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## Political Connection of Senior Executives and Excess Credit of Enterprises —Research on Based on the Perspective of Ownership System

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**Abstract:** Based on the sample of 2008-2011 A-share companies in China, This thesis empirically tested the relations between the excess credit of enterprises and political connection of senior executives, and studied the influences of political connection developed by listed companies on its debt financing under the background of transition economy system in China. The research found that the most of enterprises that have obtained over loan were state-owned enterprises, political connection of senior executives of state-owned enterprises has strengthened the formation of over loan of state-owned enterprises, some private enterprises obtained over loan, political connection was not a leading role, but rather bank-enterprise relationships. The policy implications of thesis is that development of political connection help alleviate the credit discrimination on private enterprises, but political connection of senior executives of state-owned enterprises has strengthened the formation of over loan of state-owned enterprises and exacerbated the low efficiency of credit resources allocation.

**Keywords:** Ownership system, political connection, excess credit of enterprises

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### I. INTRODUCTION

In the stage of transition economy in China, most of the financial institutions are controlled by the government; however enterprises are divided into state-owned enterprises and private enterprises according to the ownership system. Government control makes resources allocation of financial institutions with obvious political nature, inherent property right feature of state-owned enterprises obtains an advantage on the aspect of financial resources allocation, although private enterprises have a higher efficiency compared with state-owned enterprises [6, 11], but on the aspect of financial resources allocation, private enterprises are heavily restricted. So for a long time, policy-based lending formed by financial regulation firstly supported the development of state-owned enterprises, only check from the bank loan and government funding accounted for the proportion of aggregate investment, the state-owned enterprises have reached up to more than three times as private enterprises [11].

Adverse selection caused by information asymmetry led to the result that credit market were unable to be spontaneously in cleaning state, credit rationing phenomenon is widespread [1], credit rationing evolved into “ownership system discrimination” on private enterprises in China. The

property right feature of state-owned enterprises determines the closed political connection with the government, thus getting the priority position on the aspect of the credit resources allocation. At the same time, administrative intervention of capital market has further squeezed the financing space of private enterprises, the points that whether the enterprises has political relations and then obtained implicit guarantee of the government or not have already become the key for private enterprises to obtain credit funds. Based on the above, the thesis used the research logic of Richardson [2] for reference, on the basis of estimating the excess credit level for listed companies in China, and the sample of 2007-2010 A-share companies in China, empirically tested the relationships between the excess credit of enterprises and political connection of senior executives, and comprehensively studied influences of political connection developed by listed companies on its debt financing under the background of current system in China.

### II. INSTITUTIONAL BACKGROUND AND RESEARCH HYPOTHESIS

China is in the economic transformation period, the market mechanism is imperfect, policy and non-institutional factors still play a leading role, and it determines that Chinese enterprises financing is largely restricted by the government forces. The nature of property rights of state-owned enterprises,

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executive nature of state-owned enterprises executives' appointment determines closed political connection between their own and the government, resulting in the priority position of financial source allocation. Therefore, in order to obtain the benefit of the governmental intervention, actively seeking political connection has become the rational choice of most of the enterprises.

Some scholars think that political connection has the "financing effects" that supports enterprises to obtain financial credit. This is because in the considerations of self-interest, political connection people prefer to work in the enterprises of better performance and strong profit ability [8]. Base on that better performance enterprises are easy to establish prior judgments of political connection, political connection could be regarded as a kind of reputation mechanism for reflecting business performance in future [7], or signal passing mechanism [12], bank may think that the enterprises that have political connection may get well operation performance in the future, thus amend the credit decisions. The enterprises of political connection could obtain more bank loan and longer length of maturity than those who have no political connection enterprises, and even in the region of the more backward financial development, the lower law rule level and more serious infringing on property rights by government, this kind of loan effect is more obvious [9]. However, there are also some scholars who propose their worried about the over loan might generate from "financing effects" of political connection intervened by government. Government extrinsically stimulates banks through direct administrative intervention, implicit guarantee and other manners, banks probably may neglect loan risk and self-interest to issue much more loan value than that in the normal condition. As a kind of alternative informal mechanism, political connection could alleviate hindering effect of backward institution to the development of private enterprises, and helps private enterprises obtain credit support of bank [10], but the "loan effect" of political connection also may lead to over loan of enterprises.

Base on the above analysis, the thesis proposed the following hypothesis.

**Hypothesis One:** Political connection helps enterprises obtain over loan, and even compared with the private enterprises, political connection has more obvious influence on the formation of over loan of state-owned enterprises.

**Hypothesis Two:** Under the bank background of controlling senior executives, private enterprises with political connection also have the phenomenon of over loan.

### III. RESEARCH DESIGN

This thesis firstly used the research logic of Richardson [2] for reference, estimated normal loan level of enterprises, and then the difference (regression residuals) between actual loan level of enterprises and estimated normal loan level of enterprises is the degree of over loan and degree of insufficient loan. At last, over loan estimated was regarded as explained variable, and used political background of senior executives and other relevant control variables for regression analysis to study the influences of political connection on the over loan behavior of enterprises.

#### A. Variable Measurement and Model Building

##### 1) Measurement of over loan degree

Richardson [2] estimated normal capital investment level of enterprises by a model, and then took the regression residuals as the proxy variable of over-investment and under-investment, studied the influences of free cash flow on over-investment. We put this logic into the research of this thesis. So loan scale model of expected enterprises adopted in this thesis is as following:

$$\begin{aligned} Loans_t = & \beta_0 + \beta_1 Cash_{t-1} + \beta_2 Lev_{t-1} + \beta_3 Size_{t-1} \\ & + \beta_4 roe_{t-1} + \beta_5 Growth_{t-1} + \beta_6 Liquid_{t-1} + \beta_7 ZJ_{t-1} \\ & + \beta_8 Top1_{t-1} + \beta_9 Herfindahl_{t-1} + \beta_{10} Divident_{t-1} \\ & + \sum Area + \sum Industry + \sum Year + \varepsilon \end{aligned}$$

In addition, we also added industry variable "Industry" and annual variable "Year" in the model to fully consider the industry effect and year effect. According to the industry classification standard of China Securities Regulatory Commission, there were 22 industries in total, excluding financial industry, so there were 20 industries dummy variables in the model. Annual variable was used to control the influence of macro-economy; the thesis involved the data of four-year listed companies, so there were 3 annual dummy variables in total.

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Model 1 Meaning of each variable is as following:

Table 1. Variable declaration.

Variable name		Variable declaration
dependent variable	Loans	It indicates long-term loan scale of enterprises; it's the ratio of long-term loan of enterprises to total assets.
	Over_loans	It's excess part in the long-term loan of enterprises, and indicates with positive residual error after regression for Model 1.
explanatory variable	Politics	It indicates dummy variable whether enterprises have political connection or not. When enterprises have political connection, the value is 1; otherwise, the value is 0.
	State	Category of listed company controlling shareholder, if final controller is government or state-owned enterprises controlled by government, then value of State is 1, otherwise, it's 0.
control variable	Cash	Ratio of the sum of year-end cash and temporary investments to total assets.
	Size	Napierian logarithm of total assets.
	Lev	Assets liabilities ratio, it's the ratio of gross liability to total assets.
	Liquid	Liquidation value ratio, it's the ratio for net value of fixed assets to total assets.
	Roe	Return on equity, it indicates profitability of enterprises.
	Growth	Growth rate of sales revenue
	ZJ	Napierian logarithm of construction in process
	Top1	Share proportion of the largest shareholder
	Herfindahl	It reflects the degree of enterprises check-and-balance ownership structure, quadratic sum of shareholding proportion of the top three largest shareholders.
	Dividend	It's the dummy variable whether issuing cash dividends or not, if yes, the value is 1, if no, it's 0.
	Bank	It reflects bank-enterprise relationship of enterprises, if company director or general manager has the bank background, the value is 1, otherwise, it's 0.
	Occupy	It's ratio of other payables to total assets.
	Market	It's the marketization index of credit funds allocation.

2) *Political connections and the over loan of enterprises*

After confirming over loan variables, the thesis adopted Model 2 to test Hypothesis 1 and Hypothesis 2 as following:

$$\begin{aligned}
 \text{Over\_loans} = & \beta_0 + \beta_1 \text{Politics} \\
 & + \beta_2 \text{State} + \beta_3 \text{Bank} + \beta_4 \text{Occupy} \\
 & + \beta_5 \text{Market} + \sum \text{Industry} + \sum \text{Year} + \varepsilon
 \end{aligned}$$

In the Model 2, dependent variable “Over\_loans” was the positive residual error in the Model 1. “Politics” was the dummy variable whether enterprises have political connection or not, according to Fan, etc. [5], Minggui Yu and Hongbo Pan [9] and other definitions related to political connections, the thesis took the chairman or general managers who were former and current government officials, representatives of NPC or members of CPPCC as the substitution variables of political connection, when they had political connection, Politics=1, otherwise Politics=0. “State” was dummy variables of

controlling shareholder category, if final controller was government or state-owned enterprises controlled by government, then value of State were 1, otherwise, value of State were 0. “Market” was marketization index, refer to LLSV [4], Minggui Yu and Hongbo Pan [9] and other researches. In addition, we also added bank background (Bank) of senior executives and capital occupying (occupy) by major shareholders in the Model 2 to control the effect of bank background (Bank) of senior executives and capital occupying (occupy) by major shareholders on the over loan of enterprises. In the same way, we also added the industry variable and annual variable in the model.

*B. Sample Selection and Data Sources*

The thesis used the total of four years from 2008 to 2011 of all A-share listed companies in China’s Shanghai and Shenzhen stock markets for the original sample, excluding the following companies: a. Listed companies of financial industry. b. Value of accounting interval was less than 2. It was because most of variables in the Model 1 need to use the data

with one year of time lag. c. Gross debt ratio was more than 100%. d. Characteristic of ultimate controlling shareholder was unknown. Moreover, in order to eliminate the influence of extreme value, the thesis also eliminated the sample of extreme value between 0-1% and 99%-100%, after selection, the thesis finally got 3721 annual observed values.

The data used in this thesis included enterprise characteristic data and external institutional environment data. Among them, the enterprise characteristic data was from CCER database and CSMAR database developed by Shenzhen Guotaian Information Technology Co., Ltd., institutional environment data of each region was from the marketization index of each region (including 31 provinces, autonomous regions and municipalities directly under the central government) in China

compiled by Gang Fan and others (2011) in NERI INDEX of Marketization of China's Provinces 2011 Report.

IV. EMPIRICAL RESULTS AND ANALYSIS

A. *Estimation of Anticipated Loan Model*

Table 2 has reported the regression result of Model 1; explained variable of model was the ratio of enterprises long-term loan to total assets, the purpose was to get estimated value both of over loan and insufficient loan for enterprises according to regression residuals estimated by Model 1. From the regression residuals, some enterprises still got over loan under the situation of widespread "sparing loan" phenomenon in China's banking industry.

Table 2. Regression result of anticipated over loan model.

Variable	Anticipation Symbol	Coefficient	t-value
Intercept		-0.578***	(-14.606)
Cash I, t-1	-	-0.133***	(-7.570)
Lev I, t-1	+	0.193***	(16.790)
Size I, t-1	+	0.024***	(12.027)
Liquid I, t-1	+	0.115***	(11.450)
Roe I, t-1	+	0.102***	(9.217)
Growth i, t-1	+	0.004*	(1.793)
ZJ i, t-1	+	0.001**	(1.904)
Top1 i, t-1	-	-4.49E-04	(-1.125)
Herfindahl i, t-1	-	-0.054	(-1.062)
Divident i, t-1	+	0.006*	(1.706)
Area		control	
Industry		control	
Year		control	
N		3371	
Adj.R2		0.332	
F value		99.339***	

Notes: Do regression for the loan scale (Loans) that dependent variable is t years, data in the table is the regression coefficient of respective variable, the value in the bracket is T of test value, model is amended by White heteroscedasticity robustness, \*, \*\*, \*\*\* respectively indicates the obviousness in the level of 10%, 5% and 1%.

B. *Empirical Results and Analysis*

Table 5 has listed the regression result of complete sample of ownership system, political background of senior executives and over loans of enterprises. Among them, Model1 hasn't considered the result of political background of senior executives and quantity of regional listed companies. Model2 has introduced political background (Politics) of senior executives; the purpose was to study the influence of political background of senior executives on enterprises over loans under the government intervention. It was easily found in the Model1 of Table 5 the positive correlation between over loan and nature (State)of enterprises ownership system (significance level is

1%), it indicated that state-owned enterprises controlled by government has got more over loans compared with private enterprises. Model 2 in the Table 5 is the regression result for effect of political background of senior executives on over loan. Political connection (Politics) in Model 2 was obviously positive (significance level is 5%), it indicated that the enterprises with political connection could easily obtain over loan than the enterprises without political connection. It was consistent with the hypothesis that political connection helped enterprises obtain excess credit in the above.

The above empirical evidence indicates that, for the state-owned enterprises, state-owned enterprises

with political connection have obtained over loan from banks, and the closer political connection (the smaller Num), the more serious phenomenon of over loan. For the private enterprises, although they could

Table 3. Regression result of ownership system, political connection and over loans.

Variable	Model1	Model 2
Intercept	0.099*** (5.260)	0.096*** (5.034)
Politics		0.010** (2.221)
State	0.013*** (2.476)	0.011** (2.273)
Occupy	0.151** (2.321)	0.157*** (2.868)
Bank	0.005 (0.838)	0.003 (0.466)
Market	-0.003** (-2.099)	-0.004** (-2.085)
Year	Control	Control
Industry	Control	Control
N	1389	1389
Adj.R2	0.044	0.053
F Value	9.071***	8.633***

Notes: Do regression for dependent variable to be scale of over loan (Over\_loans), data in the table is the regression coefficient of respective variable, the value in the bracket is T of test value, \*, \*\*, \*\*\* respectively indicates the obviousness in the level of 10%, 5% and 1%.

also find some way to establish the political connection, but in the process of forming over loans of private enterprises, bank relationship is the leading role, rather than political connection.

### V. RESEARCH CONCLUSION

The empirical result in the thesis found that some enterprises still got over loans under the situation of widespread “sparing loan” phenomenon in China's banking industry; the further research found that the enterprises having obtained over loan were mostly state-owned enterprises, and political background of senior executives of state-owned enterprises strengthened the formation of over loan of state-owned enterprises, although some private enterprises also obtained over loans, the bank-enterprises relationship was the leading role, rather than the political connection. The research conclusion of this thesis means that under the background that Chinese enterprises are widespread facing credit constraints, the development of political connection could help alleviate the credit discrimination faced by private enterprises; but the political background of the state-owned enterprise executives strengthened formation of over loan of the state-owned enterprise, thus exacerbating low efficiency of credit resource allocation. Therefore, promoting function transformation of local government, and accelerating

the pace of monetary system reform are still the key point of Chinese marketization reform and development.

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## The Production Technology of 1:2000 Strip Topographic Map for Road Design

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**Abstract:** This paper introduces a simple and fast method for the production of 1:2000 Belt Topographic Map for road design. This method uses the information of the existing road control point, and the operation of the Google Earth is based on the collection of scattered points, the exhibition points, projection transformation and so on. Using the South CASS software, CMAP software and other mapping software to product line with the accuracy requirements of the 1:2000 Belt Topographic Map. It provides convenience for road design in the feasibility study stage.

**Keywords:** Google earth, road design, strip topographic map

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### I. INTRODUCTION

Among various kinds of engineering construction, especially for the design of railway, highway, pipeline and laid, 1:500 or 1:2000 topographic map is often regarded as external reference and design basis. However, this large scale topographic map is obtained by the whole field digital mapping or digital photogrammetric, which is time-consuming and laborious. In recent years, there has been a Belt Topographic Map, because of its practicability, economy and ease of operation is widely used in road engineering construction. But it also has its disadvantages, its strip is often horizontal or vertical long, and the other is short lead to the difficulty of measuring range. Especially the full field digital mapping because distribution not full so that the map information is missing or the distribution deviates from the path leading to the map cannot be normal use. General road design as a feasibility analysis phase of the use of 1:2000 topographic map of the accuracy of two times the accuracy of mapping topographic map, the exploration and research of other methods to produce the 1:2000 Road, which is in line with the requirements of accuracy, is very necessary.

Earth Google image and its geographic coordinates can be used to compensate for these problems. By collecting scattered points on Earth Google, expand point coordinates in drawing software, extraction of elevation and ground objects and other operations. It can not only reduce the scope

of the belt topographic map to determine the difficulty of the terrain mapping, but also can achieve the accuracy of 1:2000 terrain map for road design, so as to provide a feasibility analysis stage for the project construction.

### II. PRODUCTION OF 1:2000 STRIP TOPOGRAPHIC MAP

The choice of test area is located in Shannan Prefecture of Tibet Naqu Cuo La Xiang, the study area has an average altitude of 4000 meters, high altitude and parts of the mountain steep, the basic road along the river valley and advance. Only in measures there are some residents near the Cuo La Xiang, other place almost sparsely populated. Production of this road map requires the use of field measurement and processing of data processing. Using Google Earth and the South CASS complete the topographic map to reduce the external pressure.

#### A. The Basic Technical Requirements

The scale of the topographic map is made according to the purpose of the topographic map and the method of mapping. The highway strip topographic map is a highway design with high precision, and the features are generally not integrated. It should reflect the characteristics of the area. Banded topographic map generally adopts high precision large scale mapping. The larger the scale, the higher the accuracy, but the longer the time, the more number of the map. The 1:2000 terrain map is

not only meets the accuracy requirements but also can save money.

Most of the road map is based on the 1980 Xi'an coordinate system, and the elevation datum is based on the 1985 National Height Datum [1]. Basic contour interval of 1:2000 topographic map, such as shown in table 1.

Terrain Category	Flat ground	Hilly land	Mountain land	Alpine
Basic equal height	1.0 (0.5)	1.0	2.0	2.0 (2.5)

Table 1. Basic equal height distance (m).

Encryption in the industry, elevation note points and contours of near field outside the error in the elevation of control points is not more than as stated in table 2. The two times of the errors in Table 2 is the maximum allowable error for the road design.

Table 2. The error in elevation (m).

	Terrain Category	Flat ground	Hilly land	Mountain land	Alpine
Medium error	Pass point		0.35	0.8	1.2
	Mark point	0.4 (0.2)	0.5	1.2	1.5
	Contour	0.5 (0.25)	0.7	1.5 Terrain transformation	2.0 Terrain transformation

**B. Technical Operation Process**

For Based on the Google Earth topographic map production process is shown in Figure 1.

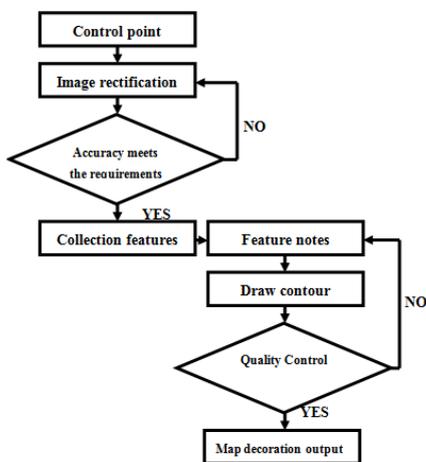


Figure 1. Production flow chart based on Earth Google.

The KML file information in Google Earth positioning road in the southern area of Tibet position, and select has obvious feature information and text information and a clear image[2]. Through the use of

the same name in the South CASS software, the use of the affine transformation is used to correct the interception of the image, and the feature points should be uniform, so as to reduce the errors and improve the accuracy. The location of the road in the Cuo La Xiang is shown in Figure 2.

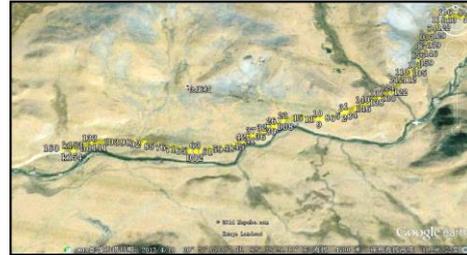


Figure 2. The road is located in the area of image.

Vectorization, the South CASS software comes with graphic symbols according to the scale and non scale walls and houses etc. based on the corrected image of vectorization. Because the road is along the river valley construction, so there will be rivers of the image as a base map and the extraction of river information and vector.

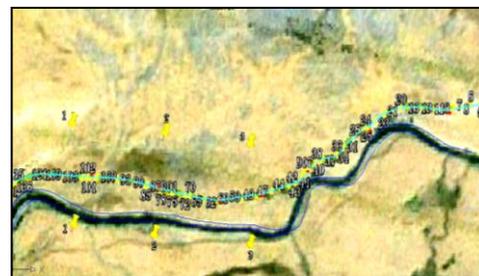


Figure 3. Road and river trend.

Note, based on the Earth Google to obtain the relevant landmark name[3], collection and collation, and then the corresponding location in the topographic map.

General digital mapping is the control points, point of break points, directly build DTM, or projection transformation to build DTM generated contour. Due to the higher elevations in this area, sparsely populated and steep terrain, not suitable for measurement of whole field broken department, involving both along the road distance is wide, all field operations. As a reference to the road line selection of the strip topographic map, because of the width of the road map is generally based on the road to the middle of the road, to the road on both sides of the 300 - meter range. Therefore, we can use the Earth Google to gather the scattered points, through the construction of DTM, and then generate the contour. Specific operating procedures are as follows:

Along the roads around inside certain limits collect the points in the Google Earth. Because

1:2000 road design with the width of the zonal topographic map is 600 meters, from the edge of the road, approximately every 30 meters acquisition a scatter. That is along the road toward each mining point line need to approximately 20 points (equivalent to a point on the 15 mm), and the interval of each mining point line is 30 meters, in the scope of the road, each 30 m x 30 m range guarantee has a scattered point. Can be used in scale measure distance in Google Earth, to ensure that the collecting scatter covers the required range. To be conducted on the basis of the feature point and feature line point, again according to 30 meters, a uniform point to gather, and record the coordinates and elevation information, the feature points on the road with a scatter symbols to distinguish, and pay attention to according to remote sensing image acquisition ridge valley points, use EXCEL for record. The coordinates of the points are in degrees, minutes, seconds, display, and need to be degrees, minutes, seconds; the conversion is the second unit. Scatter points are shown in Table 3.

Table 3. Point coordinates.

point	latitude			Longitude			Height (m)
	°	'	"	°	'	"	
1	31	4	53.38	92	51	27.24	4868
2	31	4	53.32	92	51	27.34	4867
3	31	4	53.25	92	51	27.46	4866
4	31	4	53.14	92	51	27.63	4868
5	31	4	53.03	92	51	27.80	4865
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

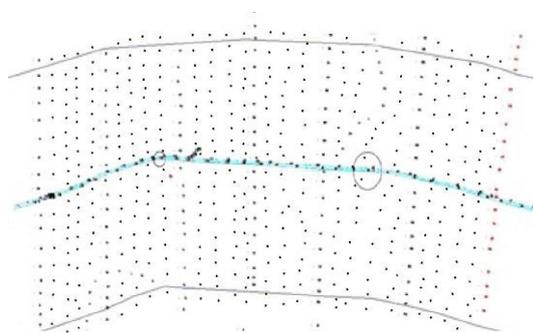


Figure 4. Point and point matching.

The acquisition of the scattered point coordinates of the projection conversion, from the WGS-84 coordinates to 1980 Xi'an coordinates. In the South CASS software to start the point, using CMAP software (A map editing software based on AutoCAD platform for the two time) as a field with the

corresponding feature points on the road of the hubs as a benchmark, the road whole scatter vector. Points of collection and registration of foreign trade points are shown in Figure 4.

Height matching, the analysis found that the height of the scattered points is higher than the control points. Therefore, to the point of elevation correction, will be scattered point elevation data output, bulk modification, and then the control points, feature points, scattered points to the unified layer, output .dat file.

By the elevation information builds DTM, and automatically generated by the DTM contour. Editing and processing contour data in CMAP software. The 1:2000 topographic map is generally required to note the 10-15 elevation points per kilometer, which can be selected according to the collection points of the points. In the South CASS software to select the appropriate spacing, the implementation of the height of the filter command, you can choose to point out the height. Contour results are shown in Figure 5.

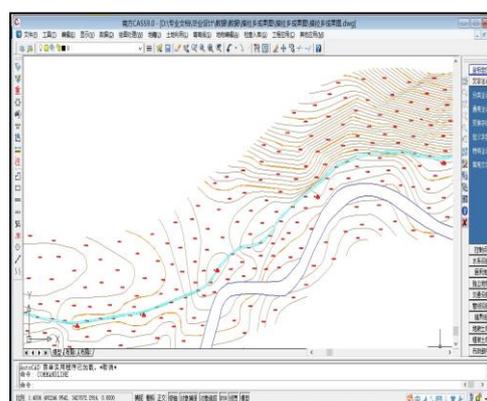


Figure 5. Contour data graph.

### III. ACCURACY ANALYSIS OF TOPOGRAPHIC MAP

#### A. Contour and Elevation Accuracy

Based on the statistical analysis of the data of the scattered point data and the road control point data, the difference between the two kinds of data is calculated. Due to road control point data accuracy is higher, so the correct elevation value of the data mining the hubs, unified increased by 2 m to achieve and road control point matching. But changes of scatter elevation value influence the contour of the actual distance of migration, thus reducing topographic map precision, lower than the total field digital mining point accuracy.

DTM is elevation point to construct the interpolation of irregular triangle net, polynomial function approximation accuracy is not high, rather than the uniform B spline function with higher precision. This method is used to calculate the second

interpolation method, the contour generated by the contour in addition to the deviation of the partial height point lead to the accuracy of the loss, the DTM automatic generation of contour error is small, and the basic can be ignored.

The error of mean square of the height of the 1:2000 topographic map of the road is not more than 0.4m, the hills are no more than 0.5m, the mountain is no more than 1.2 m, and the mountain is not more than 1.5 m. The error of mean square of two times the maximum allowable error. By calculation, the error of mean square is 0.9 m in the system of Earth Google, which meets the requirements of road design precision.

#### B. Vector Accuracy

Vector accuracy is influenced by two aspects, the first is the size of the linear error, and the second is the pixel size of the Earth Google. The aerial photograph's pixel size of city or tourist attractions and other crowded areas are small, high resolution, generally less than 0.6 m; Aerial photographs have little or no area, the pixel is relatively larger, generally less than 20 m[5]. In order to improve the accuracy of vector, we should try to reduce the scope of the field of vision and then cut the image, and then analyze the features of the object in strict accordance with the principle of remote sensing image analysis.

There are some human errors in the process of vector, such as the height of the abnormal value, the polygon is not closed, and the contour is not reasonable, hanging nodes and elements of the omission and other information. But these are avoided in the later period, and the accuracy of the topographic map of the road is the key to the terrain factor, so the vector error can be neglected, so the accuracy is not affected.

#### C. The Data Accuracy

The collection point is carried out in the Google Earth, it replaces the field measurement of the broken part, reducing the pressure in the field. But the precision is reduced, mainly reflected in:

- The scattered points collected on Earth Google are the coordinates of latitude and longitude, that is, the geographic coordinates. Its ellipsoid reference is WGS-84. The coordinates used in the control point information of the road are the plane coordinates and the ellipsoidal datum is the 1980 Xi'an coordinate system. So the coordinate conversion can have some accuracy loss.

- Spread out the points after the translation, and translation is carried out in accordance with the field matching feature points. Field feature point data accuracy unchanged, but other than industry feature points as a benchmark translational accuracy data based on feature points linearly decreasing.

#### D. The Map Deformation

The large scale topographic map is directly used in the planning and design of engineering construction projects and the relative accuracy is required. When the altitude of the survey area is relatively low, and it is located in the national 3 degrees or 6 degrees with the central meridian, it can choose the national unified Gauss plane coordinate system. Otherwise, it is often needed to use any central meridian and the projection plane to establish an independent engineering control coordinate system to reduce the projection distortion of the observed values.

#### E. The Design of System Architecture

The object is acquired by using the remote sensing image on the Google Earth, and the correct use of the affine transformation, and its correction accuracy and the uniform selection of the correction points are important. The concrete process is to use the same name point information in remote sensing image which contains the information of ground objects to use the affine transformation to correct. A total of 13 remote sensing images are used, and the error of each correction includes the largest residuals, the residuals and the error of mean square. For the average error of mean square that got the error of the whole. The maximum residual error is for 13 remote sensing images. The residual value is the residual value of all the graphs.

After correcting the road to do a set of inspection, road edge should be completely and remote sensing image of the road image, otherwise you will need to be corrected.

## IV. CONCLUSIONS

Take the design of road in the southern area of Tibet for instance. It is feasible technology to product 1:2000 Strip Topographic Map for road design in Google Earth software. This method is convenient and fast, and it can be used in the design of the road, and it can be used for the feasibility analysis of road design.

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# Interest Rate Liberation Reform and Small and Medium-sized Commercial Banks Development

## —Statistical Analysis Based on Listed Small and Medium-sized Commercial Banks

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**Abstract:** Interest rate liberation reform in China has been the crucial stage, and this reform has a great impact on small and medium-sized commercial banks. Because small and medium-sized commercial banks are facing the homogeneity, spreads narrowed, and lower profits and so on, it is very crucial to transform the profitability pattern. The significance of solving this problem is that it is related to the survival and development of many small and medium-sized banks. This paper takes the listed small and medium-sized banks as sample, and it analyses the business income structure, net interest spread, and net interest margins during the three years of 2012-2014. On the basis of drawing lessons from foreign experience, it points out that the development of small and medium-sized banks need to implement the strategy of differentiation, transformation profit model, and business transformation etc. The innovation of the paper is new data and new suggestion.

**Keywords:** Interest rate liberation, small and medium-sized commercial banks, profit model, intermediary business

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### I. INTRODUCTION

With the advancement of China's financial reform, interest rate liberation has the crucial stage. Interest rate liberation influences on small and medium-sized commercial banks greatly. From the international experience, it is the most critical and the risk is also one of the largest segments. The loan interest rate has been fully liberalized. And the floating ceiling of deposit interest rate is canceled. Almost all banks adjust the interest tables and the differential interest rate appears gradually, so competition between banks has intensified. The Deposit Insurance System has been launched, the system guarantees for further advance of interest rate liberation. In the long run, the interest rate liberation reform is helpful to optimize the allocation of resources, reduce financing costs of enterprises, promote the economic sustainable development and promote the reform of commercial banks etc. In the short term, small and medium-sized commercial banks suffer from some pain in the reform. As a result of competition, the pressure of loan interest rates downward and deposit interest rates upward may appear, which can lead to spreads narrowed and profit declining. This is a huge test for small and medium-

sized banks. In addition, the two-year macroeconomic growth becomes slow and the entity economy is common, which makes risk of the banks become larger. Under the background of profound changes in the external business environment, by analyzing the data of listed small and medium-sized banks to explore how to adjust management strategy, profit model and business structure etc., in order to realize ascension of the comprehensive competition ability and sustainable growth of bank value. This is a pressing problem.

Shusong Ba (2012) argues that, compared with the big banks, small and medium-sized banks trap in a node number, low brand awareness, narrow income channel, weak bargaining power, and lack of talent etc, so in response to the interest rate impact they will be far greater than the big banks. Specific effects include high spreads profit model unsustainable, operating risk sharply, increased capital added pressure, increasing the difficulty of pricing, the difficulty of risk management and the internal management problems [1]. Ping Lian (2013) argues that, under the background of interest rate liberation, the transformation of small and medium-sized commercial banks mainly involves three aspects: the transformation of development mode, the

transformation of business model and the transformation of management. On the change of the pattern of development, commercial banks will pay attention to the quality and efficiency of the connotation of the intensive development. On the management transformation, although the contents, means and emphasis of commercial banks will be different, fine, high efficiency and intensive management mode should be consistent aim of all banks. But in the transformation of business operation mode, direction and path of the development of the banks is not the only. Banks can make a choice according to its own characteristics [2].

Based on the listed small and medium-sized banks as sample, through the 2012-2014 annual report data analysis and theoretical analysis, the paper provides some development recommendations for small and medium-sized commercial banks.

## II. DATA ANALYSIS

### A. Revenue Structure

From horizontal direction of Tables 1 to 3, interest net income proportion of each bank declines in 2012-2014, but it still accounts for absolute advantage. Proportion of intermediary business income increases year by year, from 10% to 30%, the highest is the Minsheng bank (CMB), up to 31.99%. This shows that since 2012 the intermediary business in the banks has developed rapidly, the effect of the business structure adjustment is obvious. In 2014 the proportion of average of intermediary business income from 8 listed small and medium-sized banks was 23.64%. There is broad space for development. From the vertical development, every bank is different. CMB develops best.

Table 1. Joint-stock banks income structure in 2014 %.

Bank name	Net interest income	net charges and commissions	other net income
CITIC	75.97	20.30	3.73
CEB	74.19	24.39	1.42
HXB	84.52	13.65	1.83
PB	72.26	23.67	4.07
CMB	79.71	26.95	5.52
PDB	79.71	17.33	2.96
CIB	76.51	21.65	1.84
CMBC	68.01	28.23	3.76

Table 2. Joint-stock banks income structure in 2013 %.

Bank name	Net interest income	net charges and commissions	other net income
Bank	81.9	16.1	2.0
CITIC	77.88	22.90	(0.78)
CEB	86.0	14.0	0.0
HXB	78.0	20.0	2.0
PB	74.59	22.01	3.40
CMB	85.16	13.90	0.94
PDB	78.6	21.7	(0.3)
CIB	71.7	25.8	2.5

Table 3 Joint-stock banks income structure in 2012 %.

Bank name	Net interest income	net charges and commissions	other net income
CITIC	84.4	12.5	3.1
CEB	83.9	15.8	0.3
HXB	88.8	10.2	1.0
PB	83.1	14.4	2.5
CMB	77.95	17.41	4.64
PDB	88.44	10.54	1.02
CIB	82.4	17.1	0.5
CMBC	74.8	19.9	5.3

Table 4. Charges and commissions-- contrast analysis between Minsheng bank and Huaxia bank in 2014 %.

Item	CMB	HXB
1 card service fee	28.95	21.85
2 agent fee	22.85	18.82
3 Entrusted business commission	19.21	11.20
4 Credit commitment fees and commissions	10.40	15.67
5 financial advisory service	8.53	26.88
6 settlement fee	5.55	0.47
7 financing lease fee	0	3.22
8 other	0.30	1.89
9 total	100.0	100.0

Table 4 shows that, Minsheng Bank's card service fee, agent fee, entrusted business commission are larger. And the percentage of bank card service fees, agency fees, entrusted business commission, credit commitment fees and commissions is higher. From the table, we have seen that the front five items are major intermediary business income parts of small and medium commercial banks. Other small and medium-sized banks can expand in the above five aspects according to oneself circumstance.

*B. Net Interest Spread (NIS)*

Table 5. Net interest spread in 2012-2014 %.

	2014	2013	2012
CITIC	2.19	2.40	2.61
CEB	2.06	1.96	2.34
HXB	2.52	2.50	2.52
PB	2.40	2.14	2.19
CMB	2.33	2.65	2.19
PDB	2.27	2.26	2.87
CIB	2.23	2.23	2.39
CMBC	2.41	2.30	2.94
Average	2.30	2.31	2.51

*C. Net Interest Margin (NIM)*

Table 6. Net interest margins in 2012-2014 %.

Bank	2014	2013	2012
CITIC	2.40	2.60	2.81
CEB	--	--	--
HXB	2.69	2.67	2.71
PB	2.51	2.31	2.37
CMB	2.33	2.65	2.87
PDB	2.27	2.26	2.39
CIB	2.23	2.23	--
CMBC	2.41	2.30	2.75
Average	2.41	2.43	2.65

From the statistic data, in 2013, net interest margins in seven of the eight banks decline, including four in 2014 net interest margins appears to rise. But from the overall average, from 2012 to 2014, net

interest margin is falling, the initial declines slightly, then gradually stable.

III. INTERNATIONAL EXPERIENCE

From the international experience, interest spread firstly contract, then smooths, and then widens, eventually it gradually stabilizes according to the macroeconomic operation, policy regulation and the change of the economic cycle, fluctuations and volatility in financial markets [3]. After interest rate liberation in Japan, the average spread is from 2.29% to 1.72%; South Korea's average rate is from 3.79% to 1.67%. From international experience and lessons, we can gain the following enlightenment.

*A. The Price Competition Could not Continue*

When the price lies in certain level, it will be steady and competition will turn to other aspects. Internationally, the competition between banks has transformed from market share to integrated services.

*B. Encourage and Guide the Financial Innovation of Banks*

From an economics point of view, innovation means differentiation, certain monopoly and the new profit growth point. Innovation can bring excess profits.

*C. Develop Intermediary Business Quickly*

After interest rate liberation in USA, intermediary business income of the commercial banks accounting for the proportion of total income also changed a lot. Medium-sized Banks increase from 35% to 50%, small Banks are stable at around 30%. At present the intermediate business income of the small and medium-sized banks in China accounts for less than 30% on average, so it has the very big development space.

IV. CONCLUSION

An economist points out that the interest rate liberation is a win-win choice. As long as small and medium-sized banks try their efforts to adjust themselves, they still have very big development space.

*A. Differential Business Strategy*

At present our country's banking is in the market structure of monopolistic competition; the key is differentiation and dislocation competition. Banking services include three levels: core service, convenience service and supportive service [4]. Core services can provide core interests, such as deposits, loans service. Convenient services enable customers to better consumption, such as credit card business, online banking, agent business, etc. Supportive services provide clients with a higher value of the

services, such as investment consulting, financial management, etc. The core service is mainly on the different deposit and lending rates. Differentiation of the other two aspects reflects professional and convenient services. Small and medium-sized banks should adhere to customers as the center, provide customers with first-class financial services experience and pay attention to the non-price competition.

### B. *Diversified Profit Pattern*

With the steady progress of comprehensive operation, banks can gradually involve in many fields, such as funds, insurance, leasing, trust etc, which provides a large space for the development of banks [5]. Small and medium-sized banks should carry out diversified and differential profit pattern. That is to say, they should develop intermediate business; strengthen the wealth management and so on.

### C. *Business Transformation*

On the one hand is to strengthen intermediate business; on the other hand is to do small micro enterprise loans. In accordance with the principle of differentiation, adaptability and coordination, transformation direction of the small and medium-sized banks is differentiation, characterization and retail [6]. Medium-sized banks focus on services for small and medium-sized enterprises and constantly create characteristics. Small banks focus on small and micro enterprises and pursuit local development based on community.

### D. *Enhancing the Level of Integrated Services*

Small and medium-sized banks should improve

service levels and close the distance with the customers through fine management, diversified assessment and professional training, which makes customers feel at home. As the increase of the number of banks, customers would compare the bank services, and then make a wise choice. After the unpleasant experience of financial services, no matter whether the customer complaints, the end result is vote with their feet, namely the cancellation of the bank account in a bank. Therefore, it is crucial to improve comprehensive service level. In addition, banks in the process of dealing with customers don't get rich quickly and recommend many such as wealth management products to customers. Banks should make customers feel sense of respect and then customers can trust banks.

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## Research on Countermeasures and Suggestions of Human Resource Management in State-owned Enterprises

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**Abstract:** Human resource management plays a great role in promoting and supporting the development of China's state-owned, As for human resource (HR) management in the state-owned enterprises, there are many issues such as backward in the management, inadequate attention of the leader, imperfect of incentive system, non-standards of assessment criteria, imperfect of evaluation system, unreasonable employment system and lack of development investment and so on. On the basis of analyzing these issues, this paper is aimed at putting forward some countermeasures and suggestions to strengthen HR management.

**Keywords:** State-owned enterprise, Human Resource (HR) management, problems and countermeasures

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### I. THE CURRENT SITUATION AND MAIN PROBLEMS OF HR MANAGEMENT IN STATE-OWNED ENTERPRISES

State-owned enterprises are the pillar of the national economy, is at the forefront of economic reforming, the establishment of a modern enterprise system process, the state-owned enterprise's operation and management system had changed, ability of adapting to the market economy has ascended, however, because our country suffer from chronic planned economy idea and the system constraints, resulting there are still quite a few problems in human resources management in actual work that human resources management is not optimistic, especially since entering new century, with the deepening of reforming and opening up, the rapid development of market economy, a large amount of foreign capital enterprise to enter into China, the reform of state-owned enterprises is in the ascendant, modern enterprise management gradually as "human resources management" replaced. With skilled in enterprise's importance enhancement, the state-owned enterprise attaches great attention to human resources development and the supervisory work. Currently, due to the long-term effects of system constraints, state-owned enterprise human resources management are not timely follow-up, causing our country is restructuring or just completed restructuring of state-owned enterprise have a gap between the modern enterprise should be supporting the level of human resources management, the human resource management of state-owned enterprises is still in the

traditional work most lower level of the personnel administration phases, and don't play their due role, resulting in our country for a long time in human resource development and management optimistic, the present situation limit the development of the enterprise. Its main problems as follows:

1. The concept on HR management is lag behind and the leader doesn't pay enough attention to this issues. Human resource management concept of lag makes modern human resources management idea hasn't completely thorough popular feelings; management framework has not been formed. In the enterprises to make its development strategy, the human resources development planning was ignored, also do not consider the enterprise's human resources situation and the enterprise HR system, whether or not can effectively support business development strategy, thus seriously hampering the realization of enterprise development strategy. At present, although human resource management concept has been accepted by people, most companies have also set up human resources department, but many state-owned enterprise managers for human resources management in enterprises can't understand what a role does they play, causing many state-owned enterprises still stay in ditches that leadership thinking mode of management, such as in the employing, only pay attention to the enterprise internal coterie, take employee as management control tool, not the man as resources or do not attach the importance to this resource exploitation, just by seniority, heavy relationship light performance and pay attention to the

reality of the education, cultural degree and work ability and ignore human further study, the improve needs of the people as cost, rather than for the development of resources, focus on how to save cost, ignored training employee development work, etc. Thus inhibited the employees' working enthusiasm and creativity [1].

2. The Imperfect incentive system leads to the brain drain seriously. In management, due to ignored human's interests and subjective needs, in income distribution and performance evaluation about the lack of income distribution system, tie the income distribution of big-pot roce phenomena and equalitarianism tendencies are still very common. Due to lacking of talent values, ranking tendencies is also very serious, this lack of fair value assignment distribution, making most talents can't materialize labor value. In addition, compared to private enterprises and foreign enterprise, the state-owned enterprise employees in salaries and bonuses material incentive to still have a large gap, especially in the senior management personnel and outstanding enterprise backbone, treatment, treatment is lower, when talent feel difficult to reflect their own value, they will resign, firewood to leave or job-hopping to seek other may meet opportunities. According to the survey, the state-owned enterprise loss in the personnel that most human capital and high content of senior management staff and technical backbone or technical personnel. However, at same time these enterprises upper management and technical backbone and the loss of technical workers, they lack complement, undoubtedly state-owned enterprise management has become a very serious problem. This makes the inputs for these personnel cultivation get no reward, and have to recruit again, the cost will be higher to train the relevant personals. At the same time the outflow of human resources and will cause the enterprise's business secrets leaked. This will directly weaken the enterprise's competitive ability. In addition, the state-owned enterprises in provides staff development, training, career planning design and other forms of spiritual incentive take too little attention. Many enterprises take employee training as increase their costs, has neglected the training is the enterprise realization management tool, the goal means to promote enterprise development and achieve operational management. Therefore, cause the lacking of state-owned company worker training, causing the human resources overall knowledge updating slowly, human resource potential not fully play [2-4].

3. Assessment standards is not standard and evaluation system is imperfect. At present, the state-owned enterprise in different industries formulated different evaluation standard, cause appraisal standards is not standard, not quantification, the actual

evaluation is hard to navigate. Most often decides talents' value by the state-owned enterprise managers' impression, due to the different experience, ability and treating talent views, the concrete operation of hard to avoid unity, because of the different person, firmness make an objective, fair and justice of selecting principle, which can't materialize the assessment, resulting accuracy is not high, lacking of objectivity, such assessment is very easy to frustrate the enthusiasm of some employees, and most unit performance evaluation system and post evaluation system is not perfected, unreasonable, make forms, make cut-scenes phenomenon serious, the staff degree of self-discipline is low , assessment and evaluation effect is not apparent, incentive system is difficult to reach the goal. The specific displays in: (1) the assessment methods single. Single assessment method is mainly in leading assessment. It can prompt bad style that staff only know their boss, only obtains the superior leadership's recognition, do only leadership can see articles, while ignoring the surface with colleagues and mass requirement, do not do solid work, (2) Assessment result no mean for using . At present, most of the state-owned enterprise to grade certificate and titles in the bonus, promotion endowment, promotion position without classification, which greatly weakened state-owned enterprise personnel appeal excellent talent. (3) Assessment system is not clear. This phenomenon is more take forms and not earnest. at the end of the year, have a meeting elected several advanced employees, no specific basis, to find balance, then appeared the phenomenon to take turns to be advanced, advanced model demonstrative effect is useless played out. 4 Appraisal standards too general. the quantitative available criteria to measure too little. 5 The feedback of assessment results k is bad. Most enterprises don't feedback the assessment result to employees, and gives correction shortcoming and future work direction [5].

4. Employment system is not reasonable and perfect. The state-owned enterprises in personnel selection is under the planned economy affecting, fully management jobs and the relative autonomy is still lack of .Some state-owned enterprise important persons directly selected by superior departments, these workers are not choose according to enterprise needs, and is part of the state-owned enterprise leaders with paternalism ranking is more serious, even the curtain, and more serious favoritism is as long as had been promoted to positions of leadership, in spite of his work is whether outstand, are difficult to exit from the positions of leadership, it is virtually blocked the ways of other talents promotion, the personnel selection of power of weld, often causes information flawed, vision is not wide, transparency bad, channel

is narrow, difficult to all-round, accurate and objectively evaluate and use every employee.

In addition, the state-owned enterprise personnel selection is greatly influenced by seniority, coddles traditional ideas and habits, to a great extent, position isn't set by things and person isn't selected by position, The position in state-owned enterprise is set by person, which lead to talent idling and resources wasted seriously, many people can't get fully space to exert their ability, profession for wrong, talent, underused talent phenomena are very common, especially the enterprise internal isn't form employee turnover system yet, many employees long in the same job, no challenge, a organize of lacking energy. Finally, the state-owned enterprise personnel selection basically is still in the old orbit, lack of legal standard and scientific operating procedures, employing standard concerned, should be having both ability and political integrity, and objectively speaking, should be the public opinion and performance equal. But in practice often vary wildly, cannot reach the expected effect.

5. The ability of employees have been decreased due to the lack of investment in HR management Some enterprises only stressing senior training, neglecting the general staff training, even if some enterprise employee training, due to lack of system plan and clear objectives, training shows cope, optional, temporary, didn't take detailed analysis for training need of the investigation and formulate overall long-term training plan, make knowledge aging phenomenon serious, cannot understand new technology promptly, new technology, new equipment and grasp the advanced science and technology, many potential employees is difficult to be exhumed, cause the whole enterprise human resources quality low, virtually caused their waste, thus make the enterprise core competitive decline [6].

## II. STRENGTHENING THE COUNTERMEASURES AND SUGGESTIONS OF HR MANAGEMENT

HR management problems have already been seriously hindering the development of state-owned enterprise, in order to solve these problems, we must correctly understand the important problems such as China's state-owned enterprise brain drain, the innovation system of talents training and the use of them that can rapid the development of state-owned enterprises, therefore, we must break the traditional concept outdated, citing modern management idea, to transform the enterprise flow sheet, establish people-oriented modern human resources management system, in order to adapt to the needs of the development of the enterprise.

1. Establishing a people-oriented management philosophy and taking the talents as scientific carrier, is the pioneer and the advanced productive forces

undertakes, human resources as the most initiative of the first resource, for the liberation and development of the productive forces has special significance, the human resources management should be enterprise leader's arms, is the leader's long-term management partner, as business leaders should emancipate our minds, change ideas, set up a set of scientific and effective system of employing, establish the dominant role in management, management activities must revolve to mobilize the enthusiasm of the employees, initiative and creativity to undertake and conduct, meanwhile, has to respect employees' benefits, variable control for respect, enough attention should be paid to the employee on the material and spiritual needs, to create a comfortable working environment for employees. In addition, training staff team cooperation spirit and absorbed work style, dedicated working attitude, achieved the enterprise and employee exchange heart, making the enterprise has a feeling of cohesion, and keep the enterprise's development i sustainable development of the power the future [7-9].

2. Designing a reasonable salary system and establishing a long-term incentive system. State-owned enterprises must reform original big-pot rice and equalitarianism salary system, and establish a performance and efficiency on the basis of distribution system, tilt to a key position and special talents, set reasonable salary gap, implement diversified reward structure, risk mortgages, talent share shareholding, motivation of diversified distribution form, achieves the talents' return and enterprise asset appreciation associated with enterprise development, the benefits to contact with appreciation, make talent realize that enterprise recognize their work performance, and real in treatment, objectively reflect the talent's value, ensure all kinds of talents get the equal remuneration to their labor and dedication, it is the focus of human resource management tasks to establish and improve the effective encouraging system and apply the right incentive technique. At present material incentive is used commonly, namely more embodied in the distribution of wages, for the state-owned enterprises, relatively reasonable and effective wage system should be post performance pay system, employee wages depends on individual posts, salary, qualifications and performance situation, this kind of salary system with high transparency, facilitate supervision. Increased chances of employees to participate in the enterprise management, which will increase the sense of belonging, promotes staff employees work quality, thus help them realize their job satisfaction. Therefore, in order to reduce the loss of outstanding talent, we must make it in salary designed: (1) introducing market price system, adjust the distribution relationship. (2) Establish to post salary gives priority to the salary system, clear

responsibilities and skill, is executed with hillock fixed income, hillock variable salary change principles. (3) Break the restrictions thought of ranking. Make staff put all their energy and talent spent on the most suitable work, thus innovation to their maximum working efficiency and performance. 4 at the same time in insisting priority to efficiency of the principle of distribution, employees' historical contributions should be considered.

3. Improving the performance evaluation and evaluation system. An enterprise may promote the staff's ability and potential development through establishing scientific performance evaluation system, stimulating each staff's work enthusiasm and innovation spirit, , in order to form a high efficient work team, the first to formulate the reasonable salary incentive policy, through adjusting income distribution relationship and implement internal's salary system measures to attract talents, stabilizing personnel role. Next, take 360 degree examination, namely on employees assessment, ask its superior, colleagues, subordinates, themselves and the external personnel joint participation, but make sure any kind of assessment information sources are fair and accurate, avoid personal emotional in assessment process. Finally, in the inspection method, qualitative assessment should be combined with the quantitative evaluation, in order to avoid assessment focuses on a spy sequence, can use ratio of comparative evaluation method, for the enterprise special groups, using special inspection targets and assessing method. Third, must strengthen relationship of the performance evaluation and punish remuneration, promotion and training. Examination of the role is to make the employee and enterprise to form a benign interaction, develop together, and in this idea guidance, setting up the index and different assessment weight, the results according to 100 points summary divided outstanding, good, qualified and the unqualified four ranks and then determine the adjustment coefficient of various ranks. Final worker's performance evaluation score, should be the performance evaluation score, multiplied by the department performance adjustment coefficient, such result is fair to the worker performance assessment, simultaneously also bond workers and organizational goal together [10].

4. Optimizing human resource structure and establishing scientific talent selection system. In order to solve the unreasonable state-owned enterprise personnel system and not sound phenomenon, we should rely on system to manage, and make a set of scientific and reasonable enterprise personnel system and internal competition systems. To achieve this request, first enterprise in hiring workers must be open and transparent, procedures must be fair strict, truly achieve the human resources management new

situation where outstanding first, useless last, and the common wait avoid employing highly centralized power and unopened operation, in order to reduce the employing errors to prevent and overcome the personnel rampant. Secondly, take fully follow the mass line. Change a few choice to Most people candidate The third should formulate high-quality talent cultivation plan, tested select promising talents for further study. Especially it is important to ability and the level of cultivating talents. At the same time, we need to establish a scientific and reasonable human resource assessment system. Set up the concept of elite manage enterprises, train a number of high quality, high-level elite talents to lead talent team, promote the whole enterprise talent team develop and expanse constantly. Finally, if the head of the enterprise will recommend one person to work as his level in the company and the head should also undertake the joint responsibilities.

5. Increasing investment in human resources development and improving the state-owned enterprise quality of employees. The staff's career training and re-education is human resource regeneration and necessary for the development of human resource management, but also the inner component. If Enterprise want achieve sustainable development, they must increase investment in human resources. Especially some economic well-performing enterprises should take human capital investment enterprises as a part of the investment. using these training fund in a scientific and reasonable way, and financially to budget, and supervise the use of training funds, avoid misappropriation, waste happens, make it to have the good profit. In addition, in order to build a well internal learning environment, which will help employees and management to fully realize the importance of human training, enhancing employees' participation, make them always keep buoyant enthusiasm, the training work shall establish scientific and reasonable long-term, medium-term and short-term plan, in training content and structure should have both macro and micro, and also include; Both real need, and there a forward-looking, pioneering culture. Finally, the training effectiveness evaluation should be strengthened. Training effect quality finally should be reflected in employees' actual work, only the training which can truly improve employee performance is significant training, therefore, enterprise should contact the training and assessment results with the training personnel's promotion, promote, and mount guard, really reflect the purpose of training and effect, in order to ensure the training effect, should also assess the training result, so that can investigate whether the training achieve the desired effect [11].

In general, the problems in the human resources management of state-owned enterprise was not happened accidentally, In order to solve those problems in the process of management, it is necessary to strengthen the consciousness of human resource management, increase the opportunities of training and perfect HR incentives system. Whether HR can provide necessary advantage for the survival and development of enterprises, it completely depends on enterprises' human resources management. State-owned enterprises only make efforts to establish a new set of the state-owned enterprise human resources management system that can adapt to economic development in our country, benefit from the state-owned enterprise reform and development and attract talents and keep talents work in the enterprise longer, fully cultivate the excellent talents fully motivate the enthusiasm of business operators, professional technical personnel and general staff, which the optimal allocation of human resources will be realized and the enterprise will be laid a solid foundation in the fierce competition of the market with an invincible position.

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## Exploring to Compile a Natural Resource Balance Sheet: Implications for China's Ecological Civilization Construction

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**Abstract:** Natural resource balance-sheet can be used as an innovative attempt to strengthen the construction of China's ecological civilization. However, in china, due to the fewer theoretic and practical research in this field, there exists many fundamental unsolved problems such as the complex statistic of natural resources, the difficult assessment of the resources assets, the incomplete disclosure of statement information. Hence, this paper is devoted to explore the compilation framework of natural resource balance sheet in order to provide some ideas of solving the problems. With the DPSIR chain model, it explores the physical quantity and the quality of the natural resources. Then, with the idea of classification accounting, the total economic value of a certain natural resource can be accounted and the intergrated physical and monetary sheet of natural resources assets can be developed. In addition, referring to the green input-output model, the liabilities sheet of natural resources can be obtained, and the equity account can be calculated by the balance equation. Finally, the framework of natural resource balance sheet consists of a set of static-dynamic statements, providing the comprehensive information for evaluating the ecological performance of the government, and achieving the eco-civilization goal.

**Keywords:** Natural resource balance sheet, ecological civilization, natural resource assets statistics, governmental ecological performance assessment

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### I. INTRODUCTION

The Decision adopted in the third Plenary Session of 18th Central Committee of the Communist has regarded the preparation of natural resource balance sheet as a national strategic mission, which is a significant improvement and perfection on the defects of China's traditional national economic accounting system, and is also to promote the construction of ecological civilization demands of the resources conservation and environmental protection. The compilation of natural resource balance sheet reflects the stock and flow of the resources in the social development, which exerts profound effects on resources & environment protection and social economic development in China. Firstly, it will open a new model of ecological civilization with Chinese characteristics, guiding the market economic body to use the resources efficiently. Secondly, it will realize new normal transformation from quantity to quality in the process of economic development, increasing the product benefits by the ecological benefits to promote industrial upgrading (Zhou Zhifang et al. 2014).

Thirdly, it will provide information suitable for analyzing the performance of governmental environment management.

### II. DIFFICULTIES ANALYSIS FROM LITERATURE REVIEW PERSPECTIVE

The compilation of natural resources balance sheet is a new concept proposed by Chinese government, and the current domestic theoretical research is still in the exploratory stage. Some scholars adhere to the principle of starting with easy things first, putting forward ideas of the construction of natural resources balance sheet from hot theoretical issues (e.g., the purpose, significance and the main theories)(Hu Wenlong 2014; Chen Hongxin 2014). On a micro level, the literatures combed shows that the natural resource balance sheet presented comprehensively the assets, liabilities, the equity of natural resources on the ground of accounting theory. Yutang Zhang, Liu shuai used the two kinds of physical and value measurement model to measure and present the component of natural resources balance sheet on the premise of accounting theory. The natural resource accounting was the foundation of the resource balance

sheet, and a variety of the accounting methods were viewed to provide a probable path of the balance sheet (Feng Zhiming et al. 2014). Hangyan Zhang put forward some ideas about the natural resource accounting based on the character of accounting. On a macro level, some relevant scholars discussed natural resource balance sheet from the perspective of national balance sheet, natural resources statistics, ecological civilization and others. The natural resource balance sheet had a strong relationship with the national balance sheet, and the two kinds of sheets were the component of the System of National Account (SNA) (Geng Jianxin et al. 2014). Hongqiang Jiang, Jinnan Wang took the ecological and environmental protection as mainstay, proposed the preparing framework of natural resources balance sheet based on the system of the environmental capacity, environmental quality and ecological environment. Rongbing Huang discussed the functional orientation, government mechanism, frame structure, auditing assurance and other issues in view of ecological civilization.

Although there are no theoretical explorations for natural resources balance sheet at abroad, there is a vast amount of practice on natural resources statistic internationally. Norway has established extensive resource-accounting system to supplement their national income accounts (Costanza 1997). Several nations, including Canada, France, the Netherlands and Japan, have proposed or established the natural resource accounts. Finland established the framework of natural resources accounting including the detailed forest accounting (Lange 2004). The Mexican government incorporated oil, land, water, air, soil and forest into Environmental and Economic Accounting, the stocks and flows of which are measured in physical and monetary unit (Ana 2008). The US established their System of Integrated Environmental and Economic Accounting by drawing from SEEA-1993 to reflect their environmental information (UN 2014). Australia always went ahead in the world in terms of natural resources accounting. It had compiled relatively mature land and water resources asset account according to SEEA -2012, and built the accounting standard for water so as to promote water management activity effectively (ABS 2013). China's statistics accounting of natural resources started late, it was authorized by the United Nations research institute., and established CSEEA in accordance with Chinese reality. Since 2003, China began a preliminary physical measurement of natural resources and a part of natural resources involving national economy development(e.g., land, forests, water) were statistic, but has yet to establish a complete accounting system of natural resources.

In summary, from a practical point of view, the practice research of natural resources at home and abroad starts from the perspective of the natural resources accounting, trying to build natural resources accounts consistent with the System of National Accounts (SNA). From a theoretical point of view, the domestic research is still at an early stage and most of scholars explained the concept, significance, content and framework of natural resources balance sheet. They probed into the construction of natural resources balance sheet from different aspects and obtained some achievement, but there are some problems with the preparation process of natural resources balance sheet:

1. Because of a large amount of natural resources in china, it is difficult to count. There is a certain mechanism of action relationship between natural resources, economic development and ecological environment, so statistics objects include not only the formation, development, application procedures, protection and recycling of natural resources, but quality changes of ecological environment. Therefore, it is very urgent to build up a wide scope of statistical system is the urgent issue.

2. The difficulties are the monetization of functioned-detailed natural resources with the function of economy, society and ecology. Even it is more difficult to grapple the non-market benefits associated with non-use value.

3. Due to the disclosure information on statements, it is difficult to produce normative tables. The preparation of natural resources balance sheet should reflect not only the stock and flow of natural resources assets, but also government performance evaluation, especially the key information reported, which is the eventual use of natural resources balance sheet.

Therefore, from the macro and micro perspectives, this paper tries to build the preparation framework of natural resources balance sheet followed by the accounting theory to find out the way to solve the problems.

### III. FRAMEWORK DESIGN OF NATURAL RESOURCE BALANCE SHEET

The preparation of natural resources balance sheet, as a complicated and systematic project, depends not only on account, but couplings statistics and economics on disciplinary bases in order to build systematic accounts reflecting natural resources ownership, consumption, degradation. On the preparation content, natural resources balance sheet needs to dock current natural resources statistical system to make it become a detailed part of SNA. On the preparation methods, the balance sheet should play a monetary value on the physical measurement,

following by the principle of “first in stock and then in flow terms”. During the fiscal period, the amount of natural resource assets, the consumption, the degradation and the degree of ecological protection are disclosed comprehensively. Hence, natural resources balance sheet is not simply a kind of

accounting statements, it is more similar to a static-dynamic set of management statements, which is used to manage and monitor the state of natural resources assets, and audit and assess governmental ecological performance (Figure 1).

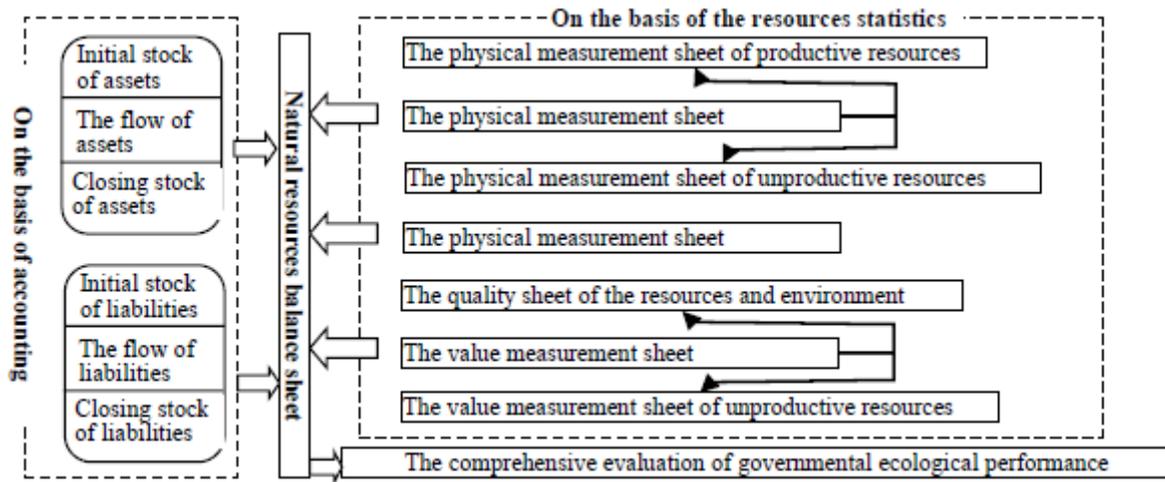


Figure 1. The general framework of natural resources balance sheet

As shown in Figure 1, the preparation of natural resources balance sheet should be split into several steps as follows: 1. According to the true, accurate and continuous statistics, get the information of natural resources utilization, development and others by the resources and environment statistical means, and then reflect the physical quantity and quality of natural resources to draw up the physical accounting accounts of natural resources and quality of ecological environment. 2. For the different construction of natural resources, appropriate valuation methods should be selected categorically to draw up the value accounts of natural resources. 3. By using the balance sheet principle, natural resources assets and environmental profit and loss brought by exploiting natural resources are measured in physical and monetary units so as to make the calculation on natural resources assets, liabilities and net assets. 4. Based on the above information, the comprehensive evaluation can be used for the ecological performance appraisal of the government.

#### A. The Construction System of the Resources Statistics Based on the Dpsir Chain Model

Natural resources, as natural medium that shaped in the specific conditions, participate in the economic production and incorporate as the waste into the ecosystem ultimately. In consideration of the interactive relationship between natural resources, environment and economy, the paper focuses on the increase or the decrease of natural resources products

and environmental quality changing with the view of the mutual relation to build the statistic system of natural resources. The theory of DPSIR chain model was put forward by Organization for Economic Cooperation and Development (OECD), which was used to reflect the interaction between natural resources and economy and do classify as natural resources statistical content. DPSIR stands for a system analysis view on environmental problems and the way society deals with them, which expresses that social and economic developments (Driving Forces, D) exert Pressures (P) on the natural resources and environment. As a consequence, the State (S) of the environment changes, which leads to Impacts (I) on ecosystems, human health, and society, eliciting a societal Response (R) that feeds back on Driving Forces, on State or on Impacts (Karen 2013).

Among the statistical indexes, the Driving Forces, Impacts and Response belong to the qualitative indicators, which are used to describe a certain kind of economic activities that will exert some negative effects on natural resources & environment. The statistical indexes reflecting Pressures and State belong to the quantitative indicators, which mainly calculate the consumption of natural resources and the environmental damages in social production activities, which is the core of natural resources statistics. But in reality, most of natural resources statistics is State indicators, but Impact and Reflection scattered in relevant economic and social statistics. Therefore, the author will focus

on analyzing the role of three indicators playing in the compilation of natural resource balance sheet.

1. The natural resources are physically accounted based on State indicator. The object of natural resources and environment statistics is mainly natural resources and environment corresponding to human economic and social system. As the reference of the classification by System of Economy-Environment Accounting of China (CSEEA), natural resources are divided into two kinds: productive and unproductive

natural resources; The former puts on the accounting of forest and grassland; The latter includes economic land resources (e.g., cultivated land, energy, et al.), energy resources (e.g., oil, coal, natural gas, et al.) and non-economic natural resources such as air, water and so on. Around the depletion of natural resources, a kind of natural resources is reflected the physical flow process according to its life cycle, thus setting up the physical accounting table of natural resources (Table 1).

Table 1. The physical accounting table of natural resources in an area.

	Forest	Grassland	Cultivated Land	Energy	Water	.....
Initial stock quantity						
Increased:						
Natural growth						
New discoveries						
Increased by economic and revalued causes						
Revaluation added						
Decreased:						
Natural loss						
Decreased by economic and revalued causes						
Revaluation decreased						
Closing stock quantity						

In Table 1, the columns calculate physical quantity of different categories of natural resources under different states; the rows display the initial and closing stocks, and flow changes of each kind of natural resources. The flow changes are classified according to the cause for the increase and the decrease of natural resources. The increase includes natural growth, new discoveries, increased by economic and revalued causes; the reduction includes natural loss, decreased by economic and revalued causes. The revaluation adjustment is caused by the change of external conditions, exerting the effects on the natural resources statistics, such as technology, price change and the improvement of the evaluation methods. Taking as an example, the equilibrium relation between stocks and flows of certain natural resources is drawn in the each column, that is “Initial quantity+ increase quantity-decrease quantity =closing quantity”.

2. The natural resources are quality statistics based on Impacts indicator. The impact of human economic activities on quality of natural resources is mainly manifested in two aspects: one is the change in the quantity and the other in the quality. Although

quality statistics of natural resources has great uncertainty on statistical methods and data processing, it is more realistic and reliable to use the existing quality indicators for natural resources. Therefore, from the perspective of environmental damage, the paper tends to evaluate natural resource qualities by calculating the degree of one kind of natural resources quality and ecological environmental media deviating from internationally recognized quality standards, or the degree of environmental medium deterioration (Gao Minxue 2004). For example, in accordance with land-use types, the main quality indicators are set to reflect land quality rank separately, which is shown in Table 2.

3. The natural resources balance sheet carries out the ecological performance evaluation based on Response indicator. Carrying out the work by government departments in the field of natural resource management and recovery, pollution control, supervision, prevention reveals the governmental effort for natural resource usage and protection, which was regarded as part of the ecological performance appraisal.

Table 2. The quality table of land resources in a region.

Unit: Square Kilometer

Indicators	Desertification	Land invasion	Toxicity influence land	Acid-deposition Influence land	Irrigation influence land
Agriculture land					
Woodland					
Industrial and residential land					
Unused land					

*B. The Evaluation Methods of the Resources Assets: Classifying The Value Methods*

John V. Crewe Umatilla proposed the value classification of natural resources dividing into the use value and the non-use value. From the perspective of environmental economics, the total value (TEV) of natural resources can be divided into the use value (UV) and the non-use values (NUV). The use value component refers to the set of benefits individuals deriving from using the resources directly or indirectly, and can be further divided into direct use, indirect use, and option use value, respectively DUV, IUV and OUV. Non-use values reflect the values individuals attached to a natural resource even if they themselves do not use it, and is divided into bequest values (BV) and existence values (EV). This leads to the following equation:

$$TEV = UV + NUV = (DUV + IUV + OUV) + (BV + EV) \quad (1)$$

In formula 1, the total value of natural resources gathers from their different values, so it needs to use

the appropriate evaluation methods to account according to the different value constructions. Market valuation method is used to estimate the direct use value (DUV) of natural resources, and uses the observations of market prices to estimate the economic value directly. There is the net price method adopted to estimate future cash flows of the resources by reasonable discounted rates on the basis of current market prices, development costs and tax rate (Salvatore 2012). Non-market valuation methods are used to estimate non-use values (DUV) and indirect use values (IUV), which can be defined as un-priced benefits from natural resources because they are not commonly traded in the market. They include the Contingent Valuation Method (CVM), Replacement cost (RE) (e.g., Averting Behavior approach, Travel Cost Method (TCM)), maintenance cost method (MC) and so on. Each evaluation method is different in the characteristics and application scope (Table 3).

Table 3. The evaluation methods for measuring natural resources.

Methods	Market valuation		Non-market valuation		
	Market price	Net price	CVM	RE	MC
Application scope	DUV		IUV, NUV		
Main content	estimating future cash flows of the resources by certain discounted rates, on the basis of current market prices		The willingness to pay for the resources improvement of public health and welfare in future, which is taken as the decrease of the resources quantity and quality.	Estimating the natural resources by the replaced resources in the trading market	The resources valuation focus on the quality changes, MC is to account the maintenance and recovery cost that is insusceptible in future.
Shorts	The resources without market price lack of realistic basis.		It is necessary to the consistent with investigators' understandings of the resources value, if not it will influence the accuracy of natural resources.	The standard of the replaced resources is hard to identify.	The estimated recovery costs has a certain deviation from the estimated effects.

In Table 3, several major valuation methods of natural resources have advantages and disadvantages. Present value approach, guided by the market reference, takes into account the relationship between market supply and demand, and reflects the characteristics of resources scarcity, so they are easy to be accepted within the limited range. While others without market reference have more superiority in the lack of perfect capital market, they have some problems as the more reliable data prediction and the stronger subjectivity. As the result, it needs to build the idea of the contingent valuation method. The value construction of the specific natural resource should be analyzed at start, then selects the appropriate evaluation methods after the distinction of use value and non-use value.

Taking the marine resource for example, it is divided into the use value and the non-use value on the basis of their functions, and the use value includes aquaculture, fisheries, coastal recreation benefits, tourism, underground mining resources, oil and gas, sea salt and so on. The part of these values can be calculated by market value or net price value approach. This leads to the following equation: the marine DUV= (Revenue from marine development-Costs of marine development)/discounted rate (Kyriaki 2010). Indirect use value includes watershed protection, CO2 sequestration and so on. Non-use values includes the potential unknown biodiversity, satisfaction from passing the availability of marine related benefits to future generations, etc.. CVM, TCM, RE and others are used to evaluate these values. Through a virtual trading market, the values are calculated by the satisfaction that the public will accept, or estimate approximately the function value of marine resource by the recovery costs and disposal costs that must be spent.

C. *The Presentation of the Balance Sheet: Building The Statements System*

- *Three accounting elements of the balance sheet*

1. All natural resources of value and reliable measurement owned by government are considered an asset. They are divided into the productive natural resources assets and the level subject of the non-productive natural resources assets consisting of two and three subordinate subjects calculating the newly-increased value of natural resources. Resources taxes and fees from the development and utilization of natural resources are charged by government to launch special funds for resource recovery and management.

2. Liability refers to the resource recovery and the environmental management costs caused by over-consumption of natural resources and environmental destruction in the process of social productive activity. Its contents includes: the expense recovering the natural resources after the depletion and degradation, the consideration cost of environmental management after worsening ecosystem of the fog haze, noise, debris flow, water pollution and so on.

3. Natural resources equity is composed of the governmental early-stage ventures, natural resources value-added and the retained earnings belonging to government. According to the degree of equity requirement listed in natural resources balance sheet, the equity includes the owned, the developed and undeveloped resources equity that owned by government (Xu Jialin 2006).

- *The Norm of Natural Resources Balance Sheet*

Although the paradigm of compiling a natural

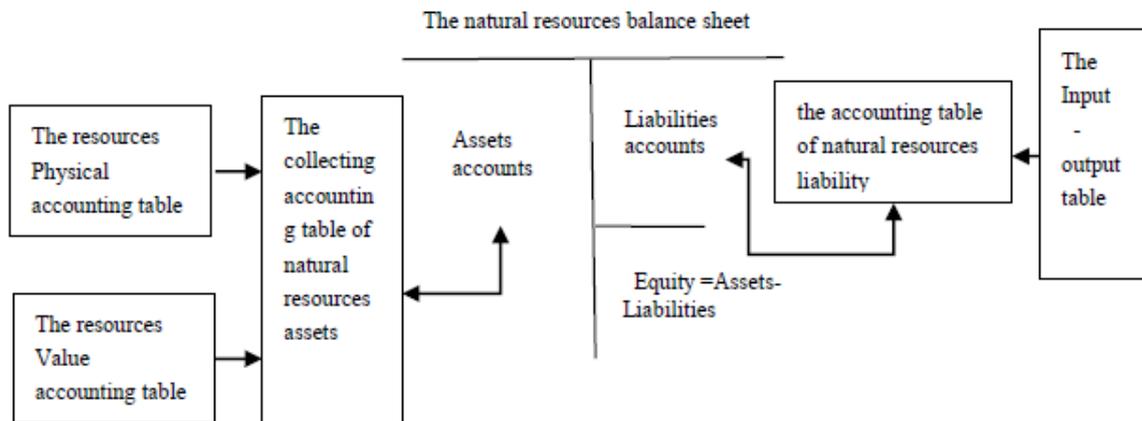


Figure 2. The programmed framework of balance sheet of natural resources.

resource balance sheet has not a unified standard, the main three elements can be shown by the follow accounts (Figure 2). The resource assets accounts can be formed by establishing the intergrated accounting table of natural resources assets; the liabilities accounts by building the table of the resource liability according to the redesign of the green input-output table, and the resources equity with the principle of accounting equation.

1. On the basis of the detailed resources physical statistics, the paper makes use of appropriate valuation methods of natural resources to build the physical accounting table and monetary accounting table of natural resources in an area. The stock and flow changes of natural resources can be acquired by the simple aggregation, so as to reflect the governmental ownership on the natural resources assets at a specific data. This is shown in Table 4:

Table 4. The collecting accounting table of natural resources assets.

Unite: physical measurement (PM) / monetary measurement (MM)

Project	Forest		Grassland		Cultivated land		Water		.....
	PM	MM	PM	MM	PM	MM	PM	MM	
Initial stock quantity									
Increased									
Natural growth									
New discoveries									
Increased by economic and revalued causes									
Revaluation added									
Others									
Decreased:									
Natural loss									
Deduced by economic and revalued causes									
Revaluation decreased									
Others									
Net assets change									
Closing stock quantity									

In Table 4, the physical measurement table and monetary measurement table provide the necessary prerequisites for the natural resources assets accounting. The resources addition belongs to the newly increased assets in the period. The resources reduction is taken as the resources assets impairment. This leads to a form: natural resources net assets change = additional assets-the resources assets impairment. As a result, natural resources assets = Initial stock quantity +net assets change.

2. Social output, including physical products and waste emissions, is determined by the external character of social production. The external diseconomy of production gives rise to environmental pollution and ecological damage. Through using the model of Green input-output, the paper redesigns the input and output of the resources material to focus on the natural resources depletion and environmental degradation.

In Table 5, the columns show the utilization of the resources in a certain period and the rows have a break down by departments, including the resource

recovery & compensation departments, environmental management departments and production departments. The resources utilizations and pollutant emissions costs are read as the resources depletion and ecological degeneration in the green input-output table. So from the stock point of view, the resources over-consumption amount indicates as the difference between the resources utilization and recovery (X-N) in the process of economical production, and the ecological degeneration degree indicates as the difference between the resources emissions and the management (E-C) in economic activities(Chen et al. 2015). Based on the information provided by the green input-output table, the integrated accounting table of natural resources liability can be built as follows.

3. Based on the previous research, the natural resources balance sheet can be prepared according to the equilibrium of "Equity=Assets-Liabilities". The concrete forms are shown in Table 7.

Table 5. The accounting table of green input-out in an area.

Input \ Output	Resource Recovery Department	Production Department	Environmental Management Department	Total Output
The resources utilizations				X
The productive resources				
The unproductive resources				
production department				
pollutant emissions				E
Newly-increased value resources				
Total input of resources	N		C	
The cost of resources depletion	X-N			
The cost of ecological degeneration	E-C			

Table 6. The integrated accounting table of natural resources liability.

	PM		MM	
	over-consumption amounts	the ecological degeneration degree	The costs of over-consumption amounts	The costs of the ecological degeneration degree
Forest				
Water				
Energy				
.....				

Table 7. The balance sheet of natural resources.

Data:

Unite: PM / VM

Projects	Initial Balance		Closing Balance		Projects	Initial Balance		Closing Balance	
	PM	VM	PM	VM		PM	VM	PM	VM
<b>The productive resources assets</b>					<b>Natural resources liabilities</b>				
Forest					over-consumption of the resources				
Grassland									
.....					Environmental degeneration				
<b>The unproductive resources assets</b>					.....				
Cultivated land					<b>The total of the liabilities</b>				
Energy					<b>The resources equity</b>				
Water					the developed resources equity				
.....					the undeveloped resources equity				
the resources assets impairment					.....				
Resources taxes and fees									
<b>The total of the resources assets</b>					<b>The total of liabilities and equity</b>				

D. *The Comprehensive Evaluation of Governmental Ecological Performance on the Basis of the Statement Information*

Based on the detailed information provided by

natural resources balance sheet, the paper can carry on the comprehensive evaluation of the resource management performance, resource & environment quality and governmental ecological performance.

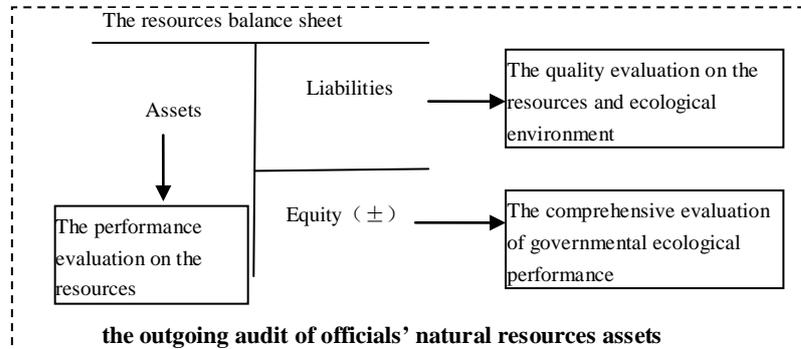


Figure 3. The relationship framework of balance sheet of natural Resources between governmental ecological performances.

1. The performance evaluation on the resources. The resource balance sheet reflects directly the stocks and flow changes of the resource assets by the rate of stocks changes, exploitation, service efficiency and so on. In addition, it can reveal indirectly the resources pricing mechanism and the enforcement standard of the property rights system on the method of physical and monetary measurement. And the account of Resources Taxes and Fees can show that the degree of governmental regulation on the resources utilization and development by means of tax, and optimization of the resources assets.

2. The quality evaluation on the resources and ecological environment. The liability accounts can reflect the degree of the over-consumption of the resources and the degradation of ecological environment. The evaluation index can be designed from three ways to evaluate the quality. Firstly, the indicators are confirmed on the resources classification, such as the vegetation destruction. Secondly, the quality was assessed from the perspective of ecological environment, such as the ecological environment pressure indexes, the degree of pollution of the environment. Finally, the resources recovery and the environmental governance can be accessible to the protection investment and environmental total costs with regard to environment costs.

3. The comprehensive evaluation of governmental ecological performance. The plus-minus situation of the resources equity can reflect the governmental ecological performance in the area. According to the equation of  $Equity = Assets - Liabilities$ , the resources assets are increased if the resources equity is positive and the performance is

great. On the contrary, the assets are decreased and the performance is poor. In the natural resources balance sheet, when even the monthly reporting figures emerge, the relevant officers stir. Should the net equity figures be negative or lower than those of the preceding month, the recession of the ecological performance is declared, the strategies and competence of environment administration are impugned and the ecological performance is heavily discounted.

IV. CONCLUSION AND SUGGESTION

The natural resource balance sheet, aiming at making clear the exact value of natural resources and revealing governmental occupation and responsibility of various resources, is an important part of China's ecological civilization construction. Based on the scientific statistic accounting, this paper uses the DPSIR chain model to count natural resources thoroughly. Besides, it builds the physical accounting table of natural resources and the ecological environment quality table by the index of the State and Impacts. On the basis of physical accounting, it introduces the idea of classifying natural resources according to their value and perfects the method of natural resources evaluation. The natural resource balance sheet is worked out by this proceed, measuring physical natural resources and their value, gathering the stock of natural resources and their flow changes, accounting the liabilities of natural resources by applying local green input-output model, and using balance equation of the balance sheet finally. The ultimate goal of the resource balance sheet is to evaluate government's performance, which can be served as a fact when auditing those leaders leaving their posts.

The natural resource balance, as the performance evaluation sheet of economic development and the resources consumption, plays a profound role on the construction of ecological civilization and the achievement of sustainable economic development. However, how to better the preparation of natural resources balance sheet and the evaluation of leaders' performances still have a long way to go. Nowadays, the theoretical researches on natural resources lags far behind the practical requirements. We don't have a complete theoretical system, which is also our research goal in the future.

In a long run, the preparation of natural resources balance sheet is a complicated system work. The paper argues that the compilation tasks should go step by step, from being simple to being complicated. The idea of multi-stages can give a way to standardize and update the preparation of the balance sheet. We can decompose the specific suggestions conferred by the preparation into three main steps:

1. In the near term, the country should build up the unification of the interdisciplinary, inter-departmental working platform, and introduce the third independent party accounting appraisal institutions. Besides, the officials should accelerate to expand the pilot work area to test the feasibility of the compilation framework and the methods, which provides experience and reference for the rest of the country.

2. In the middle term, the country should focus on the breakthrough work in layers. Important statistical index system, the approaches & techniques of the resources value evaluation, report information disclosure system and the government performance appraisal system should be the key point of promoting on the natural resources, so as to solve the virtual problems in the process of preparing.

3. In the long term, the country should perfect the policy from the multi perspectives. The property rights of the resources and ecological environment assets should be improved deeply, as well as the natural resources accounting and management system. Building up statistics system supporting the natural resources balance sheet can be devoted to make clear the resources assets to develop the green economy.

#### ACKNOWLEDGEMENTS

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## An Analysis of Diversity Management for a Diverse Workforce in the Hospitality and Tourism Industry

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**Abstract:** The diversity management has been implemented in the hospitality and tourism industry since the past decade. This report conducts a secondary research based on some contemporary journals, academic resources which are related to diversity management to obtain an insightful understanding and comprehension of the theoretical and practical implications of the diversity management in the hospitality and tourism industry. The purpose of this report is to analyse the diversity management in the tourism industry in order to explore different perspectives of several different stakeholders in the key issue addressed. Initially, this report presents a literature review that summarised the contemporary issues of diversity management from a set of readings. Second, this report explores some different perspectives in terms of the industry, organisation, government, consumer and academic aspects in the hospitality and tourism industry. Finally, some implications and recommendations will be provided for the industry to draw an improvement in implementing the diversity management in the future.

**Keywords:** Diverse workforce, hospitality and tourism industry, diversity management

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### I. INTRODUCTION

In a competitive society, the influence of globalisation, together with development of information technology and innovation of human resource management have challenged the hospitality and tourism industry since the past decade [4]. The innovation of human recourse has implemented new types of management strategies by recruiting numbers of employees who possess diverse, multicultural and cross-functional backgrounds and knowledge, resulting in more multinational and diverse workplaces [3]. Moreover, the diverse workplaces have enhanced the degrees of diversity and multiculturalism that can assist organisations to achieve greater innovation and more effective learning through diversity management [9]. Such learning and innovation will represent a knowledge advantage for the organisation, which may result in greater organisations' reputations and revenues. The report investigates the diversity management across the hospitality and tourism industry, which has experienced and encountered globalisation augmenting competitive challenges for a diverse workforce [14, 17]. The purpose of this report is to analyse a diverse workforce in the hospitality and tourism industry, in order to investigate the different perspectives of the stakeholders in the hospitality and tourism context. First, the report presents a literature

review based on some contemporary readings which are relate to diversity management in the hospitality and tourism industry. Second, some different perspectives that are associated to the managers of industry/organisation and government bodies, consumers and academic researchers in the hospitality and tourism industry will be explored. Third, the comparison of academic and industry/government viewpoints will be conducted. Finally, the report concludes with some implications and recommendations for diversity management and the tourism industry to create effective learning from diverse employment and enhance the competitiveness of the industry in the future.

### II. LITERATURE REVIEW

In the hospitality and tourism context, the diversity management is a strategic approach to maintain retention of employee and increase confidence of consumer. A service staff has been required to provide service and maintain customer satisfaction simultaneously. Since the hospitality and tourism industry is a customer-orientated and service-based industry, the amounts of diverse employees are being recruited and trained by the hospitality and tourism organisations [13]. Therefore, the key contemporary issues in the diversity management state as following.

A. *The Overall Challenges in the Hospitality and Tourism Industry*

Some challenges have always faced employees working in the hospitality and tourism organisations. Cieri and Kramar (2005) assert that coping with an intrinsic and extrinsic environmental factor allows a diverse workforce to contribute the greatest possible performance of productivity and competitiveness in the hospitality and tourism industry. As Figure 1 illustrates a specimen of human resource practice to assist companies facing the competitive challenges. HRM has been practiced to associate with the objectives of company as a strategic management, by aligning both employees and company to conquer internal and external challenges; by obeying legislations to enhance company’s competitiveness, by evaluating the skills and values of a diverse workforce and by creating a continuous learning environment for the hospitality and tourism industry. Therefore, HRM has not only encountered some challenges, but also learnt some skills and knowledge from experience in a practical phase [6].

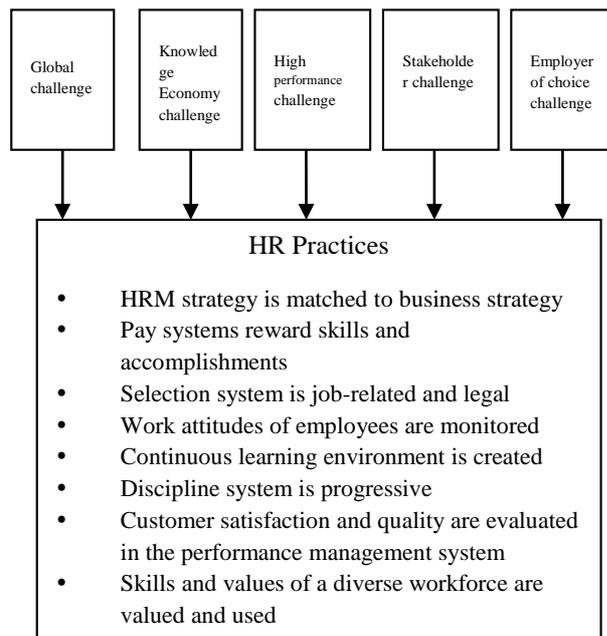


Figure 1. Examples of how HR practices can help companies meet the competitive challenges

Source: Cieri and Kramar, *Human resource management in Australia 2E: strategy people performance*, McGraw-Hill Irwin, China, p. 40, 2005.

B. *The Learning from Diversity Management*

Sajartino, O’Flynn and Nicholas (2002) demonstrate that a learning from diversity management business model which is prepared for the Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) of Australia. As Figure 2 indicates an organisation will achieve greater innovation and more effective learning through

diversity management in diverse workplaces. Creating a diverse learning environment where is involved innovation learning is expected, respected and rewarded, in resulting the organisation will develop new knowledge and ideas into marketable goods or service organisation improve effectively.

Australian workplaces are amongst the most diverse in the world; the diversity management is a inevitable challenge both of the employees and managers in the organisation, due to the fact that many of generations of immigrations all bring different knowledge and skills into diverse workplaces. The degrees of variation will reflect the diversity of the group in terms of gender, age, cultural background, education levels, functional roles and so forth [9]. The ways for managers to practice the diversity management effectively are by recognising and accounting for differences in values, beliefs and religion; by improving communication and conflict management; by respecting and understanding the perspectives of each other; and by developing equality of job opportunities [19].

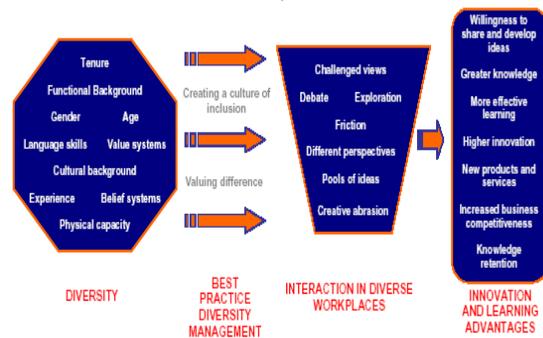


Figure 2. The innovation and learning advantage from diversity and diversity management

Source: Sajartino, O’Flynn and Nicholas, “The innovation and learning advantage from diversity: a business model form diversity management”, Australia Centre for International Business, Australia, 2002.

C. *Diversity of Consumers*

In the hospitality and tourism context, the service characteristics are changed from homogeneous into heterogeneous, due to the majority of customers have diverse backgrounds and characteristics, the service procedures have been modified to provide more effective performance to meet to complicated and diverse needs of consumers [19]. For instance, the tourism events require a diverse workforce to identify the tourist psychological and physiological needs that influence a person’s decision for one trip; based on the staff’s multilingual and multidimensional skills and knowledge create a most attractive event to achieve the needs of diverse consumers. As a consequence, one of the most crucial current changes

is that the hospitality and tourism industry has tended to recruit a diverse workforce.

#### D. Diversity of Workforce Characteristics

The diverse workforce characteristics have some variables, for example, demographic variables such as age, sex, socioeconomic status, and geographic location and ethnographic variables such as nationality, race, ethnicity, language and religion and so forth [5]. While practicing the diversity management to understand the differences of communication between genders, generations, races and culture are addressed as the challenges for an organisation [2]. Since, individuals have different interpretations of communication; the intercultural and interpersonal understanding and multilingual skills can affect the comprehension of communication [7]. Therefore, understanding the different employment characteristics can avoid some misunderstandings and conflicts, then can enhance the effective performance of employees.

### III. ANALYSIS OF DIVERSITY MANAGEMENT

#### A. The Perspectives of the Managers in the Hospitality and Tourism Industry/Organisation

In the manager's perspectives, a diverse workforce can positively affect overall team performance, and also can influence the effectiveness of problem solving. For example, when a problem occurred, team members possess a diversity of creative problem-solving approaches, the ability of some team members to be a bridge or translator between those who may misunderstand is helpful to stimulating diverse team outputs [15, 16]. These outputs are generated through clarification of individual and overall team ideas and perspectives toward an improvement to increase the business competitiveness [1].

On the other hand, a diverse workforce is a challenge for a leader, for instance, Egan (2005) identifies four major barriers in implementing a diverse workforce: time or expectation pressures, shortage of various resources, antagonistic attitudes, and team confrontation. These barriers presented that was difficult to manage a diverse workforce by leaders. Hence, the key knowledge of leaders is to recognise the characteristics of a diverse workforce and to identify the needs of a diverse workforce, so that can accelerate the success of diversity management in the practical phases. Therefore, team leaders should possess knowledge and ability by defining the team diversity, supporting team diversity, selecting team members and practicing human resource management strategies.

#### B. The Perspectives of Government Bodies

Australia is a multicultural and tolerant country, the government authorises the industry to implement a diverse workforce to increase the international competitiveness of the country by establishing various acts and legislation to protect the workers' rights in all of workplaces. To manage a diverse workforce must to obey the legal legislation, such as the Sex Discrimination Act 1984, the Racial Discrimination Act 1975, the Equal Opportunity for Women in the Workplace Act 1999, the Disability Discrimination Act 1992, and so forth [21]. These acts prohibit discrimination in employment on the basis of gender, nationality, marital status, religious, group or family responsibilities.

While practicing a diverse workforce, organisation should follow the existing policy and all of enterprises' or organisations' employment regulations should confirm with the legislation and laws in the world [2]. For instance, in Australia all of organisations running the companies should be ordered to confirm with the provisions of various acts which are monitored by the DIMIA of Australia and different level of legislative governments and departments. The major objectives are following [20].

- Maintain the principle of open competition that based on the equal opportunity and applicant confidentiality;
- Encourage members of employment-disadvantaged or disable groups to be considered employment by the organisations;
- Represent staff performances that are efficient and effective; and
- Ensure that selection and recruitment procedures are following the laws.

#### C. The Perspectives of Consumers

The hospitality and tourism industry is a customer-orientated and service-based industry, the customer satisfaction and royalty are evaluated in the diversity management system. Particularly, nowadays, the customers prefer to experience diverse and multidimensional attractions that embrace a diverse skilled and knowledgeable workforce to service them. For instance, a cultural tourism destination with a diverse workforce is likely to attract wider visitors, due to the face that a diverse workforce possesses the ability to recognise new potential needs of customer and to provide a more tailored service to enhance the customer satisfaction [10]. Moreover, developing new technologies, providing the diverse and flexible working patterns

and serving services seven days a week have been highly demanded by customers in the hospitality and tourism industry [12]. As a consequence, a diverse workforce can be implemented effectively and successfully in the hospitality and tourism industry, then can enhance the customer satisfaction and loyalty, the customer will return to business frequently. Therefore, practicing a diverse workforce has not only benefited the customers, but has also increased the company profit.

#### *D. The Perspectives of Academic Researchers*

The vast majority of scholarly research into diverse workplaces had focused on individual creativity associated with diverse workforce characteristics and impact of the work environment on individuals in the hospitality and tourism industry [18]. The researchers attempt to obtain the insightful understanding in the practical term and suggest that researchers and practitioners should collaborate to explore and recognise the gaps between theoretical and practical implications, to identify the existing problems in current diverse workplaces, and to interpret the problems into the further researches [8]. Therefore, the researchers can conduct the further researches to find out more pragmatic models and frameworks for the hospitality and tourism industry and organisation in the practical term, and assist organisation to apply the theory into actions and diversity management.

### IV. COMPARISON OF ACADEMIC, INDUSTRY/GOVERNMENT

#### *A. Differences*

In terms of the academic viewpoints, the body of theory around diversity management, with its roots in the disciplines of business policy, organisational theory, and organisational behavior, continues to expand to an ever widening number of fields including the hospitality and tourism industry. A number of theoretical frameworks and models for strategic diversity management have appeared in the literature. Those models and frameworks illustrated in the academic literature are very theoretical not easy for the hospitality and tourism industry operators and practitioners to understand. Therefore, it is difficult to have an appropriate implementation of the model into actions of diversity management.

In contrast, in the viewpoints of industry/government, the industry journals and guidebooks of diversity management are established frequently by the hospitality and tourism industry associations and governments which are more practical and straightforward. Most of them are with detailed outline and clear structure to be follow in

designing and developing effective diversity management strategy based upon the diverse resources available to the hospitality and tourism organisations. Therefore, the diversity management has not only developed for the hospitality and tourism industry to concentrate on a productive and effective workforce, but also for the government to coach and monitor the hospitality and tourism industry by the acts and legislation to create a more suited environment for a diverse mix of employee.

#### *B. Similarities*

This study explores a consensus among academics, the hospitality and tourism industry and government that it is essential for tourism organisations both private and public to have the diversity management. Thus, it can assist the organisation to practice more successfully a diverse workforce in this globalisational environment. Several similar issues are addressed in both academic and industry/government viewpoints, which summaries as following.

**The leadership and communication skills** – implementing a diversity management should establish a harmonious relationship within a diverse workforce. If a conflict occurs, it should be completely handled and controlled when it occurs initially. The key of collaboration and the most difficult part of diversity management is to implement the leadership and communication skills that are various from company to company.

**The equality of job opportunities** – in Australia, there are so many variables in a diverse workforce, to deal with viewpoints of individuals are to recognise the different perspectives of others, and to provide equality of job description and requirement for a diverse workforce. Therefore, hospitality and tourism industry, organisations, and researchers should collaborate to create the equal job opportunities for a diverse workforce to contribute their various skills and knowledge to the hospitality and tourism industry.

**The role of government and industry** – the government establish various acts and legislation to pilot the industry in implementing the diversity management, thus the country can become more competitive in the world. Moreover, to establish a significant diversity management strategy has not only relied on the government involvement, but also depended upon the industry obligation of the society. Nevertheless, their unique roles are representing the national tourism perspectives and a bridge between the public and private sectors in the hospitality and tourism industry.

## V. IMPLICATIONS AND RECOMMENDATIONS

Through this study, some relevant evidences have explored the hospitality and tourism industry has globally faced many types of challenges due to a diverse workforce. Hence, business owners and managers of hospitality and tourism industry establishments should prepare themselves well in advance to deal with diversity in an effective and efficient manner. Therefore, different stakeholders perceiving how to practice systematically and effectively a diverse workforce will determine the success of an organisation [11]. The performance of diversity management will continue to be important as the emphasis of management in the international competitive environment.

As a result, the ways to improve the diversity management in the hospitality and tourism industry are:

- Investigating a diverse workforce demand;
- Practicing different leadership competence in diverse workplaces;
- Analysing human resource management strategies;
- Learning from a competitive and innovative environment;
- Following the legislation and creating equal job opportunities; and
- Establishing the harmonious relationships with all of stakeholders.

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## Reciprocal Degree Distance of Circumcoronene

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**Abstract:** Chemical compounds and drugs are often modeled as graphs where each vertex represents an atom of molecule and covalent bounds between atoms are represented by edges between the corresponding vertices. This graph derived from a chemical compounds is called its molecular graph. The reciprocal degree distance defined over this molecular graph has been shown to be strongly correlated to properties of the compounds. In this article, by virtue of molecular structural analysis, the reciprocal degree distance of  $H_3$  is reported. The theoretical results achieved in this article illustrate the promising prospects of the application for the chemical and pharmacy engineering.

**Keywords:** Theoretical chemistry, reciprocal degree distance, circumcoronene

### I. INTRODUCTION

Investigations of degree or distance based topological indices have been conducted over 35 years. Topological indices are numerical parameters of molecular graph, and play significant roles in physics, chemistry and pharmacology science. For example, the reciprocal degree distance reflect the oxidizing property of chemical compounds.

Specifically, let  $G$  be a molecular graph, then a topological index can be regarded as a score function  $f: G \rightarrow \mathbb{R}^+$ , with this property that  $f(G_1) = f(G_2)$  if  $G_1$  and  $G_2$  are isomorphic. As numerical descriptors of the molecular structure obtained from the corresponding molecular graph, topological indices have found several applications in theoretical chemistry, especially in QSPR/QSAR study. For instance, Wiener index, Zagreb index, harmonic index and sum connectivity index are introduced to reflect certain structural features of organic molecules. Several papers contributed to determine these distance-based indices of special molecular graph (See Yan et al., [1, 2], Gao et al., [3, 4], Gao and Shi [5], Gao and Wang [6], Xi and Gao [7, 8], Xi et al., [9], Gao et al., [10] for more detail). The notation and terminology used but undefined in this paper can be found in [11].

The graphs considered in this paper are simple and connected. The vertex and edge sets of  $G$  are denoted by  $V(G)$  and  $E(G)$ , respectively. The reciprocal degree distance (also called additively weighted Harary index) of molecular graph  $G$  is defined as:

$$RDD(G) = \sum_{\{u,v\} \in E(G)} \frac{d(u) + d(v)}{d(u,v)}$$

This index has been shown to be strongly correlated to oxidizing properties of the compounds.

As the generalizations of benzene molecule  $C_6$ , circumcoronene homologous series of benzenoid is a class of molecular structures. In this paper, we discuss the base member of this family which is planar of benzene. The first three molecular structures ( $H_1$ ,  $H_2$ , and  $H_3$ ) of this series of Benzenoid are presented in Figure 1.

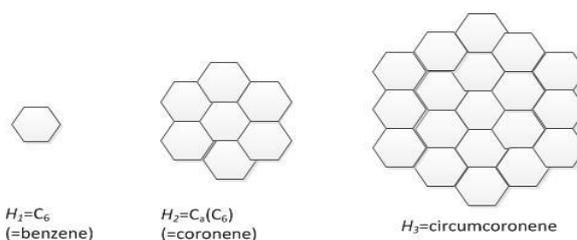


Figure 1. The first, second and third molecular graphs  $H_1$ ,  $H_2$  and  $H_3$  from the circumcoronene series of benzenoid.

As presented in Figures 1 and 2, the first terms of this series are  $H_1 = \text{benzene}$ ,  $H_2 = \text{coronene}$ ,  $H_3 = \text{circumcoronene}$ ,  $H_4 = \text{circumcircumcoronene}$ , and the circumcoronene homologous series of benzenoid is just family of molecular graph consist several copy of benzene  $C_6$  on circumference.

For a planar molecular graph, a mapping is just a new drawing on the plane. The Capra operation is

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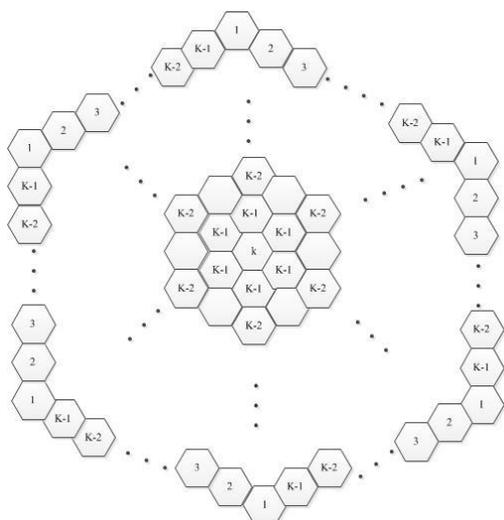


Figure 2. The circumcoronene series of benzenoid  $H_k$  for  $k \geq 1$ .

used to construct a new structure of a planar molecular graph. For a cyclic planar molecular graph  $G$ , the Capra map operation is obtained as follows:

- (i) insert two vertices on each edge of  $G$ ;
- (ii) add pendant vertices to the above inserted ones and
- (iii) connect the pendant vertices in order  $(-1,+3)$  around the boundary of a face of  $G$ . In terms of running these steps for each cycle of  $G$ , the Capra-transform of  $G$ ,  $Ca(G)$  is achieved.

Hence, the benzenoid series (see Figures 3 and 4) can be designed in view of iterating the Capra-operation on the hexagon (i.e. benzene molecular graph  $C_6$ ) and its Ca-transforms. In what follows, the Capra operation is denoted by  $Ca$ . Thus, Capra operation of arbitrary molecular graph  $G$  is  $Ca(G)$ , and we use  $CaCa(G)$  (or  $Ca_2(G)$ ) to express the iteration of Capra operation.

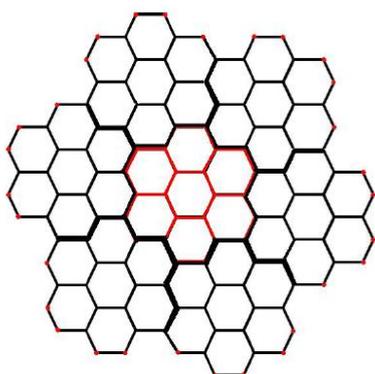


Figure 3. The structure of  $Ca_2(C_6)$ .

Although there have been several advances in Wiener index, Zagreb index, PI index, hyper-Wiener index and sum connectivity index of molecular

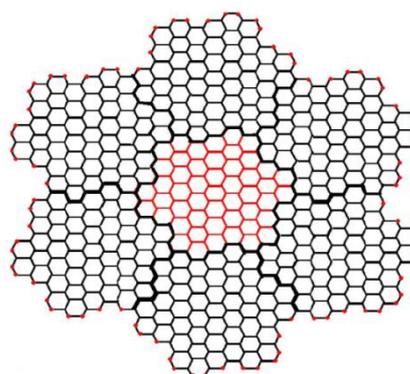


Figure 4. The structure of  $Ca_3(C_6)$ .

graphs, and sum connectivity index of molecular graphs, the study of reciprocal degree distance for special chemical structures has been largely limited. In addition, as widespread and critical chemical structures, Capra-designed planar benzenoids are widely used in medical science and pharmaceutical field. As an example, circumcoronene is one of the basic chemical structures and exists widely in benzene and alkali molecular structures. For these reasons, we have attracted tremendous academic and industrial interests to research the reciprocal degree distance of this molecular structure from a mathematical point of view.

The contribution of this paper is to determine the reciprocal degree distance of  $H_3$ .

## II. MAIN RESULTS AND PROOF

In this section, we consider the reciprocal degree distance of circumcoronene  $= H_3$ . We present the main results below.

### A. Theorem 1.

Let  $G = H_3$  be the circumcoronene. Then the reciprocal degree distance of  $G$  is equal to:

$$RDD(G) = 1962 \frac{12539}{13860}.$$

Before proving Theorem 1, we first introduce some notations, related to Figure 5.

Suppose  $\square_6 = \{0,1,2,3,4,5\}$  is the cycle finite group of order 6 (it can be regarded as the integer number of module 6). Let  $V(G)$  be the vertex set of  $G = H_3$  with  $|V(H_3)| = 54$  and  $E(G)$  the edge set with  $|E(H_3)| = 72$ . We show each vertex of  $H_3$  by automorphism  $f$  ( $f$  is bijection), such that:

$$f: V(G) \rightarrow \{u_i, v_i, x_i, y_i, z_i, t_i, a_i, b_i, c_i \mid i \in \square_6\},$$

and

$$f: E(G) \rightarrow \{v_i v_{i+1}, v_i u_i, u_i x_i, x_i y_i, y_i z_i, z_i t_i, t_i a_i, a_i b_i, b_i c_i, c_i a_i \mid i \in \square_6\}$$



Case6.

$$D_6(3,3) = \{(v_i, t_{i+3}), (v_i, z_{i+3}), (v_i, y_{i+3}), (u_i, x_{i+3}), (u_i, t_{i+2}), (u_i, t_{i-2}), (u_i, z_{i+2}), (u_i, z_{i-2}), (x_i, x_{i+2}), (x_i, y_{i-2}), (x_i, t_{i-1}), (y_i, y_{i+2}), (y_i, z_{i+1}), (z_i, z_{i+2}) \mid i \in \square_6\}.$$

$$D_6(3,2) = \{(v_i, a_{i+2}), (v_i, b_{i+2}), (v_i, c_{i+2}), (v_i, a_{i-2}), (v_i, b_{i-2}), (v_i, c_{i-2}), (u_i, a_{i-1}), (u_i, b_{i-1}), (u_i, c_{i-1}), (x_i, c_{i+2}), (y_i, a_{i-2}), (y_i, c_{i-2}), (z_i, c_{i-1}), (z_i, a_{i+1}), (t_i, b_{i-1}), (t_i, c_{i+1}) \mid i \in \square_6\}$$

$$D_6(2,2) = \{(a_i, b_{i+2}) \mid i \in \square_6\}.$$

Case7.

$$D_7(3,3) = \{(u_i, t_{i+3}), (u_i, z_{i+3}), (x_i, x_{i+3}), (x_i, y_{i+3}), (x_i, z_{i+2}), (x_i, z_{i-2}), (x_i, t_{i-2}), (y_i, y_{i+3}), (y_i, t_{i+2}), (y_i, t_{i-2}), (y_i, z_{i+2}), (z_i, t_{i-1}) \mid i \in \square_6\}.$$

$$D_7(3,2) = \{(v_i, a_{i+3}), (v_i, b_{i+3}), (v_i, c_{i+3}), (u_i, a_{i+2}), (u_i, b_{i+2}), (u_i, c_{i+2}), (u_i, a_{i-2}), (u_i, b_{i-2}), (u_i, c_{i-2}), (x_i, b_{i-1}), (y_i, a_{i+1}), (y_i, b_{i-2}), (z_i, c_{i+1}), (z_i, a_{i-2}), (t_i, c_{i-2}) \mid i \in \square_6\}$$

$$D_7(2,2) = \{(a_i, c_{i-1}), (b_i, c_{i+1}) \mid i \in \square_6\}.$$

Case8.

$$D_8(3,3) = \{(x_i, t_{i+3}), (x_i, z_{i+3}), (y_i, t_{i+3}), (y_i, z_{i+3}), (z_i, z_{i+2}), (z_i, t_{i-2}), (t_i, t_{i+2}) \mid i \in \square_6\}$$

$$D_8(3,2) = \{(u_i, a_{i+3}), (u_i, b_{i+3}), (u_i, c_{i+3}), (x_i, a_{i+2}), (x_i, a_{i-1}), (x_i, b_{i-1}), (x_i, c_{i-1}), (y_i, a_{i+2}), (y_i, b_{i+2}), (y_i, b_{i-1}), (y_i, c_{i+2}), (z_i, b_{i-1}), (t_i, a_{i+1}) \mid i \in \square_6\}.$$

$$D_8(2,2) = \{(a_i, c_{i+2}), (b_i, c_{i-2}), (c_i, c_{i+2}) \mid i \in \square_6\}.$$

Case 9.

$$D_9(3,3) = \{(z_i, z_{i+3}), (z_i, t_{i+3}), (t_i, t_{i+3}) \mid i \in \square_6\}.$$

$$D_9(3,2) = \{(x_i, a_{i+3}), (x_i, b_{i+3}), (x_i, c_{i+3}), (y_i, a_{i+3}), (y_i, b_{i+3}), (y_i, c_{i+3}), (z_i, a_{i+2}), (z_i, a_{i-2}), (z_i, b_{i-2}), (z_i, c_{i-2}), (z_i, c_{i+2})\}$$

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$$(t_i, a_{i+2}), (t_i, b_{i+2}), (t_i, b_{i-2}), (t_i, c_{i+2}) \mid i \in \square_6\}.$$

$$D_9(2,2) = \{(a_i, b_{i-1}) \mid i \in \square_6\}.$$

Case10.

$$D_{10}(3,2) = \{(z_i, a_{i+3}), (z_i, b_{i+3}), (z_i, c_{i+3}), (t_i, a_{i+3}), (t_i, b_{i+3}), (t_i, c_{i+3}) \mid i \in \square_6\}$$

$$D_{10}(2,2) = \{(a_i, a_{i+2}), (a_i, b_{i-2}), (a_i, c_{i-2}), (b_i, b_{i+2}), (b_i, c_{i+2}) \mid i \in \square_6\}$$

Case11.

$$D_{11} = \{(a_i, a_{i+3}), (a_i, b_{i+3}), (a_i, c_{i+3}), (b_i, b_{i+3}), (b_i, c_{i+3}), (c_i, c_{i+3}) \mid i \in \square_6\}$$

By our analysis in Case 1-11, we infer

$$RDD(G) = 396 + \frac{696}{2} + \frac{912}{3} + \frac{1026}{4} + \frac{1062}{5} + \frac{1008}{6} + \frac{894}{7} + \frac{714}{8} + \frac{515}{9} + \frac{300}{10} + \frac{108}{11} = 1962 \frac{12539}{13860}$$

### III. CONCLUSIONS

In our article, by virtue of the molecular graph structural analysis and mathematical derivation, we mainly report reciprocal degree distance of  $H_3$ . As the reciprocal degree distance is widely used in the analysis of oxidation procedure for chemical compounds, the theoretical conclusion obtained in this article illustrates the promising prospects of the application for the chemical and pharmacy engineering.

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## Prediction of Visitors Quantity Based on A Combined Method

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**Abstract:** Visitors quantity is regarded as the important economic indicator of weighing a country or regional tourism economic development, how to correctly and effectively predict regional visitors quantity according to relevant influencing factors is essential to the development of tourism economy. This paper firstly introduce several common prediction method principle, then according to the characteristics of visitors quantity, build combined prediction model based on neural network, Use fitting value got in front of three kinds of prediction method as input samples, use the corresponding to the actual value as the output samples, training the network learning, Amplify neural network to identify the weight of every prediction method, reduce subjective factors in the prediction process. The result shows that the method is feasible and effective, the results is accurate.

**Keywords:** Visitors quantity, prediction, combined method

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### I. INTRODUCTION

Prediction is the foundation and basis of decision. Using an appropriate prediction method to get tourism economy development rule and provide scientific basis for decision-making in the course of tourism economic development. Avoid economic and environmental loss caused by decision-making errors, it is necessary to realize the sustainable development of tourism, especial in regional tourism planning. Tourism market prediction is scientific or not, related to the tourism infrastructure, service facilities and ancillary facilities such as fixed asset investment and civil engineering is adequate, reception capacity is required, which is related to the whole tourism economy operation process. Therefore, the scientific tourism prediction play a decisive role in the begin development of tourism economy.

The current domestic visitors quantity prediction method can be divided into the following three categories: one is the extrapolation method, namely using past data to predict the future state, such as time series analysis; the second method is the law of cause and effect, according to the historical data, to find the relation between the variables to be forecasted and related variables, so as to predict the future state, as the regression analysis method; the third method is judgment analysis method, which mainly depends on the expert experience and comprehensive analysis ability to predict future states of [3].

Because of the diversity and complexity of tourism system influencing factors, although the current prediction methods have their advantages, but the data fit is not high, the prediction results have deviation from the actual value. Such as time sequence prediction method, using historical data of visitors quantity to predict the time trend, which does not take relative influencing factors into account; regression analysis method establish regression model based on some influencing factors that influence the amount of visitors quantity, but it only consider several influencing factors, Simulation ability to practical problems is not accurate. With the exception of the above methods, domestic scholars are still using some new artificial intelligence method to predict the visitors quantity.

As everyone knows, tourism science is a young discipline with only 20 years history in our country; it is still a difficult area to predict the tourism market. Compared with other industries, tourism industry has significantly volatility, and is easily affected by economic environment, political environment, unexpected incidents. Tourism is subject to the tourists' personal preferences, disposable income, paid time, enterprise marketing investment, product innovation and other factors in microcosm, it is difficult to strictly distinguish between endogenous and exogenous variables of tourism economic development. In addition, due to the development lag in China statistical system, many relevant statistical data about the development of tourism economy cannot be obtained. Therefore, research on the tourism market belongs to the "partial

information known, partly information unknown" "small sample, poor information, uncertain" system research. Based on this, this paper try to use multiple method mixed grey neural network and times series analysis to predict visitors quantity, then take Huanggang city as a example to demonstrate the feasibility of method.

## II. METHODS

### A. Artificial neural network

Artificial neural network (Artificial Neural Network ANN) is a large number of simple processing units connected neurons through extensive artificial network, the network can be used to simulate the brain nervous system function and structure. It can be known from data automatically induced rules, obtain the inherent laws of these data, and has strong nonlinear mapping ability, especially in the curve fitting with high accuracy.

At present, in the applications of the artificial neural network, the vast majority of neural network models are used in the error back propagation learning algorithm of feed forward neural network. BP neural network algorithm is as follows: The guiding ideology of BP neural network is: correct network weights ( $w_{ij}, T_{li}$ ), and threshold ( $\theta$ ), make difference function (E) drop along the negative gradient direction, Three layer of BP network nodes is represented as, input node:  $x_j$ , implicit node  $y_i$ , the output node  $o_l$ , the weight of the network between the output node and hidden nodes is  $w_{ij}$ , the weight between hidden nodes and the output node is  $T_{li}$ , the desired output the of output node is  $t_l$ , The basic calculation formula of BP algorithm is as follows:

The hidden node output

$$y_i = f \left\{ \sum_j w_{ij} x_j - \theta_i \right\} = f(net_i) \quad (1)$$

The output of output node

$$o_l = f \left\{ \sum_i T_{li} y_i - \theta_l \right\} = f(net_l) \quad (2)$$

$$\text{Function } f(x) = \frac{1}{1 + e^{-x}}$$

The relationship between

$$f'(x) = f(x)(1 - f(x))$$

$$\text{Then } f'(net_k) = f(net_k)(1 - f(net_k))$$

Output node

$$f'(net_l) = o_l(1 - o_l)$$

Hidden node

$$f'(net_i) = y_i(1 - y_i)$$

$$\text{Error control } E = \sum_{k=1}^p e_k < \varepsilon$$

$$\text{Error formula } \partial_l = (t_l - o_l)o_l(1 - o_l)$$

$$\text{Weighting formula } T_{li}(k+1) = T_{li}(k) + \eta \partial_l y_i$$

$$\text{Threshold formula } \theta_l(k+1) = \theta_l(k) + \eta \partial_l$$

### B. Time series regression analysis prediction method

When predicting visitors quantity in the use of time series regression analysis prediction method, firstly we should analyze the relation of visitors quantity between independent and dependent variables correlation, and then established the regression equation between variables, and use the regression equation as predictive model, predict the dependent variable relationship in prediction of the quantitative change according to the independent variables. Regression analysis prediction method has many types, according to the correlation between the number of independent variables of different classification, can be divided into unary regression analysis and multiple regression analysis prediction method, In a regression analysis prediction method of arguments is only one, while in the multiple regression analysis prediction method, has more than two independent variables. According to different relationship between the independent variables and dependent variables also can be divided into linear regression and nonlinear regression. Considering internal connection and law about the data of visitors quantity, and the law will affect the later development, this paper takes the time series regression analysis method, which is the application of past visitors quantity to speculate about the future development trend.

### C. Grey prediction method

When predicting visitors quantity in the use of grey prediction method, we use grey model (GM (1, 1) to solve sequence on the gray system. As a result of application of gray model data generating means, weakening the randomness of the disordered system, and make the original sequence showing a rule, Make no obvious rule becomes more obvious, and the model can identify on residual error. Using this method, even in less visitors quantity data, and data

is in arbitrary random distribution situation, the model also can get a higher precision of prediction.

If given original data series  $x^{(0)} = (x^{(0)}(1), x^{(0)}(2), \dots, x^{(0)}(n))$ , These data are irregular, random, have obvious swing, if accumulate the original data and generate new data column,  $x^{(1)} = (x^{(1)}(1), x^{(1)}(2), \dots, x^{(1)}(n))$ , in the above equation,  $x^{(1)}(i) = \sum_{k=1}^i x^{(0)}(k), i=1, 2, \dots, n$ . The new generation of data is a monotonic growth curve, increased the original data regularity, and weaken the fluctuation.

Grey system model is applied directly to the time series into a differential equation, namely, the abbreviation of grey dynamic model is GM, GM (1,1) contains a variable differential equation of first order dynamic model, GM (1,1) model of first order differential equation is:

$$\frac{dX^{(1)}(t)}{dt} + aX^{(1)}(t) = u \quad (3)$$

Use the least square method we can get

$$\hat{a} = \begin{vmatrix} a \\ u \end{vmatrix} = (B^T B)^{-1} B^T X_n \quad (4)$$

In the equation,

$$B = \begin{vmatrix} -\frac{1}{2}(X^{(1)}(1) + X^{(1)}(2)) & 1 \\ -\frac{1}{2}(X^{(1)}(2) + X^{(1)}(3)) & 1 \\ \dots & \dots \\ -\frac{1}{2}(X^{(1)}(n-1) + X^{(1)}(n)) & 1 \end{vmatrix} \quad (5)$$

$$X_n = \begin{vmatrix} X^{(0)}(2) \\ X^{(0)}(3) \\ \dots \\ X^{(0)}(n) \end{vmatrix} \quad (6)$$

$$X^{(1)}(K+1) = (X^{(1)}(0) - u/a)e^{-ak} + u/a \quad (7)$$

D. Combined prediction theory

Combined prediction method is to build a model, which is a prediction method use two or more than two different prediction methods yielded different predictive value by appropriate weighted average, finally take the weighted average value as the final prediction result. For a prediction problems, in a period of time the actual value,  $x_t$ , Combined prediction value  $y_t$  ( $t=1, 2, \dots, n$ ), the combined prediction model can be expressed as:

$$\begin{cases} y_t = \sum_{i=1}^m a_i u_{ti} \\ \sum_{i=1}^m a_i = 1 \end{cases} \quad (8)$$

Obviously, if want to make full of the advantages of each single prediction method, we should well identify weighted coefficient of various prediction methods. Currently there are many methods to determine weighted coefficient of the various single prediction method such as mathematical programming methods, neural network method, and the paper select the neural network method to determine the weighted coefficient.

III. RESULTS

E. Neural network prediction

When predicting in the use of neural network prediction, through repeated comparison and research combined with expert advice, ultimately determine the input layer of the neural network is 3, the output layer is 1, and the training samples divide into 10 groups, in 2000 ~ 2002 data to predict 2003, and so on. The MATLAB after operation is carried out, obtained Huanggang city visitors quantity fitting results and errors are shown in Table 1, the predictive values of the next few years are shown in Table 2.

Table 1. Fitting value and error of visitors quantity in Huanggang City based on the neural network model.

year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
fitting results(million tons)	229.2	251.1	286	312.1	340	507.9	742.7	747.9	909.4	688.9
error (%)	-0.7	0.4	2.02	-2.37	0.64	-0.005	-0.003	-0.0002	-0.001	0.001

Table 2. Visitors quantity forecast value based on the neural network model in Huanggang City.

Year	2014	2015	2016	2017	2018	2025
Forecast value (million tons)	1103	1227.9	1360.3	1500.4	1800.6	2412.5

F. Time series regression analysis forecast

In this paper, by means of SPSS software, to fit Huanggang city past years visitors quantity, use regression analysis method based on time series, get a regression analysis equation such as type 9,

Huanggang city visitors quantity fitting value and the error value is in Table 3, the predictive value is in Table 4.

$$y = 3.7919x^2 + 7.3523x + 139.49 \quad (9)$$

Table 3. Visitors quantity fitting value and the error value based on regression analysis forecast method in Huanggang city.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fitting value (million ton)	169.4	195.7	229.6	271.1	320.1	376.8	440.9	512.8	592.2	679.2	773.8	875.9
errors (%)	9.1	-15.6	-0.5	8.4	14.2	17.8	30.5	0.9	-20.2	-9.2	-14.9	27.2

Table 4. Visitors quantity forecast value based on regression analysis forecast method in Huanggang city.

Year	2014	2015	2016	2017	2018	2025
Forecast value (million tons)	800	952.4	1050	1171.9	1966.1	2894

In which  $x=1, 1, 2, \dots, 18$ (calculate the data represents 2000 year of Huanggang city visitors quantity, and so on.

G. Grey prediction

Considering the increase of original series dimension will affects the prediction results, this paper selects visitors quantity data in 2005 – 2012 Huanggang city as the raw data, in order to improve the prediction precision, take power function, exponential function model to preprocess the original data. That is the original series were multiplied by  $10^{-3}$  then  $a^{-x^m}$  ( $a > 1, m > 1$ ),

$a^{-x^m}$  ( $a > 1, m > 1$ ) transform, By calculations are comparison in the MATLAB, found that when  $\frac{1}{a} = 0.8, m=1.05$ , the accuracy is in the maximum, then set up GM (1,1) model, with the aid of the MATLAB analysis, Huanggang city visitors quantity data time response model type see type 10.

$$\hat{x}^{(1)}(t+1) = -45.5627e^{-0.020665t} + 46.5056 \quad (10)$$

Then exponential transform the fitting values and reduction obtained fitting values shown in Table 5.

Table 5. Fitting value and the error value of visitors quantity in Huanggang city based on Grey Theory.

year	2005	2006	2007	2008	2009	2010	2011	2012
Fitting value (million ton)	280.35	333.89	426.18	517.90	608.73	698.75	788.53	877.6
errors (%)	0	4.4	26.1	1.9	-18	-6.5	-13.3	27.4

Upon examination, the ratio of variance C was 0.4410, a small probability of error is 0.875, compare level reference table of grey forecasting accuracy (Table 6), the results are qualified, show that the

impact of prediction model can be accepted, and then use the time response model predicting visitors quantity value of Huanggang city in the next few years in Table 7.

Table 6. Grade reference table - testing of the accuracy.

Grade	P	C
Good(Class A)	>0.95	<0.35
Qualified	>0.8	<0.5
General	>0.7	<0.65
Unqualified	<=0.7	>=0.65

H. Based on neural network combined prediction

Use fitting value got in front of three kinds of prediction method as input samples, namely fitting the fitting value and the actual value obtained from

2005 in three methods, followed by analogy, sample number is 2005 ~2012, total data sets is 8, use the corresponding to the actual value as the output

samples, training the network learning, Amplify neural network to identify the weight of every predict method, reduce subjective factors in the prediction process. In network design, using the input layer is 3, the output layer is 1, the training samples is 8 group,

neurons is 5, get new fitting value in Table 8. Finally, prediction values got from three prediction methods as input samples, through the network to get the next few years Huanggang city visitors quantity forecasting values (Table 9).

Table 7. Visitors quantity forecast value of Huanggang city based on Grey Theory.

Year	2014	2015	2016	2017	2018	2025
Forecast value(million ton)	1054.2	1142.0	1229.4	1316.6	1576.4	2004.7

Table 8. Value of neural networks.

year	2005	2006	2007	2008	2009	2010	2011	2012
Fitting value (million ton)	282	278	298	504	734	742	913	694
errors (%)	0.57	-13.1	-11.9	-0.74	-1.25	-0.77	0.34	0.68

Table 9. Visitors quantity estimated value and the error value in Huanggang city based on combined prediction.

year	2014	2015	2016	2017	2018	2025
Prediction value(million ton)	1012.5	1243.1	1286.4	1417.8	1777.5	2355.7

According to the above results analysis and the deviation of fitting value and the actual value we can see that neural network combination forecast method is the most accurate, which shows that the method is feasible and effective results and accuracy, can be used for Huanggang city visitors prediction.

#### IV. DISCUSSION & CONCLUSIONS

Accurate prediction of visitors quantity can make tourism in the fierce market competition to reduce the risk, formulate reasonable tourism policy and launch a reasonable tourism product. This paper attempts to use the gray prediction model and the neural network prediction model of combined prediction. Finally, through an example to illustrate the method can effectively improve the prediction accuracy, reduce the prediction error. Based on the grey theory and neural network visitors quantity combined prediction model is proposed, extract the useful part of each single prediction model, But implementation of the combined prediction model is affected by many factors, how to improve the neural network's learning effect, determine the comprehensive prediction of nonlinear function and how to avoid every single prediction model provides a valid information, are in need of further study. Moreover, the method for short-term prediction is more effective and high precision, but for long term prediction is not necessarily to achieve satisfactory results, this is the learning direction in the study of combined prediction method to the direction of learning in the future.

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## Audition Performer Selection in Symphony Orchestras: Method of Fuzzy Preference Relations

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**Abstract:** This paper utilizes the method of fuzzy preference relations to select the audition performers in symphony orchestras. Pairwise comparisons based on consistent reciprocal additive transitivity are adopted to obtain the importance weights of evaluation criteria and to get the performance rating of tutti candidates with respect to each criterion. By multiplying the importance weights of evaluation criteria, and the performance ratings, the best candidate in symphony orchestras is determined. An illustrative example elicited from Southern Taiwan Pops Orchestra is used to demonstrate the selection procedures of this proposed approach.

**Keywords:** Symphony, orchestras, tutti candidates, audition procedures, fuzzy preference relations

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### I. INTRODUCTION

A professional symphony orchestra is a sophisticated organization consists of well-trained musicians, conductors, staff and board members, all of whom have skills to help the organization run well [1]. The core role of the orchestra is tutti. Principal conductors are the console of the orchestra with the responsibility of making long-term and short-term artistic repertoire, hiring performers, promoting programs, inviting soloists; as well as establishing the public image and remain the financial stability [2]. Therefore, to set up an efficient audition regulation seems the pivot of establishing an esteemed symphony orchestra [3]. The core value of symphony orchestra lies in the understanding for the tutti facing a composition on stage and making the audiences breathtaking [4]. Two musicologists, Bresin and Friberg [5] indicate the factors for evaluating the contributions of an orchestra include the mean values and ranges of the musical variables (tempo, sound level, articulation, register, and instrument). They also point out that music is a feeling of knowledge and aesthetics. A well-known symphony orchestra puts stress on the good quality of tone to satisfy audiences' acoustic comfortability [6]. A symphony orchestra is a bridge for music heritage, of which the orchestra directors attempt to prepare a serials of programs all the year. Therefore, the audition performers play significantly important roles in a symphony orchestra. The evaluation criteria for selecting the audition performers become the main philosophy for the musical organizations. This paper probes a systematic approach by utilizing the fuzzy preference relation to

help an orchestra forming his own regulations. An analytic hierarchy framework based on the consistent reciprocal additive transitivity for evaluate symphony orchestra to evaluate tutti quality is derived in Section III. In Section IV, an illustrative example is presented. Finally, discussion and conclusion are given in Section V.

### II. CONSISTENT FUZZY PREFERENCE RELATIONS

Frequently, the decision data is denoted with the format of preference relations in decision-making science. Herrera-Viedma et al. [7] initialize the methodology of consistent fuzzy preference relations, having the capability not only enables decision makers to express preference degree over a set of alternatives with the least pairwise comparisons, but also avoids examining the inconsistency occurred in AHP. Wan, Wang and Dong [8] use novel group decision making method with intuitionistic fuzzy preference relations for RFID technology selection. Chen and Chao [9] use fuzzy preference relation to select supplier. Chang [10] a study to possibility the win to license of microwave authority in Taiwan. Chang, Chang and Wang [11] measured the success possibility of implementing advanced manufacturing technology by utilizing the consistent fuzzy preference relations. Wang and C. [12] investigated the aggregation of fuzzy preference relations with an application to broadband internet service selection. Chao and Chen [13] evaluated the criteria and effectiveness of distance e-learning with consistent fuzzy preference relations. Wang and Lin [14] applied consistent fuzzy preference relations to select merger strategy for commercial banks in new financial environments. Chen and Chen [15] measured

fuzzy risk value by analyzing between interval-valued fuzzy numbers. Chang et al [16] developed an audit detection risk assessment system that uses fuzzy set theory. K., and S [17] applied the solving multi-period project selection problems with fuzzy goal programming based on TOPSIS and a fuzzy preference relation.

Given  $X = \{x_1, x_2, \dots, x_n, n \geq 2\}$  be a finite set of alternatives to be pairwise compared by a finite set of experts ( $E = \{e_1, e_2, \dots, e_m, m \geq 2\}$ ). We can assume that the experts' preference intensity toward the set of alternatives  $X$  may be represented in two ways [18]:

**(1) Multiplicative preference relation.** A multiplicative preference relation  $A$  on a set of alternatives  $X$  is indicated by a matrix  $A \subset X \times X$ ,  $A = (a_{ij})$ ,  $a_{ij}$  is the ratio of the preference degree of alternative  $x_i$  over alternative  $x_j$ ,  $A$  is assumed multiplicative reciprocal, that is

$$a_{ij} \otimes a_{ji} = 1 \quad \forall i, j \in \{1, \dots, n\} \quad (1)$$

**(2) Additive fuzzy preference relation.** An expert's preferences on a set of alternatives  $X$  is denoted by a positive preference relation matrix  $P \subset X \times X$ , with membership function:  $\mu_p : X \times X \rightarrow [0, 1]$ , where  $\mu_p(x_i, x_j) = p_{ij}$  indicates the ratio of the preference intensity of alternative  $x_i$  over alternative  $x_j$ . If  $p_{ij} = \frac{1}{2}$  implies indifference between  $x_i$  and  $x_j$  ( $x_i \sim x_j$ ),  $p_{ij} = 1$  indicates  $x_i$  is absolutely preferred to  $x_j$ ,  $p_{ij} = 0$  indicates  $x_j$  is absolutely preferred to  $x_i$ .  $P$  is assumed additive reciprocal, given by

$$p_{ij} + p_{ji} = 1 \quad \forall i, j \in \{1, \dots, n\} \quad (2)$$

Suppose there is a set of alternatives being associated with a multiplicative preference relation  $A = (a_{ij})$  with  $a_{ij} \in [\frac{1}{9}, 9]$ . Then the corresponding fuzzy preference relation  $P = (p_{ij})$  with  $p_{ij} \in [0, 1]$  to  $A = (a_{ij})$  is given as:

$$p_{ij} = g(a_{ij}) = \frac{1}{2}(1 + \log_9 a_{ij}) \quad (3)$$

A consistent fuzzy preference relation  $P$  on  $X = \{x_1, x_2, \dots, x_n, n \geq 2\}$  from  $n-1$  preference values  $\{p_{12}, p_{23}, \dots, p_{n-1n}\}$  can be constructed as follow.

$$B = \{p_{ij}, i < j \wedge p_{ij} \notin \{p_{12}, p_{23}, \dots, p_{n-1n}\}\} \quad (4)$$

$$p_{ji} = \frac{j-i+1}{2} - p_{i+1} - p_{i+1+2} \dots - p_{j-1j} \quad (5)$$

$$a = |\min\{B \cup \{p_{12}, p_{23}, \dots, p_{n-1n}\}\}| \quad (6)$$

$$P = \{p_{12}, \dots, p_{n-1n}\} \cup B \cup \{1 - p_{12}, \dots, 1 - p_{n-1n}\} \cup -B \quad (7)$$

$$f : [-a, 1+a] \rightarrow [0, 1], \quad f(x) = \frac{x+a}{1+2a} \quad (8)$$

### III. FRAMEWORK TO SELECT AUDITION PERFORMER IN SYMPHONY ORCHESTRAS BY UTILIZING FUZZY PREFERENCE RELATIONS

This section proposes an analytic hierarchy model based on fuzzy preference relations to select the audition performer in symphony orchestra. The procedures consist of: determining the importance weights of evaluation criteria, evaluating the performance rating of audition performer with respect to each criterion, and ranking the audition performers.

#### A. Identify the Evaluation Criteria for Audition Procedures

The evaluation criteria are derived through literature review, widespread investigation and consultation with several experts. They are: **Emotional Quotient (EQ)** (C1: Popularity from the audiences, the population of the audiences, conductor's demand, comfortability of the concert hall); **Musical expressiveness** (C2: intensity, tempo, expression skill); **Knowledges in musicology** (C3: history of musical instruments, the Middle Ages, Renaissance, Baroque, Classical, Romantic, Periods thru Jazz Ages.); **Knowledges in musicology** (C3: history of musical instruments, the Middle Ages, Renaissance, Baroque, Classical, Romantic, Periods thru Jazz Ages.); **Performing technique** (C4: quick response to the sudden tonality change, potted notes, ornaments, silence notes, dynamic, pause, trill, staccato fingering bowing and tonguing); **Family issues** (C5: marital status, financial pressure, residence and health).

#### B. Determining the Importance Weight of Evaluation Criterion

This study provides the experts linguistic variables quantified in a scale of  $[\frac{1}{9}, 9]$  to express their preferences about the importance weights of evaluation criteria (see Table 1) and the performance rating of feasible candidates (see Table 2) with respect to each criterion [19]. Fuzzy preference relations proposed by Herrera -Viedma et al. [7] are adopted in this study because it establishes a complete preference relation matrix that has  $n$  elements with the least  $(n-1)$  pairwise comparisons.

Table 1. Linguistic variables for the importance weight of criteria.

Definition	Intensity of importance
Equally important (EQ)	1
Weakly more important (WK)	3
Strongly more important (ST)	5
Very strongly more important (VS)	7
Absolutely more important (AB)	9
Intermediate values presenting compromise	2, 4, 6, 8

Table 2. Linguistic variables for the performance rating of alternatives.

Definition	Intensity of importance
Medium good (M)	1
Fairly good (FG)	3
Good (G)	5
Very good (VG)	7
Absolutely good (AG)	9
Intermediate values presenting compromise	2, 4, 6, 8

(1) The evaluators ( $E_k, k=1,2,\dots,m$ ) are inquired which is the more important of each two adjoining evaluation criteria ( $C_i, i=1,2,\dots,n$ ) for a set of  $n-1$  preference values  $\{a_{12}, a_{23}, \dots, a_{n-1n}\}$ , for example

$$A^k = \begin{matrix} & C_1 & C_2 & C_3 & \dots & C_n \\ \begin{matrix} C_1 \\ C_2 \\ C_3 \\ \vdots \\ C_n \end{matrix} & \begin{bmatrix} 1 & a_{12}^k & \times & \times & \times \\ \times & 1 & a_{23}^k & \times & \times \\ \times & \times & 1 & a_{34}^k & \times \\ \vdots & \vdots & \vdots & \ddots & a_{n-1n}^k \\ \times & \times & \times & \times & 1 \end{bmatrix} \end{matrix} \quad (9)$$

where  $a_{ij}^k$  denotes the preference intensity toward criterion  $i$  and criterion  $j$  assessed by  $k^{th}$  evaluator. The sign “ $\times$ ” indicates the remaining  $a_{ij}^k$  which can be obtained by inverse comparison methods.

(2) Use Equation (3) to transform the preference value  $a_{ij}^k \in [\frac{1}{9}, 9]$  into  $p_{ij}^k \in [0, 1]$ . The remaining  $p_{ij}^k$  can be calculated using Equations (2) and (5). If this preference matrix contains any values that are not included in the interval  $[0, 1]$ , then a transformation function is

required to preserve the reciprocity and additive transitivity, given by

$$f(p_{ij}^k) = \frac{p_{ij}^k + a}{1 + 2a}, \quad (10)$$

where  $a = |\min\{p_{12}, p_{23}, \dots, p_{n-1n}\}|$

(3) Utilize the method of average value to integrate the judgments of  $m$  evaluators, namely

$$p_{ij} = \frac{1}{m}(p_{ij}^1 + p_{ij}^2 + \dots + p_{ij}^m) \quad (11)$$

(4) Use  $r_{ij}$  to indicate the normalized fuzzy preference value of each criterion, such as

$$r_{ij} = \frac{p_{ij}}{\sum_{i=1}^n p_{ij}}, \quad i, j = 1, 2, \dots, n \quad (12)$$

(5) Given the  $\varpi_i$  denoting the importance weight of evaluation criterion  $i$ , the importance weight of which is obtained by

$$\varpi_i = \frac{\sum_{j=1}^n r_{ij}}{\sum_{i=1}^n \sum_{j=1}^n r_{ij}} \quad (13)$$

*C. Evaluating the Performance Rating of Feasible Alternatives with Respect to Each Criterion*

The evaluators are invited to express their subjective judgments regarding the performance ratings of feasible alternatives ( $A_u, u=1,2,\dots,t$ ) with respect to each criterion by using linguistic variables, as listed in Table 2.

(1) Under each criterion, the evaluators are asked to compare the performance rating of adjoining alternatives for a set of  $t-1$  preference data  $\{b_{12}, b_{23}, \dots, b_{t-1t}\}$ , for example

$${}_i B = \begin{matrix} & A_1 & A_2 & A_3 & \dots & A_t \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_t \end{matrix} & \begin{bmatrix} 1 & {}_i b_{12}^k & \times & \times & \times \\ \times & 1 & {}_i b_{23}^k & \times & \times \\ \times & \times & 1 & {}_i b_{34}^k & \times \\ \vdots & \vdots & \vdots & \ddots & {}_i b_{t-1t}^k \\ \times & \times & \times & \times & 1 \end{bmatrix} \end{matrix} \quad (14)$$

where  ${}_i b_{uv}^k$  represents the performance rating assessed by  $k^{th}$  evaluator for alternative  $A_u$  and alternative  $A_v$  with respect to evaluation criterion  $i$ .

(2) Using Equation (3), the performance rating  ${}_i b_{uv}^k$  is transformed into  ${}_i q_{uv}^k$  in a scale  $[0, 1]$ . If this preference matrix contains any values that are not included in the interval  $[0, 1]$ , then a transformation function is required, given by

$$f({}_i q_{uv}^k) = \frac{{}_i q_{uv}^k + a}{1 + 2a} \quad (15)$$

where  $a = |\min\{q_{12}, q_{23}, \dots, q_{t-1t}\}|$

(3) Synthesize the different judgments of  $m$  evaluators, namely

$${}_i q_{uv} = \frac{1}{m}({}_i q_{uv}^1 + {}_i q_{uv}^2 + \dots + {}_i q_{uv}^m) \quad (16)$$

(4) Take  ${}_i \lambda_u$  to indicate the normalized performance rating of alternative  $A_u$  with respect to evaluation criterion  $i$ .

$${}_i \lambda_u = \frac{{}_i q_{uv}}{\sum_{u=1}^t \sum_{v=1}^t {}_i q_{uv}}, \quad u, v = 1, 2, \dots, t \quad (17)$$

#### D. Ranking the Alternatives

Ranking the alternatives by the performance value  $Q$  which is defined as

$$Q_u = \sum_{i=1}^n {}_i \lambda_u \varpi_i \quad (18)$$

where  $\varpi_i$  is the importance weight of evaluation criterion  $i$ , and the best alternative is the one which has the largest performance value  $Q$ .

### IV. EMPIRICAL ANALYSIS

This study chooses the Southern Taiwan Pops Orchestra as an example to demonstrate the proposed procedures. Four feasible candidates are selected by 5 experts with respect to 5 major aspects (including 23 sub-criteria). Analytic hierarchy selections based on the consistent fuzzy preference relations are used to deal with this multiple criteria selection problem. The computations of this proposed framework are narrated as follows.

#### A. Weighting Calculation for Evaluation Criteria

Pairwise comparisons for these 5 major evaluation criteria are obtained via a series of interviews with 5 evaluators. The following examples clarify the computational process involved in obtaining the importance weights of evaluation criteria using the consistent fuzzy preference relations.

(1) The pairwise comparison matrices derived from 5 evaluators for a set of 4 adjoining evaluation criteria  $\{a_{12}, a_{23}, a_{34}, a_{45}\}$  are listed in Table 3.

Table 3. Linguistic terms assigned for 5 criteria by 5 evaluators.

	$E_1$	$E_2$	$E_3$	$E_4$	$E_5$	
$C_1$	VK	LVS	LVS	LST	LAB	$C_2$
$C_2$	ST	EQ	VS	VS	SW	$C_3$
$C_3$	VS	LVLA	LVS	LVS	LVS	$C_4$
$C_4$	AB	VS	AB	AV	VS	$C_5$

(2) Using Equation (3) to transform the linguistic variables quantified in  $[\frac{1}{9}, 9]$  listed in Table 3 into an interval  $[0, 1]$ , taking  $E_1$  as an example and yielding the following values:

$$\begin{aligned} a_{12} = WK = 3, & \quad p_{12} = (1 + \log_9 3)/2 = 0.750 \\ a_{23} = ST = 5, & \quad p_{23} = (1 + \log_9 5)/2 = 0.866 \\ a_{34} = VS = 7, & \quad p_{34} = (1 + \log_9 7)/2 = 0.943 \\ a_{45} = AB = 9, & \quad p_{45} = (1 + \log_9 9)/2 = 1.000 \end{aligned}$$

(3) Using Equation (11), the aggregated pairwise comparison matrix is obtained. The result is shown in Table 4.

Table 4. Aggregative matrix of importance weight of criteria.

	$C_1$	$C_2$	$C_3$	$C_4$	$C_5$
$C_1$	2.500	1.356	1.953	1.298	2.768
$C_2$	3.644	2.500	1.977	2.441	3.909
$C_3$	3.047	1.906	2.500	1.766	3.314
$C_4$	3.702	2.559	3.154	2.500	3.969
$C_5$	2.232	1.091	0.913	1.031	2.500
Total	15.125	9.466	10.497	9.036	16.46

The importance weight and rank of each evaluation criterion is then obtained by Equations (12) and (13), and the results are listed in Table 5. Taking  $\varpi_1$  as an example,

$$r_{11} = \frac{2.5}{2.5 + 3.644 + 3.047 + 3.702 + 2.232} = 0.165$$

$$\varpi_1 = \frac{0.165 + 0.143 + 0.186 + 0.143 + 0.168}{0.827 + 1.340 + 1.073 + 1.367 + 0.707} = 0.141$$

Table 5. Normalized matrix of importance weight and rank of evaluation criteria.

	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	Weight ( $\varpi_i$ )	Rank
C <sub>1</sub>	0.165	0.144	0.207	0.142	0.168	0.156	4
C <sub>2</sub>	0.241	0.266	0.329	0.268	0.238	0.252	2
C <sub>3</sub>	0.201	0.202	0.266	0.202	0.201	0.202	3
C <sub>4</sub>	0.245	0.272	0.335	0.274	0.241	0.257	1
C <sub>5</sub>	0.148	0.116	0.179	0.113	0.152	0.133	5

The results show that the importance order of 5 evaluation criteria is: performing technique (0.257) > Musical expressiveness (0.252) > knowledges in musicology (0.202) > EQ management (0.156) > family issues (0.133).

**B. Calculating the Performance Rating of All Feasible Candidates with Respect to Criterion**

The performance rating for all feasible candidates is calculated as follows.

- (1) These 5 experts are asked to assess which candidate is better than another according to each evaluation criterion. The linguistic variables derived from Evaluator 1 are used as examples and listed in Table 6. The linguistic terms are translated into corresponding numbers, then into the interval  $[\frac{1}{9}, 9]$  and finally in  $[0, 1]$ .

Table 6. Evaluator 1 pairwise compares the alternative in criterion 1 with linguistic variables.

	E <sub>1</sub>	A1	A2	A3	A4
C <sub>1</sub>	A1	X	LG		
	A2		X	MF	
	A3			X	AG
	A4				X

Table 7. Linguistic terms translated into number.

	E <sub>1</sub>	A1	A2	A3	A4
C <sub>1</sub>	A1	0.500	0.134	0.291	0.791
	A2	0.866	0.500	0.658	1.158
	A3	0.709	0.342	0.500	1.000
	A4	0.209	-0.158	0.000	0.500

- (2) Since there are values in Table 7 being not in the range of  $[0, 1]$ , this study uses Equation (15) to transform the values. The transformed results are shown in Table 8. This study finds that the absolute value of minimum in Table 7 is 0.158, so the  $f(q_{12}^1) = \frac{0.134+0.158}{1+2*0.158} = 0.222$ .
- (3) Use Equation (16) to aggregate the different experts' preference, the aggregated decision matrix is shown in Table 9.
- (4) Using Equation (17) to normalize the performance rating of 4 feasible candidates with respect to evaluation criteria. The results are listed in Table 9.

Table 8. Transformed numbers.

	E <sub>1</sub>	A1	A2	A3	A4
C <sub>1</sub>	A1	0.500	0.222	0.340	0.722
	A2	0.778	0.500	0.620	1.000
	A3	0.659	0.380	0.500	0.880
	A4	0.278	0.000	0.120	0.500

**C. Ranking the Performance Rating of 4 Feasible Candidate**

Using Equation (18) to multiply the importance weights of evaluation criteria by the performance ratings of candidate, an aggregative performance value  $Q_u$  for audition performer  $A_u$  is obtained. Generally speaking, the performance value is the large-the-better. Taking  $Q_3$  as an example.

$$Q_3 = (0.156 \times 0.329) + (0.252 \times 0.187) + (0.202 \times 0.316) + (0.257 \times 0.269) + (0.133 \times 0.312) = 0.271$$

The performance values of 4 feasible candidates are listed in Table 10. The ranking of 4 candidates is  $Q_3 > Q_1 > Q_4 > Q_2$ . The best candidate is A3.

Table 9. Aggregated and normalized decision matrix.

	A1	A2	A3	A4	NORM	
C <sub>1</sub>	A1	2.500	1.558	0.798	1.489	0.159
	A2	3.442	2.500	11.098	2.431	0.253
	A3	4.202	3.902	2.500	3.190	0.329
	A4	3.511	3.171	1.810	2.500	0.260
	A1	A2	A3	A4	NORM	
C <sub>2</sub>	A1	2.500	2.940	1.538	2.269	0.231
	A2	2.060	2.500	1.098	1.829	0.187
	A3	3.462	3.902	2.500	3.231	0.327
	A4	2.731	3.171	1.769	2.500	0.254
	A1	A2	A3	A4	NORM	
C <sub>3</sub>	A1	2.500	2.896	2.226	3.927	0.289
	A2	2.104	2.500	1.830	3.531	0.249
	A3	2.734	3.170	2.500	4.200	0.316
	A4	1.703	1.459	0.800	2.500	0.146
	A1	A2	A3	A4	NORM	
C <sub>4</sub>	A1	2.500	2.829	2.460	2.807	0.265
	A2	2.171	2.500	2.131	2.478	0.232
	A3	2.540	2.869	2.500	2.847	0.269
	A4	2.193	2.522	2.153	2.500	0.234
	A1	A2	A3	A4	NORM	
C <sub>5</sub>	A1	2.500	3.207	1.998	2.782	0.262
	A2	10793	2.500	1.291	2.075	0.191
	A3	3.002	3.709	2.500	3.284	0.312
	A4	2.218	2.925	1.716	2.500	1.000

\* NORM: Normalization value

Table 10. Performance value and rank of 4 hospitals.

	A1	A2	A3	A4
Q	0.244	0.222	0.308	0.225
Rank	<b>2</b>	<b>4</b>	<b>1</b>	<b>3</b>

## V. CONCLUSION

The excellent playing quality of the performer is a critical factor influencing the management and survival for a symphony orchestra. This approach is based on the reciprocal additive consistent fuzzy preference relations, rather than conventional multiplicative preference relation. That is to say, this approach takes only  $n-1$  pairwise comparisons, however the traditional AHP conducts  $\frac{n(n-1)}{2}$  judgments in a preference matrix with  $n$  essentials, it is clear that the proposed approach is faster to compute and more efficient than the conventional pairwise comparison methodologies. According to the importance weights of evaluation criteria, the professional capability and service attitude are more important than other criteria.

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