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Analysis of the evaluation system of energy enterprises based on KPI evaluation system

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Abstract. Performance evaluation is an important mean to improve the efficiency of enterprise managements. In the energy industry, the application of performance appraisal system is still in the initial stage. In order to better enhance the performance management of energy enterprises, the application of performance appraisal system in China was introduced in this paper firstly, then A company was taken as an example, and the actual application of the performance evaluation system of energy enterprises was analyzed through the method of factor analysis model. Finally, the data obtained from factor analysis was analyzed and the conclusions were drawn. The result shows that the performance evaluation system of a company is not satisfactory, and the company's performance evaluation index is seriously inconsistent with the actual operation of the enterprise. According to the research results, the problems of energy enterprise assessment systems in this paper were summarized and relevant suggestions were put forward, so as to provide some references for the improvement of the performance evaluation of energy enterprises.

Key words. KPI, energy enterprise, performance evaluation, factor analysis.

1. Introduction

The rapid development of the market economy has brought unprecedented opportunities for enterprises in all sectors of our country. Under such an era background, the effectiveness of enterprise managements is very important for the long-term development of enterprises. And the assessment system of employees directly affects the efficiency of the whole enterprise management. At present, the energy sector is one of the sunrise industries in China. The development of energy enterprises is still in the initial stage, and how to do a good job of staff assessments is crucial. There are some errors in the assessment of staffs for many energy companies, for example, the strategic target is not clear, the assessment index is unreasonable, the assessment method is not proper and the feedback efficiency of the assessment result is

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low. The assessment system and assessment management of most energy enterprises become a mere formality, which is of no benefits to the development of enterprises.

Assessment system is the basis of the staff incentive mechanism, and it is the most important part of human resource managements in energy enterprises. At the same time, the assessment system bears the primary responsibility for feedbacks on the information of employees' achievements. From this point of view, the evaluation system provides not only a bridge for communications between enterprises and employees, but also a reference for employees to continuously improve their work results. The fairness of the assessment system determines the overall development of the enterprise to a great extent. Performance appraisal system is the most widely used staff assessment system, which is an evaluation system that consists of a set of independent and interrelated evaluation indicators which can express the requirements of the evaluation. This assessment system can be used to conduct a more rational and comprehensive assessment of individual employees' work abilities through specific methods.

In the energy industry, the enterprise's human resource management departments have set up the corresponding performance appraisal system for staff assessments, but the application effect of performance appraisal system in most enterprises is not ideal. The application of performance appraisal system in our country is late, and many human managers still lack some experiences in the effective application of performance appraisals. In recent years, many enterprises begin to pay more attentions to the construction and design of performance systems. Enterprises in various industries have made great efforts in the selection of KPI indicators and the setting of weights. However, in the process of building performance evaluation systems, most enterprises draw on the experience of foreign related achievements and experiences, which is different from China's market economy and the development environment of enterprises, thus leading to the little effect of performance appraisal works in enterprises, and this phenomenon is reflected in the energy enterprises, which is particularly prominent.

Based on this, the selection of the performance evaluation index system and the optimization of the assessment system were analyzed and studied through the construction of factor analysis model in this paper.

2. State of the art

The concept of performance appraisal originated earlier in foreign countries, but our country had the form of performance appraisal since ancient times. At present, domestic and foreign scholars have conducted a lot of researches on performance appraisal systems, which not only includes the design of performance systems, the determination of evaluation indexes and the feedback validity of performance appraisals, but also makes a great deal of researches on the application of performance appraisal systems.

Wang put forward that performance management could be divided into two main aspects: peripherals and tasks. At the same time, he also made a detailed study on the model construction of performance managements (Wang et al. 2013) [1].

Under the background of international economic developments, Liu used the factor analysis method to determine the indexes and factors of enterprise performance evaluations, and the related factors that affected enterprise performance appraisals were also clarified and analyzed (Liu et al. 2014) [2]. He pointed out that the market structures, capital statuses, enterprise operating costs and enterprise profits would affect the performance of enterprises to varying degrees. Kosonen made a qualitative analysis of the effectiveness of enterprise performance managements. He studied the relationship between the two companies from the perspective of the impact of corporate reputations and corporate performances. The results show that the two are positively related (Kosonen et al. 2015) [3].

The above researches are the qualitative analysis of the concept, index and influencing factor of performance managements, which lacks the concrete analysis of the whole construction of the assessment system and the evaluation effect. At the same time, these studies have not put forward practical application performance evaluation systems from the point of view of practical applications of performance appraisal systems. Therefore, the construction of a targeted performance appraisal system is of great significance. In addition, scholars at home and abroad have done a lot of researches on enterprise performance managements. Rialland put forward a balanced scorecard approach. He believed that market shares, target customers, labor productivities and schedule completion rates should be included in the performance appraisal system (Rialland et al. 2014) [4]. Tian proposed to establish a strategy-oriented performance appraisal system, which mainly includes the intelligent behavior evaluation system, performance index evaluation system, potential evaluation and assessment system and so on (Tian et al. 2013) [5]. Piscesa believed that the development strategy of the performance management should be enterprise-oriented, and based on this, horizontal and vertical index system could be constructed, at the same time, the performance management system should include three aspects: behavior appraisal, performance evaluation and potential evaluation (Piscesa et al. 2017) [6]. Lavy believed that corporate strategies could serve as the main direction of performance managements (Lavy et al. 2014) [7]. However, it is very important to decompose the strategic performance management index and do the index decomposition and dynamic evaluation. Therefore, in view of the shortcomings of the existing research, a factor analysis model was proposed in this paper to analyze and study the existing performance appraisal system of energy enterprises. The factor analysis model can qualitatively analyze the indexes of the existing KPI evaluation system in the energy enterprises on the basis of previous studies, at the same time, the factor analysis model can also measure the rationality of the indexes through the score of each index factor, so as to provide a certain reference for the enterprise to adjust and select the assessment index reasonably.

The rest of the paper is organized as follows. In the third part, the research object and the concrete content of the factor analysis model construction were elaborated; In the fourth part, the specific data of the factor analysis model was obtained, and the data results were analyzed. In the last part, the paper was summarized and the relevant conclusion was given.

3. Methodology

In this paper, energy company A was selected as the object of study, and the KPI assessment system of energy enterprises was analyzed and researched through the construction of factor analysis model.

Company A is a subsidiary of the Energy Corporation of China in Shanxi province, and it is established in the mid-90s of the last Century, which is mainly engaged in coal washing and power generation. Enterprise achieves rapid developments under the leaderships of the head offices and their own technological advantages. At present, the company has accounted for 60 % of the market share in coal washing and power generation industries of Shanxi province. In order to make sustainable developments in the energy industry, it has introduced a more advanced human resource management system and formulated a more systematic performance appraisal system. Table 1 is the main content of the performance appraisal system adopted by A company.

Table 1. Performance appraisal system of company A based on KPI

Category	Content
Hypothetical premise	It is assumed that all necessary actions will be taken to achieve a predetermined goal
Purpose of examination	Taking the strategy as the center, and the design and application of the index system serve for the enterprise's strategic goal
Index generation	Within the enterprise, the strategic objectives are decomposed from top to bottom
Source of indicators	Based on strategic objectives and competitive requirements of value-added work outputs of enterprises
Composition and function of indexes	Through the combination of finance and non-finance, it reflects the principle of paying attention to short-term benefits and taking long-term developments into account. The index itself not only conveys the result, but also delivers the process of producing the result

In the process of performance appraisals, managers of A enterprise found that there were some problems in the assessment. Department staffs thought that management scores were biased, and managers were beginning to show negative emotions about their workload. They thought their work pressure and work task were heavy, and there was no time to fill out a large number of examination forms and documents. After two years, through this performance appraisal system, A company

had not obtained the more ideal results, so enterprise managers believed that performance appraisal system had not played its proper role. From the feedback of the performance appraisal, the author hopes to analyze the performance appraisal system of enterprises through the factor analysis, so as to find out the existing problems in performance appraisals and ultimately improve the performance evaluation results and experiences for reference of other energy enterprises.

Mascia believed that factor analysis referred to the study of statistical techniques for extracting common factors from variable groups (Mascia et al. 2016) [8]. This method of analysis was proposed by British psychologists. In the study of student achievements and other contents, psychologists found that students had good results in all subjects, so the level of achievements was good, so that they put forward the existence of common factors. From this life example, it can be seen that factor analysis is the method of finding common influence factors in different influencing factors. Figure 1 is the general idea of factor analysis of the performance appraisal system of A enterprise.

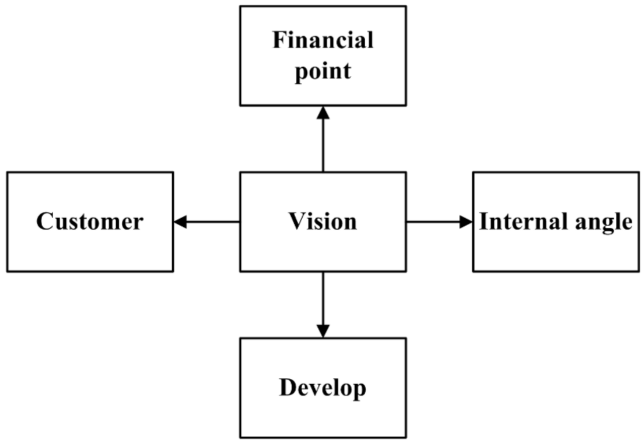

Fig. 1. Analysis thinking of evaluation factors of A company

Horta considered that factor analysis method could effectively reduce the complexity of computation and realize the best analysis of things through the assumption of variable relations (Horta et al. 2014) [9]. Tong believed that the methods of factor analysis included exploratory and confirmatory. The former does not have the hypothesis, while the latter assumes the presupposition as the basis of analysis (Tong et al. 2015) [10]. Liu thought there were many kinds of factor analysis methods. These methods are approximate analysis methods based on correlation coefficient matrixes (Liu et al. 2014) [11]. Edokpia believed that principal component analysis was a typical example of factor analysis (Edokpia et al. 2013) [12]. Veronesi believed that the main advantage of confirmatory factor analysis was that it could analyze and study the details of the theoretical model (Veronesi et al. 2015) [13]. Therefore, there are many different factor items in the analysis of validity and validation, and there are some hierarchical and progressive relations among these items. Gail-

lard considered that measurement model was one of the main application models of confirmatory factor analysis (Gaillard et al. 2016) [14]. The main reason why the paper chooses the factor analysis model to analyze the performance evaluation system of energy enterprises is that the business scope involved in energy enterprises is more specific and its business line is clear, and this kind of enterprise category is not complicated. These facts are good for factor selections and classifications of factor analysis models. At the same time, the actual operation of energy enterprises is conducive to the construction and analysis of the factor model.

In factor analysis, the number of factors needs to be specified by the analyst, while the number of factors specified is different and the result is different. In principal component analysis, the number of ingredients is certain, and there are several variables, in which there are several principal components. Compared with principal component analysis, factor analysis can help to explain factors by using the rotational technology, and it has more advantages in interpretation. Generally speaking, when searching for potential factors and explaining these factors, they are more inclined to use factor analysis, and it can help to explain better with the aid of rotational technology. If we want to change the existing variables into a few new variables for subsequent analysis, the principal component analysis can be used. Of course, this can be done with factor scores. So this distinction is not absolute.

The factor analysis method is used to construct the performance appraisal system of A energy enterprise, as follows:

Firstly, the assessment teams are established, including members of the group of human resource experts, evaluation experts and other staffs. Generally speaking, the difference between the object and purpose of the examination determines the basis for the selection of the examination experts.

Secondly, according to the related evaluation systems for factor analysis, judgment and choice, the corresponding comparison for each factor is obtained by experts of, and there will be a more specific score. Allen considers that the factor judgment of enterprise assessment systems is mainly based on the correlation of factor variables (Allen et al. 2013) [15]. Generally speaking, factor analysis should firstly be compared and divided into groups. Each group of variables represents the corresponding factor structure, and the common factor and the random variable are determined according to the structure of the factors. At the same time, we must construct the linear model of the index according to the formula

$$X = AF + \varepsilon \,, \tag{1}$$

where A is a linear coefficient, F is a common factor and ε is a random variable.

Thirdly, the result of factor comparison is compared and the score of each factor is calculated according to the following formula

$$D_{i\mathrm{R}} = \sum_{i=1}^{n} \sum_{j=i}^{n} a_{ij} \,. \tag{2}$$

Here, $D_{i\mathrm{R}}$ is the factor evaluation value and a_{ij} is the factor value.

Fourthly, the average value of factor evaluation is obtained according to the formula

$$P_i = \sum_{R=1}^{L} \frac{D_{i\mathrm{R}}}{L}\,, \tag{3}$$

where P_i is the average value of the factors and L is their value.

Fifthly, the results of the calculation of comprehensive statistics and the weights of the assessment index are calculated according to the formula

$$W_i = \frac{P_i}{\sum_{i=1}^{n} P_i}\,. \tag{4}$$

Sixthly, according to the contrast of the above calculation results and the existing assessment systems of each factor index, the problems and advantages of the performance appraisal system are found.

4. Result analysis and discussion

By using the method of factor analysis model, the performance evaluation system of A company was analyzed and studied. The results are listed in Table 1.

The indicators and weights of employees' performance appraisal of energy company A are shown in Table 2. One of the examined staffs was taken as an example, the performance evaluation indexes of each grade of KPI were calculated as follows:

Financial performance index $= 90 \times 0.3 + 100 \times 0.15 + 96 \times 0.15 + 96 \times 0.4 = 95$.

Operating efficiency index $= 95 \times 0.22 + 85 \times 0.5 + 88 \times 0.28 = 88$.

Competitive capability index $= 90 \times 0.42 + 90 \times 0.42 + 95 \times 0.16 = 91$.

Service quality index $= 95 \times 0.34 + 96 \times 0.33 + 95 \times 0.33 = 95$.

Social contribution index $= 92 \times 0.5 + 95 \times 0.12 + 90 \times 0.38 = 92$.

Capability index $= 90 \times 0.32 + 94 \times 0.68 = 93$.

The performance evaluation index score of the second-class KPI index was calculated as follows:

Financial performance index $= 90 \times 0.3 + 96 \times 0.15 + 95 \times 0.15 + 95 \times 0.4 = 94$.

Operating efficiency index $= 95 \times 0.22 + 95 \times 0.5 + 88 \times 0.28 = 93$.

Competitive capability index $= 90 \times 0.42 + 92 \times 0.42 + 95 \times 0.16 = 92$.

Service quality index $= 92 \times 0.34 + 95 \times 0.33 + 90 \times 0.33 = 92$.

Social contribution index $= 95 \times 0.5 + 90 \times 0.12 + 85 \times 0.38 = 91$.

Capability index $= 88 \times 0.32 + 90 \times 0.68 = 89$.

According to the weight of employee evaluation indexes of A enterprise, the factor function $M_i = \sum_{n=1}^{2} A_n F_n$ was applied to make the factor analysis and sorting to get two main factors. The specific contents are shown in Table 3. From the data in Table 3, it can be seen that the corporate social contribution index and the capacity index are more reasonable, and the differences between the financial performance and operational efficiency index, competition ability index and service quality index of main factors are larger. Its rationality is not ideal, and these indicators need to make some appropriate adjustments.

Table 2. Indicators and weights of employee performances in A company

The first-class KPI index	The second-class KPI index	Self-evaluation score	Assessment team score	Departmental colleague score
Financial performance index	Net assets income	90	90	86
	Turnover of total assets	100	96	95
	Sales growth rate	96	95	95
	Rate of profit growth	96	95	96
Operating efficiency index	Utilization ratio of cost	95	95	86
	Delivery accuracy	85	95	86
	Logistics management cost rate	88	88	88
Competitive capability index	Timely rate of information feedback	90	90	95
	Contribution rate of new products	90	92	95
	Technology input rate	95	95	90
Service quality index	Customer acquisition rate	95	92	90
	Customer satisfaction	96	95	92
	Customer retention rate	95	90	95
Social contribution	Rate of total assets	92	95	95
	Public participation rate	95	90	92
	Ecological efficiency	90	85	86
Capability index	Labor discipline	90	88	90
	Work efficiency	94	90	90

Table 4 is the final factor analysis score of employee performance evaluation in A company. Figure 2 is a comparison of employee factor scores in A company. The data shows that the result of factor analysis of employee performance appraisal of A company has great difference, at the same time; there is the stratification in the evaluation of performance indexes of the enterprise staffs.

Table 3. Coefficients of factor scores

Original index	Main factor 1	Main factor 2
Financial performance index	0.887	-0.106
Operating efficiency index	0.924	0.199
Competitive capability index	0.862	0.238
Service quality index	0.885	0.410
Social contribution index	0.649	0.906
Capability index	0.629	0.950

Table 4. Comprehensive factor score of staff performance evaluations in A company

Staff code	Composite score	Score of main factor 1	Score of main factor 2
1	3.460	4.542	2.189
2	3.413	4.452	2.269
3	1.485	2.548	-1.334
4	1.916	2.742	0.352
5	-2.140	-3.113	-0.201
6	-2.405	-2.597	-3.651

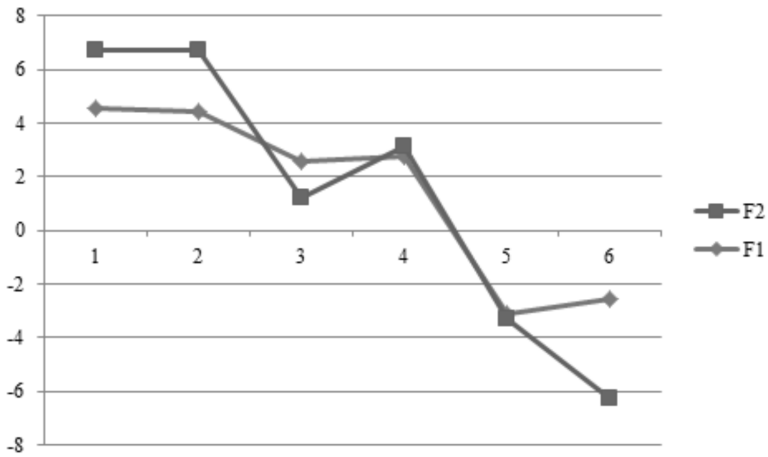

Fig. 2. Comparative analysis of employee factor scores

Thus, the performance evaluation system of A enterprise lacks a certain degree of scientificalness, and at the same time, the choice of the enterprise performance

evaluation indicators is inconsistent with the actual operating environment of the enterprise. Therefore, the author puts forward the following suggestions to adjust and improve the KPI performance appraisal system of energy enterprises: First of all, the energy enterprises should start from the actual situation to make the popularization of cultural knowledge of performance managements in the enterprise, so they to need not only actively communicate with all levels of the organization, but also implement the unified and fair performance management to all employees; Secondly, from the point of view of enterprise management systems, it is necessary to establish the interview system and complaint system of performance appraisals, so as to strengthen the layered communication of internal performance managements; Finally, the introduction of information management systems of enterprise performance appraisal systems can help employees to better understand and accept the performance management, so as to make researches reasonably choose the corresponding performance evaluation index and enhance the overall effect of enterprise performance managements.

5. Conclusion

In order to improve the performance appraisal system and enhance the effect of the enterprise performance management, in this paper, company A was taken as an example on the basis of the construction of the factor model, and the performance appraisal system of energy enterprises was analyzed, and the existing problems of performance appraisals of the enterprise were put forward. Finally, the main conclusions were drawn as follows:

(1) The social contribution index and capability index of this enterprise are more reasonable, and the differences between the other assessment indexes are greater, and their rationality is not ideal. These indexes need to be adjusted appropriately.

(2) The results of factor analysis of performance appraisals of employees in A enterprise have great differences, at the same time; there is a stratification in the evaluation of performance indexes of the enterprise staffs.

(3) The performance appraisal system of A enterprise is not scientific enough, and the choice of the enterprise's performance evaluation index does not accord with the actual operating environment of the enterprise.

To sum up, the existing performance appraisal system of energy enterprises has the problem that the index selection is inconsistent with the actual operation. The method of factor analysis used in this paper is helpful to make clear the direction of the reasonable index of performance appraisals. However, because there are still some differences among the energy companies, the research of this paper still has some reference values, but there are some shortcomings too. The author believes that energy companies can improve the effectiveness of performance managements from perspectives of system managements and performance cultures.

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