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Public credibility evaluation of scientific and technological organizations based on analytic hierarchy process

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ABSTRACT

To evaluate the public credibility of scientific and technological organizations (taking Zhejiang Province China as an example), the evaluation model based on analytic hierarchy process (AHP) was constructed. Qualified organizations were screened in 4 aspects: organization administration and capacity building, infrastructures, business activities and performance, and social impact. An evaluation indicator system was constructed with 16 evaluation indicators, covering the qualities of information transparency, organization institution, technical service, and evaluation by government and business administration authorities. The comprehensive evaluation was performed by means of AHP and using the established evaluation indicator system. The results showed that the focus of improving the public credibility of scientific and technological organizations in Zhejiang Province lies in improving institution, information transparency, technical service and training, and evaluation from government and business administration authorities. Moreover, some countermeasures are proposed.

KEYWORDS

Scientific and technological organizations; AHP; Public credibility.



INTRODUCTION

In the context of building a credentialed society, the discussion on public credibility of society has triggered widespread concern. As an important form of non-profit organizations, scientific and technological organizations have been contributing greatly to scientific and social progress^[1]. Scientific and technological organizations play increasingly important roles in China's social development. The insufficiency in public credibility of China's scientific and technological organizations has seriously impeded social progress. Public credibility of scientific and technological organizations and exploration for fundamental reasons for insufficiency in public credibility of scientific and technological organizations can provide guidance for the improvement of operation and management and the enhancement of overall competitiveness. This article focuses on scientific and technological organizations of Zhejiang Province, the public credibility of which was evaluated by using AHP.

Scientific and technological organizations are integral parts of non-profit organizations. However, the public credibility evaluation for these organizations has not been extensively carried out at home and abroad. The academic efforts are mostly devoted to the theoretical research for non-profit organization evaluation. The foreign research on non-profit organization evaluation dated back to early 1990s. The countries such as USA, UK, Japan, the Philippines and India have established many semi-official or non-governmental intermediary or academic evaluation organizations. By combining quantitative and qualitative indicator systems, the non-profit organizations were evaluated with respect to performance, project, organization management and comprehensive ability, on a regular or irregular basis^[2].

Few monographs are devoted to the evaluation of scientific and technological organizations in China. Some scholars have done exploratory researches concerning the reform and development of scientific and technological organizations, but rarely on the public credibility of these organizations. So far, the relatively systematic monograph published concerning scientific and technological organizations is "Introduction to Modern Scientific and Technological Organizations" by Yang Wenzhi^[3]. In this book, Yang Wenzhi analyzes the influence of public credibility on the funding and development of scientific and technological organizations. He proposes that the public credibility of scientific and technological organizations should be built through 5 measures: formulating the moral and ethical codes for scientific and technological organizations, clarifying the social responsibility of the organization, enhancing the internal management of the organization, and forming an interactive supervisory mechanism. He Xiaoqun and Fu Shaojun^[4] discussed the influence factors of social credibility of scientific and technological organizations from five aspects: law compliance, authority and influencing power, finance and major event publicity system, effective coordination of interest relations and reasonable utilization of resources, morality and honesty, and supervisory mechanism.

METHODS

AHP

Suppose the judgment matrix is A , and there are n indicators on one layer, thus $A = (a_{ij})_{n \times n}$, where a_{ij} is the importance of indicator i and j on the same layer relative to a certain indicator. The importance was measured on a 1-9 scale^[5]. The scale and meanings are shown in TABLE 1.

TABLE 1 : Meaning of 1-9 scale in the construction of pairwise judgment matrix

Scale	Meaning	Explanation
1	Equally important	The two indicators have equal importance.
3	Slightly more important	The former indicator is slightly more important than the latter.
5	More important	The former indicator is obviously more important than the latter.
7	Obviously more important	The former indicator is much more important than the latter.
9	Extremely more important	The former indicator is extremely more important than the latter.

2, 4, 6, 8 are the adjacent intermediate values, i.e. the intermediate values in adjacent judgment.

In order to test the consistency of matrix, the consistency index CI is calculated. The mean random consistency index I_r can be obtained by calculating I_c . On this basis, the consistency ratio CR is calculated^[5].

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

When $CR < 0.1$, the judgment matrix is consistent, i.e. it is acceptable. Otherwise, some revision needs to be made to the judgment matrix.

Method of data acquisition

The acquisition of evaluation data is to collect evidence about evaluation. It is the process of obtaining facts for public credibility evaluation of scientific and technological organizations. In this article, the evaluation data was acquired by literature review, interview and questionnaire survey.

System of indicators of public credibility evaluation of scientific and technological organizations in Zhejiang Province

The collected data was analyzed by AHP, thus constructing the urban emergency management factor evaluation model. The constructed indicator system is shown in TABLE 2.

TABLE 2 : System of indicators for public credibility evaluation of scientific and technological organizations in Zhejiang Province

Target layer	Criteria layer	Secondary target layer
Public credibility evaluation of scientific and technological organizations in Zhejiang Province C	Organization management and capacity building B ₁	Improving institution and information transparency B ₁₁
		Organizational institution B ₁₂
		Fund raising and utilization B ₁₃
		Safeguarding for relevant interest groups B ₁₄
	Infrastructures B ₂	Office conditions B ₂₁
		Scale and structure B ₂₂
		Law compliance B ₂₃
		Practitioners B ₂₄
	Business activities and performance B ₃	Science popularization activities B ₃₁
		Technical service and training B ₃₂
		Academic activity B ₃₃
		Editing and publication B ₃₄
	Social impact B ₄	Evaluation from government and business administration authorities B ₄₁
		International influence B ₄₂
Social identity B ₄₃		
Media coverage B ₄₄		

Relative degree was determined by Delphi Method under the expert's guidance^[6]. The judgment matrices for each layer of indicators were constructed by using AHP. The weights of each indicator and the maximum characteristic roots of judgment matrices were calculated, and consistency test was performed.

Weight calculation for first-layer

First-layer indicators included organization management and capacity building B_1 , infrastructure B_2 , business activity and performance B_3 and social impact B_4 . See TABLE 3. for judgment matrices.

TABLE 3. Judgment matrices for first-layer indicators

C	B ₁	B ₂	B ₃	B ₄	W ₍₂₎
B ₁	1	3	3	3	0.43
B ₂	1/3	1	1	1	0.19
B ₃	1/3	1	1	1	0.19
B ₄	1/3	1	1	1	0.19

$\lambda_{\max} = 4.06$ CI = 0.02, RI = 0.96,
CR = 0.02 < 0.1 Judgment matrices pass the consistency test.

Weight calculation for second-layer indicators

The factors corresponding to organization management and capacity building indicator B_1 are improving institution, information transparency B_{11} , organizational institution B_{12} , fund raising and utilization B_{13} , safeguarding of relevant interest groups B_{14} (see TABLE 4. for judgment matrices).

TABLE 4 : Sub-judgment matrix of scale and structure (B₁)

B ₁	B ₁₁	B ₁₂	B ₁₃	B ₁₄	P ₁₍₃₎
B ₁₁	1	3	3	3	0.43
B ₁₂	1/3	1	1	1	0.19
B ₁₃	1/3	1	1	1	0.19
B ₁₄	1/3	1	1	1	0.19

$\lambda_{\max} = 4.06$ CI = 0.02, RI = 0.96,
CR = 0.02 < 0.1 The judgment matrices pass the consistency test.

The factors corresponding to infrastructures indicator B_2 are office condition B_{21} , scale and structure B_{22} , law compliance B_{23} , practitioners B_{24} (see TABLE 5. for judgment matrices).

TABLE 5 : Sub-judgment matrices of organization management and capacity building (B₂)

B ₂	B ₂₁	B ₂₂	B ₂₃	B ₂₄	P ₂₍₃₎
B ₂₁	1	1/3	1	1	0.19
B ₂₂	3	1	3	3	0.43
B ₂₃	1	1/3	1	1	0.19
B ₂₄	1	1/3	1	1	0.19

$\lambda_{\max} = 4.06$ CI = 0.02, RI = 0.96,
CR = 0.02 < 0.1 The judgment matrices pass the consistency test.

The factors corresponding to business activity and performance indicator B_3 are science popularization activity B_{31} , technical service and training B_{32} , academic activity B_{33} , editing and publication B_{34} (see TABLE 6. for judgment matrices).

TABLE 6 : Sub-judgment matrices of business activities and performance (B₃)

B_3	B_{31}	B_{32}	B_{33}	B_{34}	$P_{3(3)}$
B_{31}	1	1/5	1/3	1	0.43
B_{32}	5	1	5/3	5	0.19
B_{33}	3	3/5	1	3	0.19
B_{34}	1	1/5	1/3	1	0.19

$CI = -0.01, RI = 0.96,$
 $CR = -0.01 < 0.1$
 $\lambda_{\max} = 3.97$
 The Judgment matrices pass the consistency test.

The factors corresponding to social impact indicator B_4 are international influence B_{41} , evaluation from government and business administration authorities B_{42} , social identity B_{43} , and media coverage B_{44} (see TABLE 7. for judgment matrices).

TABLE 7 : Sub-judgment matrices of social impact (B_4)

B_4	B_{41}	B_{42}	B_{43}	B_{44}	$P_{4(3)}$
B_{41}	1	5/3	5	5	0.50
B_{42}	3/5	1	3	3	0.30
B_{43}	1/5	1/3	1	1	0.10
B_{44}	1/5	1/3	1	1	0.10

$CI = 0.00, RI = 0.96,$
 $CR = 0.00 < 0.1$
 $\lambda_{\max} = 4.00$
 The judgment matrices pass the consistency test.

Calculation of comprehensive weights of public credibility factors

By combining the judgment matrices for the indicators of the first and second layers, the weights of each factor to overall emergency management ability are calculated. Thus, the influence degree of each factor to the overall ability is obtained, as shown in TABLE 8.

TABLE 8 : Calculation of weights of the factor of each layer to target layer

B_1				B_2			
B_{11}	B_{12}	B_{13}	B_{14}	B_{21}	B_{22}	B_{23}	B_{24}
0.19	0.08	0.08	0.08	0.03	0.08	0.03	0.03
B_3				B_4			
B_{31}	B_{32}	B_{33}	B_{34}	B_{41}	B_{42}	B_{43}	B_{44}
0.02	0.10	0.02	0.06	0.10	0.06	0.02	0.02

Consistency test:

$$CI^{(3)} = 0.01, RI^{(3)} = 0.96, CR^{(3)} = CI^{(3)} / RI^{(3)} = 0.010 < 0.1$$

The judgment matrices pass the consistency test. According to the overall ranking above, the influence degree of each factor to emergency management ability is obtained. There are three factors larger or equal to 0.1: B_{11} , B_{32} , B_{41} , which are the factors of practitioners, academic activities, and evaluation from business administration authorities^[7]. These three factors play extremely important role in public credibility of scientific and technological organizations in Zhejiang Province.

RESULT AND DISSCUSS

Based on the analysis above, the following suggestions are made:

- (1) Improving organizational structure and enhancing information transparency.

To increase the public credibility, the scientific and technological organizations have to establish a whole set of mature operation system that adapts to economic needs and the features of the

organizations. The market operation rules and the history, current situation and development trend of the organizations should be fully respected. First, the personal charm of the leaders should be maximized to ensure the fulfillment of the organization goals. Second, importance should be attached to human resources management so as to fully utilize the talents of each individual. The scientific and technological organizations should enhance the construction of websites, construct the databases of members, experts, technical achievements, projects, demand and supply information. Therefore, the users can know about the activities and scientific information by browsing, replicating, listening and viewing the websites. The information publicity system that can operate effectively over a long term should be built to provide easily accessed information to the public. Publicity channels should be opened to respond to public criticism and fulfill the publicity and transparency of activities.

(2) Enhancing the market-oriented operation and core competitiveness, and properly solving the funding problem.

Scientific and technological organizations should introduce the market mechanism into management, enhance the competition awareness and expand the influence so as to increase core competitiveness and public credibility. By integrated marketing, the organization can be placed squarely in the market environment. The service scope should be constantly expanded on the premise of improving the subscription system. The individualized demands of the public for science and technology should be studied, and appropriate services and projects should be designed. The organizations should build reputation by high-quality services and take paid services as the development direction. They should aim to provide service assurance and intellectual support, so as to increase the overall management and efficiency of the organization.

(3) Combining self-discipline and discipline by others, and combining social accountability with third-party supervision.

The government should set up specialized evaluation and supervision agencies to perform full-time, comprehensive, regular or irregular evaluation of scientific and technological organizations in the following aspects: governance structure, fund utilization and operation, proportion of operation revenues, financial and information disclosure, fund-raising campaigns and channels. The current situation of "highlighting registration, neglecting management and poor effect of annual check" should be corrected. By establishing the service information feedback mechanism, the effect of resources utilization by scientific and technological organizations can be evaluated. The final evaluation results are disclosed to the public through the media, so that the public can acquire the comprehensive information and the behaviors of the organizations can be standardized. Second, the independent third-party supervisory agencies should be developed. The legitimate intermediary agencies should formulate the standards, and the review is carried out on the member organizations and projects in the industry. On this basis, the review by the member organizations themselves is either confirmed or rejected. For example, the NPO auditing results by independent accounting firms should be public. This type of supervision is more professional, and accountability is more than a formality, which compensates for the defect of government supervision. Third, the supervision by donors, volunteers, public and media should be combined.

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