

# Index Evaluation System on the Degree of Production-City Integration in New Urban Development Zones: a case study of the Dajiangdong new town in Hangzhou

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**Abstract.** According to effect factors of production-city integration in new town construction, this paper combines with construction principle of production-city integration evaluation index system and chooses index of evaluating new production-city integration degree from perspectives of industrialization and urbanization, it puts forward problems of applying proper methods to make standardized processing on index weight, quantitative index and pointedly adopts measures etc, and it also gives corresponding solution methods.

## 1. Introduction

With the advancement of industrialization and urbanization as well as development and enlargement of industrial zone, plenty of city new towns are appearing one after another. Affected by traditional development way, new town construction appears situation of life function lags behind production function; public service construction falls behind economic construction, it accompanies with plenty of empty cities and sleep cities. Under this background, idea of production-city integration appears as times requires. On this basis, development and construction strength of Dajiangdong new town in Hangzhou is obviously accelerating; it relies on idea of production-city integration, its overall thinking and strategic key point becomes increasingly clear, system and mechanism is stable and innovative during exploration, effect of resources integration and environment optimization begins to appear, new town development and construction presents good development trend.

## 2. Evaluation index system and model of Dajiangdong new town in Hangzhou

A. Construction principle. Evaluation index system construction of Dajiangdong new town in Hangzhou needs to follow the following principles: the first one is systematic principle, which means all indexes in index system can construct one system, making evaluation target and evaluation index connect into one organized whole. The second one is scientific principle; every index should be constructed on the basis of scientific analysis, which can objectively reflect development state of industry and city. Every index should have clear concept, definite connotation, guarantee the authenticity and objectivity of city development. The third one is principle of combining with hierarchy and integrity. Production-city integration evaluation index system needs to completely reflect overall characteristics of city development, it should not only reflect development trend of mutual coordination and interaction in every subsystem, but also should reflect development state within system. Construction of index system should include 3 levels: target level, criterion level and index level. The fourth one is principle of combining with stability and dynamics. City development is always in the planning and construction without stop, it makes evaluation on different stage of city construction.

## B. Evaluation index system of production-city integration

Production-city integration development in city involves with plenty of factors, this paper makes analysis on production-city separation causes and constructs production-city integration evaluation index system of III grade.

Tab.1 The assessment index system of industry and city fusion

Target level A	I-grade index B	II-grade index C	III-grade index D	Index category
Evaluation index system A of production-city integration	Economic development B <sub>1</sub>	economic aggregate C <sub>1</sub>	GDP of unit area D <sub>1</sub> (10000Yuan • /km <sup>-2</sup> )	Positive
			amount of fixed asset investment per unit area D <sub>2</sub> (10000Yuan • /km <sup>-2</sup> )	Positive
			per capita income D <sub>3</sub> (Yuan • person/ <sup>-1</sup> )	Positive
		Economic structure C <sub>2</sub>	Gross industrial output per unit area D <sub>4</sub> (100million Yuan • /km <sup>-2</sup> )	Positive
			secondary industry proportion D <sub>5</sub> /%	Positive
			proportion of the tertiary industry D <sub>6</sub> /%	Positive
		economic benefit C <sub>3</sub>	Per capita GDP D <sub>7</sub> (Yuan • person/ <sup>-1</sup> )	Positive
			GDP growth rate D <sub>8</sub> /%	Positive
			average salary of staff D <sub>9</sub> /Yuan	Positive
	Urbanization level B <sub>2</sub>	population state C <sub>4</sub>	density of population D <sub>10</sub> (person • /km <sup>-2</sup> )	negative
			natural population growth rate D <sub>11</sub> /%	negative
		Living standard C <sub>5</sub>	per capita disposable income D <sub>12</sub> /Yuan	Positive
			Per capita year-end savings balance D <sub>13</sub> /Yuan	Positive
			consumer price index D <sub>14</sub> /%	negative
	Matching construction B <sub>3</sub>	Public service C <sub>6</sub>	Number of schools per 10,000 D <sub>15</sub> (one • 10000 persons/ <sup>-1</sup> )	Positive
			Number of hospital beds per 10,000 people D <sub>16</sub> /bed	Positive
			Number of institutions with cultural activities per 10,000 population D <sub>17</sub> (institute • 10000 persons/ <sup>-1</sup> )	Positive
			Number of public transport vehicles per 10,000 population D <sub>18</sub> (vehicle • 10000 persons/ <sup>-1</sup> )	Positive
		Environment state C <sub>7</sub>	green coverage rate of developed areas D <sub>19</sub> /%	Positive
			per capita green area D <sub>20</sub> (/hm <sup>2</sup> • 10000 persons <sup>-1</sup> )	Positive
			sewage treatment rate D <sub>21</sub> /%	Positive
			Harmless disposal rate of domestic waste D <sub>22</sub> /%	Positive

## C. Production-city integration evaluation model based on AHP

### (1) Confirm weight index

Establish evaluation index system, please see table 1, construct comparative judgment, after establishing evaluation index system, it needs to make comparison and mark on index on every level, it will get relative importance judgment of index, finally it forms one comparative matrix  $A=(a_{ij})_{n \times n}$ . The comparison scale of marks refers to quartile scaling method put forward by Suttie(table 2).

Tab.2 The comparative value of assessment index

scale	Meaning
1	2 elements compare with each other, both have the same importance
3	2 elements compare with each other, the former is more important than the latter
5	2 elements compare with each other, the former is obviously more important than the latter
7	2 elements compare with each other, the former is rather important than the latter
9	2 elements compare with each other, the former is extremely important than the latter
2, 4, 6, 8	median of the above-mentioned adjacent scale judgment
Count backwards	2 elements compare with each other, importance of the latter relative to the former

Level single sequence, as for certain element the above level, it calculates every factor weight related to in the next level. It starts from judgment matrix and uses square root method to calculate judgment the maximum characteristic root and characteristic vector.

①Step 1: according to formula:  $W_i = \frac{\left[ \prod_{j=1}^n a_{ij} \right]^{\frac{1}{n}}}{\sum_{i=1}^n \left[ \prod_{j=1}^n a_{ij} \right]^{\frac{1}{n}}} (i=1,2,\dots,k)$ , it gets characteristic vector of

judgment matrix  $B=(W_1, W_2, \dots, W_n)^T$ . ②step 2: according to formula  $\lambda_{\max} = \sum_{i=1}^n \frac{\sum_{j=1}^n a_{ij} W_j}{n W_i}$ , it gets the maximum characteristic root of judgment matrix ③step 3: it calculates consistency index of judgment matrix, formula is as follows:  $CI = \frac{\lambda_{\max} - n}{n-1}$ . Of which,  $\lambda_{\max}$  is the maximum characteristic root of judgment matrix; n is order of judgment matrix ④step 4: it makes comparison and calculation according to average random value RI (table 3) to confirm random consistency ratio. The calculation formula of random consistency is as follows:  $CR = CI/RI$ . Of which: CR is random consistency ratio; CI is consistency index; RI is average consistency index.

Table 3 Comparison table of average consistency index

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0	0	0.58	0.89	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54

If CR is less than 0.1, we think judgment matrix passes through consistency test, if CR is bigger than 0.1, we think judgment matrix dose not have satisfied consistency, it needs to make adjustment. According to the above designed calculation methods, it can get weight value of every level index in index system for the above level index. 4) Total sequence of level. In certain level index sequence result, calculates combination weight of this level for the above level, especially for final weight of the bottom index for target level, it needs to calculate level by level from index system and finally gets the final index weight set (table 4).

Table 4 Evaluation index weight and sequence of production-city integration

Target level A	I-grade index B and weight	II-grade index C and weight	III-grade index D	III-grade index weight	sequence
Evaluation index system A of production-city integration	Economic development B <sub>1</sub> 0.5842	economic aggregate C <sub>1</sub> 0.3397	GDP of unit area D <sub>1</sub> (10000Yuan • /km <sup>-2</sup> )	0.1676	1
			amount of fixed asset investment per unit area D <sub>2</sub> (10000Yuan • /km <sup>-2</sup> )	0.1056	3
			per capita income D <sub>3</sub> (Yuan • person/-1)	0.0665	5
		Economic structure C <sub>2</sub> 0.0640	Gross industrial output per unit area D <sub>4</sub> (100million Yuan • /km <sup>-2</sup> )	0.0210	15
			secondary industry proportion D <sub>5</sub> /%	0.0166	18
			proportion of the tertiary industry D <sub>6</sub> /%	0.0264	12
		economic benefit C <sub>3</sub> 0.1805	Per capita GDP D <sub>7</sub> (Yuan • person/ <sup>-1</sup> )	0.0469	8
			GDP growth rate D <sub>8</sub> /%	0.0745	4
			average salary of staff D <sub>9</sub> /Yuan	0.0591	7
	Urbanization level B <sub>2</sub> 0.2808	population state C <sub>4</sub> 0.1872	density of population D <sub>10</sub> (person • /km <sup>-2</sup> )	0.1248	2
			natural population growth rate D <sub>11</sub> /%	0.0624	6
		Living standard C <sub>5</sub> 0.0940	per capita disposable income D <sub>12</sub> /Yuan	0.0464	9
			Per capita year-end savings balance D <sub>13</sub> /Yuan	0.0184	16
			consumer price index D <sub>14</sub> /%	0.0292	11
	matching construction B <sub>3</sub> 0.1350	Public service C <sub>6</sub> 0.0675	Number of schools per 10,000 D <sub>15</sub> (one • 10000 persons/ <sup>-1</sup> )	0.0244	13
			Number of hospital beds per 10,000 people D <sub>16</sub> /bed	0.0221	14
			Number of institutions with cultural activities per 10,000 population D <sub>17</sub> (institute • 10000 persons / <sup>-1</sup> )	0.0110	19
			Number of public transport vehicles per 10,000 population D <sub>18</sub> (vehicle • 10000 persons/ <sup>-1</sup> )	0.0100	20
		Environment state C <sub>7</sub> 0.0675	green coverage rate of developed areas D <sub>19</sub> /%	0.0180	17
			per capita green area D <sub>20</sub> (/hm <sup>2</sup> • 10000 persons <sup>-1</sup> )	0.0307	10
			sewage treatment rate D <sub>21</sub> /%	0.0095	21
			Harmless disposal rate of domestic waste D <sub>22</sub> /%	0.0095	21

This index can be used to evaluate development state and improvement degree of city function construction, it makes linear weight calculation by giving weight to every index and making standardized processing, it can get the final result. The calculation formula is as follows:

$CCRH = \sum_{i=1}^n W_j U_j, (i = 1, 2, \dots, n)$ . In the formula, CCRH is development index of

production-city integration;  $U_j$  respectively represents economic development index, urbanization level index and matching construction index.  $W_j$  is weight corresponds to every index. Compared with city construction experiences both in China and abroad, it designs evaluation index standard of Chinese production-city integration according to calculation route of this paper at the same time: 0.2~0.4 is basic separation pattern, 0~0.2 is highly integration pattern, 0.6~0.8 is medium

integration pattern, we can make clear city development stage and pointedly plan city development key points by comparing with development index of production-city integration.

#### 4. Conclusions

This paper constructs production-city integration measurement system composed of urbanization index, industrialization index and separation index by learning lessons from coordinated, integration development measurement research result of industrialization and urbanization, of which, urbanization index is not restricted by population urbanization, while it introduces into aspects and factors such as environmental protection and safety etc, measurement system must be complete and scientific. Finally, it uses factor analysis to obtain the main factors of affecting production-city degree, so it further makes cluster analysis on production-city integration level of hi-tech areas in Chinese major cities, so it gets grade classification. This paper constructs production-city evaluation model of city, makes qualitative and quantitative analysis, gets effect factors and its sequence of production-city integration, constructs development index and its evaluation standard of production-city integration, provides reference ideas and methods on production-city integration construction. At present stage, there are many cities in China are actively expanding city development space, expect to relieve population and employment pressure in main cities by constructing development area, new towns etc, which has actual referential meanings for planning and development of new town. Every city is in gradual planning and construction, there are many factors affecting production-city integration, we should make proper adjustment according to actual conditions of cities, enhance science and reliability of evaluation result. On calculating weight index, we can combine with other methods to comprehensively provide weight, gradually improve evaluation methods, so that it can make more effective evaluation on production-city integration.

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