



Evaluation of the Coupling Coordination Relationship Between Public Cultural Services and Smart Technology

Based on the data of 31 provinces in China from 2015 to 2021

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Abstract. The deep integration of culture with science and technology is the inevitable trend of current cultural development. The widespread application of smart technology has changed the way of cultural production and dissemination, and the integration of smart technology and public cultural services has become a trend. This paper measures and analyzes the integration level of public cultural services and smart technology in China from 2015 to 2021 using the entropy weight method and the coupling coordination degree model. The results show that: Firstly, China's public cultural services and smart technology are at a high level of coupling, with significant differences in the degree of regional coupling and level of integration, and a steadily increasing degree of coupling. Secondly, the level of integration in China is generally higher in the southern region than in the northern region, and in the eastern region than in the western region, showing a lack of development momentum in the northern and western regions. Thirdly, by 2021, all 31 provinces in China have reached the level of good coordination, and some provinces have reached the level of excellent coordination.

Keywords: public cultural services · smart technology · coupling coordination degree · evaluation on the integration

1 Introduction

The deep integration of culture with science and technology is the inevitable trend of current cultural development [1]. The widespread application of smart technology has changed the way of cultural production and dissemination, and given rise to more new cultural formats [2]. In recent years, governments at all levels have attached great importance to and continuously strengthened the integrated development of public cultural services and smart technology, thus promoting the continuous improvement of the modern public service system. Public cultural services and smart technology are an organic

integration, coupled and promoted by each other, involving several subsystems. With the help of the coupling coordination degree model, the running state of each subsystem under mutual promotion can be clearly analyzed [3]. At present, how to evaluate the integrated development of public cultural services and smart technology is still under discussion and exploration, and related issues urgently need further systematic research. Against this background, this paper aims to measure the development of coupling coordination between public cultural services and smart technology in China by using the coupling coordination degree model.

2 Study Design

2.1 Index System Construction and Index Selection

As mentioned above, there is a coupling coordination relationship between public cultural services and smart technology, where the coupling refers to the mutual influence and correlation formed between the two independent systems and the independent elements in each system through a series of connections. In the two systems, the public cultural service system includes public cultural infrastructure, the scale of public cultural infrastructure, and public cultural products and activities, while the smart technology system includes industrial enterprises above designated size, domestic patents, the technology market, and so on. This paper uses the above elements to create an index system for measuring the integration of public cultural services and smart technology, and the weight of the index is calculated by entropy method [4]. Data are mainly taken from the China Statistical Yearbook and the statistical bulletins of national economic and social development of various provinces. Since there are some missing values in the data of the Tibet Autonomous Region, the paper mainly uses the grayscale prediction model to estimate the missing values [5]. This paper constructs an index system to measure the integration of public cultural services and scientific and smart technology from the above elements, and the weight of the index is calculated by entropy method.

2.2 Coupling Coordination Degree Model and Its Evaluation Criteria

Assuming that the comprehensive evaluation indexes of public cultural services and smart technology are U_1 and U_2 respectively, the synthetic evaluation function of the contribution degree of each subsystem of public cultural services and smart technology to the coupling system is:

$$U_1 = \sum_{j=1}^m \varphi_{1j} X_{1j} \tag{1}$$

$$U_2 = \sum_{j=1}^m \varphi_{2j} X_{2j} \tag{2}$$

In the above formulas, U_1 and U_2 represent the respective synthetic evaluation index of each subsystem. φ_{1j} and φ_{2j} represent the weight of the respective index of the subsystem, and the index weight of this paper is determined by the entropy weight method [6]. The coupling coordination degree model is as follows:

$$C = 2 \frac{\sqrt{U_1 * U_2}}{U_1 + U_2} \tag{3}$$

Table 1. Criterion for evaluating coupling coordination degree

Numerical range	Coupling coordination degree	Numerical range	Coupling coordination degree
(0.0–0.1)	Extreme discordance	[0.5–0.6)	Basic coordination
[0.1–0.2)	Serious discordance	[0.6–0.7)	Primary coordination
[0.2–0.3)	Moderate discordance	[0.7–0.8)	Intermediate coordination
[0.3–0.4)	Mild discordance	[0.8–0.9)	Good coordination
[0.4–0.5)	Near discordance	[0.9–1.0)	Excellent coordination

$$D = \sqrt{C * T} \quad (4)$$

$$T = \alpha U_1 + \beta U_2 \quad (5)$$

In the above formulas, C represents the degree of coupling. The larger the value of C, the better the coupling state of the two systems, whereas the smaller the value of C, the more unstable the coupling state of the two systems. T represents the synthetic evaluation index of public cultural services and smart technology. α and β are undetermined parameters whose sum is equal to 1. As the two systems have the same level of importance, $\alpha = 0.5$ and $\beta = 0.5$ are assigned. D stands for the degree of coupling coordination (degree of integration) between public cultural services and smart technology. The larger the value of D, the better the coupling coordination between the two systems. In order to directly reflect the degree of coupling of the coordinated development of the two systems, this paper formulates the criterion for evaluating coupling coordination according to the relevant literature, as shown in Table 1 [7].

3 Empirical Analysis

According to the index system of public cultural services and smart technology, the degree of coupling coordination (degree of integration) of public cultural services and smart technology of 31 provinces (excluding Hong Kong, Macao and Taiwan) in China from 2015 to 2021 is calculated using Formulas (1) to (5), and the results are shown in Fig. 1.

3.1 Analysis on the Integrated Development Trend

As can be seen from Fig. 1, the overall average level of coupling coordination (degree of integration) between national public cultural services and smart technology from 2015 to 2021 is 0.6250, with a general level of integration and a stage of primary coordination. The general trend of change over the last seven years shows that the integration of public cultural services and smart technology is in a rapid phase of development, and the level

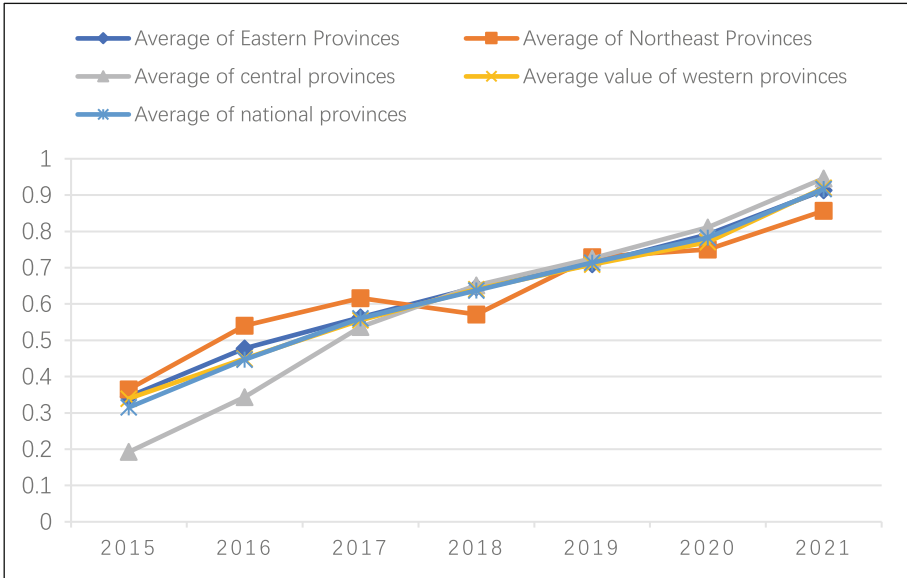


Fig. 1. The trend of integration of public cultural services and smart technology

of integration is increasing year by year, from 0.3154 in 2015 to 0.9169 in 2021, from mild discordance to excellent coordination, indicating that the policy of promoting the digitization of public cultural services has achieved remarkable results in recent years. From 2015 to 2021, the average annual integration level of public cultural services and smart technology in China’s 31 provinces shows a decreasing trend from the northeastern region to the eastern, western and central regions. In terms of trend, the central region has the highest growth rate and the largest range; The degree of integration in the northeastern region is the most unstable, with certain fluctuations; The trend of other regions is almost the same and relatively stable.

3.2 Analysis on the Spatial Characteristics

As can be seen from Fig. 2, in 2016, the level of coupling coordination of Beijing, Shanghai, Jilin Province, Heilongjiang Province and Xinjiang Uygur Autonomous Region has risen to the state of coordination, at the stage of basic coordination or above, and the rest of the provinces are at the stage of moderate discordance to near discordance. Although the overall level of integration is still low, the degree and scope of integration are constantly improving. At this time, Beijing, Shanghai, Tianjin and other municipalities with good economic development, a high degree of smart technology and an excellent foundation of public cultural services have a better degree of integration, which is higher than that of other regions. Affected by the benefits of policies and other factors, the degree of integration in Jilin Province, Heilongjiang Province, Inner Mongolia Autonomous Region, Xinjiang Uygur Autonomous Region and other provinces in the northern region is good.

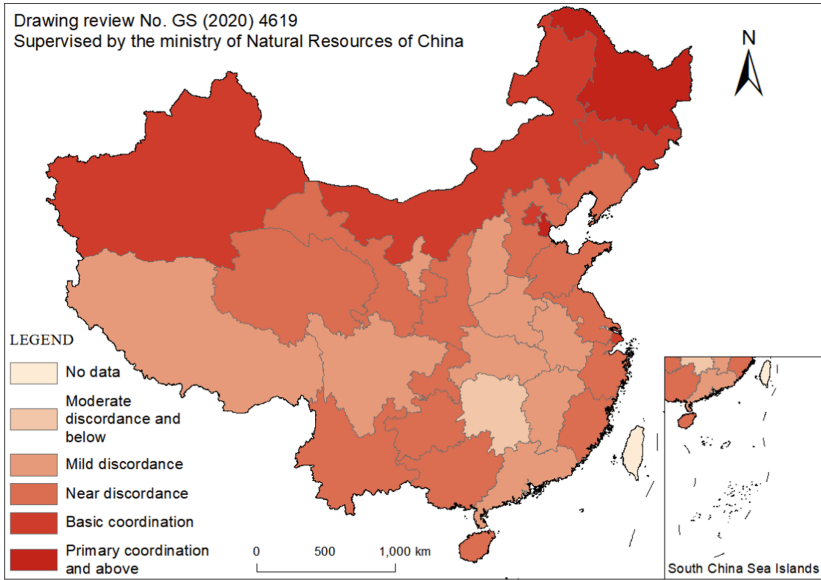


Fig. 2. Spatial distribution of the integration of China’s public cultural services and scientific and smart technology in 2016

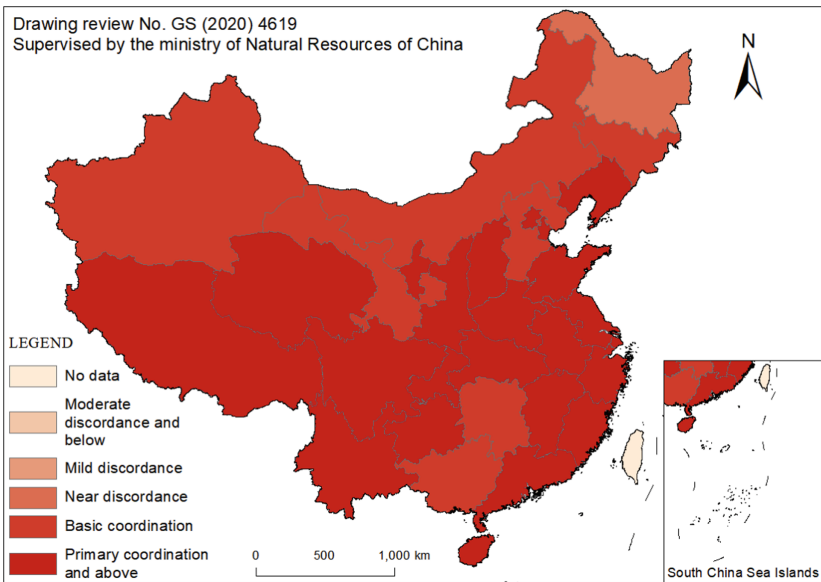


Fig. 3. Spatial distribution of the integration of China’s public cultural services and scientific and smart technology in 2018

As can be seen from Fig. 1 and Fig. 3, in 2018, except for Heilongjiang Province, Xinjiang Uygur Autonomous Region, Hebei Province, Inner Mongolia Autonomous Region, Hunan Province, Guangxi Zhuang Autonomous Region, Jilin Province and Gansu Province, which are still at the stage of basic coordination or below, the level of coupling coordination in other provinces has reached the primary coordination level or above. The level of integration of public cultural services and smart technology in our country is generally higher in the southern region than in the northern region, and in the eastern region than in the western region. At this point, the provinces in the northern region, such as Jilin Province, Heilongjiang Province, Inner Mongolia Autonomous Region and Xinjiang Uygur Autonomous Region, are obviously deficient in driving force, and their level of integration doesn't increase significantly compared with that of 2016. By 2021, all 31 provinces in China have reached the level of good coordination, and some provinces have reached the level of excellent coordination. Public cultural services and smart technology are becoming increasingly integrated in China, and the digital construction of public cultural services has started to achieve results and is pushing forward to a stage of high-quality development.

4 Conclusions

After empirical analysis, this paper draws the following conclusions: Firstly, there is a coupling coordination relationship between public cultural services and smart technology. Smart technology enables the "precise supply" of public cultural services, and public cultural services, to a certain extent, promote the transformation of the driving force of smart technology. Secondly, China's public cultural services and smart technology are at a relatively better stage of coupling, with significant differences in the degree of regional coupling and level of integration, and a steadily increasing degree of coupling. Thirdly, there is a significant spatial "agglomeration effect" in the level of integration level of public cultural services and smart technology in China. The level of integration is generally higher in the southern region than in the northern region, and in the eastern region than in the western region, showing a lack of development momentum in the northern and western regions. Fourthly, by 2021, all 31 provinces in China have reached the level of good coordination, and some provinces have reached the level of excellent coordination. Public cultural services and smart technology are becoming increasingly integrated in China, and the digital construction of public cultural services has started to achieve results and is pushing forward to a stage of high-quality development.

This paper analyzes the current situation of the integration of Chinese public culture and smart technology, summarizes the existing problems, and provides theoretical and practical support for subsequent research. The follow-up research can start from the following aspects: Firstly, the application of smart technology in grass-roots public cultural services [8]. Secondly, the application of smart technology in digital libraries, digital cultural centers and digital museums [9]. Finally, the impact of smart technology on the elderly, children and other special groups [10].

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