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Abstract: With the development of economic globalization and rapid technological revolution, enterprise soft power plays a more and more important role in enterprises. As the pillar industry of china's national economy, petroleum enterprise soft power will directly affect the process of enterprise internationalization, the implementation of energy development diversification strategy, the sustainable development of petroleum enterprises and their international competitiveness. Taking petroleum enterprise soft power as the research object, sets up petroleum enterprise soft power evaluation indicator system is set up, which enriches the connotation of petroleum enterprise soft power research and lays the groundwork for improving petroleum enterprise soft power, through factor analysis of index selection.

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1. Introduction

In recent years, the world economic situation has undergone great changes, new technologies develop rapidly and the speed of technological upgrading and spreading is significantly improved, all these factors further exacerbate changes in the way of business competition. In this situation, the competition resources on which the businesses rely is no longer just the hard power resources, but more importantly, is the soft power resources, the enterprises need to rely on soft power to continually integrate a variety of resources to further enhance the competitiveness of them.

The petroleum industry is a pillar industry, petroleum enterprises shoulder the heavy responsibility to protect the nation's petroleum security. In the backdrop of the internationalization of businesses, diversification of energy development, complication of oil and gas occurrence, China's petroleum enterprises keep changing development strategies, taking effort to complete the "two changes", which mean from the large domestic enterprises to large international enterprises and from the oil and gas enterprises to energy enterprises. Therefore, the strength of the soft power of the petroleum enterprises will directly affect their sustainable development and international competitiveness, the soft power construction of the petroleum enterprises will also directly affect the national soft power construction.

The petroleum enterprises have made some achievements in the construction process of the soft power, but there are still many shortcomings, like not forming a more perfect soft power construction

system. The lack of objective basis has becoming an important factor affecting the construction of soft power. So we need to build a scientific and objective soft power evaluation indicator system of the petroleum enterprises, accurately grasp the level of soft power construction of the petroleum enterprises, clear the focal points and weaknesses for the construction of petroleum enterprise soft power to focus on, then explore effective ways and strategies to enhance the petroleum enterprise soft power, these all have important practical significance^[1].

2. The principles of building the petroleum enterprise soft power evaluation indicator system**(1) The principle of scientific and comparability**

The evaluation indicator system should accurately reflect the contents and main factors of the petroleum enterprise soft power, in order to ensure that the evaluation system is scientific and the evaluation result is objective; the indicator selection method should be scientific, at the same time, selected indicators should be easy to access to relevant data, in order to overcome such difficulties as indicators are difficult to quantify caused by the characteristics of recessive, difficult to quantify, and non-material form of the petroleum enterprise soft power.

(2) The principle of stability and dynamic

Once the evaluation indicator system is established, it should be maintained relatively stable in a certain period, in order to help to study and compare the development process of the petroleum enterprise soft power and predict its development trend; at the same time, the design of the indicator system should be relatively dynamic to reflect the

conditions of enterprise development and change and environmental change, etc. And to comprehensively reflect the development and change process of oil companies, in order to effectively predict and manage it^[2].

(3) The principle of simplicity and completeness

The evaluation indicator should be as complete as possible, be able to cover the main aspects and important features of the petroleum enterprise soft power. However, more chosen indicators and more extensive coverage will make data processing more complicated, then the accuracy will be reduced, at the same time, the possibility of indicator repeat and conflict will be greatly increased. Therefore, the indicators should seek to be concise on the basis of having a relatively complete representation to facilitate the evaluation and analysis.

3. The process of building the petroleum enterprise soft power evaluation indicator system

The process of building the petroleum enterprise soft power evaluation indicator system is as follows .

(1) Determine the preliminary indicators. On the basis of learning from existing research results of Hao Hongyi and other scholars and oilfield enterprise managers^[3], get the preliminary indicators by the way of experience selection and expert advice.

(2) Indicator selection. By the application of factor analysis, we determine the main content of the preliminary indicators and do indicator selection on the basis of the experts rating the preliminary indicators of the petroleum enterprise soft power.

(3) Determine the indicator system. According to the results of indicator selection, get the final evaluation indicators, and then determine the indicator system.

4. Indicator selection based on factor analysis

4.1 The mathematical model and algorithm of factor analysis

(1) The mathematical model of factor analysis

Factor analysis is a multivariate statistical method to find the factor model which has potential dominant role, its main function is making use of data extraction with the idea of dimension reduction to find the relationships between the variables, and then make an effective classification of the variables which have strong relationships^[4].

Assume the original variable X_1, X_2, \dots, X_n , which contain independent common factors $F_1, F_2, \dots, F_m (n \geq m)$ with the number of p , e_i is

the unique special factor of the original variable X_i , and e_i is independent with F_i , then the factor model can be expressed as:

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1m}F_m + e_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2m}F_m + e_2 \\ \dots\dots\dots \\ X_n = a_{n1}F_1 + a_{n2}F_2 + \dots + a_{nm}F_m + e_n \end{cases} \quad (1)$$

Among them, a_{ij} is the factor loading, and this model needs to satisfy the following

condition: $\sum_{i=1}^m a^2_{ij} = 1 (j = 1, 2, \dots, n)$. Special factors are not related to each other and the common factors are not relevant.

(2) The algorithm of factor analysis

1) The original data standardization:

$$x_{ij} = \frac{x_i - E(x_i)}{\sqrt{D(x_i)}} \quad (2)$$

2) Calculate the relevant coefficient

matrix: $R = (r_{ij})_p * P$, (in it, $r_{ij} = \frac{1}{n} \sum_{n=1}^m x_{ni} \cdot x_{nj}$) (3)

3) Calculate λ , which is the characteristic roots of R and its unit eigenvectors C

$$C = (c_1, c_2 \dots c_p) = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1p} \\ c_{21} & c_{22} & \dots & c_{2p} \\ \vdots & \vdots & \vdots & \vdots \\ c_{n1} & c_{n2} & \dots & c_{np} \end{bmatrix} \quad (4)$$

It requires the cumulative contribution rate $\sum_{i=1}^m \lambda_i / \sum_{i=1}^n \lambda_i \geq 85\%$, the corresponding factor loading matrix is as follow:

$$A = \begin{bmatrix} c_{11}\sqrt{\lambda_1} & c_{12}\sqrt{\lambda_2} & \dots & c_{1m}\sqrt{\lambda_m} \\ c_{21}\sqrt{\lambda_1} & c_{22}\sqrt{\lambda_2} & \dots & c_{2m}\sqrt{\lambda_m} \\ \vdots & \vdots & \vdots & \vdots \\ c_{p1}\sqrt{\lambda_1} & c_{p1}\sqrt{\lambda_2} & \dots & c_{pm}\sqrt{\lambda_m} \end{bmatrix} \quad (5)$$

4) Do orthogonal rotation transformation for A to make the load factor of the common factor f_j which the jth factor represents change to the larger (to 1) or smaller (to 0):

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1m} \\ a_{21} & a_{22} & \dots & a_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ a_{p1} & a_{p2} & \dots & a_{pm} \end{bmatrix} \rightarrow A' = \begin{bmatrix} a'_{11} & a'_{12} & \dots & a'_{1m} \\ a'_{21} & a'_{22} & \dots & a'_{2m} \\ \vdots & \vdots & \dots & \vdots \\ a'_{p1} & a'_{p2} & \dots & a'_{pm} \end{bmatrix} \quad (6)$$

5) Extract the key factors according to the principle that factor loadings should be greater than 0.8, then determine the ultimate indicator^[5].

4.2 Indicator selection

On the basis of drawing on the existing research results, make use of the method of combining expert advice and experience selection to determine the preliminary indicators, which includes 6 level indicators (corporate culture power, management control power, enterprise innovation power, social responsibility power, corporate image power, and resources integration power) and 26 secondary indicators. For the preliminary indicators, design a questionnaire using the Likert five-level scoring method in which the degree of importance of the indicators relative to the petroleum enterprise soft power are in turn expressed as "5 - very important; 4 - important; 3 - General; 2 - not important; 1 - very unimportant", then invite experts to rate on this basis.

A variety of different forms to distribute and recycle questionnaires was used, including the form of e-mail, mail, fax and on-site interviews. 130 copies of questionnaires were totally issued to the relevant management personnel and researchers, among them each of the China National Petroleum Corporation (CNPC), Daqing Oilfield Co. Ltd., Jilin Oilfield and Liaohe Oilfield were issued 20 questionnaires, and each of Xinjiang Oilfield, Shengli Oilfield, China University of Petroleum, Northeast Petroleum University and Southwest Petroleum University were issued 10 questionnaires. 125 copies of the 130 issued questionnaires have been recovered with 121 valid questionnaires; it means that the valid questionnaire rate was 93.08%. The distribution of the persons under investigation is shown in Table 1.

Table 1 Distribution of samples

Position	Number of people/people	Proportion/%
Senior managers	37	30.58
Middle managers	33	27.27
Grass-roots workers	19	15.70
University researchers	32	26.45

This survey covers relevant personnel engaged in the study of soft power and petroleum business management in different regions. SPSS 16.0 software is implicated to get a factor loading matrix and polarization from the survey data to achieve the purpose of screening indicators. On the basis of collecting and sorting out the survey results, enter the original data into SPSS 16.0 software, then use the Analyze-Data Reduction-Factor to analyze to get the orthogonal rotation load matrix, as shown in Table 2.

Table 2 Orthogonal rotation load matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Vision of the petroleum enterprises	0.901	0.012	0.459	-0.234	0.328	0.297
Spirit of the petroleum enterprises	0.876	0.123	0.305	0.023	0.025	-0.697
Corporate cohesion	0.896	-0.128	0.195	0.297	-0.013	0.098
Cross-cultural integration capabilities	0.962	0.078	0.031	0.098	0.086	-0.697
Characteristics culture of the petroleum enterprises	0.667	0.598	-0.697	0.423	-0.295	0.369
Power of strategic management and control	0.059	0.915	-0.292	0.598	0.127	0.009
Power of financial management and control	0.125	0.934	0.067	0.125	0.345	-0.114
Power of operational management and control	0.792	0.846	0.102	0.164	0.594	-0.593
Power of risk control	0.459	0.892	-0.325	0.167	-0.145	0.123
Power of cultural management and control	0.031	0.041	0.148	0.456	0.167	0.164
Power of technological innovation	0.159	0.596	0.853	0.145	0.169	-0.06
Power of management innovation	0.648	0.684	0.899	0.349	-0.197	-0.09
Power of knowledge innovation	0.296	-0.114	0.863	0.648	-0.104	0.009
Power of marketing innovation	0.097	-0.593	0.921	0.296	0.285	-0.159
Power of institutional innovation	-0.369	0.123	0.008	0.347	0.609	0.401
Power of national energy security	-0.095	0.237	0.103	0.888	0.149	0.129
Power of environmental responsibility	-0.03	0.041	0.255	0.885	-0.19	0.158
Power of economic responsibility	0.254	0.009	-0.493	0.928	-0.174	0.594
Power of moral responsibility	0.009	0.314	0.032	0.897	0.445	-0.154
The image of entrepreneurs	-0.06	-0.03	0.041	0.249	0.839	0.149
Staff image	0.254	0.347	0.264	-0.154	0.916	0.285
Power of network reputation	-0.59	-0.034	0.164	0.153	0.861	0.151
Power of product image	-0.048	-0.095	-0.09	0.296	-0.064	-0.593
Power of information resources integration	-0.09	0.153	0.164	0.254	0.103	0.868
Power of human	0.489	0.598	0.127	0.129	0.255	0.875

resources integration						
Power of material resources integration	0.041	-0.164	0.237	0.264	0.008	0.525
The cumulative variance contribution rate %	22.33	34.61	51.64	69.84	76.53	86.38

According to the principle of critical factor extraction, factor loading should be greater than 0.8, and the cumulative variance contribution rate should be greater than or equal to 85% to meet the requirements of indicator selection^[6]. It can be seen from the data in Table 2, the cumulative variance contribution rate is 86.38% > 85%, which was in line with the principle of factor extraction; most of the factor loadings in the table were greater than 0.8, which was in line with the essential requirements of the key factor extraction. But the factor loadings of five indicators including characteristics culture of the petroleum enterprises, power of cultural management and control, power of institutional innovation, power of product image and power of material resources integration were less than 0.8, so they should be removed in accordance with the principle of factor extraction.

4. The establishment of the petroleum enterprise soft power evaluation indicator system

Collating the results of indicator selection, 6 level indicators and 21 secondary indicators were established, which together constituted the petroleum enterprise soft power evaluation indicator system (as shown in Table 3).

Table 3 the petroleum enterprise soft power evaluation indicator system

Level indicators Mi	secondary indicators Mij
Power of corporate culture M1	Vision of the petroleum enterprises M11
	Spirit of the petroleum enterprises M12
	Corporate cohesion M13
	Cross-cultural integration capabilities M14
power of management and control M2	Power of strategic management and control M21
	Power of financial management and control M22
	Power of operational management and control M23
	power of risk control M24
Power of business innovation M3	Power of technological innovation M31
	Power of management innovation M32
	Power of knowledge innovation M33
	Power of marketing innovation

	M34
Power of social responsibility M4	Power of national energy security M41
	Power of environmental responsibility M42
	Power of economic responsibility M43
	Power of moral responsibility M44
Power of enterprise image M5	The image of entrepreneurs M51
	Staff image M52
	Power of network reputation M53
Power of integration of resources M6	Power of information resources integration M61
	Power of human resources integration M62

5. Directions of the petroleum enterprises soft power evaluation indicator

(1) Power of corporate culture

The corporate culture is the core part of enterprise soft power; it plays a role by the widely recognized corporate culture inside and outside of the enterprises, and thus produces a sustained driving force for enterprise development.

1) Vision of the petroleum enterprises. It outlines the future vision and mission of the oil companies, and inspires all the staff to struggle together.

2) Spirit of the petroleum enterprises. It is the cornerstone of the petroleum enterprises culture, is the core value of the petroleum enterprises, is the common concept of all staff, and is the positive mental set, value orientation and the dominant sense which are formed by carefully nurtured^[7].

3) Corporate cohesion. It is a sense of team cohesion and coordination is the expression form of centripetal force and responsibility showed by the corporate members to the enterprise, it can be explained by the degree of harmony relationship between the members, the team state, and the unit degree for resisting outside attack.

4) Cross-cultural integration capabilities. It is the capability of effectively reconciling the contradictions caused by cultural differences in cross-border mergers and acquisitions of oil companies, achieving cultural integration, forming new value orientation acceptable to each other, establishing new corporate culture which integrates the length of all the parties.

(2) Power of management and control

Management and control power is the ability of the oil companies to take effective method to effectively manage and control its subordinate units or functional departments, in order to fully realize the intent of its own business and achieve business development goals. It is one of the necessary abilities to have for the long-term development of the oil

companies, with the characteristics of integrity, dynamic, feasibility and effectiveness^[8].

1) Power of strategic management and control. It is the ability of oil companies to have scientific co-ordination planning from a strategic height and in advance for the overall, long-term and directional major issues, in order to achieve the development and operational plans by the leading of development strategies, and be certain to win in the fierce international competition.

2) Power of financial management and control. It is one of the most basic means for the oil companies to implement effective management and control, is the ability to maximize enterprise value and optimize resources allocation.

3) Power of operational management and control. It is the ability of the oil companies to optimal design enterprise business process and applies a variety of methods to solve business problems based on the business objectives.

4) Power of risk control. It is the ability to adapt the high-input, high-risk, high-yield and other characteristics of oil industry, improve the resistance risk ability of the oil companies, and guarantee the continuing competitiveness.

(3) Power of business innovation

Business innovation is the essential characteristics of knowledge-based economy, is the soul of enterprise survival and development, and is the source of enterprises to maintain their vigor and vitality. Also it is the core competency to ensure the organization achieve continued success^[9], is an important cornerstone constituting the soft power of the enterprises.

1) Power of technological innovation. It is the comprehensive ability of the oil companies formed on the basis of the existing level of technology and science to master the core technology, overcome technical bottlenecks and improve the contribution rate and competitiveness of science and technology by optimal allocation of the internal and external innovation resources.

2) Power of management innovation. It is the ability of oil companies to integrate enterprise resources through a new or more effective way on the basis of the existing human, material and financial resources, including both the macro-management level of innovation--organizational and institutional innovation and the micro-management level of innovation.

3) Power of knowledge innovation. It is the ability to get knowledge on basic science, technological science and management science through scientific research. In the development process of oil companies, knowledge innovation includes innovation of scientific knowledge and

identify of technical knowledge, in particular, the cognitive ability of high-tech innovation, scientific and technological knowledge integrated innovation and management knowledge innovation.

4) Power of marketing innovation. It is the ability of the oil companies in the context of China's oil companies connecting with international competitive environment, according to the marketing environment changes, combined with their own resources and management strength to seek breakthroughs or changes of marketing elements in a particular area or a series.

(4) Power of social responsibility

The power of social responsibility refers to the internal driving force for the enterprises to fulfill their social responsibilities to achieve the harmonious development of enterprises and society, and the appeal and influence of the corporate behavior embodied in this power on the social objects. It is an important part of the petroleum enterprises soft power. The petroleum industry is closely related to the environment and public life.

1) Power of national energy security. It refers to the ability of the oil companies to fully play the dominant role of the domestic energy field, adhere to the implementation of the resources, markets and international strategies, and effort to ensure the safe and smooth supply of national oil and gas to guarantee the national energy security.

2) Power of environmental responsibility. It refers to the ability of oil companies as a resource-based enterprise to increase the safely environmental protection and energy saving investment considering resource utilization, pollution emissions, oil spills, environmental costs and other aspects, in order to achieve the harmonious development of the enterprises and the natural environment.

3) Power of economic responsibility. It is the ability of oil companies to adhere to the economic efficiency and strict management and to strive to create more profit to contribute to state revenues and economic development.

4) Power of moral responsibility. It refers to the awareness and ability of the oil companies to concern about public welfare, do public welfare investments and carry out social donation and activities which can ease employment pressure when develop their own.

(5) Power of enterprise image

The power of enterprise image is the internal driving force of oil companies to enhance the competitiveness through image building; it is an important part of the soft power of enterprises.

1) The image of entrepreneurs. It is the intrinsic cultivation and external image of the entrepreneurs dependent on human behavior, conduct

and personal integrity. As the state-owned monopoly large enterprises, the operation of the oil companies has multiple attributes of economic and political, good image of entrepreneurs must greatly enhance the visibility and reputation of the enterprises, and establish a good corporate image.

2) Staff image. Staff image to some extent reflects the level of enterprise management; it is the manifestations of the inherent quality of enterprises. Good staff mental outlook is an important factor to win a good social image and reputation for the corporates.

3) Power of Network reputation. It is the ability of the oil companies to prevent public opinion attacks from the depths of the network, maintain their own image and shape the network reputation by means of reputation management and crisis prevention, etc.

(6) Power of resources integration

Force of the integration of resources is the ability to integrate various resources inside and outside the oil companies which are related to each other but separated from each other through the organization and coordination, and to integrate the partners outside the enterprises which are involved in the common mission and have independent economic interests into a customer service system ability to achieve the effect of "1 + 1 > 2".

1) Power of information resources integration. It is the ability closely related to the sustainable development of information construction. In the survival process of the oil companies, the level of information, the scope of information technology, information collection and processing capacity and information utilization ability all reflect the strength of the enterprise information integration ability.

2) Power of human resources integration. It is the ability of the oil companies to fully understand the basic characteristics of human resource, such as scarcity, exploitability and protectiveness, to focus on the development, optimize allocation and reasonably taking good care of the shortage critical technology, management talent, and so on. Especially the awareness and ability to prevent the brain drain in large-scale enterprises activities, such as business development, overseas mergers and acquisitions and so on.

6. Conclusions

From the foreign research on the soft power and the soft power of the state to domestic research on the soft power of the enterprises, the concept of "soft power" has been widely accepted by the domestic theory and business circles. The soft power of the oil companies usually have these features, such as intangible, difficult to copy, recessive difficult to

quantify, marginal incremental, difficult to control, etc^[10]. The indicator selection based on factor analysis makes the correlation of the selected indicators and the petroleum enterprise soft power greatly enhanced to better reflect its main features, so the established evaluation indicator system can be more scientific and reasonable to laid the foundation for the petroleum enterprise soft power evaluation.

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