A Model for Evaluating the Efficiency of Government Functional Departments based on VFT-AHP Data Analysis

Yisheng Wang*, Ran Zhou, Xiaojun Li, Yi Zhang

Tianjin Research Institute for Water Transport Engineering, M.O.T. Tianjin, 300456, China
wangyisheng@tiwte.ac.cn, chinaphoebe@126.com, lixiaojun709@126.com, zhangyi@tiwte.ac.cn
**Corresponding author:Yisheng Wang*

ABSTRACT

An efficiency evaluation model of government functional departments is constructed, taking China`s Maritime Department as an example. Firstly, based on the value-focused-thinking method, an evaluation indicator system of maritime government departments efficiency evaluation is constructed, including 4 dimensions, 21 secondary indicators, and 41 tertiary indicators, constructing 2 categories of target indicators and monitoring indicators. Secondly, the weight of each indicator is determined by the AHP using the MATLAB software. Finally, the generalized utility function is used to calculate the comprehensive evaluation value of efficiency and an empirical analysis was conducted. The evaluation model will help to deepen the theoretical connotation of the efficiency of government functional departments and promote the exploration of quantitative evaluation methods of government efficiency.

Keywords: *Government Efficiency; Evaluation Model; Maritime; Data Analysis; VFT; AHP*

1. INTRODUCTION

Focusing on improving government efficiency, China has carried out long-term and in-depth administrative reforms around the transformation of government functions. Faced with the increasingly complex development situation and administrative affairs, it is an important task for government departments to improve their governance level by responding to the needs of the public in a timely manner, improving service quality and work efficiency. Nowadays, government efficiency improvement and evaluation have received widespread attention. Focusing on the role and nature of government functional departments, this paper proposes an efficiency evaluation model based on VFT-AHP.

2. CONCEPT DEFINITION AND LITERATURE REVIEW

2.1 Government efficiency

In practice, efficiency is more often applied to social science fields such as management and administration, and the literal meaning is generally decomposed into two aspects, one is efficiency, effect, effectiveness, and the other is ability [1]. Peng generalized efficiency as the potential and beneficial functions of things, the goals and the degree to which they are realized under specific conditions [2]. Studies of government efficiency interpretation are diverse. Zhao et al. believed that it is the unity of the government's work efficiency, management efficiency and service quality, which is a comprehensive reflection of the efficiency, effect and benefit achieved by government agencies using their capabilities and energy to perform their duties and ultimately achieve administrative goals [3]. Zhu and Chen argued that the concept of government efficiency is a measure of the achievement of government administrative goals mainly highlighting the quality of government activities [4]. Wang et al. pointed out that core of government efficiency research is the government performance and capacity, through which the government generally improved administrative efficiency [5].

2.2 Government efficiency evaluation

The research and practice of government efficiency evaluation in western countries started earlier covering the influencing factors of government efficiency, evaluation model, evaluation system, evaluation method, evaluation reflection, etc. The classic evaluation model is

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the "4E" model formed around economy, efficiency, effectiveness and equality. Using indicators such as government intervention, administrative efficiency, supply of public goods, government scale, and political freedom to evaluate and compare different countries, La et al. found that the historical evolution has a great influence on the government efficiency, and the government scale has a positive correlation with the government efficiency [6]. Andrews and Boyne analysed the internal and external factors that affect the efficiency of government management and public services through empirical research on British local government public services [7].

Besides, Chinese scholars have carried out more research on local governments, but less on functional departments. For the value orientation of government efficiency evaluation, Ma made a theoretical analysis of the value orientation of government performance evaluation from the perspective of political philosophy and believed that the basic value orientation in the issue of government performance evaluation is growth, fairness, democracy and order [8]. Shi and Fang pointed out that the evaluation of government public governance effectiveness should reflect the scientific development concept, people's livelihood-oriented, fairness and justice and other value pursuits [9]. Liao and Sun have argued that there are 3 points of value orientation that government performance evaluation should reflect: one is transforming from government-based to people-oriented; second is transforming from omnipotent government to efficient government, and third is transforming from one-sided development to sustainable development [10]. Wu et al. have proposed that the basic value orientation of government performance evaluation should be: transforming from simply focusing on economic growth to comprehensive, coordinated and sustainable economic and social development; transforming from government-based to people-oriented; transforming from unlimited government to limited government; transforming from efficiency standards to benefit standards; transforming from factor evaluation to system evaluation [11]. For the government efficiency evaluation indicator system, the research group of "Research on Chinese Government Performance Evaluation" proposed a set of Chinese government performance evaluation indicator system composed of three first-level indicators: functional indicators, impact indicators and potential indicators. Zhao et al. considered that different evaluation objects such as governments at all levels, government functional departments, and authorized organizations should be distinguished, and indicator systems should be set up separately. For instance, the efficiency evaluation of government functional departments should be carried out from four aspects: the performance of statutory duties, the completion of key tasks, the state of administration according to law, and administrative transparency [16]. Shi and Fang have built an evaluation indicator system for upgrading government efficiency from three dimensions: policy efficiency, institutional efficiency and behavioral efficiency. Then they took the indicators of the Shanghai as the benchmark to investigate and evaluate the government governance efficiency of four provinces, including Zhejiang, Liaoning, Hunan, and Yunnan [9].

In general, there are many efficiency evaluation studies for all levels of integrated government. And it is necessary to conduct special research on evaluation of government functional departments.

3. EFFICIENCY EVALUATION INDICATOR SYSTEM: TAKING CHINA MARITIME DEPARTMENT FOR EXAMPLE

3.1 Indicator system construction method

The construction of evaluation indicator system is the core work of government efficiency evaluation. Based on the theoretical model of Value Focused Thinking (VFT), this paper combines policy analysis, case studies, stakeholder interviews and other methods to construct an evaluation indicator system.

The Value Focus Thinking Method (VFT) is an analytical method for multi-objective decision-making proposed by scholar Keeney, which is based on the value concerns of decision makers and stakeholders, transforming value goals into evaluation indicators, and then solving multi-objective problems that require highly subjective decision-making [12]. The key to this method is to determine the evaluation values and convert the values into goals. Therefore, it is necessary to identify the evaluation stakeholders and grasp the decision-making situation [13] [14]. Parnell et al. proposed the gold standard, platinum standard, silver standard and composite standard for constructing qualitative value models, in which the policy is the gold standard for constructing the model [15]. The application of VFT method in the construction of evaluation indicator system has been verified. Wang et al. used the VFT method to analyze the value goals of various stakeholders of the e-government project and constructed an overall evaluation indicator system for the e-government project [16]. After that, the VFT method was also used for policy analysis, and an evaluation indicator system of government governance efficiency based on big data application was constructed [5]. Zhou et al. used the VFT to build a consumer purchasing decision-making indicator system on Xi'an tourism website [17].

In the study, based on the gold and platinum criteria constructed by the value model, the efficiency evaluation of the maritime government departments identifies value objectives in 3 main areas. Firstly, we have interpreted the strategic policy documents implemented by maritime government departments, which reflect the fundamental

strategic goals and value pursuit of maritime efficiency construction. Then, the development experience and concepts of the first-class maritime sector widely recognized at home and abroad were analyzed, which reveals the development trend and actual needs of industry governance practices. Finally, civil servants of the maritime sector, employees of port and shipping companies, and industry researchers were surveyed and interviewed, which reflected stakeholders' demands for the efficiency of government supervision services.

3.2 Value target identification

3.2.1 Value target analysis of higher-level policies

Laws, regulations, strategic planning, and management policy documents related to the state, the transportation industry, and the maritime system, were selected for analysis. Through policy analysis, it is found that the higher the level of the policy document, the more macroscopic the value target for this specific maritime sector, and vice versa, the more specific the value target. Based on the analysis, it is concluded that the main targets for efficiency improvement in the maritime department are water traffic safety, water environment protection, crew rights protection, national strategic support, public service experience, institutional system construction, and administrative enforcement and law enforcement supervision.

3.2.2 Value target analysis of cases study

The efficiency evaluation of government functional departments should not only adapt to the overall logic of government efficiency evaluation, but also need to be analyzed in combination with specific functions and specific problems. The research summarizes the development experience of maritime management benchmarking institutions with high reputation recognized by the public at home and abroad and refines the value target of the efficiency evaluation of maritime government departments. In terms of traditional maritime powers, the study mainly summarizes the practices of maritime sectors in the UK, Singapore, Denmark and the Netherlands. As far as China is concerned, the development practices of maritime departments in Shanghai, Shenzhen, and Tianjin, which are at the forefront of maritime system development, are mainly selected. Through case studies, it is concluded that the value objectives of first-class maritime management organizations are reflected in the development strategy concept, industry influence, management service means, talent team, and management and technical innovation capacity.

3.2.3 Value target analysis of stakeholders interview

The study selected civil servants in the maritime sector, employees of port and shipping enterprises, and industry researchers as stakeholders, and conducted research and interviews in groups. Different stakeholder groups have different focus on the maritime sector efficiency value goals. The study organized a survey and interview with each business department of a maritime bureau directly under the jurisdiction of a maritime bureau and distributed and recovered 14 questionnaires. 30 indicators were listed in the questionnaire, and the question of "suggested indicators" was set. In the same way, 10 questionnaires were distributed to employees of port and shipping enterprises, and 5 questionnaires were distributed to relevant experts of a scientific research unit. Through summary and analysis, public servants' goals for the efficiency value of the maritime sector are generally concentrated in the level of function performance, the level of rule of law construction, the level of internal management, the level of facilities and equipment, and the protection of employees' rights and interests. The employees of port and shipping enterprises pay more attention to the public service experience of the maritime department, the degree of administrative law enforcement, the effectiveness of law enforcement supervision, and the level of protection of the rights and interests of the crew. Industry researchers pay more attention to the maritime sector's strategy and concept leadership, management innovation means, technology application level, talent team support level, industry influence and other indicators.

3.3 Establishment of indicator system

3.3.1 Evaluation dimension

Based on the analysis and research on the role positioning of government functional departments, this paper proposes the efficiency evaluation logic framework of the four -dimensional government functional department of function realization, management operation, external impact, and sustainable development as shown in Figure 1. Among them, function realization is the foundation of government efficiency. Management operation is the internal power of government efficiency. External influence is the social effect of government efficiency. And sustainable development is the long -term pursuit of government efficiency.

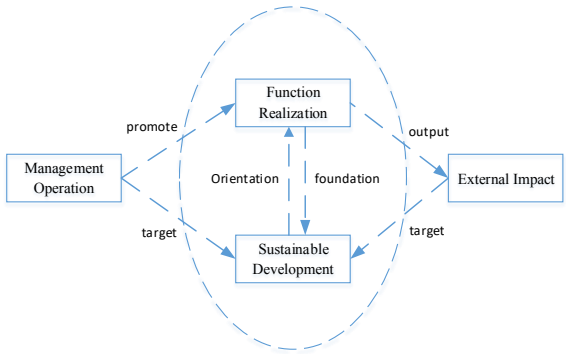

Figure 1 Efficiency evaluation logic framework

3.3.2 Indicator system

Based on the theory of government efficiency evaluation, the VFT method is used to analyze the efficiency goals of maritime government departments from three aspects: policy analysis, case analysis, and stakeholders' research and interviews, forming 4 first grade indicators of "Function Realization", "Management Operation", "External Influence" and "Sustainable Development". Then, a three -level indicator system is established by summarizing the results of relevant policy analysis, case analysis, and research interviews as shown in table 1. The primary and secondary indicators are relatively stable and more goal-oriented. The tertiary indicators, on the other hand, are typical indicators to measure the effectiveness of this work and can be adjusted according to the requirements of different periods.

Table 1: Evaluation indicator system for the efficiency of maritime government departments

First grade	Second grade	Third grade
A1 Function Realization	B1 Water traffic safety level	Accident rate of ships entering and leaving the port
		Fatalities in water traffic accidents
		Economic loss rate of water traffic accidents
		The level of risk prevention and control for enterprise safety production
		The success rate of rescue of life at sea
	B2 Water environment protection level	Comprehensive oil spill removal capability
		Pollutant emissions from ships in operation
	B3 The level of protection of the rights and interests of the crew	The level of protection of the rights and interests of the crew
	B4 National strategic support level	Measures to support national strategy
	B5 Regional development participation level	Participation level of regional key work
	B6 Public service experience	The level of facilitation of government affairs
		Supervision and inspection of law enforcement efficiency
		Service level of new marine industries
A2 Management Operation	B7	Institutional document coverage of administrative law enforcement

First grade	Second grade	Third grade
	The degree of perfection of the institutional system	The timeliness of the current system documents
	B8 Administrative law enforcement norms and civilized level	Administrative law enforcement complaint rate
	B9 Effectiveness of law enforcement supervision	Monitoring mechanism and channel setting
		The establishment of administrative accountability and error correction mechanism
	B10 Intensive and precise management mechanism	The degree of clarity of the authority and responsibilities of the department
	B11 Administrative Efficiency	The quality and efficiency of official document circulation
	B12 Employee occupational treatment level	Employee satisfaction
A3 External Influence	B13 Featured jobs and brands	Number of experienced practices positively promoted
		Number of collective and individual honorary titles
	B14 Participation in industry rulemaking	The number of regulations involved in the development of industry issues
		The number of regulations involved in the development of regional issues
		The number of political proposals adopted and approved by the competent authorities
		The number of senior advice adopted
	B15 Social evaluation	Customer satisfaction
		Social satisfaction of government sectors ruled by law
	B16 Media coverage	Number of positive reports in mainstream media
A4 Sustainable Development	B17 Political construction normative level	Political construction normative level
	B18 Development strategy foresight and leading level	Development strategy foresight and leading level
	B19 Reform and innovation ability	Innovation level of supervision service means

First grade	Second grade	Third grade
		Industry advanced technology application level
	B20 Human resource	Proportion of high-end talents
		Proportion of professionally competent personnel
	B21 Facility equipment support level	Dynamic monitoring system coverage
		Adaptability of boats and vehicles
		Infrastructure support level
		Informatization level of supervision services
		Standardization rate of personal equipment

4. EVALUATION MODEL CALCULATION

4.1 Indicators standardization

4.1.1 Quantitative indicators

There are 2 kinds of indicators: quantitative indicators and qualitative indicators. And the indicators should be standardized, so as to be compared in the same dimension.

This paper adopts the linear scaling method to standardize the quantitative indicators positively.

There are 2 types of indicators in the indicator system: the larger the better the positive indicators and the smaller the better the reverse indicators within a reasonable range. The set of evaluation indicators for the first 2 types is denoted by z_i (i=1,2).

For $z_i \in Z$, let its range of values be $d_i = [min\, x_i\, , max\, x_i]$, then the formula

$$r_i = z_{di}(x_i) \text{ i=1,2,3,…,n} \quad (1)$$

is defined as the standardized value of the attribute value x_i of the evaluation indicator z_i by the decision maker. And z_{di} is the normalized function of the indicator z_i defined on the range of values d_i.

Thus, the Positive indicator normalization function is

$$r_i = z_{di}(x_i) = \frac{x_i}{max\, x_i}. \quad (2)$$

And the inverse indicator normalization function is

$$r_i = z_{di}(x_i) = \frac{min\, x_i}{x_i}. \quad (3)$$

In order to reflect the evolution trend of the efficiency of maritime government departments, the data of the last three years (including the evaluation year) can be used for measurement when determining the standardized values of the indicators. In order to reflect the efficiency level of a maritime government department in the system, the corresponding data of other maritime bureaus in the system can be selected for comparison and calculation.

4.1.2 Qualitative indicators

In order to facilitate the operation and make the evaluation consistent, the evaluation of each influencing factor was quantified, drawing on the application of standardized methods for qualitative indicators in the literature [19]. In this paper, the hierarchical affiliation (good, better, fair, poor, terrible) was determined using the method of rank affiliation and assigned to the corresponding evaluation criteria scales (1, 0.8, 0.6, 0.4, 0), which were scored and evaluated according to the actual situation of that indicator during the evaluation and normalized to the [0,1] interval.

4.2 Weighting calculation

4.2.1 Build evaluation decision judgment matrix

For the primary and secondary indicators, considering their strong value orientation, this paper adopts the hierarchical analysis (AHP) on a 5/5-9/1 scale to assign weights to the indicators. For the weighting of the tertiary indicators, the study adopts the equal weighting approach under the same level of indicators.

According to the indicator system, a 3-layer evaluation structure of target layer, criterion layer and indicator layer is established, and a judgment matrix is built based on the evaluation structure. Based on this structure, the judgment matrices of the relative weights among the elements of the criterion layer-target layer and indicator layer-criteria layer are established respectively, and the single-level weight ranking is calculated from top to bottom. There are 4 elements of the criterion layer governed by the target, and the judgment matrix $A=\{a_{ij}\}$ is established relative to the target layer, then the judgment matrix should have the following form:

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{14} \\ a_{21} & a_{22} & \cdots & a_{24} \\ \vdots & \vdots & \ddots & \vdots \\ a_{41} & a_{42} & \cdots & a_{44} \end{pmatrix}. \tag{4}$$

The meaning of element a_{ij} in Equation 4 is: the importance of element A_i relative to A_j under the domination of the total goal. The meanings of the scale values are shown in Table 2.

Table 2: Scale value meanings

Scale values	Meanings
5/5	A_i is as important as A_j
6/4	A_i is slightly more important than A_j
7/3	A_i is significantly more important than A_j
8/2	A_i is strongly more important than A_j
9/1	A_i is extremely more important than A_j
5.5/4.5, 6.5/3.5, 7.5/2.5, 8.5/1.5	The importance of A_i and A_j is between the above judgments

Similarly, the importance judgment matrix between the elements of the indicator layer relative to the criterion layer is built separately.

4.2.2 Weight data collection

The work of maritime government departments is relatively specialized, and it is difficult for external personnel to grasp the overall maritime situation. Based on this, this study sought the opinions of two staff members from functional and operational departments of a direct maritime bureau, and two researchers from relevant scientific research units to score the importance between indicators at each level in a two-by-two comparison to obtain the expert judgment matrix dataset.

4.2.3 Data processing and calculation

The processing of judgment matrix data requires the process of matrix consistency test and correction, single-level weight calculation, individual composite weight calculation, total consistency test, and group decision weight calculation [18].

Before determining the weights, the matrix is tested for consistency. The judgment matrix consistency test is performed by calculating the matrix consistency ratio CR.

$$CR = \frac{CI}{RI} \tag{5}$$

where CI is a matrix consistency indicator calculated by

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{6}$$

where λ_{max} is the largest eigenvalue of the judgment matrix and n is the dimension of the judgment matrix. In addition, the RI is a constant value determined by the selected scale, as shown in Table 3.

Table 3: Judgment matrix RI values

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.1690	0.2598	0.3287	0.3694	0.4007	0.4167	0.4370

When CR < 0.1, the matrix satisfies the consistency condition and the indicator weights can be further calculated. For the matrix that does not pass the consistency test, the method of calculating the elemental perturbation variables followed by the correction of the maximum element of deviation is used to correct the matrix.

The following is an example of the process of calculating the weights for expert 1.

Table 4: Objective level-criteria level judgment matrix

Z	A1	A2	A3	A4	weight	indicators
A1	5/5	6/4	7/3	6/4	0.3532	CI=0.0221 RI=0.2598 CR=0.085 < 0.1. Consistency judgment passed.
A2	4/6	5/5	6/4	3/7	0.1882	
A3	3/7	4/6	5/5	3/7	0.1355	
A4	4/6	7/3	7/3	5/5	0.3231	

Table 5: The initial judgment matrix of " Sustainable Development " for the indicator layer

A4	B17	B18	B19	B20	B21	indicators
B17	5/5	3.5/6.5	3.5/6.5	3/7	2.5/7.5	CI=0.0989 RI=0.3287 CR=0.3008 > 0.1. Consistency judgment failed
B18	6.5/3.5	5/5	5/5	4.5/5.5	4/6	
B19	6.5/3.5	5/5	5/5	4.5/5.5	4/6	
B20	7.3	5.5/4.5	5.5/4.5	5/5	4.5/5.5	
B21	7.5/2.5	6/4	6/4	5.5/4.5	5/5	

Since the consistency test CR=0.3008>0.1, the initial judgment matrix of "sustainable development" on the indicator layer fails the consistency test and needs to be adjusted by calculating the elemental perturbation variables.

Suppose the nth-order square matrix $A' = (a_{ij}')$ is a complete consistency matrix whose elements satisfy $a_{ik}\, a_{kj} = a_{ij} (\forall i, k, j = 1,2,3, \dots, n)$. Since the feature vector of the largest eigenvalue λ'_{max} of matrix A' is $w' = (w_1', w_2', w_3', \dots, w_n')^T$, then $a_{ij}' = \frac{w_i'}{w_j'}$. For the judgment matrix A, it can be regarded as generated by the joint action of each element a_{ij}' in the complete consistency matrix A' and the perturbation variable $\Delta\sigma_{ij}$. The perturbation variables have the following properties.

$\forall i, j = 1,2,3, \dots, n$, ①$\Delta\sigma_{ij} > 0$; ②$\Delta\sigma_{ij} = \frac{1}{\Delta\sigma_{ji}}$; ③$\Delta\sigma_{ii} = 1$

Then, the elements in matrix A can be expressed as

$$a_{ij} = a_{ij}' \cdot \Delta\sigma_{ij} = \frac{w_i'}{w_j'} \Delta\sigma_{ij}, \quad i, j = 1,2,3, \dots, n. \quad (7)$$

Therefore, the perturbation variable $\Delta\sigma_{ij}$ can be calculated by

$$\Delta\sigma_{ij} = a_{ij} \frac{w_j'}{w_i'}, \quad i, j = 1,2,3, \dots, n. \quad (8)$$

If the judgment matrix A is a consistent matrix, the perturbation variable value is 1. If the matrix A is inconsistent, the correction should start from the element with the largest perturbation variable value.

$$\Delta\sigma_{ijmax} = max\left\{a_{ij} \frac{w_j'}{w_i'}\right\} \quad (9)$$

The judgment matrix based on the 5/5-9/1 scale can be written in the form

$$\begin{cases} a_{ij} = \frac{p}{10-p} \\ a_{ji} = \frac{10-p}{p} \end{cases} \quad (10)$$

Because the judgment matrix is the reciprocal inverse matrix, it is known from its nature that the maximum element of the perturbation variable should be corrected at the same time, and the reciprocal inverse element should be corrected accordingly.

The maximum element of the perturbation variable is corrected to

$$a_{ij} = \frac{p-0.5}{10-(p-0.5)}. \quad (11)$$

The minimum element of the perturbation variable is corrected to

$$a_{ji} = \frac{10-(p-0.5)}{p-0.5}. \quad (12)$$

In this example, the perturbation variable $\sigma_{34} > \sigma_{24} > \sigma_{41}$ is calculated, so the correction starts from the element of the 4th column of the 3rd row with its mutual inverse element. We adjust 4.5/5.5 to 4/6 and its mutual inverse element to 6/4, and calculate the consistency for the adjusted judgment matrix. At last, the consistency judgment of the matrix is passed.

Next step, the total consistency of the target layer is examined. Assume that the jth factor in the k-1th level is the comparison criterion, the consistency test metric for the kth layer is $CI_j^{(K-1)}$, the average random consistency index is $RI_j^{(K-1)}$, we get $CI^k = CI^{(K-1)} \cdot w^{(k-1)}$ as the single-level ranking consistency index for the two-way comparison of factors in the kth level. And similarly we get $RI^k = RI^{(K-1)} \cdot w^{(k-1)}$. Then we have

$$CR^k = \frac{CI^k}{RI^k}. \quad (13)$$

If $CR^k < 0.1$, the evaluation model can be considered to meet the consistency requirement at the k-tier level; otherwise, the matrix needs to be adjusted accordingly. In this example, we have $CR^1 = \frac{CI^1}{RI^1}$=-0.00705/0.341399=-0.02064 < 0.1. So, the total consistency of the target layer test passed. The relevant data are shown in table 6.

Table 6: Total consistency test calculation table

Indicator layer				Guideline layer		
	CI3	RI3	CR3	CI2	RI2	CR2
A1	0.0035	0.3694	0.0096	0.0221	0.2598	0.085
A2	0.0045	0.3694	0.0122	Target layer		
A3	-0.0421	0.2598	-0.1621	CI1	RI1	CR1
A4	-0.0106	0.3287	-0.0323	-0.00705	0.341399	-0.02064

Finally, the combined weights of individual decisions were obtained by normalization

At last, the weighting results of each expert are equally weighted and the weighted geometric mean is used to obtain the group decision weights of the four experts. The group decision weights are obtained by the MATLAB software as shown in Table 7, and the specific process is not repeated.

Table 7: Combined weights of group decision

Target layer	Guideline layer	Weight	Indicator layer	Weight
Z	A1	0.3337	B1	0.1254
			B2	0.0502
			B3	0.0433
			B4	0.0455
			B5	0.0317
			B6	0.0376
	A2	0.2008	B7	0.0525
			B8	0.0419
			B9	0.0300
			B10	0.0241
			B11	0.0252
			B12	0.0271
	A3	0.1916	B13	0.0352
			B14	0.0791
			B15	0.0644
			B16	0.0109
	A4	0.2739	B17	0.0258
			B18	0.0572
			B19	0.0513
			B20	0.0649
			B21	0.0747

4.3 Efficiency evaluation value calculation

In this paper, the tertiary indicators are the direct monitoring indicators of the efficiency evaluation, and the comprehensive evaluation value is calculated by the conduction of the evaluation value of the tertiary indicators. In other words, the standard values of tertiary indicators after equal weighting are calculated by the weighted arithmetic average method, and then the comprehensive evaluation value is calculated from the evaluation value of secondary indicators. This paper uses

a generalized utility function to calculate the comprehensive evaluation value of the efficiency of the maritime government department, drawing on relevant research practices [19], as shown in Equation 14:

$$U(P) = \sum_{j=1}^{21} T_j W_j \quad (14)$$

where $U(P)$ is the comprehensive evaluation value, T_j is standardized value of the jth secondary indicator, and W_j is weight value of the jth secondary indicator.

4.4 Empirical Analysis

Using the evaluation model, the work indicators of a maritime government department for three years from 2019 to 2021 were evaluated, and the situation of each indicator in 2020 and 2021 was mainly compared as shown in Table 8.

Table 8: Comparison of efficiency evaluation scores of a maritime government department

First grade indicators	2020	2021
A1	0.2562	0.3224
A2	0.1585	0.1765
A2	0.1677	0.1552
A4	0.2347	0.2597
Total score	0.8171	0.9138

Overall, the efficiency score in 2021 is higher than the score in 2020, indicating a positive trend in the efficiency of the maritime department. Specifically, in the three indicators of function realization, management operation and sustainable development, the performance in 2021 is better than that in 2020, indicating that the maritime department has achieved a healthy development. It is worth noting that in terms of external influence, the score in 2021 is lower than the score in 2020, indicating the need to increase the investment in participation in the development of industry rules, publicity of work efficiency and social evaluation.

5. CONCLUSIONS

The evaluation of the efficiency of government is a cognitive process of transforming desired values into action goals and then into evaluation indicators. Based on the golden rule and platinum rule of VFT, this paper clarifies the value objectives of maritime government department efficiency construction through superior policy analysis, case study analysis and stakeholder interview analysis. Then, through theoretical analysis, expert consultation and other methods, a three-level efficiency evaluation indicator system including target indicators and monitoring indicators is established in conjunction with the actual work of maritime government departments. After that, the linear proportional transformation method was used to standardize the monitoring indexes, and AHP was applied to assign weights to the target indexes. Finally, the generalized utility function was used to calculate the comprehensive evaluation value of the effectiveness of maritime government departments, and the empirical analysis was conducted to complete the transformation from qualitative to quantitative evaluation of effectiveness. Considering the accessibility of indicators and the operability of evaluation, the comprehensiveness of the indicator system has certain shortcomings and needs to be further expanded and improved. This study provides a quantifiable tool for the evaluation of the effectiveness of maritime government departments, and at the same time, it can provide reference for the evaluation of the effectiveness of government functions in terms of evaluation value target determination, evaluation dimensions, and model calculation methods.

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REFERENCES

[1] Wu, Jiannan, Ma Liang, Yang Yuqian. (2011). Xiaonengjianshe in the Comparative Perspective: Performance Improvement, Innovation and Service Oriented Government. J. Chinese Public Administration. 35-40.

[2] Peng Xianggang. (2013). Research on Administrative Efficiency Construction in the Perspective of Harmonious Society. M. Beijing: China Social Science Press.

[3] Zhao Rusong, Chen Suping, Liu Ying, et al. (2017). A Preliminary Investigation of Government Effectiveness Assessment Index System. J. Research on Government Legal System. 452-482.

[4] Zhu Zhengwei, Yang Jingjing. (2007). A review of domestic government effectiveness research. J. Special Zone Economy. 271-272.

[5] Wang Fang, Zhang Baihui, Yang Lingzhi, et al. (2020). Constructing an Evaluation Index System for the Government Efficacy in Governance Using Big Data. J. Journal of Information Resources Management.17-28.

[6] La Porta R, Lopez-de-Silanes F, Shleifer A, et al. (1999) The quality of government. J. The Journal of Law, Economics, and Organization. 222-279.

[7] Andrews R, Boyne G A, Law J, et al. (2005). External constraints on local service standards: The

case of comprehensive performance assessment in English local government. J. Public Administration. 83(3): 639-656.

[8] Ma Baocheng. (2001). Experimenting with the value orientation of government performance evaluation. J. Chinese Public Administration, (05):18-20.

[9] Shi Xuehua, Fang Shengju. (2010). Designing an index system for evaluating the effectiveness of public governance in Chinese provincial governments. J. CASS Journal of Political Science. 56-66.

[10] Liao, Xiaoming, Sun, Li. (2010). On the Value Orientation in the Performance Evaluation of Local Governments in China. J. Chinese Public Administration. (4): 27-31.

[11] Wu Shaoqi, Niu Haiyan, Wang Zhiyong, et al. (2008). Reshaping the value orientation of current government performance evaluation in China. J. Journal of Xiangfan Vocational and Technical College. 94-96.

[12] Keeney, R. L. . (1992). Value-focused thinking: a path to creative decision-making.

[13] Lynette Drevin, Hennie A. Kruger, Tijaart Steyn. (2007). Value-focused Assessment of ICT Security Awareness in an Academic Environment. J. Computers & Security, (26):36-43.

[14] Palph. L. Keeney. (1996). Value-focused Thinking: Identifying Decision Opportunities and Creating Alternatives. J. European Journal of Operational Research. 537-549.

[15] G S. Parnell. (2007). Value-Focused Thinking Using Multiple Objective Decision Analysis, Methods for Conducting Military Operational Analysis: Best Practices in Use Throughout the Department of Defense. M. USA: Military Operations Research Society. Chapter 19.

[16] Wang Fang, Li Zhaojing, Bai Meiling. (2014). Developing an Evaluation Indicator System for E-government Project: Using a VFT Approach. J. Chinese Public Administration. 32-37.

[17] Zhou Zhen, Ge Jiazhu,Lin Yun. (2015). An Evaluation Indicator System for Online Travel Sites Purchas Decision Based on Value Focused Thinking. J. Mathematics in Practice and Theory. 146-154.

[18] Wang Yisheng. (2018). Sustainability Assessment Methodology of Metro Depot Yard Design Project. D. Beijing Jiaotong University.

[19] Zhang Jun. (2007). Study on the Integrated Evaluation for the Sustainable Development of Urban Traffic System. D. Southwest Jiaotong University.