Research and suggestion on urban transformation in Tangshan City

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Abstract

Tangshan is a Resource-based city which have rich coal, iron and steel, petroleum resources . the city industrial transformation and sustainable development is like a major systems engineering involving economic, resource, environmental, social demographic and so on . This paper analyzes the current situation of Tangshan economic development, based on the improved system dynamics model and the introduction of the concept of shadow efficiency. we Established the evaluation model of urban transformation combining with industry evaluation index system. analysising of the main industries in the transition process of development effectiveness and competitive edge. taking into account the economic , social and environmental benefits, industry transformation and competitive advantage derived composite score. selecting the transition process of restructuring and development of priority sectors, to make reasonable suggestions for future development of the city.

Keywords

City transformation, system dynamics, resource based city, shadow effect.

1. Preface

Tangshan is the "modern industrial cradle" reputation. The famous Kailuan coal mine was founded in 1878, China's modern development of the earliest coal enterprises, is currently the state-owned large coal production base. It has proven reserves of about 7.1 billion tons .There are Linxi, Zhaogezhuang, Lu Jiatuo 8 wells, with an annual output of more than 50 million tons of coal. Tangshan Iron and Steel enterprises in a large amount, Tangshan Iron and Steel industry has completed a total of 84.336 million tons of pig iron, crude steel 82.67 million tons, 11.1993 million tons of steel in 2015, which output is greater than the sum of the United States and the European Union. It can be seen that Tangshan is a typical resource-based city, its development has a resource-based city distinctive cyclical [1] features, inevitably go through the development period, increasing production period, stable production period, recession and other resource-based cities Development stage [2]. According to the contents of the Urban Development Bulletin in recent years, Tangshan is now facing such problems as serious environmental pollution, decreasing resources, slow or even shrinking economic growth ,irrational industrial structure, regional financial turnover difficulties and so on. In seeking urban sustainable development, transformation and other aspects should be a reasonable plan to improve the urban ecological environment, reduce unemployment, to achieve healthy development of the industry and maintain social stability.

Based on the analysis of Tangshan economic and social development status and industrial structure, the application of new economic growth theory and sustainable development theory, based on the system dynamics model [3] improved industrial input-output relationship model, analysis of the input and output of various industries Than in the consideration of economic and environmental benefits under the premise of choice in the process of urban transformation in the priority development of the industry, looking for the future direction of Tangshan transformation, and put forward a reasonable future urban development proposals.

2. Current Situation and Challenges of Economic Development in Tangshan City

Tangshan is the birthplace of modern Chinese industry, located in the center of Bohai Bay, the eastern region of Hebei Province, with a total area of 17040 square kilometers, rich in natural resources [4].The city is rich in iron ore resources, its reserves of 6.2 billion tons, One of the three major iron ore concentration area, the territory is rich in gold resources; energy resources are very rich, large-scale coal mining has been 100 years of history, coal reserves of 6.25 billion tons, annual output of more than 50 million tons, Oil and natural gas from the beginning of the census in 1956, 1934 to carry out oil geological survey, has found five oil and gas fields, oil-bearing areas are more Jidong Oilfield, one of the characteristics of oil geology, the new proven reserves in 2007 10 Billion tons of large oil fields. Tangshan City, the main pillar industry around the exploitation and use of natural resources, natural resources and energy mining increased year by year.

Through statistical yearbook , in recent years, from the oil and mineral resources, mining and processing increased year by year to promote the employment of related mining industry, bringing considerable economic growth and fiscal revenue, but also brought a series of social problems, Such as reduced resources, increased air pollution, and increased prevalence of respiratory illnesses.

In recent years, due to excess steel production capacity, price fluctuations, the international oil prices and other factors, Tangshan City, gross domestic product (GDP) growth slowed down, fiscal revenue and expenditure decline, CPI growth faster, affecting the lives of residents Level:

Table1 the economic indicators of Tangshan City in recent years

Project	2000	2005	2010	2015
CPI	100.00	106.15	121.45	136.80
Non-agricultural population (million people)	190.71	229.95	247.41	254.01
Total household population (ten thousand)	699.79	714.51	735.00	755.00
Gross Domestic Product (100 million yuan)	915.05	2027.64	4469.08	6103.10
The proportion of the primary industry (%)	18.90	13.30	8.70	8.50
The proportion of the second industry (%)	50.50	56.70	58.90	58.70
The proportion of the tertiary industry (%)	30.60	30.00	32.40	32.80
Local fiscal revenue (100 million yuan)	48.14	226.46	438.95	566.50
Local fiscal expenditure (100 million yuan)	40.50	127.79	331.19	524.66
Residents' per capita disposable income (yuan)	6802	10488	19556	23465

It can be seen from Table 1 that the population of Tangshan City is increasing and the GDP is increasing year by year. The proportion of the primary industry has decreased by about 10% from 2000 to 2015, the proportion of the secondary industry has increased from 50.50% to 58.70% The proportion of tertiary industry increased from 30.60% to 32.80%. At present, it is more prominent that the proportion of the secondary industry is too heavy, so that the region in the settlement of excess capacity problems faced difficulties, although the development of the tertiary industry to a certain extent, alleviate this phenomenon, but to truly realize the transformation of Tangshan City, City economic development situation, still face great challenges.

3. Urban transformation evaluation model

3.1 Improved system dynamics model

According to the theory of economic growth, the production function reveals the economic and technical links between different input elements and outputs under certain technical level [5]. Investment elements are divided into: capital investment, labor input, human capital investment three categories. The total production function is:

$$Y_t = A_t f(L_t, K_t, H_t) \quad (1)$$

In formula, Y_t indicates the output, A_t expressed the contribution rate of scientific and technological progress, L_t said labor input, K_t show capital input, H_t said capital investment, t shown time.

Now examine the impact of the total investment in each sector x on the industry's output Y, order $x = a[A_t(L_t, K_t, H_t)]$, have:

$$Y = af(x) \tag{2}$$

In formula, a is adjustment coefficient,GDP is used to calculate the total output of each industry,have:

$$GDP = Y_1 + Y_2 + ... + Y_n = \sum_{i=1}^{n} Y_i \tag{3}$$

In formula: Y_i show the GDP of i industry.(3) to differentiate, get:

$$dGDP = \sum_{i=1}^{n} dY_i = \sum_{i=1}^{n} \frac{dY_i}{GDP} GDP$$

Call GDP growth rate is g, the proportion of the number i industries in GDP is W_i, the growth rate of i industries is g_i, E_i is the Contribution rate of economic growth of i industries, so the Contribution rate of economic growth of i industries is:

$$E_i = (\frac{dY_i / Y_i}{dGDP} \times \frac{Y_i}{GDP}) = \frac{g_i}{g} \times W_i = g_i \cdot W_i / g$$

Economic growth pull of i industries is:

$$Z_i = g_i \cdot W_i$$

It can be seen that the economic growth of various industries led to the growth of total GDP.

Considering the impact of investment Δt in the future on the promotion of the industry, we introduce the concept of shadow benefit: shadow effect refers to the future increase in investment in an industry sector, the growth rate of its output growth. According to its growth function of the concavity and convexity to measure the growth potential, so for (2) for the second derivative:

$$Y_i'' = af''(x_i) = a\frac{d}{dx_i}(\frac{dY_i}{dx_i}) = a\frac{d^2Y_i}{dx_i^2} \tag{4}$$

If $Y'' > 0$, forever have $f(\frac{x_{i1} + x_{i2}}{2}) > \frac{f(x_{i1}) + f(x_{i2})}{2}$, It is said that the growth function is concave function,Said that the future time, continue to increase investment in the industry, its growth rate continues to increase, the future increase in investment effective ; if $Y'' < 0$, forever have $f(\frac{x_{i1} + x_{i2}}{2}) < \frac{f(x_{i1}) + f(x_{i2})}{2}$, It is said that the growth function is a convex function, in the future time, continue to increase investment in the industry, its growth rate slowed down, the future increase in investment is invalid, should reduce the input to the industry; when the function inflection point, the growth rate of convex Change, to give due consideration to the increase or decrease in investment.

The growth function of the industry can be calculated according to the "China Input-Output Table". The fitting curve shows the approximate relationship between input and output. It can judge the growth potential of each industry and combine the actual situation of the city to determine the future development direction of the city industry.

3.2 Evaluation Index System of Industrial Transformation

Based on the basic principles of the design of the evaluation index system [6], this paper uses the experience of the domestic and international industrial transformation evaluation system to construct the following evaluation index system by using the analytic hierarchy process content

If b_1:Shadow benefit, b_2:Economic contribution rate, b_3:Environmental benefit, b_4:Social results, we use $a_{ij}=\frac{b_i}{b_j}$ show the i factor importent for the j factor,use1-9 to measure the degree of importance. The higher the value, the higher the importance. USe $a_{ji}=\frac{b_j}{b_i}$, to make the Comparison matrix (Reciprocal matrix):

$$A=\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$

Get the eigenvector of the above matrix $w=(w_1,w_2,w_3,w_4)^T$ show four factors in the industry evaluation index system in the weight. The above weight should be tested as a weight vector.

4. Empirical analysis

4.1 Input-output analysis

According to the data of "Tangshan City Statistical Yearbook" and "China Input-Output Table" [7], the SPSS software was used to analyze the principal component analysis, select agriculture, forestry, animal husbandry and fishery, coal mining and washing industry, oil and gas extraction industry, Metal processing industry, electrical and mechanical equipment manufacturing, electric power production and supply industry 10 industries as the object of study, extracted from the input and output table The data is shown in Table 2 below:

Table 2 Ten industry input-output table （Unit: million）

	Agriculture, forestry, animal husbandry and fishery		Coal mining and washing industry		Oil and gas extraction industry		Metal dressing		Oil processing, coking industry	
Year	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output
2012	370625314	894213470	114130877	225082366	47715344	122639212	76176612	124815555	325716678	400131722
2010	287862000	693198000	109017130	201661338	47201000	116732519	74565879	114098978	241663717	301486097
2007	202338262	488930000	52160456	96450530	38382759	95348874	39825182	61493459	173224493	210745642
2002	119482762	285787423	17306415	40109089	9423477	32633053	8271704	14524833	50382592	60846185
1997	99357988	246773827	10834977	22274791	4271604	16313945	7714194	11947826	24147138	30981911
1995	81827721	203410000	6255510	13315130	5989315	15036050	4623876	7435442	19585009	26446779
1987	14736690	46757000	1093344	2729554	639420	2652151	442475	915305	2537579	4248565

	chemical industry		Metal smelting and processing industry		Transportation manufacturing		Electrical and mechanical equipment manufacturing		Electricity, heat production and supply	
Year	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output
2012	1259100721	1592027903	1026123774	1423397995	517989192	646565010	649951253	794759633	361390935	486933591
2010	751960361	932510585.3	674616260	820817921	474890674	587033598	385936583	458949435	327867229	437484871
2007	494052772	619980926	491673010	610959762	265551634	329784416	225272256	271550146	226761363	314859884
2002	157633500	215726168	116183831	153676938	71174728	96466983	54025039	71216365	39492371	79116903
1997	111267717	152122332	61910052	77750306	39208989	53138393	43177916	55600362	22205940	39087093
1995	89787659	120853100	58634281	80103350	30734209	40506990	300336296	39843400	15124208	29338950
1987	12274290	18161240	7355460	10864780	2813716	4011614	4199244	5959155	1670881	3943149

According to the data in the above table, we have fitted the corresponding input-output relationship curves of these ten industries, as shown in Figure 4. It can be seen from the graphs that the functions of agriculture, forestry, animal husbandry and fishery, petroleum processing industry and chemical industry The mining industry, the electrical and mechanical manufacturing industry, the electric power production and supply industry, the coal mining and the washing industry, the metal mining industry, the function of the convex function of the form, the shape of the function of the metal mining industry, The oil and gas extraction industry, oil processing and coking industry, the two functions of the two forms of trade, in considering the industry investment should be selected concave section of the sector to invest in the investment, So that a reasonable proportion of production.

According to the country's input-output situation, select some industries and enterprises in Tangshan City as a priority in the process of urban transformation. In the choice of industry, we must take into account the specific socio-economic situation in Tangshan, but also scientific optimization objectives, in order to improve the reliability of choice, we will combine the industry evaluation index system analysis

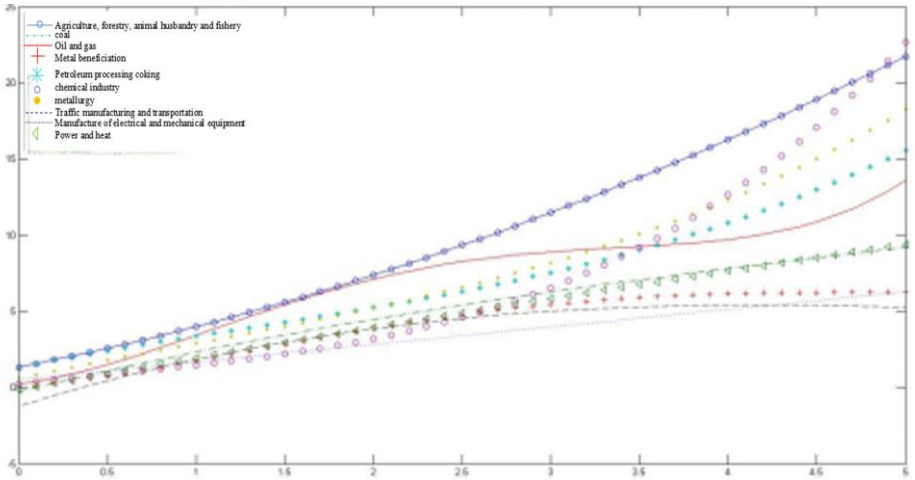

Figure1 Ten industry input-output curve

4.2 Industry evaluation index system

According to the domestic research method [8], we choose the four factors: shadow benefit, economic contribution rate, environmental benefit and social benefit to quantitatively examine the decision-making problem in the process of industry selection. According to the expert scoring situation, we get the following comparison matrix:

$$A=\begin{bmatrix} 1 & 5 & 3 & 2 \\ \frac{1}{5} & 1 & \frac{1}{4} & \frac{1}{3} \\ \frac{1}{3} & 4 & 1 & 2 \\ \frac{1}{2} & 3 & \frac{1}{2} & 1 \end{bmatrix}$$

The maximum eigenvalue of the matrix is $\lambda^{*}=4.1383$,The pairing comparison matrix is tested for consistency, get $CR=\frac{CI}{RI}=0.0983<0.1$,Through the consistency test,So its normalized eigenvector $w=(0.4816,0.0713,0.2608,0.1864)^{T}$ can be used as the weight of the four rating indicators.Above has been the second layer of the first layer of the weight vector, with the same method to construct the third layer of each industry on the second layer evaluation factors of the pair of comparative matrix, Calculate the weight vector $w_k^{(3)}$ maximum eigenvalue λ_k and consistency test index CI_K Included in the following table:

Table 3 Factor score

k	1	2	3	4	Composite score	ranking
$w_k^{(3)}$	0.377	0.236	0.429	0.193	0.346	9
	0.563	0.382	0.265	0.458	0.453	4
	0.542	0.553	0.326	0.587	0.495	2
	0.243	0.305	0.587	0.175	0.324	10
	0.583	0.602	0.298	0.191	0.437	6
	0.605	0.411	0.397	0.216	0.464	3
	0.423	0.251	0.142	0.506	0.353	8
	0.451	0.224	0.461	0.523	0.451	5
	0.476	0.412	0.499	0.642	0.508	1
	0.392	0.200	0.341	0.743	0.430	7
λ_k	3.005	2.971	3.000	3.009		
CI_K	0.021	0.014	0.017	0.029		

After obtaining the pairwise comparison matrix of the third layer, the weight vector can be calculated, and the weight vector of the two layers is multiplied and multiplied, and the combined weight vector is obtained, and finally the comprehensive score is obtained.Calculated as follows:

$$F_n = 0.4816x_{n1} + 0.0713x_{n2} + 0.2608x_{n3} + 0.1864x_{n4}$$

$F_1 = 0.377 \times 0.4816 + 0.263 \times 0.0713 + 0.429 \times 0.2608 + 0.193 \times 0.1864$,among x_{ni} show the n indursty of the i weight will choice 10 Sample industry into the formula. The results are shown in Table 3 above.

According to the calculation results, it can be seen that the mechanical equipment manufacturing industry, the oil and gas extraction industry, the chemical industry, the coal mining industry and the transportation and manufacturing industry have higher scores in the comprehensive evaluation and occupy the advantages in the competition. PetroChina processing industry, the input and output function of the chemical industry presents concave function form, suitable for increasing investment, oil and natural gas extraction industry should pay attention to the investment interval investment, so that a reasonable production ratio. Therefore, the development of coal mining and metallurgical steelmaking and other industries should be controlled to meet the long-term development strategy, through industrial upgrading and industrial chain extension of the transformation [9]; in the chemical industry and oil processing industry may be appropriate to increase investment, The upgrading of the industrial chain, making it a pillar industry in the process of transformation of Tangshan city; for machinery and equipment manufacturing and transportation, because of its input and output trend down, but in the industry more competitive advantage, can maintain the existing Investment scale under the premise of optimizing the investment structure, increase investment in research and technological upgrading of investment.

Tangshan is now the formation of coal, steel-oriented heavy industry cluster model development, the current municipal government in response to national policy and with the "Beijing-Tianjin-Hebei integration" regional construction requirements, to ensure the existing economic volume under the premise of the gradual reduction of resources The development of the oil industry, equipment manufacturing and chemical industry policy, financial support, the current construction of Caofeidian petrochemical base, Fengrun EMU R & D production base and heavy equipment industrial park, focusing on supporting coal chemical and petrochemical enterprises Construction, to build oil and gas processing as the pillar industry, equipment manufacturing and EMU R & D and production for the new growth point, chemical industry as the support of the industrial cluster development model, this model in Tangshan economic development occupies a large proportion. According to the principle of

shadow benefit and comparative advantage of industrial evaluation, in the process of transformation can continue to increase the investment in these industries, taking into account the environmental and social benefits, so Tangshan can use the "industrial chain extension upgrade + industry replacement" Integrated development model.

5. Industrial development proposals

Tangshan City, iron and steel, energy, building materials, equipment, chemical and other traditional industries have a solid foundation, has become a pillar of regional economic development, but the traditional industry is not strong, low-level enterprises to repeat the construction of serious, leading to large and not high, In the process of industrial restructuring and optimization should strive to solve the extensive, low-end, homogeneous development dilemma.

Tangshan City, the leading steel production in the world, but also faced with overcapacity, the lack of market competitiveness. Iron and steel enterprises should be in the basic market demand to meet the premise of reducing crude steel production, increase the steel and special steel R & D investment and industrial upgrading support to reduce the consumption of steel resources to enhance the competitiveness of enterprises in the domestic and international markets , Some enterprises can be extended to chromium, nickel, manganese and other non-ferrous metals industry, to achieve industrial diversification, differentiation of competition. The use of existing steel advantages, focusing on building large-scale port machinery, complete sets of equipment, high-speed train manufacturing, shipbuilding, professional industry lathe machinery production and other industrial clusters, and gradually the equipment manufacturing industry has become an important support industry, play a resource advantage, Geographical advantages, ease the excess capacity of the steel industry, Tangshan will be built into northern China production equipment manufacturing base.

Speed up the development of modern industry, the establishment of a new oil - coal recycling economy development model to focus on oil, relying on Caofeidian Industrial New Chemical Base, with high value-added, deep processing of petrochemical industry chain. Fostering key enterprises in Kailuan Group as the leading enterprises, speed up regional development, cluster industrial base construction, encourage coal charcoal joint, steel coke joint, coking and other new cooperative mode, and promote deep processing of coal tar. Crude benzene refining, methanol series of three major chemical industry chain cross. Efforts to build chemical industry development of circular economy model, training highly competitive chemical enterprises.

6. Summary

Based on the analysis of Tangshan's economic development, Tangshan is a city with abundant natural resources. However, the development and utilization of natural resources has brought about many social problems such as environmental pollution. After analyzing the comprehensive factors of each industry, it can be seen that , The proportion of secondary industries with resource extraction and processing is still too large, which makes the sustainable development of urban industry face challenges. Therefore, it is necessary to discuss the industrial transformation of Tangshan industry to follow the principle of gradually reducing the proportion of secondary industry and increasing the share of industry Principle. In this paper, the existing advantages of industry around Tangshan, through the extension of industrial chain way to strengthen the industrial competitive advantage and the construction of a strong industry to build the city's well-known brands, change the previous extensive economic exploitation of resources, deep processing and high value-added industrial forms.

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