Evaluation on the Management and Construction of Service-Oriented Government in International Metropolis Based on Principal Component Analysis and Matter-Element Model

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Abstract: The management and construction of service-oriented government is becoming more and more important in the governance of major cities in the world. Especially with the development of new technology, the efficiency of service-oriented government construction and management has been rapidly improved. By considering the effectiveness of construction, we can find out the problems, understand the gap between cities, and further enhance the energy level and core competitiveness of cities. From four aspects of financial and social expenditure, public service, e-government and information disclosure, 21 indicators are selected to form the evaluation system of service-oriented government construction performance index. Using SPSS software, the paper evaluates the construction effect of service-oriented government in seven international metropolises, such as London and New York City, by means of principal component analysis and matter element analysis. The results show that: the second echelon cities have obvious advantages in e-government construction, and focus on the technical experience of "Government Online-offline Shanghai". The gap between the two echelons is mainly reflected in the financial expenditure. The focus of service-oriented government construction in China's international metropolis is to increase social financial expenditure.

1 INTRODUCTION

With the economic globalization, New York, London and other international metropolises play important roles in the world, and gradually develop into the world economic center, political and cultural center. Service oriented government is a kind of government which takes citizen service as its purpose, which undertakes service responsibility under the guidance of citizen standard and social standard. It is established through legal procedures and according to the will of citizens (Liu 2002). Establishing a service-oriented government is not only an important measure to achieve scientific development and deal with various social problems, but also a change of governance mode and governance philosophy. It requires the government to realize the transformation and change from traditional to modern management system, operation mechanism, management mode and other aspects. We should pay attention to the functions of the government in the social field and put the social management and public service functions in an increasingly important position. The construction of service-oriented government can enhance the city's energy level and core competitiveness, and constantly improve the governance capacity and governance level of the socialist modern international metropolis.

The essence of the evaluation of the construction effect of service-oriented government is the comprehensive consideration of the construction effect of each city's service-oriented government. It can not only comprehensively evaluate the comprehensive effect of the city in the construction of service-oriented government, but also find out the problems restricting the improvement of the effect through the evaluation, so as to provide a reference for the future government work (Li and Zheng 2020).

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2 RESEARCH METHODS

2.1 Data Standardization

In order to promote the comparability between the data, the initial data is dimensionless. For indicator which is the larger, the more favorable, the calculation formula of positive indicators is used; For indicator which is the smaller, the more favorable, the calculation formula of Negative indicators is used, as follows

$$\text{Positive indicator: } x' = x_{ij}/\max(x_j) \quad (1)$$

$$\text{Negative indicator: } x' = \min(x_j)/x_{ij} \quad (2)$$

Where x` represents index value after standardization, x_{ij} represents original index value, x_j represents column J indicators (Fan, Wang and Zhou 2012).

2.2 Principal Component Analysis

Principal Component Analysis (PCA) is to solve the eigenvalue and eigenvector of the correlation coefficient matrix of the sample indicators, transform multiple correlated indicators into a few independent comprehensive indicators (i.e. principal component), and analyze the standardized indicators. The calculation process includes extracting principal components according to the cumulative contribution rate of principal component variance, calculating the score and weight of each principal component.

2.3 Matter-element Model

Matter Element Model is a new subject founded by Chinese scholar Professor Cai Wen (Luo and Wu 2014), which studies the laws and methods of solving incompatibility problems. It includes establishing the matter-element model of service-oriented government construction, establishing the system of evaluation indicators, determining the classical domain and matter-element matrix, determining the correlation function and correlation degree, calculating the comprehensive correlation degree and determining the evaluation grade.

Table 1: Evaluation index system of service oriented government construction.

Target layer	Criterion layer	Evaluating indicator	Index attribute
Achievement of service oriented government construction	The level of financial social expenditure	Proportion of social expenditure x_1/（%）	V
		Growth rate of proportion of social expenditure in recent three years x_2/（%）	V
	Public service level	Safety index x_3	V
		Health care index x_4	V
		pollution index x_5	Λ
		Traffic flow index x_6	V
		Quality of life index x_7	V
		Business collaboration x_8/(item)	V
		Service Quantity x_9/(item)	V
	E-government level	Unified hotline / email x_{10}	V
		APP x_{11}	V
		Facebook x_{12}	V
		Twitter x_{13}	V
		Instagram x_{14}	V
		Weibo x_{15}	V
		WeChat x_{16}	V
		The earliest legislative year x_{17}/(year)	Λ
	Degree of information disclosure	laws and regulations x_{18}/(item)	V
		Information disclosure data organization x_{19}/(item)	V
		data set x_{20}/(item)	V
		Data category x_{21}/(item)	V

Note: In the indicator attribute column, "V" indicates that the larger the indicator, the better; "Λ" indicates that the smaller the indicator, the better.

3 EMPIRICAL RESEARCH

3.1 Indicator System and Data Sources

According to the eigenvalue size and variance cumulative contribution rate to extract principal components, table 2 shows that the cumulative contribution rate of the first five principal components reaches 97.909%, so we can use these five principal components to make principal component analysis on the construction effect of service-oriented government. According to the principal component load matrix, the five principal components are divided into financial expenditure factor, e-government factor, public service quantity factor, information disclosure factor and public service quality factor.

3.2 Dimension Reduction

The software spss22.0 was used for principal component analysis to obtain the characteristic value, variance contribution rate and the cumulative variance contribution rate of the sample indexes. The cumulative contribution rate extracts the main components according to the characteristic value and variance cumulative contribution rate. The five principal components can be used to analyze the construction effect. According to the load matrix of principal component, the five main components are divided into fiscal expenditure factor, e-government factor, public service quantity factor, information disclosure factor, and public service quality factor.

3.3 Effectiveness Evaluation

3.3.1 Determine the Matter-element of Service-oriented Government Construction

Service-oriented government construction effect R, service-oriented government construction effect characteristic C and characteristic value V constitute the matter element of service-oriented government construction effect.

$$R = \begin{bmatrix} N & c_1 & v_1 \\ & c_2 & v_2 \\ & \vdots & \vdots \\ & c_n & v_n \end{bmatrix} = \begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_n \end{bmatrix} \quad (3)$$

Where R is the matter-element of the construction effect of n-dimensional service-oriented government, r = (n, C, V).

3.3.2 Classic Domain and Node Domain Matter-Element Matrix for Determining the Effectiveness of Service-Oriented Government Construction

The classical domain matter-element matrix of the construction effect is expressed as follows:

$$R_{0j} = (M_{0j}, c_i, V_{0jt}) = \begin{bmatrix} M_{0j} & c_1 & V_{0j1} \\ & c_2 & V_{0j2} \\ & \vdots & \vdots \\ & c_n & V_{0jn} \end{bmatrix} = \begin{bmatrix} M_{0j} & c_1 & < a_{0j1}, b_{0j1} > \\ & c_2 & < a_{0j2}, b_{0j2} > \\ & \vdots & \vdots \\ & c_n & < a_{0jn}, b_{0jn} > \end{bmatrix} \quad (4)$$

Table 2: Principal component factor scores of the construction effect.

City	Score of each principal component				
	Fiscal expenditure factor (v1)	e-Government factor (v2)	Public service quantity factor (v3)	Information disclosure factor(v4)	Public service quality factor(v5)
New York	4.134	2.566	2.953	0.202	0.549
London	4.508	1.085	-0.230	0.241	0.346
Hong Kong	4.519	1.135	-0.038	0.044	0.822
Tokyo	-1.687	4.814	1.109	0.657	0.389
Beijing	-2.312	3.514	1.670	0.495	0.269
Shenzhen	-2.245	3.002	2.059	-0.732	-0.058
Shanghai	-1.964	3.601	1.913	0.704	0.223
weighting factor	0.423	0.228	0.179	0.110	0.061

Note: the weight coefficient is equal to the proportion of each principal component variance contribution rate to the total variance contribution rate.

Where R_{0j} is the classical domain entity, M_{0j} represents the j-level of the construction effect of the service-oriented government (J = 1, 2, 3, 4), c_i indicates the i-th evaluation index. The interval $< a_{0jn}, b_{0jn} >$ is the range of the value (V_{0jn}) corresponding to the evaluation level J, which is the classical domain.The classical domain is the value range of evaluation grade, which is the basis of matter element evaluation. According to the extension of the construction effect of service-oriented government, it is divided into four levels(M_{01}-M_{04}), which is qualitatively described as excellent, good, medium and poor.

3.3.3 The Domain Matter Element Matrix for Determining the Construction Effect of Service-oriented Government

The domain matter-element matrix of the construction effect of service-oriented government is expressed as follows:

$$R_p = (N_p, c_i, V_{pi}) = \begin{bmatrix} N_p & c_1 & < a_{p1}, b_{p1} > \\ & c_2 & < a_{p2}, b_{p2} > \\ & \vdots & \vdots \\ & c_n & < a_{pn}, b_{pn} > \end{bmatrix} \quad (5)$$

Where R_p is called nodal domain matter element. The nodal domain matter element ($V_{pi} =< a_{pn}, b_{pn} >$) is the magnitude range of the feature. P stands for the whole evaluation level of service-oriented government construction.

3.3.4 Determination of Matter Element to be Evaluated

The matter element (R_x) of the object to be evaluated (N_x) is expressed as:

$$R_x = \begin{bmatrix} N_x & c_1 & v_1 \\ & c_2 & v_2 \\ & \vdots & \vdots \\ & c_n & v_n \end{bmatrix} \quad (6)$$

3.3.5 Determination of Correlation Function and Correlation Degree

The correlation function of service-oriented government construction performance indicator (K_x) is defined as:

$$K_x = \begin{cases} \frac{-\rho(X,X_0)}{|X_0|}, X \in X_0 \\ \frac{\rho(X,X_0)}{\rho(X,X_p)-\rho(X,X_0)}, X \notin X_0 \end{cases} \quad (7)$$

Where $\rho(X, X_0)$ represents the distance between the point X and the finite interval $X_0 = [a_0, b_0]$, $\rho(X, X_p)$ represents the distance between point X and the finite interval $X_p = [a_p, b_p]$, X represents the characteristic value of matter-element of the construction effect of service-oriented government to be evaluated, X_0 represents the value range of classical domain matter-element, X_p represents the value range of node domain matter-element.

3.3.6 Calculate the Comprehensive Correlation Degree and Determine the Evaluation level

Comprehensive correlation degree of the object to be evaluated with respect to grade J.

$$K_j(N_x) = \sum_{i=1}^{n} a_i K_j(x_i) \quad (8)$$

When K(x) ≥1.0, it means that the object to be evaluated exceeds the standard level. The larger the value, the greater the degree of exceeding the standard; When 0≤K (x)<1.0, it means that the object to be evaluated conforms to the standard level. The larger the value is, the closer it is to the upper limit of the standard level; When -1.0 ≤ K(x) ＜0, it means that the object to be evaluated does not conform to the standard level, but has the conditions to be converted to the standard level, and the larger the value is, the easier it is to be converted, so it can be judged that it belongs to the standard level; When K(x)＜-1.0, it means that the object to be evaluated does not meet the requirements of standard object,

Table 3: Evaluation results of service oriented government construction.

City	Relevancy				Grade	Echelon
	Excellent	Good	Medium	Poor		
New York	0.099	0.132	0.044	0.000	good	The first echelon
London	0.000	0.089	0.072	0.004	good	
Hong Kong	0.000	0.120	0.010	0.001	good	
Tokyo	0.000	0.044	0.176	0.000	medium	The second echelon
Beijing	0.000	0.060	0.148	0.000	medium	
Shenzhen	0.000	0.084	0.124	0.008	medium	
Shanghai	0.000	0.126	0.171	0.000	medium	

and does not have the conditions to convert to standard level.

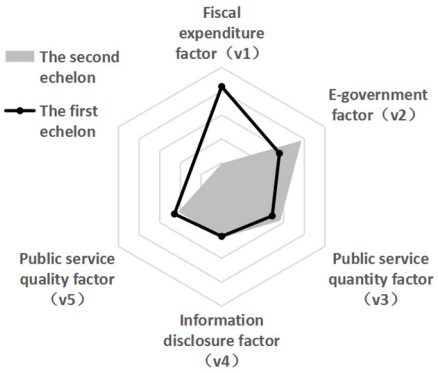

Figure 1: Radar chart of evaluation results of service-oriented government construction

3.4 Evaluation Results

According to the matter-element evaluation model, we can calculate the evaluation results of service-oriented government construction in seven cities, and the overall evaluation level is general. Among them, New York, London and Hong Kong are in the first echelon, while Beijing, Shanghai, Shenzhen and Tokyo are in the second echelon.

4 CONCLUSION

By comparing the principal component factor scores of the first-echelon cities and the second-echelon cities (Figure 1), it can be found that although the second-echelon cities are slightly better than the first-echelon cities in the number of e-government and public services, the first-echelon cities are far ahead of the second-echelon cities in the financial expenditure factor. In particular, as China's first government service brand, "Government Online-offline Shanghai" ranked first in the investigation and evaluation report on the integrated government service capacity of provincial governments (2021). By 2020, 357 reform measures had been implemented, 3197 intervention matters had been involved, and 150 million cumulative number of work was done. The reform of "Government Online-offline Shanghai" is also advancing in depth, changing from technology driven to system driven (as shown in Figure 2), so as to realize the innovation of governance mode, the reconstruction of governance mode and the reconstruction of governance system.In addition, there is little gap between cities in terms of public service quality and information disclosure. The gap between the two echelon cities is mainly reflected in financial expenditure. Therefore, the focus of the construction of service-oriented government in China's international mega cities in the future should be the improvement and improvement of financial social expenditure.

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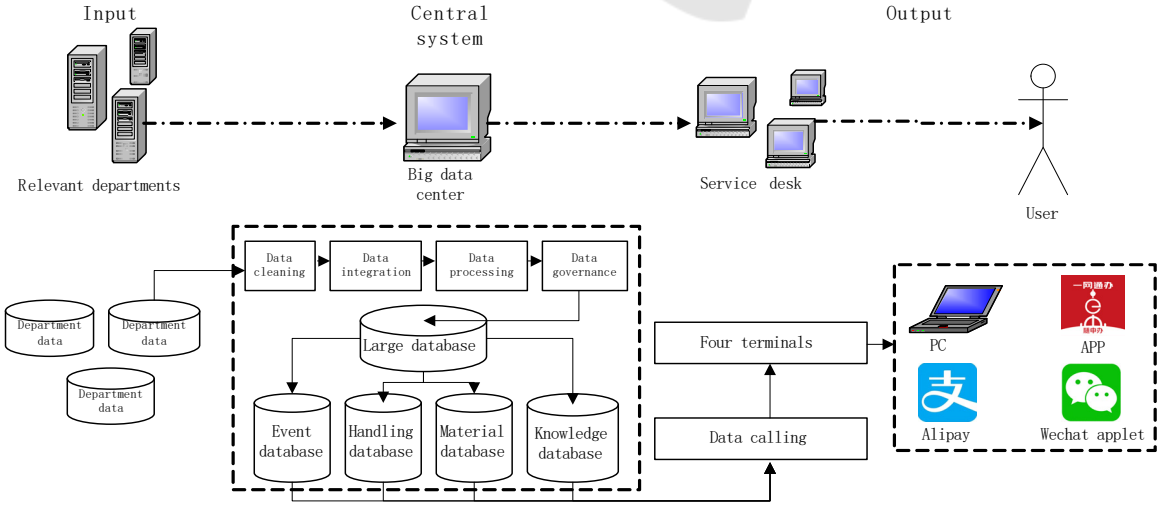

Figure 2: The technical architecture of “Government Online-offline Shanghai”.

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