The Analysis and Evaluation for the Development Environment of Yangluo Port

Mei Zhang, Chengxuan Cao
State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, Beijing 100044, P.R. China

Keywords: evaluation matrix, development environment, Fuzzy Analytic Hierarchy Process,Port, the fuzzy judgmentmatrix.

Abstract. The development environment of Yangluo Port will influence the port's development strategy. This paper applies the FuzzyAnalytic Hierarchy Process (FAHP) to the evaluation of port's development environment, and provides a mathematical model about it, then gives the formula of weight.Through making up the evaluation matrix of inner and external factors, it quantifies the advantages and disadvantages as well as the opportunities and threats the port faced with .Thus it gets the conclusion that Yangluo Port should adopt the growing development strategy.

Introduction

The environment is of great significance to the promotion of the port's further development. This paperapplies the FAHP to evaluate the internal and external environment of Yangluo port. In this evaluation process,we mainly calculate the weight of environmental factor.In fact,many methods were proposed for the calculation of the weight in the literature and many scholars applied the Analytic Hierarchy Process (AHP) analysis to deal with the weight[1-6].

Althoughsome scholars have made some achievements on the study of Yangluo port's development,a majority of articles adopted the AHP analysis to solve the problemsof Yangluo port's development. AHP method is greatly influenced by the subjective thinking. The results tend to be crudeand it is hardly convincing.In this paper, we combine the AHP with the fuzzy mathematics[7-10]when calculating the weight,which makes the results more reasonable.

The port's analysis of the development environment

The port's analysis of the strengths and weaknesses

Internal factors including strengths and weaknesses in Table 1.

Table1 Internal factors including strengths and weaknesses

strengths B1	C1：Superior geographical position; C2:Forming integrated logistics service network; C3：Excellent deep-water coastline and good deep-water Channel； C4：Having a prosperous port-vicinity industry.
weaknesses B2	D1:The infrastructure and service ability is poor; D2:The level of integration of resources and rational utilization rate is not high; D3:The Informatization level is not high; D4: The management level needs to be strengthened.

Evaluation and analysis of the various factors,methodsare presented as follows：

Tableting hierarchies:Thetargetlayers is the development of Yangluoport,guidelines layers are the strengths and weaknesses of port enterprises,program layers is a key factor already identified .

Structure fuzzy judgment matrix: Compare each relevant element separately and mark it,Here we refer the importance as r_{ij} ,the values are as follows:① r_{ij}=0.5, meaning that two factors a_i and a_j are of equal importance; ② $0 \le r_{ij} < 0.5$,meaning that a_j is more important than a_i ; ③ $0.5 < r_{ij} \le 1$,meaning that a_i is more important than a_j. According to a number of indicators of the intermediate layer,we can get several judgment matrix. First,we should structure the fuzzy judgment matrix. Generally,we adopt 0.1-0.9 scale to measure them. The results are listed as Table 2.

Table 2 The definition of r_{ij}

Scaling	Meaning
0.5	Compared to two factors, it is equally important
0.6	One factor is a little important than the other
0.7	One factor isobviously more important than the other
0.8	One factor is strongly more important than the other
0.9	One factor is extremely more important than the other

Second,transforming the fuzzy judgment matrix to fuzzy consistent matrix,the transformation formula is:

$$r_i = \sum_{k=1}^{m} f_{ik}, i = 1, 2, \cdots\cdots, m \qquad (1)\ r_{ij} = \left(r_i - r_j\right) / 2n + 0.5, i = 1, 2, \cdots\cdots m, \qquad (2)$$

Finally,calculating the value of the weight of each index,the formula is

$$l_i = \sum_{j=1}^{m} r_{ij} - 0.5,\ i = 1, 2, \cdots\cdots m \ (3)\ w_i = 2l_i / m(m-1),\ i = 1, 2, \cdots\cdots m \ (4)$$

The results are as follows:

The fuzzy judgment matrixA$\rightarrow$B:

$$A = \begin{bmatrix} 0.5 & 0.6 \\ 0.4 & 0.5 \end{bmatrix}$$

The fuzzy consistent matrix A$\rightarrow$B:

$$A = \begin{bmatrix} 0.5 & 0.55 \\ 0.45 & 0.5 \end{bmatrix}$$

The fuzzy judgmentmatrix of strengths $B_1 \rightarrow$C:

$$B_1 = \begin{bmatrix} 0.5 & 0.4 & 0.3 & 0.4 \\ 0.6 & 0.5 & 0.4 & 0.6 \\ 0.7 & 0.6 & 0.5 & 0.4 \\ 0.6 & 0.4 & 0.6 & 0.5 \end{bmatrix}$$

The fuzzy consistent matrix $B_1 \rightarrow$C:

$$B_1 = \begin{bmatrix} 0.5 & 0.4375 & 0.425 & 0.4375 \\ 0.5625 & 0.5 & 0.4875 & 0.5 \\ 0.575 & 0.5125 & 0.5 & 0.5125 \\ 0.5625 & 0.5 & 0.4875 & 0.5 \end{bmatrix}$$

The fuzzy judgmentmatrix of weaknesses $B_2 \rightarrow \mathrm{D}$

$$B_2 = \begin{bmatrix} 0.5 & 0.6 & 0.3 & 0.6 \\ 0.4 & 0.5 & 0.6 & 0.8 \\ 0.7 & 0.4 & 0.5 & 0.6 \\ 0.4 & 0.2 & 0.4 & 0.5 \end{bmatrix}$$

The fuzzy consistent matrix $B_2 \rightarrow \mathrm{D}$

$$B_2 = \begin{bmatrix} 0.5 & 0.4625 & 0.475 & 0.5625 \\ 0.5375 & 0.5 & 0.5125 & 0.6 \\ 0.525 & 0.4875 & 0.5 & 0.5875 \\ 0.4375 & 0.4 & 0.4125 & 0.5 \end{bmatrix}$$

Then,we calculate the total weight of each index to the target,thus we get the Internal Factor Evaluation(IFE) matrixshow in Table 3.

Table 3IFEmatrix

	Key internal factors	Weight	Score	Weighted score
Strengths（B_1）	C1	0.1192	4	0.4768
	C2	0.1421	4	0.5684
	C3	0.1467	4	0.5868
	C4	0.1421	4	0.5684
Weakness（B_2）	D1	0.1125	2	0.2250
	D2	0.1238	1	0.1238
	D3	0.1200	1	0.1200
	D4	0.0937	2	0.1874
	sum	1		2.8539

The port's analysis of the opportunities and threat

With the same method we can get the External Factor Evaluation(EFE) matrix show in Table 4 and Table 5.

Table 4 Internal factors including opportunities and threat

	key external factors
Opportunities	C1: The construction opportunities of Yangtze River waterway; C2: The rapid development of the port industry; C3: Port cooperation is the realistic need.

Threat	D1:The domestic economic is slowing down; D2:The competition between ports is becoming more and more fierce; D3:The development of the logistics industry leads to cargo diversion.

Table 5EFEmatrix

	key external factors	weight	score	weighted score
Opportunities	C1	0.2019	4	0.8076
	C2	0.1832	4	0.7328
	C3	0.1711	3	0.5133
Threat	D1	0.1499	1	0.1499
	D2	0.135	2	0.2700
	D3	0.1652	2	0.3304
	sum	1		2.8040

Through the analysis above we can easily know that the total score of Yangluo port's IFEmatrix is 2.8539,and the EFE matrix is 2.804. Both are greater than 2.5,that means that means Yangluoport is in a dominant position and opportunities outweigh the threats, so we get the conclusion that Yangluo Port should adopt the growing development strategy.

Conclusions

TheFAHP analysis is a systematic method, which it is simple and has potential application to evaluate the port development. The FAHP has advantage to analyze the complex evaluation problem mathematically.

In this paper, we mainly deal with the following problems:

(1) Confirming the main factors affecting the port's development;

(2) Combining the AHP with the fuzzy mathematics andestablishing several fuzzy judgment matrix toconfirm each index's weight;

(3) With the experts' estimation,we get the weighted score,which can decide the final result.

Acknowledgements

This research was supported in part by the National Basic Research Program of China (Grant No. 2012CB725400), the National Natural Science Foundation of China (Grant No. 71131001-1), and the Research Foundation of State Key Laboratory of Rail Traffic Control and Safety, Beijing Jiaotong University, China (Grant No. RCS2014ZT19).

References

[1] Jia, S.,Ecological assessment and analysis about the port planning.*Environmental Management of China*,2010(2).

[2] Wang, S., Wuhan Newport's research of development strategy.*Wuhan University of Technology*, 2008.

[3] Wang, S. and Zhang, X., SWOT analysis of Wuhan Newport's development.*Science and Technology of Ports*,2010(3).

[4] OOCL honored by Port of Long Beach for Environment efforts.http://www.oocl.com/schi/aboutoocl/corporatemessages/2007/24apr2007.2007(4)
[5] W.Peng, W. and Jiang, H., Accelerate the construction of Wuhan Newport Promote regional logisticsdevelopment in Wuhan, *Transportation Enterprise Management*,2011(7).
[6] Sun, J. and Jiang, D., Consistent method to construct judgment matrix in AHP analysis.*Journal of Southeast University*,1991,21(3):69～75.
[7] Zhang, J., Comparison of the three ranking methods for the fuzzy consistent judgmentmatrix. *Systems Engineering and Electronics*,2003,25(11):79-85.
[8] Zhang, J., Fuzzy analytical hierarchy process. *Fuzzy Systems and Mathematics*,2000,14(2):80-88.
[9] Lan, J. and Yang, J., The weight of fuzzy analytic hierarchy process study.*Systems Engineering-theory&Practice*,2006,26(9).
[10] Saaty, T.L., Modeling unstructured decision problems. *The Theory of Analytical Hierarchies*,1978.