



Research on Evaluation of Department Decision-Making Ability Based on AHP

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Abstract. This paper evaluates the decision-making capacity of the department. By analyzing a variety of the factors that affect departmental decision-making, a departmental decision-making capability evaluation index system is constructed. Based on the AHP, a quantitative model for departmental decision-making evaluation is constructed to determine the weight of each indicator and obtain the corresponding evaluation results. Based on the results, formulate effective measures to improve the decision-making capacity of the department.

Keywords: departmental decision · evaluate quantitative models · AHP

1 Introduction

With the continuous complexity of China's department management system, the department decision is correct or not is related to the survival and long-term development of the Department. By AHP method to evaluate the Department's decision-making ability, we can effectively improve the Department's decision-making efficiency, and play a positive role in promoting the Department to adapt to the changing market environment and create considerable benefits. The Analytic Hierarchy Process (AHP) is a problem-solving framework [11] and a theory of measurement [12]. It has been proposed as a decision analysis technique to evaluate complex multi-attribute alternatives among one or more decision-makers. Since it allows the inclusion of subjective factors, it is considered as an advancement compared to other decision-making methods. Therefore, The Analytic Hierarchy Process (AHP) approach is widely used for the decision-making in department management [1]. To evaluate the decision-making ability of the department, it is necessary to comprehensively consider various factors, and to make a comprehensive analysis of each influencing factor with the ability to make correct decisions as the evaluation standard [3]. If the synthesis of each impact factor is regarded as a system, we can try to construct and analyze the departmental decision-making index system from the perspective of the system [2].

1.1 Internal Factors

Internal factors that affect departmental decision-making include leadership, resilience, pressure resistance and teamwork [4].

The leadership skills include foresight, influence and control. The foresight means to have a clear plan for the development of the department, to have a clear prediction of the development of external things, and to have a comprehensive understanding of the industry [5]. The influence mainly refers to the ability of decision makers to influence subordinates, covering communication methods, resulting the control power mainly refers to the ability to control the direction, trend and overall situation of the development of things.

The resilience mainly includes reaction ability, decision-making ability and stabilization ability. The reaction ability mainly refers to the ability to solve emergencies encountered in the decision-making process in a timely manner and make a decisive decision. The decision-making ability mainly refers to the ability to comprehensively consider the advantages and disadvantages of various schemes, and the ability to take a certain decision decisively. The stabilization ability means being able to keep calm and steady in the development and change of the environment.

The ability to withstand pressure mainly refers to the ability of decision makers to face various pressures, which mainly refers to related to the pressure itself and the burden of decision makers.

The team cooperation ability includes team staffing, team cooperation time, team business ability and so on. Among them, the internal staffing of the team should be reasonable, and a variety of talents should be reasonably matched. Each member of the team should be found with their own strengths and placed in suitable positions. the team cooperation time should be long, usually the longer the time, the better the collaboration ability. The more refined the personal business of the team members, the higher the overall ability and the stronger the combat effectiveness [6].

1.2 External Factors

It is necessary to analyze the external factors that affect the decision-making of the department, and comprehensively consider various factors, focusing on factors such as capital turnover, leadership support and department development direction.

The capital turnover refers to the repeated capital cycle. The core issue is the speed of production (or the amount of money) and its impact on the value of the product. The time that capital starts from a certain form and returns to this form after movement is called capital turnover time. Capital turnover time consists of production time and circulation time. Due to the different product properties and technical production conditions produced by each enterprise, as well as the different geographical location, production and marketing distance and means of transportation, the production time and circulation time must be different, forming different capital turnover time.

The development direction of an enterprise is related to its development strategy. The enterprise development is the process of enterprise growth and expansion, which includes both quantitative and qualitative changes. The development direction of enterprises has four characteristics. One is integrity, the other is long-term, the third is basic and the fourth is strategic. The integrity is relative to locality, long-term is relative to short-term, basic is relative to specificity, and the strategic is relative to routine. The enterprise development strategy must have these four characteristics at the same time. The lack of one characteristic is not the development direction of the enterprise. The enterprise

development direction is not the medium and long-term plan of enterprise development, but the enterprise development direction is the soul and program of the medium and long-term plan of enterprise development. The enterprise development direction guides the medium and long-term plan of enterprise development, and the medium and long-term plan of enterprise development implements the enterprise development direction.

1.3 Other Factors

At present, the external environment of enterprise operation is the fierce competition in the world. In order to win in the competition, enterprises must continue to grow and maintain enduring vitality. The focus is to analyze the current domestic relevant policies, the competition in the same industry and the domestic and international market environment.

Relevant domestic policies need to keep up with the trend of the times, and the policies at all times and stages are different. Department leaders should not only study the current policies timely and accurately, but also pay attention to the possible development and changes of policies, so as to make better decisions.

With the deepening of China's reform and opening up, the competition of domestic enterprises is becoming more and more fierce, especially in the face of the increasing competitive pressure of enterprises all over the world. Grasp the direction of the enterprise by understanding the situation of competitors in the same industry. The competition situation in the same industry is mainly to analyze the current competitive position of competitors, study the public statements issued by competitors to achieve competitive success, collect the current action data and potential change information of competitors, study the past actions and leadership styles of competitors, and determine who among competitors is more likely to take new strategic actions and who will implement new strategic actions.

Changes in the market environment can not only bring market opportunities to enterprises, but also form some threats. The market environment is an uncontrollable factor in the social and the economic environment in which enterprises operate. It mainly includes political environment, economic and technological environment, social environment, natural geography and competition. Therefore, if enterprises want to have better development, they need to investigate and analyze the market environment, which is the premise for leaders to make correct decisions and carry out business activities.

2 Construction of the Evaluation Index System of Departmental Decision-Making Ability

According to the constructed evaluation index system, a multi-level hierarchical structure model of AHP can be established the target layer is departmental decision-making ability; the criterion layer includes three first-level indicators. They are internal factors (S1), external factors (S2) and other factors (S3). The indicator layer is specific evaluation indicators. They are leadership (P1), resilience (P2), compressive ability (P3), team-work (P4), capital turnover (P5), leadership support (P6), department direction (P7), relevant policies (P8), peer-competition (P9) and the market environment (P10).

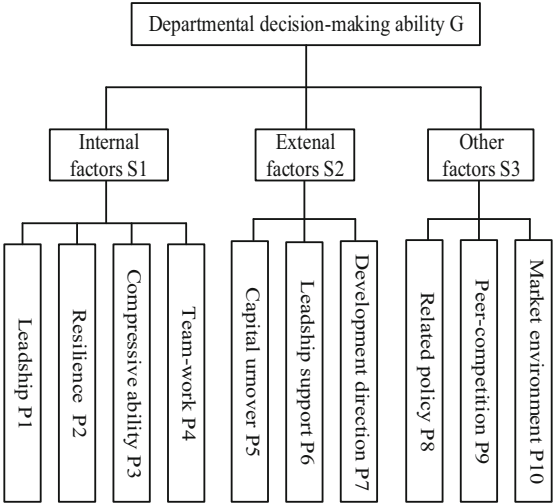


Fig. 1. Hierarchy diagram

2.1 Build a Hierarchical Model

According to the order of the target layer, the criterion layer and the index layer, the decision objects are layered according to the hierarchical relationship between them, and a hierarchical structure diagram is drawn (Fig. 1).

2.2 Construct Judgment (Pairwise Comparison) Matrix

When determining the weights between factors at each level, if it is only a qualitative result, it is very unconvincing. Therefore, a consistent matrix method is proposed, that is, all factors are compared with each other to obtain their relative importance, which can be as much as possible. It reduces the difficulty of comparing factors of different nature with each other to improve accuracy. For example, for a certain criterion, use the criterion as a standard to compare the schemes under it in pairs, and rate them according to their importance.

The proportion of each criterion in the criterion layer is not necessarily the same in the target measurement. In the mind of the decision maker, they each account for each proportion, and the number 1–9 and its reciprocal are used as the scale to define the judgment matrix $A = a_{ij}(n \times n)$.

2.3 Hierarchical Single Sort and Its Consistency Test

By calculating the maximum eigenvalue of each matrix and normalizing it, it is judged whether it is satisfactory. Although the method of constructing a pair comparison judgment matrix can reduce the interference of some other factors and more objectively reflect the difference in the influence of a pair of factors, when the results are integrated, there may be a certain degree of inconsistency, which needs to be done. Further judgment. Judging the maximum eigenvalue eigenvector W corresponding to the pairwise

Table 1. RI.

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

comparison matrix A , the normalized vector is the ordering weight of the relative importance of the corresponding elements of the same level to the elements of the previous level, which is called a single level sort.

① Calculate CI (consistency index)

$$a_{ij}a_{jk} = a_{ik}, \forall i, j, k = 1, 2, \dots, n \quad (1)$$

A positive and negative matrix that satisfies relation (1) is a consistent matrix, in which the n -order matrix A is a consistent matrix if and only if the largest eigenvalue of the A matrix is $\lambda_{\max} = n$, and if and only if the A matrix is not consistent, the largest eigenvalue root $\lambda_{\max} = n$.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (2)$$

② Find the consistency index table RI (Table 1).

③ Calculate Consistency Ratio

$$CR = \frac{CI}{RI} \quad (3)$$

When $CR < 0.10$, it is considered that the consistency of the judgment matrix is acceptable, otherwise appropriate modifications should be made.

2.4 Hierarchical Total Ranking and Its Consistency Test

What we get above is the weight vector of a set of elements to an element in the previous layer. In the end, we need to get each element, especially the sorting weight of each scheme in the lowest layer for the target, so as to select the scheme [7]. The total ranking weights combine the weights under the single criterion from top to bottom. Multimedia figures – video and audio files [14].

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3.1 Constructing the Pairwise Comparison Matrix of the Target Layer--Criteria Layer

According to the weights of S1, S2 and S3, the obtained comparison matrix is as following (Table 2).

In G-S, the weight vector $\beta = (0.5714, 0.2857, 0.1429)^T$ can be obtained by calculation, that is, from the perspective of the criteria level of departmental decision-making, the priority factors are S1 internal factors, S2 external factors, and S3 other factors. Where $CI = 0.0268$ and $CR = 0.0515$.

Table 2. Comparison matrix of G-S.

G	S1	S2	S3	Weights
S1	1	2	4	0.5714
S2	1/2	1	2	0.2857
S3	1/4	1/2	1	0.1429

Table 3. Comparison matrix of S1-P.

S1-P	P1	P2	P3	P4	Weights
P1	1	2	3	2	0.4155
P2	1/2	1	3	2	0.2926
P3	1/3	1/3	1	1/2	0.1070
P4	1/2	1/2	2	1	0.1849

Table 4. Comparison matrix of S2-P.

S2-P	P5	P6	P7	Weights
P5	1	3	2	0.5396
P6	1/3	1	1/2	0.1624
P7	1/2	2	1	0.2970

3.2 Constructing a Pairwise Comparison Matrix Between the Criterion Layer and the Indicator Layer

By constructing the pairwise comparison matrix between the criterion layer including internal factors (S1), external factors (S2) and other factors (S3) and the index layer, We can get the corresponding weight and the importance of each influencing factor. By analyzing CI and CR, we can judge whether the matrix meets the consistency requirements and get reliable results.

① Constructing the pairwise comparison matrix of the criterion layer (S1) and the index layer, and obtain the comparison matrix in the order of P1, P2, P3, and P4 (Table 3).

From the pairwise comparison matrix, $\beta = (0.4155, 0.2926, 0.1070, 0.1849)$ can be obtained, and its influencing factors in order of weight can be obtained P1 leadership ability, P2 adaptability, P4 teamwork ability, P3 pressure resistance, among which $CI = 0.0237$, $CR = 0.0266 < 0.1$, meeting the consistency requirements.

② Constructing the pairwise comparison matrix of the criterion layer (S2) and the index layer, and obtain the comparison matrix in the order of P5, P6, and P7 (Table 4).

From the pairwise comparison matrix, its $\beta = (0.5396, 0.1624, 0.2970)$ can be obtained, and its weight can be obtained by Influencing factors after reordering P5,

Table 5. Comparison matrix of S3-P.

S3-P	P8	P9	P10	Weights
P8	1	3	5	0.6370
P9	1/3	1	3	0.2583
P10	1/5	1/3	1	0.1047

capital turnover, P7 departmental development direction, P6, leadership support, other Medium CI = 0.0046, CR = 0.0088 < 0.1, meeting the consistency requirements [10].

③ Constructing a pairwise comparison matrix between the criterion layer (S2) and the index layer, and follow the order of P8, P9, and P10. order to get the comparison matrix (Table 5).

From the pairwise comparison matrix, $\beta = (0.6370, 0.2583, 0.1047)$ can be obtained, and its influencing factors in order of weight can be obtained P8, relevant policies, P9, peer competition, P10 market environment, where CI = 0.0193, CR = 0.0370 < 0.1, which meets the consistency requirements [9].

3.3 Hierarchical Total Ranking Consistency Test

The total ranking is to calculate the ranking weight of the relative importance of all factors in the same layer to the target layer. This process is carried out step by step from bottom to top, so that the weights of the sub-criteria layer P to the target layer G can be calculated, and they can be sorted to obtain their importance ranking. Among them, P1—G is $0.2507 * 0.5714 = 0.1432$, and the weight ratio of P2 to P10 to the total target can also be obtained, that is, its relative weight is as following [8] (Table 6).

From the result weights, it can be concluded that the order of factors that have a greater impact on the goal is P1 leadership ability; P2 adaptability; P5 capital turnover; followed by P4 teamwork ability with general and relatively close influencing factors; P8 Relevant policies, P7 is radiation range, P3 is ability to withstand pressure; then P6 is Leadership support, P9 is peer competition, and finally market environment P10.

The consistency test of the total ordering of the hierarchy is also carried out step by step from the lower layer to the upper layer, and its random consistency ratio is as following.

$$CR = \sum_{i=1}^3 S_i(CI) / \sum_{i=1}^3 S_i(RI) \tag{4}$$

Similarly, when the CR of the total ordering is <0.1, we consider that the total ordering of this level is consistent and satisfactory, otherwise we need to make further judgments on each pairwise comparison matrix, by calculating the random consistency ratio of the P layer is CR = 0.0231 < 0.1, that is, it can be considered that the total ordering of the hierarchy satisfies the consistency [13].

Table 6. The weight ratio of P-G.

P—G	P1	P2	P3	P4	P5
W	0.2374	0.1672	0.0611	0.1057	0.1542
P—G	P6	P7	P8	P9	P10
W	0.0464	0.0849	0.091	0.0369	0.015

4 Enterprise Decision-Making Ability Assessment

After obtaining the weights of the indicators at all levels relative to the target layer, the evaluation of the decision-making ability of the department can be achieved by scoring the three-level indicators. In the scoring process, two scoring methods are used comprehensively. The scoring subject will quantitatively score the three-level indicators of each evaluation object according to the scoring standards, and obtain the respective index scores of the two scoring methods. After the weighted average, the evaluation of each three-level indicator is obtained Score Q_i . Multiply the score Q_i of each indicator with the corresponding weight to get the result R of the departmental decision-making evaluation. The reference standard for evaluation result R is as following.

$R \in (0, 2)$, It shows that the decision-making ability of the department is poor, and the problem needs to be identified and rectified.

$R \in (2, 3)$, It shows that the decision-making ability of the department is average, and effective measures need to be formulated for improvement.

$R \in (3, 4)$, It shows that the Department has good decision-making ability and needs to formulate a few measures for improvement.

$R \in (4, 5)$, It shows that the decision-making ability of the department is excellent and needs no improvement.

5 Conclusions

In conclusion, by analyzing a variety of the factors that affect departmental decision-making, this paper is instructive to improve the decision-making ability of department by constructing the evaluation index system of departmental decision-making ability and the quantitative model of departmental decision-making evaluation. Modeling method of this paper is not comprehensive enough owing to the various factors and errors of the judgment value. Neural network algorithm can be considered to optimize the model in our future work.

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