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Research on Collaborative Development Level of Beijing-Tianjin-Hebei Smart City Based on Coupling Correlation Degree Analysis

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ABSTRACT
The coordinated development of The Beijing-Tianjin-Hebei region is one of the major national strategies and a key development content of Beijing's 14th Five-Year Plan. However, in terms of implementation results, the coordinated development of the Beijing-Tianjin-Hebei region has improved somewhat, but it still falls far short of expectations. In recent years, with the development of digital economy, smart city development has been promoted nationwide, and Hebei province has also begun to promote smart city pilot, which has injected new factors and possibilities into the coordinated development of The Beijing-Tianjin-Hebei region. In order to better study wisdom construction of city's contribution for the integration of the Beijing-Tianjin-Hebei region coordinated development, this paper based on entropy weight TOPSIS method and coupling coordination degree analysis system evaluation from 2014 to 2019 the coordinated development of Beijing-Tianjin-Hebei urban wisdom level and its change trend, and on this basis for the coordinated development of Beijing-Tianjin-Hebei urban wisdom provide new ideas and Suggestions.

Keywords: *Smart city; Coordinated development of The Beijing-Tianjin-Hebei region; Entropy TOPSIS; Coupling correlation degree;*

1. INTRODUCTION

Since the founding of The People's Republic of China, Beijing, Tianjin and Hebei have maintained close economic ties due to their close geographical location. However, in the planned economy period, resource allocation depends more on the central command, production factors are easy to concentrate in the central cities, the connection within the Beijing-Tianjin-Hebei region is more reflected in the one-way flow of materials, and the regional development imbalance is prominent. Way after the reform and opening up, the allocation of resources change, have strengthened the economic and technical cooperation between adjacent areas, the national level and encourage the collaboration through more regional and even national economic development, at the time, "capital", economic and technical cooperation zone of north China, "the Beijing and Tianjin tang region" and " the Bohai sea economic zone planning" is put forward, take this opportunity to expand cooperation areas, Beijing-Tianjin-Hebei, Hong Kong Technological links have been strengthened, and a series of cooperation and support projects have been carried out between governments at all levels. The positive spillover effect and coordination of central cities have been improved to some extent. After entering the 21st century, the practical demand for further coordinated development of The Beijing-Tianjin-Hebei region has become increasingly prominent, and the theoretical discussion and practical promotion have gradually deepened. In 2000, Academician Wu Liangyong raised the issue of coordinated development of The Beijing-Tianjin-Hebei region from the perspective of urban planning and put forward the construction idea of "greater Beijing". In 2003, the third Plenary Session of the 16th CPC Central Committee stressed the importance of "coordinating regional development". In 2004, the National Development and Reform Commission led the governments of Beijing, Tianjin and Hebei to hold the Regional Economic Development Strategy Seminar in

Langfang, and reached the "Langfang Consensus" on strengthening regional cooperation. In 2010, the Regional Plan for The Beijing-Tianjin-Hebei Metropolitan Area compiled by the National Development and Reform Commission was submitted to The State Council, proposing an "8+2" model in which Beijing and Tianjin drive their neighbors. In 2011, the outline of the 12th Five-Year Plan proposed to "build the Capital Economic circle".

In 2014, General Secretary Xi jinping emphasized "The significance of the coordinated development of Beijing, Tianjin and Hebei" in the forum on the coordinated development of Beijing, Tianjin and Hebei, and elevated it to a national strategy. Since then, the coordinated development of Beijing, Tianjin and Hebei has entered a new stage. In 2016, the national Economic and Social Development Plan for the Beijing-Tianjin-Hebei Region during the 13th Five-Year Plan period, the first cross-provincial regional plan for the 13th Five-Year Plan, was published and implemented. The plan defines the development goals of the Beijing-Tianjin-Hebei region for the next five years and sets forth a series of requirements for regional integration. In 2018, the party central committee and the State Council on establishing a more effective regional coordination development in the new opinions clearly put forward to relief function of the capital Beijing as the "key" to promote coordinated development of the Beijing-Tianjin-Hebei region, promote Hebei male Ann district deputy center and the Beijing urban construction, effective governance "big city disease", explore its population orderly organization in Beijing's economic function.

In recent years, the overall development of the Beijing-Tianjin-Hebei region has achieved remarkable results in many areas. The regional development index of the Beijing-Tianjin-Hebei region measured by the National Bureau of Statistics has improved year by year, and the coordinated development within the region has made steady progress. However, compared with the relatively flat Yangtze River Delta region, the Beijing-Tianjin-Hebei region is characterized by decentralization and polarization (Sun, J. and Yuan, Q.,2014[1]), especially, The siphon effect of Beijing as the capital is obvious, the bright spot of Tianjin is not enough, the positive radiation of Hebei is relatively limited, and the imbalance between "developed center" and "backward hinterland" has not been fundamentally changed.

The 14th Five-Year Plan stresses the need to promote high-quality development in an all-round way so that the fruits of development will benefit all the people. This is the inevitable choice of China's development to the present stage, but also put forward higher requirements for regional coordinated development. In addition to giving full play to each other's economic advantages, it is also more necessary to comprehensively enhance mutual assistance and sharing of knowledge and technology, social resources and environmental protection within the region. In recent years, with the arrival of the digital era, digital technology, data resources, and the combination of urban planning and social governance created the concept of intelligent city, from the point of future development, advocated the intelligent wisdom city participation, resource optimization, open innovation, people-oriented concept and the connotation of quality development, Smart city construction will also become an important support to boost high-quality economic development. Wisdom for the coordinated development of Beijing-Tianjin-Hebei urban construction has brought new opportunities, with the help of big data, Internet of things, cloud computing and other modern information technology, give full play to the city outside effect, maximum limit down space and regional concept, the advantages of radiation to the whole area of center city, provide new opportunities for the development of integration of the Beijing-Tianjin-Hebei region.

Therefore, this paper will use the smart city construction of the Beijing-Tianjin-Hebei region as the breakthrough point, through build smart city coordinated development level evaluation system, analysis of the current situation of the development of Beijing-Tianjin-Hebei smart city from 2014 to 2019 and the collaborative, explore its development situation and existing problems, and the smart city construction of the Beijing-Tianjin-Hebei region and the coordinated development provides the beneficial reference.

2. LITERATURE REVIEW

Regional development imbalance is a common problem in the initial stage of development of various countries. The research on the early development imbalance in China mainly focuses on the economic development imbalance in the east, the middle and the west. Central rise, along with the development of the western region, revitalizing old industrial base strategy is put forward, such as play around the comparative advantage to promote the common progress of the economic concept of harmonious development is deeply rooted in the hearts of the people, the country is on the basis of geographical agglomeration formed multiple economic development zone, Hebei is one of them, the coordinated development of its effects and problems also got the attention of the academic circles for a long time.

The connection and cooperation between The Beijing-Tianjin-Hebei region has a long history, and relevant policies and practices have been advancing. However, from the perspective of implementation results, it is generally believed that the Beijing-Tianjin-Hebei region is more unbalanced in urban development and relatively backward in coordination compared with the Yangtze River Delta and pearl River Delta (Ma, G., Tian, Y., SHI Y., 2010[2]; Zhang, M., ZUO, Y., 2013[3]）. The reasons are various, including objective differences in

initial endowment, administrative status and economic development status of cities within the region (Du, C., Wang, X., Liu, Z., 2013[4]; Bo, W., Chen, F.,2015[5]; Du, Z., Guo, H., 2015[6]), and the deficiency of supporting mechanism design in the coordination process (Yin, C., Li, X., 2018[7]).

In 2014, the coordinated development of The Beijing-Tianjin-Hebei region was elevated to a national strategic height. Since then, the coordinated development has become the core theme of the economic development of the Beijing-Tianjin-Hebei region. The policy-oriented coordination mechanism has been improved, and more and more scholars have begun to pay attention to the quantitative evaluation of its synergistic effect. Zhu, E.and He, X (2016)[8] used entropy method to measure and analyze the coordinated development of Beijing-Tianjin-Hebei Region. Huang, Q. et al. (2017)[9] constructed the evaluation index system of Beijing-Tianjin-Hebei Coordinated Development Index from the perspective of five development concepts, and measured the Beijing-Tianjin-Hebei Coordinated development Index from 2005 to 2015. The index showed an upward trend year by year, especially in 2014-2015. Li, J. et al. (2017)[10] made a quantitative analysis of panel data of Beijing-Tianjin-Hebei region from 1995 to 2014 by using the distance synergy model, and found that the economic development and synergy level of Beijing-Tianjin-Hebei region showed phased characteristics, and the synergy level improved after 2010. Zhang, Y. and Wang, D. (2017) [11]quantitatively measured the degree of systematic coordination in The Beijing-Tianjin-Hebei region and pointed out that there was a large spatial difference in the degree of order in the Beijing-Tianjin-Hebei region, but the degree of coordinated development deepened in the interval from 2010 to 2015. Xu, A.(2018)[12] studied the construction of Beijing-Tianjin-Hebei smart urban agglomeration and pointed out the problems faced by the construction. Chen, X. et al. (2020)[13] empirically tested the synergy degree of the financial system in The Beijing-Tianjin-Hebei region by establishing the synergy degree model of the composite system, and found that from the three dimensions of financial scale, structure and efficiency, the synergy degree of the system had a downward trend in recent years, and the steady state of regional financial synergy had not yet been formed. Zhang, J.(2020)[14]quantitatively measured the coordinated development level of The Beijing-Tianjin-Hebei region through the order degree model, and found that there was still a large spatial difference in the order degree of the coordinated development of the Beijing-Tianjin-Hebei region, but the development level of the three regions showed a trend of gradually shrinking.

In the existing literature, scholars have evaluated and studied the coordinated development of The Beijing-Tianjin-Hebei region from various perspectives. It is generally found that the level of the coordinated development of the Beijing-Tianjin-Hebei region has risen in recent years, but the development imbalance still exists, and the degree of coordination needs to be further improved. However, in the current index evaluation system, few scholars take smart city construction as a starting point. At present, the construction of smart city not only emphasizes the integration and application of resources supported by technology and knowledge, but also pays more attention to innovative and friendly system and harmonious ecological construction, which is the comprehensive embodiment of high-quality regional development. Since 2013, smart city construction has been on the agenda, advocating the integration of intensive, low-carbon, ecological, smart and other advanced concepts into the specific process of urbanization to promote sustainable economic development. Beijing, Tianjin and Hebei have all been selected as cities (districts), and the future coordinated development of Beijing, Tianjin and Hebei cannot be separated from the construction of smart cities. Therefore, this paper uses entropy-weight TOPSIS and coupling coordination degree model to evaluate and analyze the synergy degree of collaborative development of Beijing-Tianjin-Hebei smart city from 2014 to 2019, and on this basis, provides targeted suggestions for the future collaborative development of Beijing-Tianjin-Hebei region.

3. MEASUREMENT OF COLLABORATIVE DEVELOPMENT DIFFERENCE INDEX OF BEIJING-TIANJIN-HEBEI SMART CITY

3.1. Construction of collaborative development indicators for Beijing-Tianjin-Hebei smart city

In 2013, the Ministry of Housing and Urban-Rural Development announced the first batch of 90 national smart city pilot list, including Shijiazhuang and Qinhuangdao. On October 3, 2020, Hebei province announced the first batch of new smart city construction pilot list, including Shijiazhuang, Tangshan and Cangzhou. According to relevant requirements, the pilot cities will take the opportunity of being selected to accelerate the development of digital economy, promote the construction of new smart cities, upgrade the modernization of social governance system and governance capacity, cultivate and strengthen strategic emerging industries, and actively create a long-term operation mode for the construction of new smart cities. Therefore, Shijiazhuang, Tangshan, Qinhuangdao and Cangzhou were selected as the representative samples of Hebei province after comprehensively considering the list of two pilot cities. According to the above evaluation system of smart city construction level, we selected Beijing, Tianjin and four typical smart city construction cities in Hebei as samples and collected data. The data in this paper are from the National Bureau of Statistics and

the statistical bulletin of national economic and social development in various years.

Especially since the concept of smart city has been put forward, the focus of urban development has expanded from the past economic development to multiple dimensions, and more emphasis has been placed on the overall development of the city and the improvement of residents' satisfaction. The construction of smart city covers many aspects. We split the overall construction level of smart city into five dimensions: economy, technology, education, environment and life. A total of 14 detailed indicators are selected from the five dimensions (see Table 1).

Since we take the construction level of smart cities as the consideration basis for the level of regional collaborative development, this paper first evaluates the construction level of smart cities in Beijing, Tianjin and Hebei in recent years by using the entropy weight TOPSIS method, and obtains the annual evaluation value of each indicator of each city. Then, the annual evaluation value of sample cities is used to build a coupling coordination model. Smart economy, smart technology, smart education, smart environment collaboration and smart life are selected as the second-level indicators of smart city collaborative development, and the evaluation values obtained are set as specific indicators.

Table 1. Indicators of collaborative development of smart cities in Beijing-Tianjin-Hebei Region

Level indicators	The secondary indicators	Specific indicators
Degree of collaborative development of smart city	Degree of coordinated development of smart economy	GDP (Appraised Value)
		Value-added of tertiary Industry (Appraised Value)
		Per capita disposable income (Assessed value)
	Degree of collaborative development of smart technology	Number of patent applications (Assessed value)
		Number of patents granted (Appraised value)
		Proportion of R&D in GDP (Evaluation value)
	Degree of collaborative development of intelligent environment	Green vegetation coverage rate (Evaluation value)
		Reduction rate of energy consumption per unit GDP (Evaluation value)
	Degree of collaborative development of wisdom education	Proportion of Total Enrollment to Total population (Evaluation value)
		Proportion of education expenditure in Financial Expenditure (Evaluation Value)
		Number of Colleges/Universities per 100,000 population (Assessed Value)
	Degree of collaborative development of smart life	Registered urban unemployment rate (Appraised value)
		Annual Total volume of Goods transported by road (Appraised value)
		Total volume of Passenger Transport by Road (Assessed value)

3.2. Calculation and evaluation method for collaborative development system of Beijing-Tianjin-Hebei smart city

3.2.1. Determination of weight

In the selection of the weight of each index, we use the entropy weight TOPSIS method to calculate the relative weight of each index.

(1) Standardized treatment of indicators:

Most of the indicators selected by us are positive indicators, that is, the larger the index value is, the better the corresponding evaluation is. For such indicators, we adopt the following methods to standardize them:

$$X_{ij} = \frac{X_{ij} - \min(X_{1j}, X_{2j}, L, X_{mj})}{\max(X1j, X2j, L, Xmj) - \min(X1j, X2j, L, Xmj)} + 1$$

（$i = 1,2,L$， m； $j = 1,2,L$， n；）

However, registered urban unemployment rate, one of the indicators of smart life development, is a contrarian indicator, so we treat it separately with the following formula.

$$X_{ij} = \frac{\max(X1j, X2j, L, Xmj) - X_{ij}}{\max(X1j, X2j, L, Xmj) - \min(X1j, X2j, L, Xmj)} + 1$$

（$i = 1,2,L$， m； $j = 1,2,L$， n；）

(2) Calculate the entropy value and difference coefficient of the JTH index

$$e_j = -k * \sum_{i=1}^{n} P_{ij} \ln(P_{ij})$$

，

$g_j = 1 - e_j$， （The higher the g value, the more important the indicator）

（3）And then finally, the weight

$$w_j = \frac{g_j}{\sum_{j=1}^{m} g_j} (j = 1,2L\ m)$$

（4）The specific weights are shown in the following table:

Table 2. Specific weight table of Beijing-Tianjin-Hebei smart city collaborative development system

Level indicators	The secondary indicators	Information entropy e	Information utility d	Weight coefficient W	
Intellectual economy	GDP	0.6839	0.3161	0.0794	0.268
	Value-added of tertiary industry	0.5878	0.4122	0.1035	
	Per capita disposable income	0.6627	0.3373	0.0847	
Wisdom technology	Patent applications	0.5509	0.4491	0.1128	0.296
	Number of patents granted/piece	0.5569	0.4431	0.1113	
	The proportion of R&D in GDP	0.7125	0.2875	0.0722	
Wisdom environment	Green vegetation coverage	0.8574	0.1426	0.0358	0.08
	Reduction rate of energy consumption per unit of GDP	0.8256	0.1744	0.0438	
Education wisdom	Proportion of total enrollment to total population	0.8323	0.1677	0.0421	0.151
	Proportion of education expenditure in financial expenditure	0.7433	0.2567	0.0644	
	Number of colleges and universities per 100,000 people	0.822	0.178	0.0447	
Intelligent life	Registered urban unemployment rate	0.8378	0.1622	0.0407	0.205
	Total amount of goods transported by road	0.8649	0.1351	0.0339	
	Total highway passenger transport	0.4795	0.5205	0.1307	

3.2.2. Construction of coupling degree coordination model

（1）Calculate the coupling degree C value

Set u_i as the second-level evaluation index of each city, and the C value of the coupling degree of each city can be obtained from the following formula. The greater the C value is, the greater the coupling correlation degree of each subsystem is.

$$C = \left\{ \frac{u_1 u_2 u_3 u_4 u_5 u_6}{(u_1+u_2)(u_2+u_3)\cdots(u_5+u_6)(u_6+u_1)} \right\}^{\frac{1}{6}}$$

（2）The coupling coordination degree D value was calculated

Set T as the total evaluation value of the six sample cities and A-f as the weight of subsystems, we can calculate the coupling coordination degree and use it to locate its range. The corresponding coordination situation is shown in Table 3.

$$T = au_1 + bu_2 + cu_3 + du_4 + eu_5 + fu_6$$

$$D = \sqrt{C \times T}$$

Table 3. Standard table of grade classification of coupling coordination degree

Classification standard of coupling coordination degree		
D value interval of coupling coordination degree	Coordination level	Degree of coupling coordination
(0.0~0.1)	1	Extreme imbalance
[0.1~0.2)	2	Seriously imbalance
[0.2~0.3)	3	Moderate imbalance
[0.3~0.4)	4	Mild imbalance
[0.4~0.5)	5	On the verge of imbalance
[0.5~0.6)	6	Barely coordination
[0.6~0.7)	7	Primary coordination
[0.7~0.8)	8	Intermediate coordinate
[0.8~0.9)	9	Good coordination
[0.9~1.0)	10	Quality coordination

3.3. Evaluation results and analysis

3.3.1. The overall coordinated development level of smart cities

Table 4. Overall collaborative development level of Smart cities in Beijing-Tianjin-Hebei Region

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.523	0.484	0.503	6	Barely coordination
2015	0.583	0.606	0.594	6	Barely coordination
2016	0.503	0.575	0.538	6	Barely coordination
2017	0.94	0.535	0.709	8	Intermediate coordinate
2018	0.299	0.524	0.396	4	Mild imbalance
2019	0.561	0.647	0.603	7	Primary coordination

Table 4 shows the overall coordinated development level of The Beijing-Tianjin-Hebei region from 2014 to

2019. In general, after years of development, the coordination degree of the Beijing-Tianjin-Hebei region has improved significantly in recent years, starting to enter the stage of coordinated development, and has entered the primary coordinated state in 2019. Policy-driven resource allocation flow and complementary advantages brought by in-depth coordinated development can drive multidimensional improvement of the whole region, and the coordinated development of The Beijing-Tianjin-Hebei region has achieved certain results. However, there were obvious fluctuations in 2018, mainly due to the abnormal fluctuations in the situation of smart education, which to some extent reflects that the steady state of Beijing-Tianjin-Hebei coordinated development has not yet been formed and is vulnerable to interference.

3.3.2. Level of coordinated development of smart economy

Table 5. The coordinated development level of smart economy in Beijing-Tianjin-Hebei

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.456	0.611	0.528	6	Barely coordination
2015	0.517	0.579	0.547	6	Barely coordination
2016	0.473	0.545	0.508	6	Barely coordination
2017	0.426	0.479	0.451	5	On the verge of imbalance
2018	0.558	0.111	0.249	3	Moderate imbalance
2019	0.136	0.175	0.154	2	Seriously imbalance

Only from the situation of each sample city from 2014 to 2019, the economic development performance is obvious to all. However, from the perspective of regional coordination (as shown in Table 5), the coordination degree of smart economy has declined significantly. The situation has been deteriorating year by year since 2016, and it has become seriously disordered in 2019. This shows that there are still significant differences in the speed of economic development and industrial structure upgrading in the Beijing-Tianjin-Hebei region in recent years. In terms of the evaluation value of sample cities, only Shijiazhuang performs well among the sample cities in Hebei Province, but there is still a gap between it and Beijing and Tianjin, and the phenomenon of extreme economic development has not been significantly improved. Imbalance of economic development is growing in the coordinated development of Beijing-Tianjin-Hebei, circulation of industrial transformation and upgrading, elements can be used to improvement, technical collaboration to strengthen, but the solution is still a long process, and wisdom city construction is through the introduction of new elements and social aspects of pull, zoom around behind the city's economic development advantages, in particular, Create new economic growth points. For example, the technological innovation and industrial upgrading of Cangzhou city are in the process of exploring the path of green development in line with The Times and social development. Qinhuangdao city should further increase the added value of tourism.

3.3.3. Level of collaborative development of smart technology

Table 6. Collaborative development level of smart technology in Beijing-Tianjin-Hebei Region

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.203	0.362	0.271	3	Moderate imbalance
2015	0.316	0.355	0.335	4	Mild disorder
2016	0.387	0.399	0.393	4	Mild disorder
2017	0.549	0.282	0.393	4	Mild disorder
2018	0.813	0.546	0.666	7	Primary coordination

2019	0.389	0.65	0.503	6	Barely coordination

As can be seen from Table 6, the coordination degree of smart technology development in The Beijing-Tianjin-Hebei region has been steadily improving on the whole. Although there were fluctuations in 2018-2019, the overall trend remained unchanged, and the technological development changed from maladjustment to coordination, which also provided beneficial technical support for future further development. "Much starker choices-and graver consequences-in planning is emphasized in hebei province adhere to innovation and development, it means" take full advantage of the Beijing and tianjin innovation resources ", promote innovation platform to build infrastructure and services, "promote regional innovation resources connectivity and open sharing", and in the sample of Shijiazhuang and Baoding city in Nanping science and technology achievements transformation test area construction. The improvement of the coordination degree of technological development reflects that the preliminary planning of Hebei province has achieved certain results, and the coordination degree is expected to be further improved in the future.

3.3.4. Smart environment synergy development gap

Table 7. Collaborative development level of smart environment in Beijing-Tianjin-Hebei Region

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.674	0.471	0.563	6	Barely coordination
2015	0.539	0.627	0.581	6	Barely coordination
2016	0.173	0.209	0.19	2	Seriously imbalance
2017	0.915	0.683	0.791	8	Intermediate coordinate
2018	0.656	0.46	0.549	6	Barely coordination
2019	0.516	0.509	0.513	6	Barely coordination

As can be seen from Table 7, the coordinated development of intelligent environment in The Beijing-Tianjin-Hebei region is at a barely coordinated level in most years, and is generally stable except for extreme cases of serious imbalance in 2016 and intermediate coordination in 2017. In 2015, the fifth Plenary Session of the 18th CPC Central Committee put "green" together with innovation, coordination, openness and sharing into five development concepts. Seen from the development of the Beijing-Tianjin-Hebei region, the concept of green development has been put into practice since it was proposed. Driven by innovation, low-energy production has become possible. According to the long-term development goals of "carbon peak" and "carbon neutral" proposed in the 14th Five-Year Plan of China, Shijiazhuang, Tangshan and Cangzhou, as traditional heavy industry cities, need to further reduce industrial energy consumption and promote the transformation and upgrading of industrial structure in the future.

3.3.5. Smart education synergy development gap

Table 8. Collaborative development level of smart education in Beijing-Tianjin-Hebei Region

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.199	0.5	0.315	4	Mild imbalance
2015	0.775	0.603	0.684	7	Mild imbalance
2016	0.883	0.605	0.731	8	Intermediate coordinate
2017	0.859	0.456	0.626	7	Mild imbalance
2018	0.242	0.322	0.279	3	Moderate imbalance
2019	0.804	0.653	0.725	8	Intermediate coordinate

Table 8 shows the overall development coordination of smart education level in Beijing-Tianjin-Hebei

Region. Except for the extreme situation in 2018, the coordinated development level fluctuates little, showing a relatively stable and high level trend. Talent is a strong support for regional development, but the education measurement index we choose focuses more on the supply side, and the matching problem with the demand side still needs to be paid attention to when the investment is relatively coordinated. At the same time, in the context of the promotion of regional integration in Beijing-Tianjin-Hebei region, the differences in talent attraction between different regions may also lead to the cross-city flow of human capital. Therefore, from the perspective of market demand and factor flow, it is necessary to further enhance the mutual assistance and sharing of educational resources in the region.

3.3.6 Smart life synergy development gap

Table 9. Collaborative development level of smart life in Beijing-Tianjin-Hebei Region

Coupling coordination degree calculation results					
year	Coupling degree C value	Coordinate index T value	Coupling coordination degree D value	Coordination level	Degree of coupling coordination
2014	0.331	0.468	0.393	4	Mild imbalance
2015	0.686	0.415	0.533	6	Barely coordination
2016	0.883	0.78	0.83	9	Good coordination
2017	0.751	0.587	0.664	7	Mild imbalance
2018	0.559	0.556	0.558	6	Barely coordination
2019	0.304	0.192	0.242	3	Moderate imbalance

The ultimate goal of regional development is to improve people's living standards and satisfaction. Therefore, smart city construction lays more emphasis on "people" living in it and advocates efficient and convenient governance mode. However, it can be seen from Table 9 that the coordinated development level of smart life in Beijing-Tianjin-Hebei region fluctuates greatly in the sample period: The level of coordination in 2019 was even lower than that in 2013. This reflects that there is a great difference in the harmony degree of social development in the sample cities, leading to an increasingly unbalanced change in the quality of life in the Beijing-Tianjin-Hebei region. Although the development of smart city is a process of innovation and replacement at various levels such as technology, its fundamental purpose is still "people" oriented, specifically to improve residents' living standards. Therefore, in the next stage of development, attention should be paid to improving the convenience and livable degree of relatively backward cities and communicating the supply coordination between regions.

4. COORDINATED DEVELOPMENT OF BEIJING-TIANJIN-HEBEI SMART CITY

Overall, from 2014 to 2019, the coordinated development of The Beijing-Tianjin-Hebei region entered a new stage, with the overall development shifting from unbalanced to coordinated, but fluctuations occurred from time to time, and even regression occurred in some sub-dimensions (such as economy and life). Of course, we need to understand that coordinated regional development is a long-term and arduous task, and now with digital transformation, future development will face more uncertain challenges. Therefore, in the future development, The Beijing-Tianjin-Hebei region should pay more attention to the opportunity of smart city construction, make use of new production factors, break down barriers, strengthen communication and contact within the region, forge the long board and strengthen the weak board, and further enhance multi-dimensional coordination and interaction.

1. Give full play to the radiating and driving role of Beijing and other central cities, and improve the mechanism for coordinated development of the Beijing-Tianjin-Hebei region

In the process of the development of the Beijing-Tianjin-Hebei region, for a long time "siphon effect" is greater than the effect of radiation, with the adjustment of the function orientation of Beijing and male "vice center" is put forward for the construction of Ann, the situation improved, while regional technical coordination degree increase also let us see the radiation effect in certain areas to give full play to. As the largest central city in the Beijing-Tianjin-Hebei region, Beijing is far ahead in science and technology and economic strength. In the future development, Beijing should further give full play to its radiating and driving role. Tianjin, as another central city of regional development, on the one hand, should further enhance its own innovation and development capacity, and on the other hand, should provide more assistance to neighboring cities. To improve the mechanism for coordinated development of the Beijing-Tianjin-Hebei region, emphasis should be placed on the overall development of the region. In smart city construction planning, each central city should give more consideration to the coordinated development of surrounding cities and promote the establishment of smart city construction community.

(2) Developing and reforming economically and

technologically backward cities, and jointly exploring future possibilities with leading cities

From the empirical results, the wisdom of the Beijing-Tianjin-Hebei region city economic and technological dimensions of the construction of the unbalanced development problem is very outstanding, Beijing and tianjin as a municipality directly under the central government has more natural resources, in the sample cities in hebei province, shijiazhuang as a provincial capital city, industry and high and new technology resources allocation is also significantly more to its tilt, Other cities often face the dilemma of insufficient resource support in smart city construction.

For cities with low development level, it is necessary to transform and upgrade backward and old pillar industries into a new production and operation mode that conforms to the current development trend through industrial technological innovation based on their current industrial structure and development characteristics, so as to reawaken the vitality of the industry and provide strong support for economic development. At the same time, we should have the courage to explore the emerging industries suitable for the development characteristics of the city, enrich its own industrial structure, and build a diversified economy and technological system. In addition, explore the channels of cooperation to provide a more open economic and technological environment, rather than a single intra-city cycle. Finally, it is essential to learn from the experience of cities with advanced development status to make up for the defects of our own cities. The more developed cities should take the lead, through some economic and technological development support and dialogue, enabling the common prosperity of other regions and discovering more possibilities to promote or maintain their own economic and technological foresight.

3. Integration of educational resources in The Beijing-Tianjin-Hebei region has helped reform, innovation and development of the college entrance examination

It has been several years since the proposal of smart city and Beijing-Tianjin-Hebei integration construction, and fruitful results have been achieved in all aspects. In terms of smart education, with the coordinated development of The Beijing-Tianjin-Hebei region and the wave of the new college entrance examination reform, the cooperation in the education field in the Beijing-Tianjin-Hebei region is increasing day by day.

Represented by Beijing education resources type city ought to support collaborative development of surrounding cities, give full play to the role of the capital, to promote education develop together, and the surrounding areas of cities in hebei province should be according to the new times education development phases and characteristics of various types of education at all levels, with emphasis on the transformation of the mode of education resources, and strive to narrow the gap between regional education level. In the regions with relatively scarce educational resources, more attention should be paid to the development and reform of local education under the opportunity of regional coordination. Strong policies should be adopted in both the construction of educational resources such as schools and the investment in educational infrastructure.

However, the inherent gap in educational resources between regions can not be ignored, which determines the ability of talent cultivation in this region. Therefore, areas with relatively weak educational resources can send teachers to visit and study in cities with relatively rich educational resources. Excellent teachers can use online courses, live streaming and other online teaching methods to realize the mutual benefit of high-quality education resources, so that students in The Beijing-Tianjin-Hebei region can master a variety of rich educational resources and high-quality learning environment, and lay a good foundation for the future development of the motherland.

4. Opening a one-hour traffic circle between Beijing, Tianjin and Hebei, standardizing and optimizing the convenience of urban life

The fundamental purpose of smart city construction is to provide residents with a better standard of living, and always flatter the core idea of "people-oriented". However, in the present stage of development, Beijing with excellent economic and technological development has the common problems of big cities. In order to better alleviate the "big-city disease" of Beijing and change the problems of traffic congestion, population expansion and fast life in Beijing for many years, tianjin and Hebei surrounding Beijing should focus on transformation and development. The relevant departments of the state should vigorously build the Beijing-Tianjin-Hebei loop expressway and railway, and all municipal transportation committees should give full cooperation to help speed up the construction process, carry out transportation facilities construction projects, and actively promote the formation of the Beijing-Tianjin-Hebei one-hour commuting circle. Only by solving commuting problems and saving people's time on the way to work can people's living problems such as housing and employment be effectively alleviated and people's happiness in life be enhanced.

The formation of the Beijing-Tianjin-Hebei transportation circle is a strong foundation and guarantee for coordinated development. It not only alleviates the traffic pressure in the capital, but also facilitates the life and travel of residents in neighboring provinces and cities. It is a good measure that meets the expectations of the people and should be attached importance to and implemented as soon as possible by relevant departments.

5. CONCLUSION

In this paper, we use the smart city construction of the Beijing-Tianjin-Hebei region as the breakthrough point, through build smart city coordinated development level evaluation system, analysis of the current situation of the development of Beijing-Tianjin-Hebei smart city from 2014 to 2019 and the collaborative, explore its development situation and existing problems, and the smart city construction of the Beijing-Tianjin-Hebei region and the coordinated development provides the beneficial reference.

We found that, after years of development, the overall coordination degree of the Beijing-Tianjin-Hebei region has improved significantly in recent years, starting to enter the stage of coordinated development, and entering the primary coordination state in 2019. However, the coordination degree of smart economy showed an obvious downward trend, and the situation worsened year by year since 2016, and became a serious imbalance in 2019. The coordination degree of smart technology development in The Beijing-Tianjin-Hebei region is generally stable. The coordinated development of smart education and smart environment in Beijing-Tianjin-Hebei region is at a coordinated level in most years and generally stable. The level of coordinated development of smart life in The Beijing-Tianjin-Hebei region fluctuates greatly in the sample period, which reflects the large difference in the harmonious degree of social development in the sample cities, leading to the increasingly unbalanced changes in the quality of life in the Beijing-Tianjin-Hebei region.

In view of this, we propose the following suggestions: 1. Giving full play to the radiating and driving role of Beijing and other central cities, and improve the mechanism for coordinated development of the Beijing-Tianjin-Hebei region; 2. Developing and reforming economically and technologically backward cities, and jointly exploring future possibilities with leading cities; 3. Integrating of educational resources in Beijing, Tianjin and Hebei to promote the reform and innovation of college entrance examination; 4. Open up the one-hour traffic circle between Beijing, Tianjin and Hebei, standardize and optimize the convenience of urban life.

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