Research of Electric Power Enterprise Knowledge Workers' Incentive Based on Fuzzy Model

Jianchang Lu\textsuperscript{a}, Yinchun Lv\textsuperscript{a,*}

\textsuperscript{a}North China Electric Power University, Baoding, 071003, China

Abstract

In recent years, with the continuous development of knowledge-based economy and the reform deepening of China's power industry, how to attract, retain and develop knowledge-based talent, has become an urgent task in business management of power companies. This paper firstly introduces the background and significance of the topic, then describes the necessities of research on electric power enterprise knowledge workers' incentive. Secondly, through analyzing the features and demands of knowledge workers, combined with the actual situation of power enterprises, this paper builds the knowledge workers' incentive mechanism, and establishes the evaluation index system through this mechanism, and then it evaluates knowledge workers' incentive mechanism of power enterprises by using the fuzzy comprehensive evaluation method. Finally, the paper proves the feasibility and effectiveness by an example, and then knowledge workers' incentive of electric power enterprise is studied scientifically.

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Keywords: electric power enterprise; knowledge workers; incentive; fuzzy; evaluation

1. Introduction

In the 21st century, the influence of knowledge on economic development is more and more obvious. As a knowledge carrier, the knowledge worker play an important role in enterprises, and gradually become the core resources which is most valuable for the enterprise, it is an important part of the core competitiveness of enterprises, directly determines the survival of enterprises. Management guru Peter
Drucker once noted that the productivity of knowledge workers will become a central issue in personnel management and the greatest challenge for management in the 21st century [1].

As knowledge-intensive enterprises, the electric power enterprise has a higher proportion of knowledge workers, who hold an important position. But as the state's fundamental industry, electric power enterprise is in a monopoly position for a long time, few people concerned about the research of electric power enterprise knowledge workers' incentive mechanism. In recent years, with the reform deepening of Chinese electric power system, the power sector monopoly is being broken. Facing the pressure of fierce market competition and the loss of knowledge workers, the research of incentive mechanism should be subject to wide attention for power enterprises.

In response to the needs of management, the experts at home and abroad have had some researches for the incentive problems of knowledge workers in recent years. Knowledge management expert, Ma Han EITAM studies that the four factors of prompting knowledge workers are personal development, job autonomy, business success and money wealth. In China, many scholars also have a lot of research. Chinese scholars Wangjun Zhang and Jianfeng Peng research that the top five of Chinese knowledge workers' incentive factors are the wages and rewards, personal growth and development, challenging work, the company's future, secure and stable work [2]. Xiaogang Cun reviews the research of self-determination theory (SDT) and proposes the motivating model based on SDT in Chinese culture context [3]. Xiyuan Li etc put forward incentive factor model and incentive effect model and its implementing ways aiming at Chinese knowledge workers, in view of solving the knowledge workers' incentive problems of Chinese enterprises. Zhihong Zhang constructs knowledge workers' incentive mechanism of incentive strategy combinations [4]. Hua Su and Ning Zhang make a in-depth research for optimal mode and related countermeasures of State-owned enterprise knowledge-based employees incentive mechanism [5]. From these scholars' research, we can see the academia haven't get a consistent conclusion currently about knowledge staff incentive research, and they also have different views about the incentive methods of knowledge workers. At present, most research mainly stay in the theoretical exploration stage, rarely used in specific instances, and the incentive evaluation research for enterprise knowledge workers is also rare. According to the related conclusions from domestic and foreign researchers, this paper builds the knowledge workers' incentive mechanism, and on this basis establishes fuzzy mode, and then evaluates knowledge workers' incentive mechanism of power enterprises.

2. Electric Power Enterprise Knowledge Workers' Incentive Mechanism

Knowledge workers are different from the general workers. They, with high quality and strong autonomy, have strong innovation ability and value-added intention, the pursuit of high level value, and have strong incentives to achievement, they have unique features which is different from the general workers'. According to the significant differences between knowledge workers and general workers, the demand of knowledge workers can be summed up as the following: the needs of self-development, the needs of job autonomy, the needs of work achievement, the needs of fairness and justice [6]. Management psychology thought that demand and the resulting motivation are the starting point and basis for motivation [7], to grasp the demand of knowledge workers has an important role in the implementation of effective incentive mechanism.

Based on analysis for the feature and demand of knowledge workers, combined with the electric power enterprise's actual situation, this paper mixes the following incentive strategy, and then establishes the electric power enterprise knowledge workers' incentive mechanism model.

(1) Material incentive ($X_1$). This is one of the most commonly used methods, and at the same time, a very effective incentive mode. Material life security, is not only the premise of survival and development, but also the foundation, by which knowledge workers can produce higher levels of demand and pursuit.
The electric power enterprise knowledge workers have higher material basis, but to get more material benefit is still employees’ common desire. Meanwhile, besides having exchange value, material interests have symbolic value, is the important symbol to measure working achievement and social status for a person [8]. Therefore, reasonable material incentive completely can arouse the knowledge staff’s work enthusiasm in a certain extent. It includes four incentive factors such as salary incentive ($X_{11}$), bonuses incentive ($X_{12}$), welfare incentive ($X_{13}$), and stock incentive ($X_{14}$).

(2) Environmental incentive ($X_2$). To create a good, free and harmonious working environment for employees, can make the knowledge workers feel social respect, understanding and care to knowledge and talents, can promote their full enthusiasm for work and show their inherent ability and intelligence in imperceptible. It mainly includes policy environment incentive ($X_{21}$), the objective environment incentive (such as office environment, office equipment, environmental sanitation, etc.) ($X_{22}$), competition environment incentive ($X_{23}$), enterprise culture incentive ($X_{24}$) and so on.

(3) Work incentive ($X_3$). To seek the best matching for knowledge workers with the job, making work meaningful and challenging and fully mobilizing the enthusiasm of staff. Through these, encouraging employees work hard. Including: job autonomy ($X_{31}$), working content rich ($X_{32}$), work is challenging and conducive to self-development ($X_{33}$), participating in management ($X_{34}$) and so on.

(4) Emotional incentive ($X_4$). Knowledge workers are self-launching, self-learners and independent thinkers [9], whether their potential can be full played is related to a sense of satisfaction and happiness, which they obtained from their enterprises. Therefore, in the knowledge-based employees’ excitement, emotional incentive is indispensable. Emotional incentive mainly includes five incentive factors: care for employees ($X_{41}$), own work achievement ($X_{42}$), promotion development ($X_{43}$), prospect of company ($X_{44}$), interpersonal relationship ($X_{45}$) and so on.

3. The Fuzzy Comprehensive Evaluation of Electric Power Enterprise Knowledge Workers’ Incentive Mechanism

The electric power enterprise knowledge workers’ incentive mechanism evaluation is a decision-making problem with multiple attributes and schemes, and has certain fuzziness, fuzzy comprehensive evaluation model can be applied to the evaluation. The so-called fuzzy comprehensive evaluation is a method of making a comprehensive decision-making for a things, in fuzzy environment and considering the influence of many factors, for some purposes [10]. Because of the weight of each index will seriously affect the accuracy of the evaluation results, this paper uses the analytic hierarchy process to determine the weights of the index, it can further ensure the rationality of the evaluation. Its evaluation procedure is as follows:

(1) Establishment of the evaluation index sets.

Definition: level 1 index include the mentioned incentive strategy, they are material incentive, environmental incentive, work incentive and emotional incentive. So level 1 index set is $X=(X_1,X_2,X_3,X_4)$. level 2 index include the corresponding incentive factors, their corresponding vectors are $X_1=(X_{11},X_{12},X_{13},X_{14}),X_2=(X_{21},X_{22},X_{23},X_{24}),X_3=(X_{31},X_{32},X_{33},X_{34}),X_4=(X_{41},X_{42},X_{43},X_{44},X_{45})$.

(2) Establishment of the comment sets.

Considered that the operation and precision of the practical problems, five-level comment set is adopted, which is $Y=\{A,B,C,D,E\}$, the corresponding comment is {better, good, neutral, bad, worse}.

(3) Experts give the judge matrix of each level according to the 1 to 9 scaling method.
Normalizing $A$, using the type (1), the weight of each index can be calculated.

$$w_i = \frac{\sum_{j=1}^{n} a_{ij}}{\sum_{j=1}^{n} \sum_{i=1}^{m} a_{ij}}$$

Among it, $a_{ij} = \frac{a_{ij}}{\sum_{j=1}^{n} a_{ij}}$

(4) Making a consistence check.

In order to ensure the correctness of calculated $w_i$, the consistence check is necessary. The judge matrix is considered tolerable if $CR<0.1$, otherwise, the judge matrix should be modified. Computation formula of $CR$ is:

$$CR = \frac{CI}{RI}$$

Among it, $CI$ is the ratio of consistency index, $CI = (\lambda_{max} - n) / (n-1)$, $RI$ is average random consistency index whose value is determined by Table 1.

Table 1. Values of the average random consistency index

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td></td>
</tr>
</tbody>
</table>

(5) Determining the weight of index’s each level.

Through the consistence check, the whole weight can be determined. Definition: level 1, $X_1, X_2, X_3, X_4$, its corresponding weight vector is $W=(W_1, W_2, W_3, W_4)$, the weight vector of the level 2 is $W_1=(W_{11}, W_{12}, W_{13}, W_{14})$, $W_2=(W_{21}, W_{22}, W_{23}, W_{24})$, $W_3=(W_{31}, W_{32}, W_{33}, W_{34})$, $W_4=(W_{41}, W_{42}, W_{43}, W_{44}, W_{45})$.

(6) Experts give the fuzzy membership matrix $R$, and then establishing fuzzy evaluation matrix $Q_i$.

If only considering index $X_{ij}$ under $X_i$, the degree of index $X_{ij}$ belonging to comment $T_t$ is $r_{ijt}$, so the fuzzy membership matrix of $X_i$ is $R_i$.

$$R_i = \begin{bmatrix}
    r_{i11} & r_{i12} & \cdots & r_{ilm} \\
    r_{i21} & r_{i22} & \cdots & r_{i2m} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{in1} & r_{in2} & \cdots & r_{inn}
\end{bmatrix}$$

Among it, $i$ is the number of level 1 index, $n$ is the number of level 2 index corresponding level 1 index, $m$ is the number of related evaluation index. With fuzzy operator $M(\lor, \land)$, carry matrix synthetic operation on fuzzy membership matrix $R$ and its weight vector $W$. So, the fuzzy evaluation matrix $Q_i$ is computed:
\[ Q_i = W_i \odot R_i = (W_{i1}, W_{i2}, \ldots, W_{in}) \odot \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i1m} \\ r_{i21} & r_{i22} & \cdots & r_{i2m} \\ \vdots & \vdots & \ddots & \vdots \\ r_{im1} & r_{im2} & \cdots & r_{imm} \end{bmatrix} = (a_{i1}, a_{i2}, \ldots, a_{im}) \]

Among it, \( a_{ij} = \bigvee (w_{ij} \land r_{im}) \).

(7) Calculating fuzzy evaluation matrix \( Q \), it gets the final evaluation according to the principle of maximum membership degree.

\[ Q = (a_1, a_2, \ldots, a_m) = W \odot \begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \\ Q_4 \end{bmatrix} \]

4. Case Study

To prove the validity of the model, this paper takes a power enterprise knowledge workers incentive mechanism evaluation for example to use the above method.

Taking level 1 index for example, the calculation of the weight is given. Experts give the judge matrix of level 1 index as follows:

\[ A = \begin{bmatrix} 1 & 1/2 & 1/3 & 1/5 \\ 2 & 1 & 1/2 & 1/3 \\ 3 & 2 & 1 & 1/2 \\ 5 & 3 & 2 & 1 \end{bmatrix} \]

The weight vectors calculated is \((0.09, 0.16, 0.27, 0.48)\) and its maximum eigenvalue is 4.0145, CR = 0.0054 for less than 0.1, it is verified through the consistency check. Similarly, it can get the weight of corresponding secondary indexes. Meanwhile, according to the expert scoring, it gets the fuzzy evaluation value by experts group for the project. Results such as Table 2 shows.

Table 2. Each weight of level 2 index and fuzzy evaluation value
<table>
<thead>
<tr>
<th>Level 1 index</th>
<th>Level 2 index</th>
<th>Weight</th>
<th>Fuzzy evaluation value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material incentive</td>
<td>salary incentive</td>
<td>0.0954</td>
<td>[0.9, 0.6, 0.5, 0.4, 0.1]</td>
</tr>
<tr>
<td></td>
<td>bonuses incentive</td>
<td>0.1601</td>
<td>[0.85, 0.6, 0.5, 0.3, 0.1]</td>
</tr>
<tr>
<td></td>
<td>welfare incentive</td>
<td>0.2772</td>
<td>[0.8, 0.7, 0.5, 0.3, 0.1]</td>
</tr>
<tr>
<td></td>
<td>stock incentive</td>
<td>0.4673</td>
<td>[0.7, 0.5, 0.3, 0.1, 0]</td>
</tr>
<tr>
<td>Environmental incentive</td>
<td>policy environment incentive</td>
<td>0.1601</td>
<td>[0.6, 0.4, 0.3, 0.2, 0]</td>
</tr>
<tr>
<td></td>
<td>the objective environment incentive</td>
<td>0.0954</td>
<td>[0.8, 0.6, 0.5, 0.4, 0.1]</td>
</tr>
<tr>
<td></td>
<td>competition environment incentive</td>
<td>0.2772</td>
<td>[0.7, 0.5, 0.4, 0.3, 0.1]</td>
</tr>
<tr>
<td></td>
<td>enterprise culture incentive</td>
<td>0.4673</td>
<td>[0.8, 0.6, 0.5, 0.3, 0.1]</td>
</tr>
<tr>
<td>Work incentive</td>
<td>job autonomy</td>
<td>0.0969</td>
<td>[0.8, 0.5, 0.4, 0.2, 0]</td>
</tr>
<tr>
<td></td>
<td>working content rich</td>
<td>0.1820</td>
<td>[0.8, 0.6, 0.5, 0.2, 0]</td>
</tr>
<tr>
<td></td>
<td>work is challenging and conducive to self-development</td>
<td>0.4348</td>
<td>[0.7, 0.5, 0.3, 0.1, 0]</td>
</tr>
<tr>
<td></td>
<td>Participating in management</td>
<td>0.2863</td>
<td>[0.6, 0.4, 0.3, 0.1, 0]</td>
</tr>
<tr>
<td>Emotional incentive</td>
<td>care for employees</td>
<td>0.0783</td>
<td>[0.8, 0.4, 0.3, 0.1, 0]</td>
</tr>
<tr>
<td></td>
<td>own work achievement</td>
<td>0.3999</td>
<td>[0.7, 0.3, 0.2, 0.1, 0]</td>
</tr>
<tr>
<td></td>
<td>promotion development</td>
<td>0.2427</td>
<td>[0.7, 0.4, 0.3, 0.2, 0.1]</td>
</tr>
<tr>
<td></td>
<td>prospect of company</td>
<td>0.1200</td>
<td>[0.7, 0.4, 0.3, 0.2, 0]</td>
</tr>
<tr>
<td></td>
<td>interpersonal relationship</td>
<td>0.1592</td>
<td>[0.7, 0.5, 0.4, 0.2, 0.1]</td>
</tr>
</tbody>
</table>

According to the above, obtained:

\[
\begin{bmatrix}
Q_1 \\
Q_2 \\
Q_3 \\
Q_4
\end{bmatrix} =
\begin{bmatrix}
0.4673 & 0.4673 & 0.3 & 0.2772 & 0.1 \\
0.4673 & 0.4673 & 0.4673 & 0.3 & 0.1 \\
0.4348 & 0.4348 & 0.3 & 0.1820 & 0.1 \\
0.3999 & 0.3 & 0.2427 & 0.2 & 0.1
\end{bmatrix}
\]

\[
Q=(a_1,a_2,\ldots,a_m)=W \odot \begin{bmatrix}
Q_1 \\
Q_2 \\
Q_3 \\
Q_4
\end{bmatrix} = (0.09, 0.16, 0.27, 0.48) \odot \begin{bmatrix}
Q_1 \\
Q_2 \\
Q_3 \\
Q_4
\end{bmatrix}
\]

We can get the final evaluation value \((0.3999, 0.3, 0.27, 0.2, 0.1)\) through calculation, according to the principle of maximum membership degree, this power enterprise’s incentive mechanism of knowledge workers evaluation result is better. From above results, the electric power enterprises do a well job on the whole about the incentive work of knowledge workers, especially in work incentive and emotional incentive. At the meanwhile, we can understand stock incentive, enterprise culture incentive, work is challenging and conducive to self-development, own work achievement, are the main factors which could affect every incentive strategy directly according to all the weight of the incentive factors. Just because these incentive works in these respects does moderately, which could make the enterprises’ incentive reach a good effect finally. In order to motivate employee better and excavate the potential of employees fully, this electric power enterprises could develop their advantage sequentially and place more emphasis on the stock incentive, enterprise culture incentive, work is challenging and conducive to self-
development, own work achievement, and other important factors, based on the existed results, and then perfect incentive methods, making the actual result of incentive mechanism get a better promotion.

5. Conclusions

Based on analysis for the feature and demand of knowledge workers, electric power enterprise proposes the electric power enterprise knowledge workers' incentive mechanism combining the current situation, and constructs the fuzzy comprehensive evaluation model accordingly. Then making evaluations about the incentive effect, evaluation results are reliable, through which could make electric power enterprise understand the company’s incentive work achievements for the knowledge workers. Moreover take specific judgement and improvement, further enhance incentive effect, to improve efficiency and effectiveness of electric power enterprise.

With the knowledge economy age developing, enterprise's survival management way have changed profoundly. Knowledge workers have become the key factors to promoting the enterprise development, so incentive mechanism has become modern electric power enterprise development essential motive force. As electric power enterprise managers, they must realize the importance of effectively incentive mechanism on attracting, retaining and developing the knowledge workers, pay attention to the effective from humanized management and place human factors on the company’s strategies. In the face of the fierce competition, the traditional management method can not satisfy the needs of the development of the electric power enterprise transformed. If the electric power enterprises want to get the advantage and seek the development in the competition, they have to establish an effective mechanism which could be suitable to the characteristics of its own. With this method, they could stimulate the biggest potential of knowledge workers and seek the common development of the enterprise and employee.

References


