Research on Evaluation Index System of Waterway Construction Project Expenditure Budget Performance

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Abstract: Through disclosing the status quo of the evaluation on the expenditure performance in waterway construction project, the paper attempted to establish corresponding evaluation index systems abiding by the rules of waterway construction project, which includes functional performance, financial performance, economic performance and social performance.
Key words: Waterway Construction Project; Evaluation Index System; Expenditure budget; Performance

1 Introduction

Promoting the performance evaluation of project expenditure budget, reasonable evaluating the compliance and effectiveness of budgetary fund of the waterway institution project expenditure, and standardizing the index system of project expenditure budget performance evaluation is a priority work of the waterway institution for continuing to deepen reform. These efforts for strengthening the project control and budget control, improving fund efficiency is important.

The work of project expenditure budget performance evaluation of the waterway institution has just started in China. So evaluation index system is going to be perfect just like: 1) There are more single quantitative indexes or qualitative indexes in project expenditure budget performance evaluation index system, failure to use a combination of both. In addition, some indexes do not address the actual situation of the institution, so the indexes are lack of practicalityand scientific; 2) When the waterway institution is building the evaluation index system of waterway construction project expenditure budget performance, they pay more attention to the evaluation of the project itself without regard to a comprehensive evaluation of project internal and external factors, ignoring the need to integrate into the development of macroeconomic environment; 3) The implementation process of performance evaluation is still a gap compared with standard procedures, so performance evaluation is behind the summary of the implementation or project completion and acceptance; 4) Performance evaluation results are not fully playing its reference role, guide role and restrict role in budget management.

2 Building the Evaluation Index System

Learning the experience of performance evaluation from developed countries, the evaluation indexes of waterway construction project expenditure budget must be appropriate, truly reflecting the various influence factors of the project budget (Olumhense A. Imoisili, 1989)[1]. In addition, the waterway construction project expenditure budget performance index system should follow the basic principles such as operational, scientific, a combination of quantitative and qualitative indexes and so on. Waterway construction project is affected by the impact of natural environment, Facilities in different environments asking for different project demands means the analysis of project evaluation should be targeted. A wide range of project expenditure budget determines when assessing focus area should be differentiated. Simple use of qualitative methods or quantitative methods can not solve these problems. Because the absence of a scientific and rational system of quotas and related basic data, the project budget worked out is not scientific, impacting evaluation of the project expenditure budget, need to assist with qualitative methods to solve the situation which is difficult to be quantified. Therefore, evaluation of waterway construction project expenditure budget will need to combine quantitative methods and qualitative methods together (Huang Mengfei, 2009) [2]. According to the problems of project expenditure budget performance evaluation system of the waterway institution at present, we establish waterway construction project expenditure budget performance evaluation system on the basis of its objectives and basic business analysis (shown in Table 1).

Table 1　Waterway Construction Project Expenditure Budget Performance Evaluation Index System

Project expenditure budget performance (E)	Functional performance(A)	Degree of realization of the project(A1)
		Production targets of waterway navigable capacity(A2)
	Financial performance(B)	Compliance with budget implementation and budget approval
		Budgetary estimate implementation (B2)
		Fund appropriative rate (B3)
	Economic performance (C)	Economic net present value $EVPN$ (C1)
		Economic internal rate of efficiency $EIRR$ (C2)
		Investment recovery period (C3)
	Social performance (D)	Social benefits(D1)
		Environmental benefits (D2)
		Employment benefits (D3)
		Coordination development benefits (D4)

2.1 Index explanation

(1) Functional performance

Degree of realization of the project: The degree of realization to the project function which compares with the requirements of the project approval after implementation such as waterway regulation, reef explosion, and various functions to meet the needs of the community;

Production targets of waterway navigable capacity= Actual ability to project navigation / Ability to predict project navigation×100%

(2) Financial performance

Compliance with budget execution and budget approval: Focus on assessing whether the actual project expenditures are consistent with budget approval;

Budgetary estimate implementation: Focus on assessing the reasonableness of project budgetary estimate execution, final budgetary estimate approval and reasonableness of proposed budgetary estimate adjustments (Xiong Li, 2005) [3];

Fund appropriative rate: The actual appropriative funds / planned available funds

(3) Economic performance

$$EVPN = \sum_{T=1}^{n}(B_T - C_T)\frac{1}{(1+i_s)^T} \qquad (1)$$

Where n means project calculation period; B_T means the net benefits value of T-th year in project calculation period; C_T means the cost value of T-th year in project calculation period; i_s means discount rate.

Whe $\sum_{T=1}^{n}(B_T - C_T)\frac{1}{(1+i_s)^T}=0$, i is equal to $EIRR$;

Where n, B_T, C_T have the same mean as the above formula; Interpolation and test algorithm can be used to strike $EIRR$.

Investment recovery period: The years of cumulative total income equal to the total amount of investment, calculates from the moment that the project is completed and system is started. Investment recovery period is divided in static and dynamic investment recovery period.

（4) Social performance

Social benefits: The project's stimulating effect on the area's economic, and the contribution to economic development along the waterway, as well as the influence of promoting development of the industrial and commercial along the water area. Refer to the evaluation findings of relevant experts;

Environmental benefits: The main evaluation of the role of the implementation of the project in

aspects of reducing pollution and protect the ecological in the water areas;

Employment benefits = New increased quantity of employment (including direct employment and indirect employment) / Total investment (Unit: person / ten thousands)

Coordination development benefits: The evaluation of the promoting role of the project implementation in the rational use of transport resources and the coordinated development of the local economy(Xiong Li, 2005) [3].

2.2 Determining indexes weight

For the above index system using the Analytic Hierarchy Process (AHP) to determine the index weight, based on the evaluation index system the hierarchical structure model is established directly. The main evaluation index of the hierarchical structure model has three levels. The highest level is the project budget performance, the middle layer is the function performance, financial performance, economic performance and social performance, the bottom is the fund appropriative rate. Then we determine the scale of thinking and judgment quantification. Analytical Hierarchy Process (AHP) uses nine kinds of importance levels to express people's judgments. They are equally important, somewhat important, obviously important, strongly important, extremely important, and an intermediate level between the two each with 1-9 integer to indicate the level shown in Table 2.

Table 2   The Meaning of Importance of Scale

the importance of scale	Meaning
1	Express that two elements have equal importance compared with each other
3	Express that when two element compared with each other, the former is slightly important than the latter
5	Express that when two element compared with each other, the former is obviously important than the latter
7	Express that when two element compared with each other, the former is strongly important than the latter
9	Express that when two element compared with each other, the former is extremely important than the latter
2,4,6,8	Express that intermediate value between above-mentioned judgment
$1/b_{ij}$	Two elements are anti-compared with each other($b_{ij}=1$; $b_{ji}=1/b_{ij}$)

After the scale of thinking and judgment quantification determined, experts are invited to construct judgment matrix. In accordance with waterway construction project budget expenditure performance evaluation index system of the transportation unit, experts need to construct different levels of judgment matrix, including matrix A, B, C, D, E (respectively, function performance, financial performance, economic performance, social performance and the code of the overall project budget performance). The construction of these matrices is agreed by experts through the "Brainstorming". And is judged, compared and scaled (Ming Zhe, 2008) [4]. Constructing the judgment matrix as follows:

Table 3   Judgment Matrix of Waterway Construction Project Expenditure Budget Performance Weight Design and Project Expenditure Budget Performance Index Weight Value

E	A	B	C	D	ω
A	1	1/3	1/3	1/7	0.06595
B	3	1	1/3	1/5	0.12804
C	3	3	1	1/3	0.23722
D	7	5	3	1	0.56879

Calculates the product and n-th root of element per row in the judgment matrix E, and then normalizes value of the equation (i.e., vectors) to get ω. Calculates the maximum characteristic root of judgment matrix E:

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(E_\omega)_i}{\omega_i} \tag{2}$$

$$E_\omega = \begin{pmatrix} 1 & \frac{1}{3} & \frac{1}{3} & \frac{1}{7} \\ 3 & 1 & \frac{1}{3} & \frac{1}{5} \\ 3 & 3 & 1 & \frac{1}{3} \\ 7 & 5 & 3 & 1 \end{pmatrix} \begin{pmatrix} 0.06595 \\ 0.12804 \\ 0.23722 \\ 0.56879 \end{pmatrix} = \begin{pmatrix} 0.26896 \\ 0.51872 \\ 1.008793 \\ 2.38231 \end{pmatrix}$$

$$\lambda_{\max} = \frac{1}{4}\sum_{i=1}^{4}\frac{(E_\omega)_i}{\omega_i} = \frac{1}{4}\left(\frac{0.26896}{0.06595} + \frac{0.51872}{0.12804} + \frac{1.00879}{0.23722} + \frac{2.38231}{0.56879}\right) = 4.14260$$

Takes consistency test:

$$C.I = \frac{\lambda_{\max} - n}{n-1} = \frac{4.14260 - 4}{4-1} = 0.047532$$

Comparing $C.I$ with Average random consistency index $R.I$, then obtains inspection number. Usually considering that for the third order of the judgment matrix or third order above, as long as $C.R < 0.1$, we can determine the judgment matrix is consistent with satisfactory, where $R.I$ is related with the order of judgment matrix. The order of judgment matrix is greater, the possibility of deviation from random consistency is greater(Ming Zhe, 2008) [4]. Generally $R.I$ as follows:

Table 4   Average Random Consistency Index Value

Order	3	4	5	6	7	8
R.I	0.58	0.9	1.12	1.24	1.32	1.41

$$C.R = \frac{C.I}{R.I} = \frac{0.047532}{0.90} < 0.1$$

So passes the test, ω can be used as weight.

Index weight of the middle layer is designed in the same way. First, constructs the corresponding judgment matrix, and calculates the weight. The index weights must pass the consistency test to determine whether they are appropriate. After a consistency test, the results are shown in Table 5.

Table 5   Consistency of Test Results Values of Waterway Construction Project Expenditure Budget Performance Index Weights

	$\lambda_{\max}$	$C.I$	$C.R$	Result
B_i	3.03000	0.01000	0.03000	consistent with satisfactory
C_i	3.08000	0.04000	0.07000	consistent with satisfactory
D_i	4.174009	0.058003	0.064448	consistent with satisfactory

The order of the judgment matrix A is too small which is not suitable for calculating, therefore not included in Table 5. Table 5 shows that the weights of performance indexes have been passed the consistency test which can be used for the actual analysis process.

2.3 Evaluation method of project expenditure budget performance

First experts score on the qualitative indexes and quantitative indexes of waterway construction project expenditure budget performance evaluation system, which is useful for consistency of the indexes values meaning. Then weights sum of the score of indexes in accordance with their respective weights, getting the final scores. First, determine the evaluation project (Ming Zhe, 2008) [4].

After formulating the levels and standards, the experts are organized to understand the situation. Based on their understanding of the situation, each expert makes judgments and evaluation on the evaluation index respectively, and scores on the score sheet. Firstly make class judgments on the performance the evaluation index which can achieve (such as the degree of realization of the project

achieves good level), then further refine to determine at what level in the hierarchy, and grade a specific point within the score in this level (e.g. 85 points). Assuming the weights of the evaluation indexes and each evaluation index has been identified, specific indexes are calculated as follows: taking the project implementation level of functional indicators for example:

$$A_i = \frac{\sum_{p-1}^{n} a_{ik}}{n} (i = 1, 2, 3 \ldots) \tag{3}$$

Where A_i means Degree of realization of the project; n means the number of experts participated in marking; a_{ik} means the k-th expert scores on the index A_1. Then A_1 can be obtained by the weight average method. Similarly, the values of other indicators can be calculated. Finally, calculates the composite score $E = A\omega_1 + B\omega_2 + C\omega_3 + D\omega_4$, where ω_1 is the weight of functional performance, ω_2 is the weight of financial performance, ω_3 is the weight of economic performance, ω_4 is the weight of social performance respectively.

2.4 Evaluation results analysis

The calculation proposes the scores of the waterway construction project expenditure budget performance evaluation. It can be judged by the scores to determine whether the budget expenditure is reasonable and effective. At the same time, comparing similar projects can help us analyzing the causes, finding out disparity and making improvement in the future. For the expenditure number of construction project is large and the coverage is wide, in practical work, people should give adequate attention to the project expenditure budget performance evaluation results. In addition, combining with the waterway institution budget performance evaluation results can make the final results more complete.

3 Conclusions

This paper simply discussed the indexes system of waterway construction project expenditure budget performance evaluation. The waterway institution in the evaluation should be given some adjustment according to the practical situation. Building waterway construction project expenditure budget performance evaluation index system need to pay attention to the following aspects: strictly following the principle of input and output; institutions internal management and external benefits should be combined, also business development goals and economic efficiency combined, quantitative and qualitative evaluation method combined; pay attention to the overall budget expenditure performance and each part budget expenditure performance, the two of which are indispensable. Comprehensive, systematic and integrated evaluates the waterway institutions of the use situation of financial capital (Huang Mengfei, 2009)[2], so as to enhance the use situation of waterway institutions founds benefits, financial management level and work efficiency.

The project expenditure performance evaluation is a complex technical work, in addition to need information technology support, also need to coordinate with various departments (Poterba James and Jurgen Von Hagen, 1999) [5]. On the basis of learning from foreign advanced experience, and based on the actual situation of the China's public finance construction and budget reforms, gradually builds up a scientific and standard project budget expenditure performance evaluation system, core in improving the government management function and the utilization of financial capital, aiming at realizing performance budgeting.

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