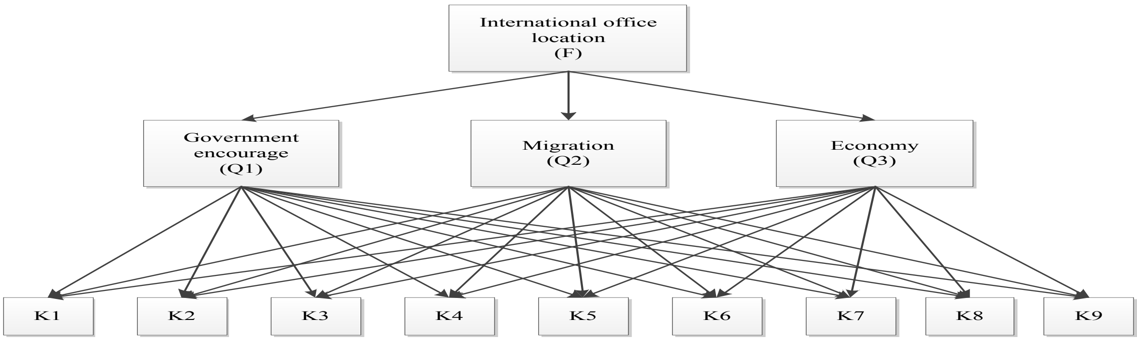

Fig.1 Level Analysis Chart

B. *Analysis Process*

According to the important impact indicators, we can find out the countries with English as the second mother tongue, and then analyze, we can see the distribution map of Figure 2.

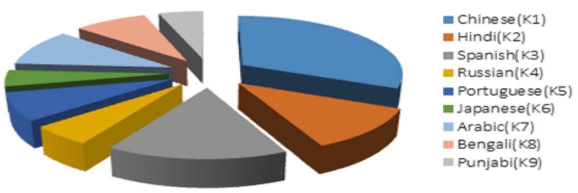

Fig.2 English-speaking countries

Based on extensive literature review, combined with linguistic data in these countries and the location of international offices related to various factors in recent years, a judgment matrix can be constructed from the top to the bottom based on the scale of the Table II judgment matrix

Table II. Judgment Matrix

Scale	meaning
1	i factor and j factor as important
3	i factor is more important than j factor
5	i factor is more important than j factor
7	i than j factor is very important
9	i factor than j factor is absolutely important
2,4,6,8	Is the scale value corresponding to the intermediate state between the about two judgments
reciprocal	If the j factor is compared with the factor i, the judgment values are $a_{ji} = \frac{1}{a_{ij}}, a_{ii} = 1$

According to the scales in the table, the relative importance of the first layer of each link in the second layer can be analyzed, and an F-Q judgment matrix can be established. For details, please refer to Table 3.

Table III. F-Q Judgment Matrix

F	Q1	Q2	Q3
Q1	1	1/5	1/3
Q2	5	1	2
Q3	3	1/2	1

According to the same method of establishment, we can establish the judgment matrix of the third layer of each factor to the second layer. The judgment matrix Q1-K, the judgment matrix Q2-K, and the judgment matrix Q3-K can be derived. See Tables IV, V and VI for details.

Table IV. Q1-K Judgment Matrix

Q1	K1	K2	K3	K4	K5	K6	K7	K8	K9
K1	1	2	3	2	3	4	2	4	5
K2	1/2	1	2	4	5	3	2	4	3
K3	1/3	1/2	1	1/2	1/3	3	2	4	3
K4	1/2	1/4	2	1	2	4	5	3	6
K5	1/3	1/5	3	1/2	1	1/2	1/7	4	3
K6	1/4	1/3	1/3	1/4	2	1	3	5	2
K7	1/2	1/2	1/2	1/5	7	1/3	1	4	3
K8	1/4	1/4	1/4	1/3	1/4	1/5	1/4	1	2
K9	1/5	1/3	1/3	1/6	1/3	1/2	1/3	1/2	1

Table V. Q2-K Judgment Matrix

Q2	K1	K2	K3	K4	K5	K6	K7	K8	K9
K1	1	3	2	5	6	4	5	1/3	1/2
K2	1/3	1	1/3	2	1/2	1/4	1/5	2	3
K3	1/2	3	1	1/2	1/3	2	2	4	3
K4	1/5	1/2	2	1	1/3	1/4	5	3	2
K5	1/6	2	2	3	1	2	4	6	3
K6	1/4	4	1/3	4	1/2	1	2	3	5
K7	1/5	5	1/2	1/5	1/4	1/2	1	2	3
K8	3	1/2	1/4	1/3	1/6	1/3	1/2	1	2
K9	2	1/3	1/3	1/2	1/3	1/5	1/3	1/2	1

Table VI. Q3-K Judgment matrix

Q3	K1	K2	K3	K4	K5	K6	K7	K8	K9
K1	1	4	1/2	1/3	3	6	2	1/2	3
K2	1/4	1	4	2	3	1/4	1/2	2	2
K3	2	1/4	1	1/3	2	3	3	2	1/2
K4	3	1/2	3	1	2	1/4	3	1/2	3
K5	1/3	1/3	1/2	1/2	1	3	4	2	3
K6	6	4	1/3	4	1/3	1	3	2	4
K7	1/2	2	1/3	1/3	1/4	1/3	1	1/2	2
K8	2	1/2	1/2	2	1/2	1/2	2	1	3
K9	1/3	1/2	2	1/3	1/3	1/4	1/2	1/3	1

C. *Consistency Check*

We use the method is to use the maximum eigenvalue of the judgment matrix and its eigenvectors to calculate the weight vector of the order, the accuracy of the method is high. Using mathematical software Matlab to determine the judgment matrix, the maximum eigenvalue of the judgment matrix F-Q is $\lambda_0 = 3.00369$, which is normalized with the corresponding eigenvector to obtain $\omega^F = \{0.1095, 0.5816, 0.3090\}$, and use this vector as the weight vector of the second layer. In order to ensure the reliability of the above weight vector, we need to test the consistency of the judgment matrix. First calculate the consistency indicator.

$$CI^F = (\lambda_0 - n)/(n-1)$$

Where n is the order of the judgment matrix, the correspondence index K_1 corresponding to the judgment matrix F-B is 0.00185, and then

Look up the table to get the corresponding random consistency index R1 = 0.58, so as to get the consistency ratio:

$$CR^F = \frac{K_1}{R_1} = 0.00318$$

Because $CR^F < 1$, Passed the consistency test, you can use the normalized eigenvector ω^F as the second layer of the weight vector order. Similarly, the maximum eigenvalues of other judgment matrices, ranking weight vectors, consistency indexes and consistency ratios can be obtained, see Table VII.

Table VII. Consistency Ratios

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.50

Since CR^{Qi} (i = 1, 2, 3, 4) passes the consistency check (See Table VIII), that is, the degree of consistency of the judgment matrix Qi-K (I = 1, 2, 3, 4) is within the allowable range, use naturalized eigenvector as its weight vector.

Using the weight vectors ω^F and ω^{Qi} (i = 1, 2, 3 and 4) that have been obtained, the weight vector of the total rank of the hierarchy can be calculated as

Ω = (0.0228, 0.0222, 0.0106, 0.0181, 0.0082, 0.0096, 0.0116, 0.0033, 0.0032, 0.1340, 0.0375, 0.0641, 0.0545, 0.0921, 0.0729, 0.0432, 0.0488, 0.0345, 0.0553, 0.0337, 0.0375, 0.0366, 0.0312, 0.0612, 0.0146, 0.0261, 0.0128).

Table VIII. The Judgment Matrix Qi-K Calculation Result

Judgment matrix	Maximum eigenvalue	Sort weight vector	consistency index	Consistency ratio
Q1-K	λ1 = 10.953	ω^{Q1} = [0.2087, 0.2024, 0.0965, 0.1649, 0.0753, 0.0874, 0.1056, 0.0304, 0.0289]	$CI^{Q1} = 0.244$	$CR^{Q1} = 0.168$
Q2-K	λ2 = 12.988	ω^{Q2} = [0.2305, 0.0644, 0.1102, 0.0938, 0.1583, 0.1254, 0.0742, 0.0839, 0.0593]	$CI^{Q2} = 0.499$	$CR^{Q2} = 0.344$
Q3-K	λ3 = 13.792	ω^{Q3} = [0.1790, 0.1090, 0.1213, 0.1185, 0.1010, 0.1981, 0.0472, 0.0843, 0.0415]	$CI^{Q3} = 0.599$	$CR^{Q3} = 0.413$

Since the final influencing factors take into account the three factors of economy, population migration and state encouragement, adding the weights of the three factors leads to the final impact weight of the final country.

Obtained the weight vector:

Ω = [0.2121, 0.0934, 0.1084, 0.1092, 0.1315, 0.1437, 0.0694, 0.0782, 0.0505]

Arrange the weights of each country and draw out Figure 3.

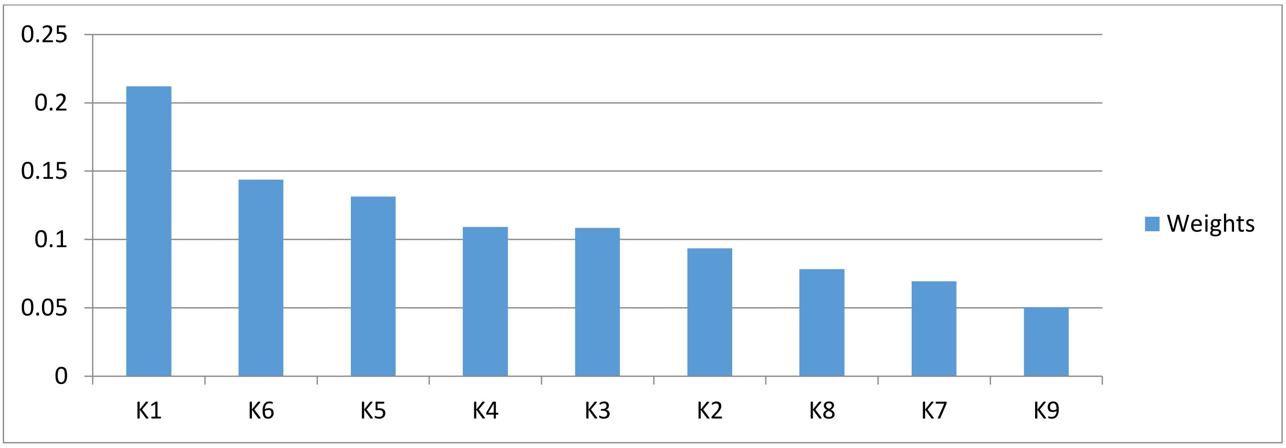

Fig.3 Each Country Weight Map

IV. Conclusion

After comprehensive consideration, this paper chooses three factors: economy, population migration and government encouragement, and sets up a new weight combination by using AHP. According to the final influence weight, we arrange the order of various language regions. The first six languages of the weight were found in Chinese, Japanese, Portuguese, Russian, Spanish and Hindi, and the countries and regions in which they were native were identified in different colors on the map. Finally, the areas established by these international offices were obtained. We can select the regions where the top six languages are located, as shown in Figure 4 with K1 being native to Chinese, K2 in Hindi using K3 Spanish as a native language; K4 as a native language; K5 as a native Portuguese; K6 as a native Japanese language.

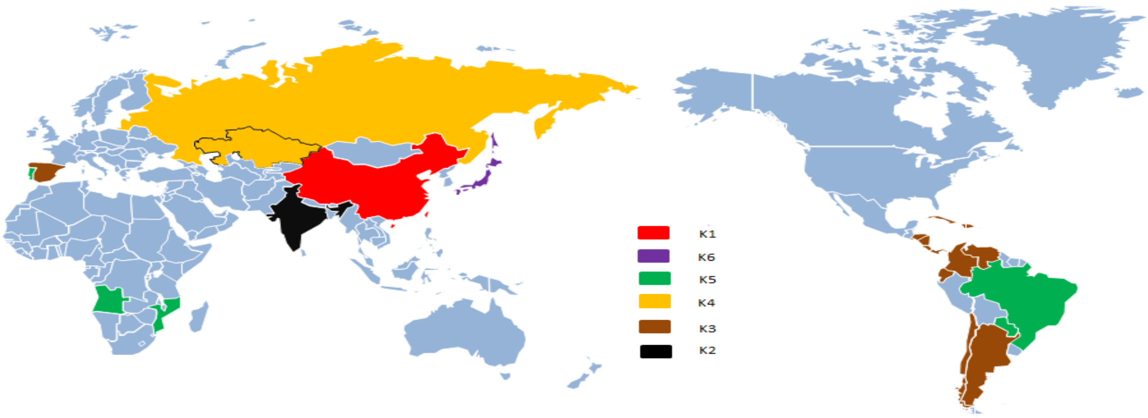

Fig. 4. International Office Selection Char

REFERENCES

[1] Michael Armstrong and Angela Baron. Performance Management [M]. London: The Cromwell Press.1998. W.-K.
[2] T.L. Saaty. The Analytic Hierarchy Process [M]. Mc. Graw: Hill International Book Company.1980.
[3] European Management Journal Volume [J] : 21, lssue: 3, June, 2003. Pp 323 - 337.
[4] Discretion and bias in performance evaluation: the impact of diversity and subjectivity Volume [J] : 30, lssue: 1, January, 2005, pp. 67-78.
[5] Ge Jun, Ge Lunying. AHP method to determine the weight of water quality indicators [J]. Contemporary Architecture, 2003, 3(1): 22-23.
[6] Hu Yonghong, He Enhui. Comprehensive Evaluation Method [M]. Science Press, 2000:167-188.
[7] Jiang Qiyuan. Mathematical model [M]. Higher Education Press, 2005: 225-231.
[8] Xi Jijian, Liu Chengping. Fuzzy mathematics method and its application [M]. Huazhong University of Science and Technology Press, 2000: 205-211.
[9] Zhao Huancheng. Analytic Hierarchy Process - A Proposed New Decision-Making Method [M]. Science Press, 1986: 23-35.
[10] Li Yanhai. Student Scholarship Evaluation Based on Analytic Hierarchy Process [J]. Science Education and Culture Review (Last Issue), 2009, (08).
[11] Li Wei, Peng Jialin, Liu Zhiyong et al. Methods for determining the weight of reproductive health service quality indicators for urban floating population [J]. Journal of Huazhong University of Science and Technology (Health Sciences), 2009, (04).

AUTHOR'S PROFILES

Hanzeng Wang, male, Jilin Province, China, born in October 1997, studying at Yanbian University School of Engineering, as an undergraduate of Communication Engineering.

Chenglong Hu, male, Jilin Province, China, born in November 1996, studying at Yanbian University School of Engineering, as an undergraduate of Computer Science and Technology.

Jinhan Sun, female, Jilin Province, China, born in May 1997, studying at Yanbian University School of Science, as an undergraduate of mathematics system .

Hui Xu, male, Communication author, associate professor, master tutor, teacher of Yanbian University School of Science. Research direction: mathematical modeling, intelligent algorithm, mathematics teaching technology.