The Application of AHP Method for Universities Procurement and Bidding

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Abstract

Accompany with the vigorous development of higher education, the materials and equipment requirements in college are increasing year by year. Just, fair and scientific materials bidding method has a decisive significance to ensure that tendered and bidder's legitimate rights and interests. So the method to determine the winning company becomes the focus that tender, bidders and bid evaluation committee pay attention. The commonly used methods that review bid, tender side usually depend on the qualitative analysis and logical judgment, lack quantitative analysis. Bid evaluation is multiple objective decision making problem including technology, economy, security, management and other factors. The applications of the AHP method, taking the influence factors of evaluation as a system to consider, show that the qualitative index can be changed into quantitative index, the evaluation process and conclusions is objectively, fairly and reasonably. This paper proposes a method to quantify the relationship between object and factors in bidding universities procurement of materials, based on the AHP Method and analysis of the representative factors in bidding decision. This model is of universal significance in application.

Key words: AHP Method; Universities; Procurement of materials; Biding

INTRODUCTION

In order to adapt to the vigorously developing requirements for education in Colleges and Universities, the college must study seriously the characteristics of market economy in order to adapt to the market economy rule[1,2]. They must increase the transparency of purchasing work, implement supervision during the whole process and adopt scientific method of bid evaluation[3]. Bidding scheme has advantages and disadvantages. Various indicators will even contradict each other[4]. Several evaluation methods are commonly used at present but they still have shortcomings[5]. The tenderer usually depend on the qualitative analysis and logical judgment, lacking basis of quantitative analysis[6]. In order to achieve this goal, establish scientific evaluation indicator system and evaluation model to evaluate the bidding scheme comprehensively, we must systematically analyze the material procurement tendering and bidding activities, to select the satisfactory suppliers.

Evaluation refers to essentially multiple objective decision making that involves technical, economic, secure, managing aspects. In this paper, AHP is applied to the work of bid evaluation which can help decision makers analyze the influential factors of evaluation bid rationally and logically, improve justice, fairness and scientificalness of the bid evaluation, so that the college can achieve the goods and services conforming to the user demand as far as possible, reasonable price and after-sale service.

1. THE TYPICAL ELEMENTS THAT IMPACT COLLEGE MATERIAL BIDDING

According to the materials and equipment bidding in general, influential factors of current university evaluation can be divided into four items and each influencing factor contains several important secondary factors, this model can be adjusted when it is practically applied

combining with the bidding material characteristics and the requirements of the bid invitation documents.

1) Tender offer

The reasonable prices of goods and materials, such as the main product prices, the user selected parts prices, wearing parts prices, equipment installation, commissioning cost and preferential payment conditions, should be considered.

2) Technical performance of products

Advanced technology, technical maturity, the service life of the product, the failure rate of the equipment

3) After-sale service

This factor considers enterprise service guarantee system and the efficiency of the service, such as the quality of service, repair response time, repair engineer quantity, the training for use, and the evaluation of bidders' previous customer service by domestic users' service.

4) The credibility of enterprises and comprehensive strength

Strengthening the audit work of company ability and credibility can help owners to prevent risk. Tenderer considers the business reputation, business intelligence, the sales performance of procurement supplies equipment nearly three years in the domestic market.

2. COLLEGE PROCUREMENT OF MATERIALS BIDDING EVALUATION AHP MODEL

The method divides the factors in decision problem into goals, standards, programs and other levels, on this basis, the paper makes a qualitative analysis and quantitative analysis of a decision making method. This method analyzes the nature of complex decision-making problems in-depth, its inherent factors relationship between each other, construct a hierarchical structure model, and then format the decision making process in mathematical thinking formation by using less quantitative information, so as to solve multi-objective, multiple criteria or unstructured properties of the complex decision problems, provide a simple method of decision-making. [7,8,9,10]

The AHP method Work steps and contents generally include the following:

1) Establishment a multilevel hierarchical structure model about the purpose, evaluation index (guidelines) and alternative plan etc of evaluation system.

2) The method compares the elements belonging to the same class, takes upper level elements as a criterion, according to the evaluation criteria to determine the relative importance degree and establish the judgment matrix.

3) The method calculates the eigenvector matrix of Judgment matrix to determine the relative importance degree of each factor.

4) The method sorts all sorts of plan elements on the basis of comprehensively important calculation at last, so as to provide a basis for decision-making.

This model quantifies the relationship between the evaluation target and influencing factor, influencing factors and bidding scheme, through synthetic operation and weighted operation of fuzzy calculation, obtains the satisfaction decision of evaluation bidding. Because the model is simple and effective, and it has a strict mathematical foundation that provides certain help to make use of computer aided bidding (see Figure 1). The first stage is the target layer, showing that policy makers must achieve the goal; second level is the index layer or rule layer, showing that policy makers measure whether achieve the criterion of the target; third level is the solution layer, showing that policy makers can select bidding scheme (supplier).
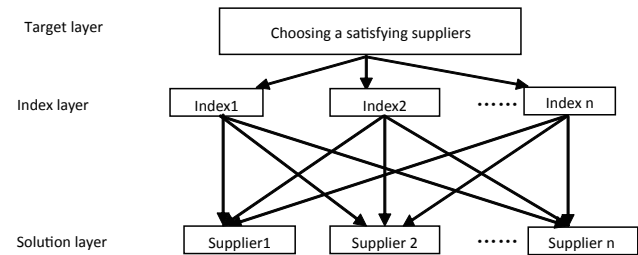

Figure 1
AHP Model in Bid Evaluation of Universities' Procurement of Materials

The connections of the layers express the correlation of upper and lower elements. To determine judgment matrix, this paper uses expert evaluation method.

Table 1
Two Element Contrast Level of Importance and Assignment

Elements i and j comparison results	aij Numerical value
Elements i and j are equally important	1
Elements i than j slightly important	3
Elements i than j distinctly important	5
Elements i than j strongly important	7
Elements i than j extremely important	9
Importance between each other	2, 4, 6, 8
The value of elements compared is its reciprocal value if the latter to the former	$1/aij$

3. AHP MODEL APPLICATION EXAMPLE

For example, our school used the analytic hierarchy process method to evaluate bidding when we purchased a batch of computer for teaching. The general aim of this tender is to obtain reliable products on the lowest possible price. We validated A, B, C three companies bidding products finalist preliminary according to the target, then we determined the price, performance, after sale service for the evaluation index. So we constituted a complete

correlation evaluation hierarchy. There were five experts who participated in the bid evaluation.

It can be constructed the three level structure model as shown in Figure 2.
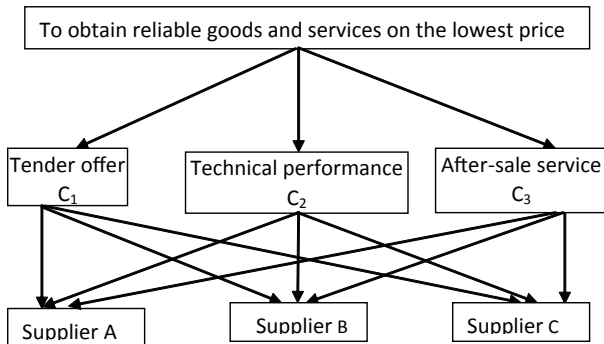

Figure 2
The Hierarchy Model of Choosing Supplier

Constructing judgment matrix: The evaluation team integrated judgment technical performance is the key factor of project, it was slightly important than price. It was distinctly important than after-sale service. The price was slightly important than the after sale service.

The criterion layer against the target layer judgment matrix: G.

Second we took indexes of the index layer as Criterion，compared Various schemes between each other, then Constructed judgment matrix: C_1, C_2, C_3.

$$G = \begin{pmatrix} 1 & 1/3 & 3 \\ 3 & 1 & 5 \\ 1/3 & 1/5 & 1 \end{pmatrix}, C_1 = \begin{pmatrix} 1 & 1/4 & 2 \\ 4 & 1 & 8 \\ 1/2 & 1/8 & 1 \end{pmatrix}$$

$$C_2 = \begin{pmatrix} 1 & 4 & 1/3 \\ 1/4 & 1 & 1/8 \\ 3 & 8 & 1 \end{pmatrix}, C_3 = \begin{pmatrix} 1 & 1 & 1/3 \\ 1 & 1 & 1/5 \\ 3 & 5 & 1 \end{pmatrix}$$

We used square root method to solve weight vector of judgment matrix got the results as follows:

$W_G = (0.256, 0.637, 0.105)^T$
$W_{C_1} = (0.1818, 0.7272, 0.0910)^T$
$W_{C_2} = (0.2559, 0.0733, 0.6708)^T$
$W_{C_3} = (0.1851, 0.1562, 0.6587)^T$

W_{C_1}, W_{C_2}, and W_{C_3} were composed of a weight matrix, as shown below:

$$W_C = [W_{C_C}, W_{C_2}, W_{C_3}] = \begin{pmatrix} 0.1818 & 0.2559 & 0.1851 \\ 0.7272 & 0.0733 & 0.1562 \\ 0.0910 & 0.6708 & 0.6387 \end{pmatrix}$$

We analyzed the above matrix structure. We found that the three elements of the first row which in turn is the A scheme share of the three standards. And the three standards' share of the target is the three components of the weight vector in turn.

So the A scheme' share in the target is exactly the first row vector of the above matrix structural and the vector W_G inner product that is: $(0.1818, 0.2559, 0.1851)$ $(0.258, 0.637, 0.105)^T = 0.229$. The rest followed by analogy.

Based on the analysis above, synthetic weight vector can calculate according to thus: $W_T = W_C * W_G$. The A, B and C share of the target is 0.229, 0.251 and 0.518 in turn. Therefore the university should first select C supplier, second select B supplier.

CONCLUSIONS

In the bidding process, the bid evaluation methods directly influence the bidding work. AHP model overcomes the simplification and subjectiveness in the evaluation process in existing evaluation methods. It solves the problem that qualitative indexes converses to quantitative indexes. It makes the evaluation process objective, impartial and the conclusions conform to the objective situation. So it is a reasonable and effective decision method. It is worth using widely in the bidding management practice of universities.

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