

## Research Article

### Performance Evaluation Study on Human Resource Management of Food Enterprise Based on Grey System Theory

Li Haoyong

Hennan Polytechnic University, Jiaozuo, 454000, China

**Abstract:** Performance evaluation of human resources management level is significant for improving the level of food enterprise and therefore the application of grey system theory on it should be studied in depth. Firstly, the difficulties of performance evaluation of human management level of food enterprise are discussed. Secondly, the basic theory of grey system theory is studied in depth, the corresponding mathematical model are analyzed in depth. Thirdly the performance evaluation index system of human management level of food enterprise is constructed and a food enterprise is used as example, the corresponding evaluation is carried out, results show that the grey system theory is an effective tool for evaluating the human resource management level for food enterprise.

**Keywords:** Food enterprise, grey system theory, human resources management

#### INTRODUCTION

The food enterprise faces the severe test affected by Macroeconomic Situation and frequent food safety affairs. Safety supervision is growing continuously, then the security of production process and storage and transportation process for the food enterprise increase too. China domestic food has high homogeneity and the market competition intensifies and the profit space of the food enterprise shrinks. With improvement of labor force welfare system and social security system of government and increasing of prices and labor cost, recruitment difficulties has occurred in the food enterprise, the human resource management has become a main problem for food enterprise. The human resource management relates to strategic planning of human resource, talent introduction, employee training, employing and leaving person scientifically. Therefore it is necessary to evaluate the human management level of the food enterprise effectively, then the human and material resources of interior and exterior food enterprise can be integrated well, the difficult problem faced by the food enterprise can be solved effectively (Xu *et al.*, 2015).

Grey system theory is a main evaluating method for dealing with incomplete information system by using mathematical technology. The grey system theory can measure the correlation degree among different factors through evaluate the similar and different degrees of developing trend among different factors, the limitations of a large number of samples and typical probability distribution can be avoided and this method is simple and easy to be done. Therefore the grey system theory can be applied in the evaluation of human resources management of food enterprise

effectively and the evaluation results can offer important basis for constructing the proper human resource management system of food enterprise.

**Difficulties of performance evaluation of human management level of food enterprise:** In modern society, the development of food enterprise is decided by construction of talent team, the brain drain of high-quality talents and the deficiency of professionals has negative effect on the development of pharmaceutical, therefore the training of talent team is a task of top priority. The effective evaluation system can inspire the employees effectively and form reasonable salary system, then the excellent talents can be retained, the development of the enterprise can be achieved. The existing problems of performance evaluation are listed as follows (Chuang and Chang, 2014).

**The recognition of performance is low:** The executor of performance evaluation is competent department of employees for most food enterprise, Very few of other main bodies are introduced to evaluate the employees, furthermore, although other reviewers are invited, the weight of them is often low and they can not affect the results finally. On the other hands, the evaluation results lack fairness, many evaluations has no substantial progress, which have become a mere formality. The higher-ups want to make every department harmonious, they often pursue the equalitarianism. Those who work hard are seldom rewarded, the Go-slow people is not punished.

**Performance evaluation system is relatively isolated:** At present, the performance evaluation system cannot be combined with frame of human resources of food

enterprise. The performance evaluation system of food enterprise cannot link up with salary of employees, chance of promotion and the reward directly and cannot offer the projects of training the job skill of employees. The food enterprises only carry out pure performance evaluation and ignore the feedback and amendment of performance, therefore the performance evaluation cannot work effectively and the employees cannot be inspired effectively.

**Performance evaluation indexes are unreasonable:** Generally the quantity index has a united calculating standard, can be expressed by the exact number, then the transparency and operability of evaluation can be improved and it is benefit for the future informatization of performance evaluation system. Presently the number of quantifiable indexes is low for the performance evaluation of the food enterprise.

### METHODOLOGY

**Basic theory of grey system theory:** The grey equation is applied in denoting the features and schedule of the grey system. The grey equation concludes the following aspects.

**Grey algebra model:** The grey algebra model contains grey coefficient. The number of grey equation can be confirmed based on the value of the grey coefficient. When all grey coefficients all choose limited value on bounded grey domain, then the grey equations can describe the limited white equations. When the grey coefficients of equation use the infinite value, the grey equations can be used to describe the infinite white equations. The grey equation chooses different value for different grey coefficient, which have something with the different value in solution collection (Zhao *et al.*, 2012).

**Grey differential model:** The grey differential equation is used to study the grey system effectively. The grey system has incomplete and uncertainty information, the activity of it is denoted by series; it is the finite information object. The grey differential equation is established through the equation with the grey derivative.

For the grey system, the time series can describe the features of the system. The information increment in  $i$  level time can be listed by Wei (2014):

$$d^{(i)}(k_i) = x(k_i) - x(k_i - 1_i) \tag{1}$$

where  $k_i = 1_i, 2_i, \dots, n_i$ ,  $1_i$  is a unit of time.  $d^{(i)}(k_i)$  is the grey derivative, which can be denoted by  $d(k)$ .

The data series that denote the characteristics of the grey system can be defined by  $X^{(0)}$ , the first accumulation of  $X^{(0)}$  generates the series  $X^{(1)}$ , the expressions of  $X^{(0)}$  and  $X^{(1)}$  can be expressed by Tian *et al.* (2013):

$$X^{(0)} = [x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(n)] \tag{2}$$

$$X^{(1)} = [x^{(1)}(1), x^{(1)}(2), \dots, x^{(1)}(n)] \tag{3}$$

where  $x^{(1)}(k) = \sum_{i=1}^k x^{(0)}(i)$ ,  $k = 1, 2, \dots, n$ .

The grey derivative of  $X^{(1)}$  is listed by Mark (2014):

$$d(k) = x^{(0)}(k) \tag{4}$$

According to series  $X^{(1)}$ , the differential equation is constructed, which can be listed by Mark (2014):

$$x^{(0)}(k) + az^{(1)}(k) = b \tag{5}$$

where  $z^{(1)}(k)$  is background value, the corresponding expression of it is listed as follows:

$$z^{(1)}(k) = 0.5x^{(1)}(k) + 0.5x^{(1)}(k - 1) \tag{6}$$

### RESULTS AND DISCUSSION

According to the real situations of human resources management of food enterprise, the performance evaluation index system can be established, which be shown in Table 1.

The evaluation value of all second grade indices for  $i^{\text{th}}$  first grade indices constructs the vector, which is expressed as follows (Yang *et al.*, 2014):

$$V_i = (V_{1i}, V_{2i}, \dots, V_{mi}) \tag{7}$$

where,  $V_{ki}$  denotes the evaluation value of  $k^{\text{th}}$  second grade indices for  $i^{\text{th}}$  first grade indices,  $k = 1, 2, \dots, m$ ,  $i = 1, 2, \dots, n$ .

The optimal value  $V_{k_0} = \text{Best}(V_{ki})$  of  $k^{\text{th}}$  second grade indices is used as  $k^{\text{th}}$  weight of referenced series and the referenced series can be expressed by:

$$V_0 = (V_{10}, V_{20}, \dots, V_{m0}) \tag{8}$$

The matrix of evaluation system can be expressed by:

$$V = \begin{bmatrix} V_{11} & V_{12} & \dots & V_{1n} \\ V_{21} & V_{22} & \dots & V_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ V_{m1} & V_{m2} & \dots & V_{mn} \end{bmatrix} \tag{9}$$

In order to make the dimensions of all the indices consistent, the normalizing treatment is implemented for the evaluation indices based on the formulation (10), which is shown as follows:

Table 1: Performance evaluation index system of human resources management of food enterprise

Object level	First class level	Second class level
Performance evaluation of human resources management of food enterprise (A)	Appointment of employees (A1)	Recruitment system can hire the right person (A11) Selection process and operation (A12) Quits rate of new employee (A13) Adaptability degree between the employee's ability and business requirement (A14)
	Education and training (A2)	Continuing education and training of employee (A21) Rate of training charge to mean number of employees (A22) Rate of training charge to revenue (A23) Evaluation of education and training achievement (A24) Total period of training for every employee (A25)
	Performance management (A3)	Productivity and output quality of employee (A31) Standard-reaching rate of performance index (A32) Feedback degree of head to the performance of employee (A33) Satisfaction of employ to performance evaluation system (A34)
	Salary management (A4)	Welfare system (A41) Salary system (A42) Management of labor cost (A43) Retirement and pension scheme of employee (A44)
	Strategy and planning of human resources management (A5)	Human resources planning (A51) Incubator program of head (A52) Degree of human resources department entering the planning of strategy (A53) Adaptability of human resources department with other function departments (A54)

$$X_{ki} = \frac{|V_{ki} - Best(V_{ki})|}{|Best(V_{ki}) - Poor(V_{ki})|} \quad (10)$$

where  $Poor(V_{ki})$  is the bad value of  $k^{th}$  second class indexes and the final evaluation vector can be expressed by:

$$X_i = (X_{1i}, X_{2i}, \dots, X_{mi}) \quad (11)$$

**Calculation of relational coefficient:** The relational coefficient is calculated the distant between the referenced point and comparative point of all second grade indices. The vector madding up of data of every second grade indices for different first grade indices is normalized to obtain the new referenced series  $X_0 = (X_{10}, X_{20}, \dots, X_{m0})$  and the vector  $X_i (i = 1, 2, \dots, n)$  is used as comparative series and the relational coefficient can be calculated according to the following expression:

$$c_{ki} = \frac{\min_k \min_i |X_{k0} - X_{ki}| + \lambda \max_k \max_i |X_{k0} - X_{ki}|}{|X_{k0} - X_{ki}| + \lambda \max_k \max_i |X_{k0} - X_{ki}|} \quad (12)$$

where,  $\lambda$  distinguishing factor,  $\lambda = 0.5$  in this research.

Based on formulation (11), the relational coefficient matrix can be got, which is expressed by:

$$C = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1n} \\ c_{21} & c_{22} & \dots & c_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m2} & \dots & c_{mn} \end{bmatrix} \quad (13)$$

Standard data of  $k^{th}$  second degree indexes in recent years for food enterprises the vector  $Z_k = (Z_{k1}, Z_{k2}, \dots, Z_{kt})$ , ( $k = 1, 2, \dots, m$ ), the comprehensive score of human resources management level of some food enterprises in recent  $t$  years constructs vector

$Z_0 = (Z_{01}, Z_{02}, \dots, Z_{0t})$ . The absolute relational degree between  $Z_k$  and  $Z_0$  can be computed by the following expression:

$$\alpha_{0k} = \frac{1 + |r_0| + |r_i|}{1 + |r_0| + |r_i| + |r_i - r_0|} \quad (14)$$

where,  $r_i$  is calculated based on the formulation (14), which is shown as follows:

$$r_i = \sum_{j=1}^{t-1} (Z_{kj} - Z_{k1}) + \frac{1}{2} (Z_{kj} - Z_{k1}), \quad i = 0, 1, \dots, t \quad (15)$$

The relative relational degree between  $Z_k$  and  $Z_0$  can be obtained based on the following expression:

$$\delta_{0k} = \frac{1 + |r'_0| + |r'_i|}{1 + |r'_0| + |r'_i| + |r'_i - r'_0|} \quad (16)$$

where,  $r'_i$  can be got based on expression (15), which is shown as follows:

$$r'_i = \sum_{j=1}^{t-1} \left( \frac{Z_{kj}}{Z_{k1}} - 1 \right) + \frac{1}{2} \left( \frac{Z_{kj}}{Z_{k1}} - 1 \right) \quad (17)$$

Then the comprehensive relational degree between  $Z_k$  and  $Z_0$  is calculated based on the following expression:

$$\mu_{0k} = \xi \alpha_{0k} + (1 - \xi) \delta_{0k} \quad (18)$$

where  $\xi$  is the regulator,  $\xi = 0.6$ .

The weight of every second glass indexes can be got through using comprehensive relational degree, which can be expressed by:

Table 2: Performance evaluation index system of human resources management of food enterprise

First class index	Weight	Second class index	Weight
A1	0.22	A11	0.37
		A12	0.23
		A13	0.18
		A14	0.22
A2	0.24	A21	0.13
		A22	0.28
		A23	0.25
		A24	0.14
		A25	0.20
A3	0.28	A31	0.20
		A32	0.18
		A33	0.32
		A34	0.30
A4	0.12	A41	0.47
		A42	0.12
		A43	0.26
		A44	0.15
A5	0.14	A51	0.11
		A52	0.48
		A53	0.24
		A54	0.17

Table 3: Evaluation results of human management level of food enterprise

First class indexes	Relational degree
A1	0.532
A2	0.621
A3	0.505
A4	0.438
A5	0.411

$$W = [\omega_1, \omega_2, \dots, \omega_m] \tag{19}$$

where,  $\omega_i$  is calculated based on the following expression:

$$\omega_i = \frac{\mu_{0i}}{\sum_{i=1}^m \mu_{0i}}, i = 1, 2, \dots, m \tag{20}$$

The relational degree of the first class indexes can be obtained based on the following expression:

$$R = WC \tag{21}$$

The value of the relational degree for every first level index is the importance for improving the human management level of food enterprise.

A food enterprise is used as a case and the corresponding study is carried out based on the grey system theory, 50 human resources management experts are invited to evaluate the every evaluation index of this food enterprise, based on the computing procession of grey system theory, the weight of every evaluation index is obtained finally and the analysis results are shown in Table 2.

The final relational degree of human resources management performance evaluation for this food enterprise is calculated based on expression (20), the corresponding calculating result is shown in Table 3.

The importance of every first class indexes is calculated based on grey system theory and the corresponding results are shown as follows:

$$A2 > A1 > A3 > A4 > A5$$

As seen from the analysis results, the education and training are important for improving human management level of food enterprise, the corresponding training plans should be taken.

### CONCLUSION

In recent years, the food enterprise has faced many developing difficulties. The human management level of food enterprise should be improved through choosing the proper measurements and then the food enterprise can improve the competition itself and develops constantly. Case study shows that the grey system theory is an effective analysis tool for evaluating the human management level of food enterprise, based on the evaluation results the food enterprise can find out the week aspects and choose effective measurement for amend the disadvantages.

### REFERENCES

Chuang, T.F. and Y.H. Chang, 2014. Comparison of physical characteristics between *Rana latouchii* and *Rana adenopleura* using grey system theory and artificial neural network. *Ecol. Eng.*, 68(7): 223-232.

Mark, E., 2014. An alternative approach to estimating the parameters of a generalised Grey Verhulst model: An application to steel intensity of use in the UK. *Expert Syst. Appl.*, 41(4): 1236-1244.

Tian, J., B. Yu, D. Yu and S.L. Ma, 2013. Missing data analyses: A hybrid multiple imputation algorithm using Gray system theory and entropy based on clustering. *Appl. Intell.*, 40(2): 376-388.

Wei, M.C., 2014. The influence factor analysis for sexual harassment on campus in Taiwan via grey system theory. *J. Grey Syst.*, 17(4): 207-213.

Xu, G.Y., J.Q. Shen and B. Liu, 2015. Study on the effectiveness evaluation of internal control of food enterprises based on the improved matter-element model. *Adv. J. Food Sci. Technol.*, 7(8): 262-271.

Yang, Y.S., C.Y. Shih and R.F. Fung, 2014. Multi-objective optimization of the light guide rod by using the combined Taguchi method and Grey relational approach. *J. Intell. Manuf.*, 25(1): 99-107.

Zhao, Z.J., X.M. Wu and X. Xie, 2012. Performance evaluation of edible agricultural products enterprise implementing traceability system: The samples from Sichuan Province. *J. Sichuan Agric. Univ.*, 30(1): 35-36.