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Improving Detection of Illegitimate Scores and Assessment in Most Advantageous Tenders

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***Abstract*—**Adopting Most Advantageous Tender (MAT) for the government procurement projects has become popular in Taiwan. As time pass by, the problems of MAT has appeared gradually. People condemn two points that are the result might be manipulated by a single committee member's partiality and how to make a fair decision when the winner has two or more. Arrow's Impossibility Theorem proposed that the best scoring method should meet the four reasonable criteria. According to these four criteria this paper constructed an "Illegitimate Scores Checking Scheme" for a scoring method and used the scheme to find out the illegitimate of the current evaluation method of MAT. This paper also proposed a new scoring method that is called the "Standardizing Overall Evaluated Score Method". This method makes each committee member's influence tend to be identical. Thus, the committee members can scoring freely according to their partiality without losing the fairness. Finally, it was examined by a large-scale simulation, and the experiment revealed that the it improved the problem of dictatorship and perfectly avoided the situation of cyclical majorities, simultaneously. This result verified that the Standardizing Overall Evaluated Score Method is better than any current evaluation method of MAT.

***Keywords*—**Arrow's impossibility theorem, most advantageous tender, illegitimate scores checking scheme, standard score.

I. Introduction

WITH the procurement of the subject becomes ever more pluralistic, complex, traditional way of awarding the lowest price no longer applies to all types of procurement cases, since the minimum standards plus award system is implemented, around the standard, cheap grab common standard, and other circumstances, is ensure the quality of procurement, the government issued by the Republic of the Government Procurement Law, where the third paragraph of Article 52 will be the most advantageous tender as the method of award, open up a new way for government procurement.

Spirit is a collection of the most advantageous tender advice of experts to conduct a comprehensive selection on the subject of the proposed technology, quality, features, benefits, etc., in a limited selection of the best meets the needs of the budget, the highest value of the subject matter. The most advantageous embodiment of the subject is indeed effective in improving the standard, low-cost bids, and other circumstances, but with the most advantageous tender gradually being taken seriously, using many of the missing are also drawbacks surfaced one by one [1].

In recent years, the adoption of the most advantageous tender The average number of cases per case tender declining [2], together with major public works procurement disputes broke out after another, significant impact most advantageous tender system for all sectors of confidence. In particular, the current scoring methods, are easy to produce uneven impact assessment to points, and even a selection alone affect the results of the dictatorship had occurred, more deep circles for the most favorable underlying mistrust [3]. Thus improving the scoring method, how to avoid the generation of dictatorial circumstances, it is for the current engineering problems need to be solved [4], [5].

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II. Arrow's Impossibility Theorem

Arrow's Impossibility Theorem is a 1972 Nobel laureate in economics proposed by Kenneth J. Arrow. Arrow pointed out to the individual's preference ordering the summary of preference rankings collective, must meet the requirements of the four basic conditions, namely: rational assumption among mutual motion with independence, unlimited range, non-authoritarian conditions.

Arrow also in the "Social choice and individual value (Social Choice and Individual Value, 1963)" [6], a book has shown that only in two or more members of society, options over three or more, no one voting method can meet this four seemingly natural conditions, it is called "Arrow's Impossibility Theorem." Here on the impossibility theorem, the four conditions mentioned will be briefly described as follows [7]:

A. Rationality Assumptions

1. Completeness

In the case of the two programs A, B, the group decision-making must be able to determine the relationship between the two programs is "A better than B", "B is better than A" or "A and B as well," one of them, and the three cases should be possible occur, the opportunity may not produce any kind of situation there is a limit.

2. Transitivity

The results generated through the group decision-making, must comply with the transitive rule, that is, if A is better than B and B is better than C, then A must be better than C, C is better than A's cannot produce conflicting results.

3. Cyclical Majorities

To avoid the problem of group decision making controversial majority decision, it may not produce the majority of the plight of the case through the process of group decision-making, such as the total score the same total order

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bits of the same.

B. The Independence of Irrelevant Alternatives

The relative ranking among the motion should be independent of each other, so when a program was added sort or quit, the original relationship between intensity and preferences relative ranking among other programs cannot be changed. That is between the two options for sorting and preferences should determine only by the strength of the two programs, other programs may not be affected.

C. Unrestricted Domain

Voting methods (scoring method) using the shall not restrict the motion for individual ranking to, nor be bound to score. That scoring method shall be used for limiting the assessment to the manufacturers of the sort and the degree of preference, must be free to review responses in order of preference for the manufacturers as well as the degree of preference for the manufacturers through the score.

D. Non-Dictatorship

In the collective decision-making process, not cause violations of the dictatorship. The purpose of collective decision-making through the personal preferences of the summary is to get the order of preference groups, so one person can alone decide the final outcome of the case affect the dictatorship, it is not allowed to happen.

III. Construction of Illegitimate Scores Checking Mechanism

In this study, Arrow's Impossibility Theorem as a best practice selection criteria [6], through its four conditions for the goal, the establishment of testing methods, the construction of the "most advantageous tender score violate loss testing mechanism." This mechanism can filter out the illegal loss of scoring methods like state, the current scoring methods will be tested, parallel lines appear missing scoring methods are compared.

A. Rationality Assumptions

1. Integrity Test

Group Decision must be able to sort between the scheme (A is better than B, B is better than A or A as well as B) make a judgment, and not dismiss any chance of a situation arise.

2. Transitive Test

The method of selection results observed score narrative; it must comply with transitive rules. That is if A> B and B> C is bound to C> A.

3.Majority Probability Test

To produce a majority vote (i.e., the same score) as an indicator of the probability method of judging the merits of the score, the lower the probability of generating a majority vote means that the more excellent scoring method. Suppose m reviewers, to divide the range of a ~ b, c score is taken after the decimal place, resulting in the probability of the same points as in (1).

$$\frac{1}{(b-a+1)\times 10^{c}\times m} \tag{1}$$

B. Test of Independence of Irrelevant Alternatives

Review the scores given to each vendor independently should not be subject to influence from other vendors. Sort Order counterpoint to determine its state scores, while the number of firms Alert, manufacturers have to increase or decrease by point vendors of influence, leading to changes in the gap between the manufacturers, it cannot by law-order bits of the condition of the test.

The total score for the assessment division manner to give the manufacturers of 1 to 100 points per space, regardless of the manufacturer or withdraw temporarily join sorting sort, the manufacturers and the resulting scores will not be affected by other manufacturers to change, and then review in relative ranking and the degree of preference among the various manufacturers will not change, so the total score by examining the condition of the present.

C. Unrestricted Test

Scoring methods cannot give points for review and sort some restraint, nor restrict expression for each review the degree of preference among manufacturers.

So that the gap between law-order bits of the manufacturers unanimously, does not reflect the size of the gap between manufacturers, resulting in the assessment does not reflect the extent of their preference for the manufacturers, the so-order method cannot test this condition is to the sort.

The total score only provides for the assessment of the sub-rights from 0 to 100 points, the assessment can freely express their score by manufacturers for sorting and the degree of preference, you can examine the conditions of the present.

D. Non-Dictatorship Condition

In this study, half of the review to the points and the correlation coefficient is defined as the total score of the dictatorship indicators. The correlation coefficient can display relevant circumstances between the two groups of figures, which means that the coefficient can be learned through the review to the sub-selection for the final result, are subject to a special review of the impact. To achieve a better selection of quality opinions shall have half the height of the impact assessment of the selection results if dictatorship indicators of 0.9 or more are excellent, and between 0.6 and 0.9 are good.

In this study, the number of random simulation approach, the simulation when one of the review to the sub-biased, and the next review in addition to the outside at least half of the assessment form opinions at odds with their condition, half unanimous points relevant to the assessment of the overall score obtained vendors degree.

Taking all these test procedures, constitute "most advantageous tender rates violate the loss test mechanism" can be tested for a variety of scoring methods, scoring methods to filter out the potential loss of violations like state.

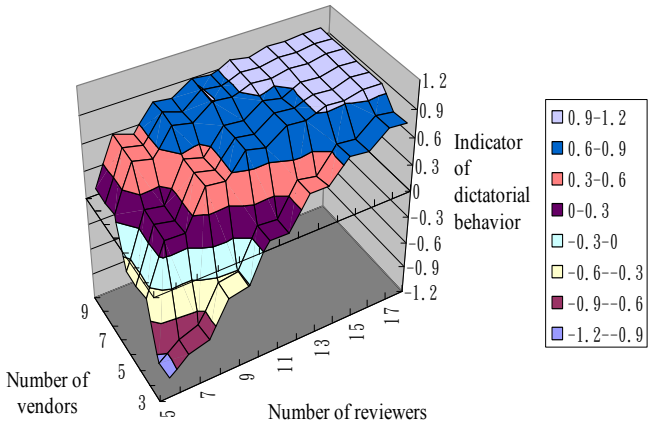


Fig. 1 Test results for overall evaluated score method Non-dictatorship

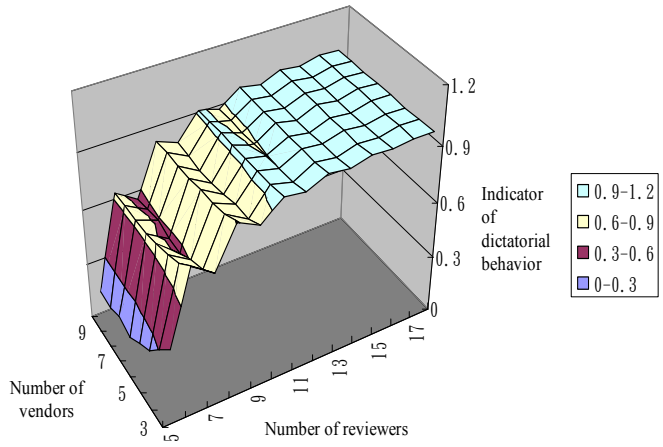


Fig. 2 Test results for ranking method Non-dictatorship

Fig. 1 shows the indicator of dictatorial behavior produced by overall evaluated score method, and Fig. 2 shows the indicator of dictatorial behavior produced by the ranking method. The results show that the ranking method outperforms overall evaluated score method the in avoiding the dictatorial behavior in the scoring process.

TABLE I
THE ILLEGITIMATE STATES IN OVERALL EVALUATED SCORE METHOD AND RANKING METHOD

Scoring Method	Illegitimate states
Ranking method	(1) Possible production cyclical majorities. (2) Although reviewers can express strength of preference for vendors, the method is vulnerable to dictatorship.
Overall evaluated Score method	(1) High probability of cyclical majorities. (2) No independence of irrelevant alternatives (IIA) (3) Reviewer vendor preference can be distorted, contrary to the requirements of unrestricted fields. (4) Overall evaluated score method inhibits dictatorial behavior, but dictatorial situations can still occur.

The analyzes of illegitimate states in overall evaluated score method and ranking method is described in Table I.

E. Test Current Scoring Method

The most advantageous tender based selection methods, the current most advantageous tender, adopt three scoring methods, namely: the total score Price Law and Order counterpoint. The total score and order bit method can be incorporated into the price of appraisal, the price is not included in the appraisal, pay a fixed price of several modes. Rating Price Law which scoring is the same as the total score, so we are testing it, but their selection was decided by the total score and price of the quotient, prone to cheap grab the standard of the circumstances, is not conducive to project quality.

IV. STANDARDIZING OVERALL EVALUATED SCORE METHOD

Through the above analysis, the biggest problem lies in the total score easily be a particular impact assessment, the result, their assessment of the impact of lower half. Although the law and order position has improved to the extent dictatorship, but there are still many missing now be improved. Therefore, this study attempts to find a better way of scoring, both to enhance the dictatorship index, also meet the requirements of the most advantageous tender rates violate the loss test Mechanism.

A. Standardizing Overall Evaluated Score Method

From the statistical point of view, to points level from the size will be reflected in the standard deviation value, so this study is intended to improve the policy from the correction points each accreditation standard deviation to begin to reduce the inter-assessment too severe to grade from, thereby reducing extreme to the point review of the selection results of influence.

To improve the total score of the distance to the problem of excessive classification, reducing the gap between the standard deviation of the review, this study was performed in a standardized manner to improve the total score. In the standardization process, all reviews will be transferred to the sub to a mean of 0 and standard deviation of the standard Z score 1. Through this conversion process, and can avoid the review to the classification from the gap is too big impact; they can keep the difference between the evaluation preferences for various manufacturers. Therefore, the comprehensive advantages of the present Law and order total score of counterpoint, and the median standard score Z after the decimal point, can effectively avoid the plight of the majority decision, and then provide opportunities to reduce engineering disputes.

Standardizing overall evaluated score method is very simple and requires only a few steps, with manual calculation or a computer-assisted calculation of Excel to complete. To facilitate user reference, a simple example of the calculation process was illustrated as below.

Step1: Conducted a total score, and calculate the mean and standard deviation to indicate the score difference between the reviewers (See Table II).

Step2: According to the assessment of standardizing overall evaluated score, the B vender wins the bid. The results are shown in Table III. From the standard deviation, we can find the difference between each reviewer's score has been reduced.

Through this case, can be learned, M review of the level to the sub-distance (90-74 = 16) compared with other vendors' influence on the standard deviation can be learned O reviewer by exception. But after a standardized step of converting a standard deviation of all reviews are corrected to 1, but the O on

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A ~ E manufacturers standard scores, can still be found to save the difference between the preferences of the manufacturer. Moreover, through the process of standardization, accreditation M, N, Q and other reviewers that the majority of the best venders were able to bid.

TABLE II
THE SCORES OF OVERALL EVALUATED SCORE METHOD

Reviewer Vender	M	N	O	P	Q	Ranking Score	Ranking Order
A	71	74	95	83	80	403	1
B	83	83	64	88	83	401	2
C	76	78	72	89	82	197	3
D	70	76	76	90	76	388	4
E	72	70	69	80	73	364	5
Average	74.40	76.20	75.20	80.60	78.80		
Standard deviation	4.76	4.31	10.65	3.85	3.76		

TABLE III
THE RESULT OF CONVERTING TOTAL SCORES TO STANDARD SCORES

Reviewer Vender	M	N	O	P	Q	Ranking Score	Ranking Order
A	-0.715	-0.511	1.860	-0.780	0.319	0.174	3
B	1.807	1.578	-1.052	0.520	1.116	3.970	1
C	0.336	0.418	-0.301	0.780	0.850	2.084	2
D	-0.935	-0.046	0.075	1.040	-0.744	-0.600	4
E	-0.504	-1.439	-0.582	-1.560	-1.541	-5.627	5
Average	0.000	0.000	0.000	0.000	0.000		
Standard deviation	1.000	1.000	1.000	1.000	1.000		

The results of the total score with this particular turn-order bits of the proposed law are compared with the total score turn-order method results shown in Table IV. From the table can be found in this case, to adopt a total score turn-order law, the case will have the same points, triggering a dispute, it is in this case only the total score standardized method can successfully solve all the problems.

TABLE IV
THE EVALUATION RESULTS OF USING RANKING METHOD

Reviewer / Vender	M	N	O	P	Q	Ranking Score	Ranking Order
A	4	4	1	4	3	16	4
B	1	1	5	3	1	11	1
C	2	2	3	2	2	11	1
D	5	3	2	1	4	15	3
E	3	5	4	5	5	22	5

Among the most advantageous tender score violation under test mechanisms lost a total score Standardization Law in the performance are better than the current total score and law-order bits, so the value of this law is really a promotion.

B. Inspect by Illegitimate Scores Checking Mechanism

The same testing mechanism for illegitimate scores for most advantageous tender (MAT) is used to test the standardizing overall evaluated score method, test results for an indicator with which dictatorial behavior influences are shown in Fig. 3.

After using the dictatorship test, the standardizing overall evaluated score method, the overall evaluated score method and the ranking method, the combined test results for the frequency of influence of dictatorial behavior is shown in Fig. 4

The results show that the standardizing overall evaluated score method is more effective than other methods in inhibiting dictatorial behavior, especially in situations with low numbers of reviewers. This means the proposed model can reduce the number of reviewers. Thus, the proposed method is also considered more cost effective than the current scoring methods. The comparison analysis of the test results is illustrated in Table V.

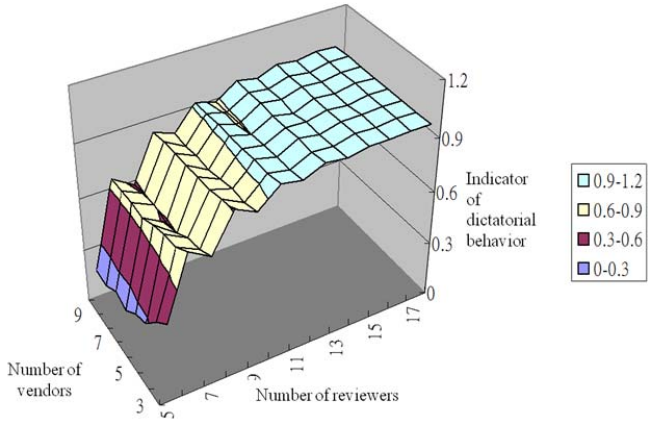


Fig. 3 Test results for standardizing overall evaluated score method Non-dictatorship

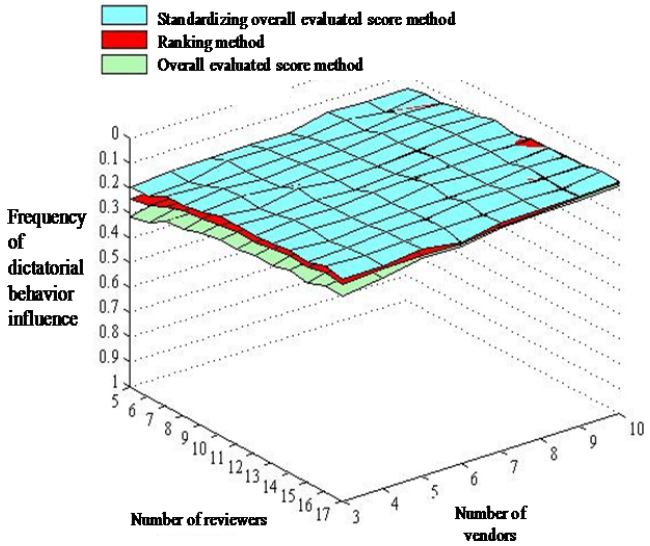


Fig. 4 Comparison of influence of dictatorial behavior through standardizing overall evaluated score method, ranking method and overall evaluated score method

TABLE V
COMPARISON OF TEST RESULTS FOR ILLEGITIMATE SCORES IN MOST ADVANTAGEOUS TENDER

Test results for "Illegitimate scores in most advantageous tender"						
Test Item / scoring method	Rationality Assumptions Test			Independence test	Unrestricted field test	Non-dictatorship test
	Completeness test	Transitivity test	Cyclical majorities test			Influence on probability to win
Overall Evaluated score method	Pass	Pass	Low	Pass	Pass	High (Fig. 1, Fig. 4)
Ranking method	Pass	Pass	High	Fail	Fail	Medium (Fig. 2, Fig. 4)
the standardizing overall evaluated score method	Pass	Pass	Practically zero	Pass	Pass	Low (Fig. 3, Fig. 4)

V. CONCLUSION

Through this mechanism, we can find out the illegitimate scores of the current evaluation method, as an indicator to provide the information that is used as an improvement and comparative tool for the scoring methods. The proposed method established a baseline for comparison of the advantages and disadvantages of scoring methods. The assessment can be used as required to hire the number of reviewers to adopt the most advantageous tender. The detection mechanism also improved as a scoring method to determine an important indicator of the influence of the dictatorial behavior. The mechanism of the proposed model can be an effective tool for the organizers to realize the different potential violations that involved in each scoring methods.

Standardizing overall evaluated score method used in this study, the effective retention of the advantages of the total score, improving its most serious criticisms of dictatorship issues. In authoritarian index performance, the method is slightly better, and the most advantageous tender through test score violate lose inspection mechanism, comparison, and more can be found in the total score of the Standardization Law, in the performance are better than the current scoring method. Therefore, the adoption of this law will help to reduce the controversy caused because the same points, failing firms inclusion scoring problems, reduce the chances of further review dictatorship. Therefore, the total score of the Standardization Law, the relevant units worth further discussion and try to implement.

Total score Standardization Law of the adoption of this study, in theory, than the existing methods are good, it is suggested that the relevant units of small open trial of this Act case confirm its usefulness, and continue to improve as a reference. The Institute of Construction score violates the most advantageous tender test mechanisms lost, can be used as a method to improve test scores indicators related studies, can also provide follow-up studies related to improving direction. We hope that, through continuous improvement, scoring method can find out the better scoring method for practitioners to use, improve the quality of the overall project.

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