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Construction of Rural Governance Digital System Driven by Big Data in the Context of Public Health

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Abstract Rural governance lays the foundation for national governance, while public services provide the foundation for economic and social stability. The two directly affect the level of rural public health and the implementation of the rural revitalization strategy. Informatization plays a fundamental role in supporting the rural governance system and rural public services. Only by building a new rural digital governance system can rural society be healthier, more harmonious, and more orderly. However, at present, the problems of "scattered" rural grass-roots party organizations, "heavy" grassroots comprehensive governance burden, and "few" means of villager self-government are still prominent. The level of digital application is not high, and it is imminent to implement digital governance capabilities. Therefore, this paper used big data and Internet technology to build a digital system of rural governance driven by big data to build the cornerstone of rural community development. The experimental results showed that the rural governance digital system driven by big data improved the villagers' satisfaction with rural governance affairs by about 13.58%. The acceleration of digital village construction in the new era could better promote the overall improvement of agriculture and enhance the overall progress of rural areas. The tide of digital economic development was closely followed to give full play to the auxiliary role of digital technology in digital village governance, and strive to eliminate the digital divide between urban and rural areas and between regions. The new situation of digital village construction was continuously opened up to promote rural revitalization.

Index Terms Digitalization of Rural Governance, Big Data Government Management, Internet Technology, Public Health

I. Introduction

In recent years, with the rapid economic and social development and the continuous advancement of urbanization, the rural social structure has also undergone profound changes, and the interests of villagers have become increasingly diversified. By systematically studying the construction of the digital system of rural governance driven by big data, this paper strives to innovate the rural governance model and improve the level of digitalization.

There are some studies on the digitization of rural governance by scholars: Singh S conducted a survey to discuss the challenges of rural governance related to digitization. In addition, how network security could prevent information leakage during online operations was comparatively analyzed [1]; Liu Y's research analyzed how local rural governments and rural community leaders could build and scale a successful rural governance network through the effectiveness of digital tools [2]; Yin Z's research showed that the operation of administrative power in administrative villages and the comprehensive introduction of information-based governance technology formed a structural squeeze on the governance of villagers' groups after policy empowerment. The optimized overall village governance path was as follows: For the villages mainly based on technical governance, the organic combination of village governance and technical governance was promoted and the advantages of technical governance were brought into play, so as to jointly improve the rural governance capacity [3]; Wong S W's research elucidated how the process of village informatization improved village management and conceptualizes the subtle interdependence between localities, village collectives, and villagers [4]; Ghanshala K K proposed a new model of electronic governance centered on village-level decentralization and informatization intervention. He studied and considered factors affecting village-level governance and used electronic participation as a viable informatics solution [5]. The above research analyzed the digitization of rural governance.

Many scholars have conducted research on big data government affairs management: Under big data analysis, Duman G M studied the transformation of unorganized and unstructured government affairs-related data into useful information. If this was used properly, big data analytics would offer great potential for creating clear and

meaningful strategic planning [6]; Lv Z's research showed that: Through the effective management and utilization of urban multimedia big data, three-dimensional analysis and visualization of urban multimedia information could be carried out on the disaster management platform, which facilitated the provision of different disaster management services to policymakers and other relevant stakeholders in government and industry [7]; Lnenicka M proposed a new framework for government big data that used cloud computing for data storage, processing and distribution. He defined key concepts and specifies basic architectural roles and components, including implementation steps, solutions, and responsibilities recommendations for them [8]; Zhang J L discussed the main problems of big data serving government management and analyzed the solutions to promote the strategy of sharing big data and improve the government's public management capabilities, so as to to find an efficient and scientific route [9]; Lh A's research focused on the working principle of the Internet of Things and the governance mechanism of big data sharing, which provided a reference for the government to promote and regulate the development of the Internet of Things and the big data industry [10]. The research of the above scholars has made fruitful progress in the application of big data government affairs management.

The supply capacity of rural public services is far behind that of cities, and the improvement of rural public service efficiency is the most direct manifestation of the effect of rural governance and a practical problem that needs to be solved urgently. This paper used big data technology to carry out rural public service efficiency improvement activities, and focused on agricultural education, medical care, social security and other areas of livelihood security. The enabling role of digital technology was being brought into play in an effort to promote the equalization of basic public services in urban and rural areas.

II. Basic Concepts of Rural Governance

(1) Rural communities

The so-called community is a social group composed of people who live together in a certain area [11]. Community is an important part of society, which is usually divided into rural community, town community and urban community. The transformation of primitive villages into rural communities is accelerating due to continued urbanization [12]. Rural communities are relatively small in density and size. Rural communities are the main focus of this paper, and agriculture is their main source of income. The functions of rural communities are shown in Figure 1:

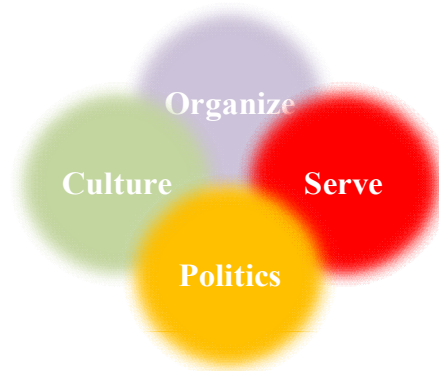


Figure 1: Rural community function

As shown in Figure 1, rural communities have four functions: politics, culture, organization and service [13]. Among them, the political function specifically refers to the main role of rural communities in participating in social and political life as villagers, and conducting democratic elections, democratic decision-making, democratic management and democratic supervision; the cultural function is reflected in the material facilities for cultural education and the conditions for various cultural activities in the rural community; the organizational function is reflected in the psychological organization, behavioral restraint and social control, which helps to coordinate and unify the behaviors and concepts among the members of the rural community; the service function is reflected in basic security and welfare care, and the maintenance of residents' medical treatment and living needs.

(2) Governance of rural public affairs

Public affairs are public activities that provide public goods and services to relevant subjects, which fundamentally belong to the scope of contract theory [14]. In the form of a social contract, countless individuals give way to judicial power to form a state, and the state manages those affairs that are not clearly divided and individuals are unwilling or unable to perform alone [15]. The subjects of rural governance are diverse, but in the

special political composition of villages, villagers have much greater autonomy in public affairs than towns. Villagers' active participation in public affairs can make affairs more efficient. In the big data environment, individuals are both information publishers and information receivers. The development of mobile Internet and big data has strengthened the multiple attributes of knowledge governance. The public affairs governance structure is shown in Figure 2:

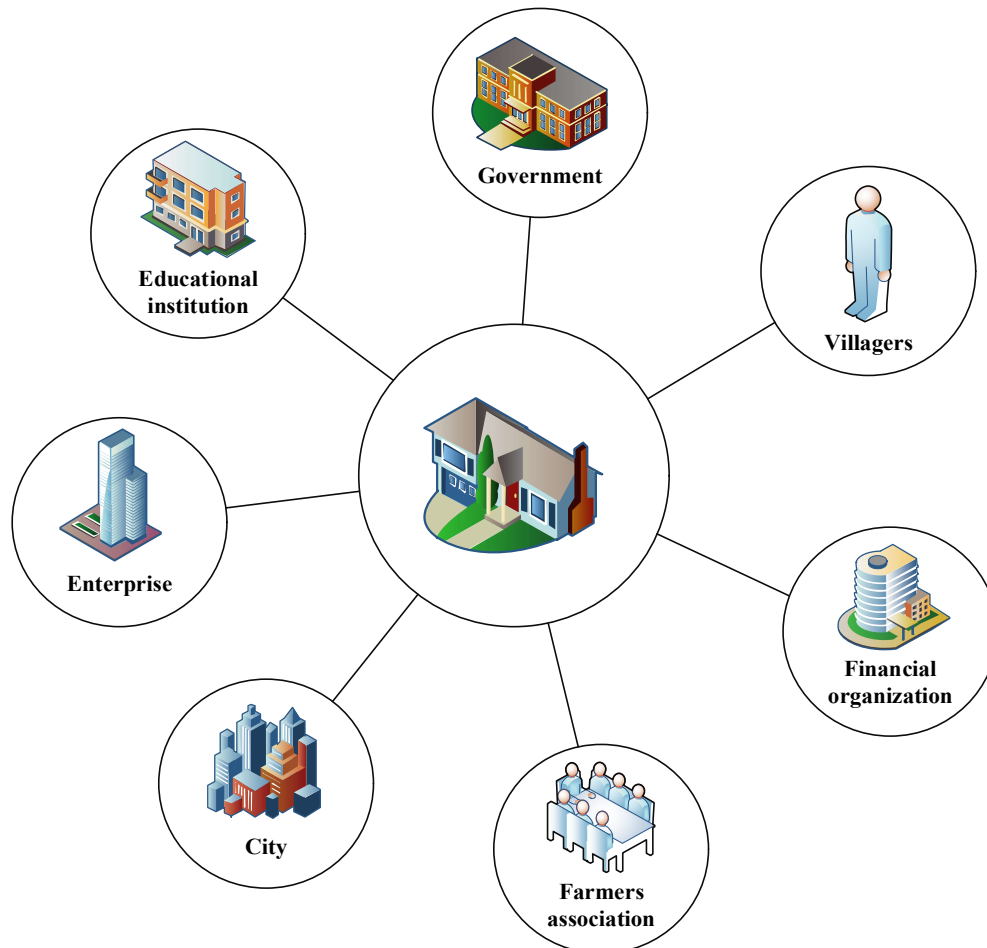


Figure 2: Public affairs governance structure

From Figure 2, it can be seen that through the perspective of knowledge governance, the problems arising from public affairs in rural communities are managed, and the knowledge behaviors between individuals and organizations are reconciled to solve the problems of public affairs governance and achieve the purpose of governance.

At present, there are many drawbacks in the management of public affairs in rural communities. The main manifestation is that the enthusiasm of villagers to participate in the management of public affairs is not high, and it is difficult to ensure that all villagers can express their opinions. Village cadres passively discuss matters in order to maintain political performance and do not supervise in place, and they pay more attention to their own interests when dealing with problems. It is difficult to reconcile the contradiction between collective and individual interests, and the consequence is the failure of public affairs management in rural communities. To this end, knowledge governance must be used to solve the shortcomings of public affairs management in rural communities at this stage, and a series of institutional designs must be used to coordinate individual and collective actions. Education and training should be used as a starting point, so as to focus on strengthening the exchange and learning of subjects and take the integration of fragmented knowledge as the path. Multi-subject consensus is reached as the goal to improve the public affairs processing of rural communities, so as to achieve the purpose of rural revitalization.

(3) Balancing the interests of rural public affairs governance

The top layer is carefully designed to ensure that governance interests are balanced. It not only acts on the organization through external coercive power and pays attention to the use of coercive power, but also uses interests and other incentive and restraint mechanisms to relieve and guide multiple subjects. As far as rural community governance is concerned, if too much attention is paid to the ruling dimension of governance, it may lead to decision-making mistakes, that is, the disadvantages of governance. If excessive control is unintentionally carried out, it would be difficult to meet the needs of multiple agents and would fall into the dilemma of high cost and low efficiency. If too much attention is paid to the dimension of dredging and relying solely on market governance or network governance, it would be difficult to control the main body of governance and cause market failure, which would lead to the failure of public affairs management in rural communities.

The top-level design must be authentic and effective to reconcile the interests of multiple subjects. In the process of forming consensus among multiple subjects, the required rules and standards are realistic. For the governance body, it is necessary to make thinking productive. In the process of building consensus, only smart people and smart tools are not enough. Large-scale thinking usually relies on infrastructure to ensure that the consensus is true and effective. The primary infrastructure is a set of accepted rules and standards that are necessary for any knowledge sharing to greatly reduce the cost of thinking and coordinating transactions. Only when all the villagers understand a certain rule and criterion and the rule criterion is true and credible, the villagers can reach a group consensus on this basis [16].

III. Design of Rural Governance Structure Driven by Big Data

(1) Big data rural construction theory

In the context of current big data, this paper uses the Internet of Things and cloud computing intelligent technology to solve the problem of general insufficient development of rural communities. This breaks the barriers of traditional systems, and multi-subject participation and cooperation in rural communities can achieve the purpose of improving governance capabilities. The big data rural construction theory is shown in Figure 3:

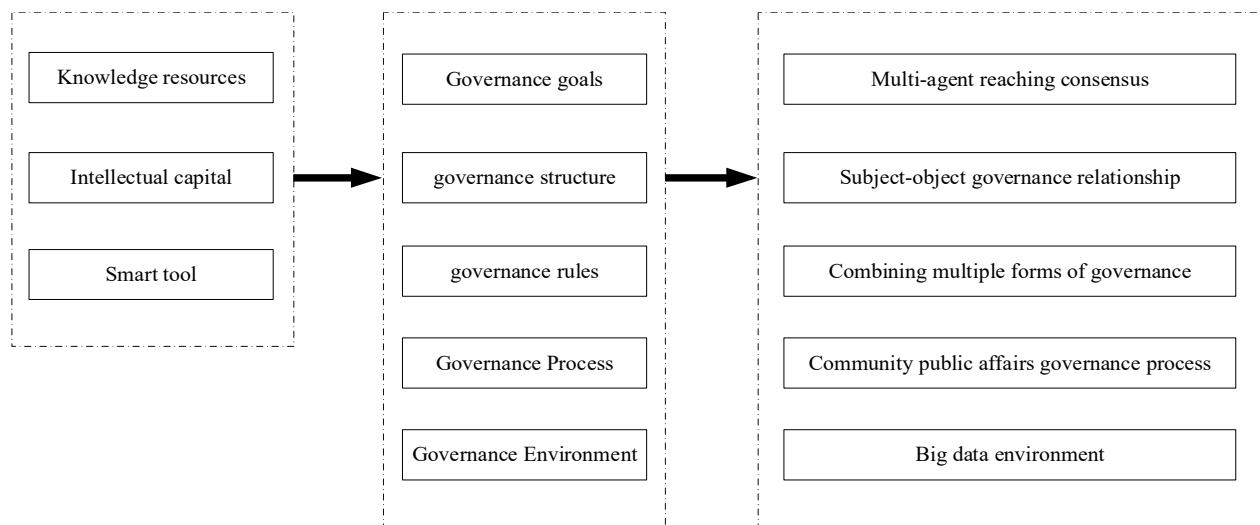


Figure 3: Big data rural construction theory

The construction of the digital system of rural governance driven by big data has the following three practical significance:

a) The reshaping of the agricultural development model has a positive role in promoting the development of agricultural modernization.

b) The quality of farmers and the level of farmers' spiritual culture are improved. The digital system of rural governance driven by big data can significantly increase the income level of farmers and improve their living conditions, thereby changing their way of life. Villagers have the opportunity to enjoy higher education and improve the overall level of intellectual capital. The prevention of problems such as network gaps and technical islands in rural communities can effectively promote the formation of consensus among multiple subjects and the synergy of interests, and advance the development of resource sharing.

c) The integrated development of urban and rural areas has been promoted. Driven by big data, a digital system of rural governance has been built, which creates conditions for market networking and narrowing the urban-rural

income gap. This whole process maintains the original regional characteristics of rural communities and maintains the original appearance of "green water and green mountains".

(2) Big data rural construction framework

Based on the perspective of knowledge governance and through the analysis of three levels of rural community knowledge resources, intellectual capital and smart tools, this paper makes a series of rational designs for the goals, structures, rules and processes of rural community knowledge governance in the context of big data. At the same time, it strives to achieve the purpose of forming a consensus among multiple subjects. The big data rural construction framework is shown in Figure 4:

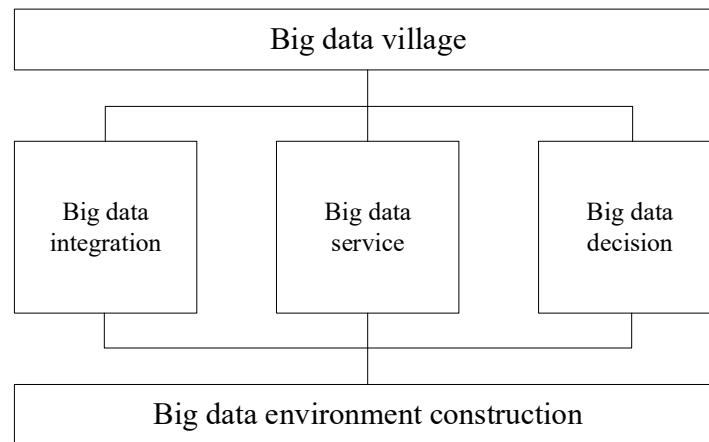


Figure 4: Big data rural construction framework

This paper places knowledge governance in the construction of big data villages, which corresponds to the elements of governance goals, structures, rules, processes, and environments. Knowledge governance methods are used to solve the current governance problems in rural community public affairs, so as to achieve the purpose of improving rural community public affairs management capabilities.

Big data integration promotes the precision of knowledge governance content. In recent years, with the continuous advancement of the urban-rural integration process, the government has increased its investment in rural community public services and public products year by year [17]. The use of big data technology can improve the content accuracy of knowledge governance in rural community public affairs.

a) The construction of a big data environment can effectively understand the demands of multiple subjects. Due to the high mobility of villagers, it is difficult for traditional methods to collect all demands. However, the use of big data and mobile Internet technology can effectively collect the actual needs of villagers and provide a guarantee for accurate collection of governance content, so as to promote demand-oriented public affairs governance in rural communities and achieve precise analysis and precise governance.

b) The construction of big data environment can realize the classification of knowledge governance objects and promote the accuracy of knowledge governance content. For rural communities, multi-agent needs are often inconsistent. If the provided knowledge service is single and lacking in specificity, the user experience is usually not high. Big data technology is used to carry out personalized services and improve the utilization of knowledge. Through the classification of governance objects and the development of targeted and precise services, the level and ability of rural community governance have been improved.

c) The construction of a big data environment can integrate the fragmented knowledge in rural communities and promote the simplicity of knowledge governance content. With the help of the smart platform construction, multiple subjects in the rural community can quickly, comprehensively and carefully understand all the content and avoid misunderstanding caused by fragmented knowledge, so as to solve the "indescribable" problem for villagers and play a positive role in promoting accurate interpretation of policies and guidelines for villagers.

(3) Technical support

The first is to build a barrier-free interactive sharing platform to provide rural community knowledge services with multiple subjects, anytime, anywhere, multiple terminals, and multiple platforms through mobile Internet devices. The young and middle-aged labor force of villagers often go out to work, so it is difficult for them to fully understand the public affairs of rural communities and conduct effective discussions [18]. With the help of a real-time interactive platform such as the mobile phone WeChat group, multiple subjects can express their opinions and demands according to the supply and demand of rural public affairs at any time, any place, and barrier-free.

Second, the current user experience is poor and it is difficult to respond to the increasingly diverse demands of the villagers. Most of the government affairs platform information is pre-edited by administrators, and the masses passively participate. There is often a lack of response efficiency to the real demands of the masses, which leads to a lack of enthusiasm for participation in the villagers. Finally, the use of the smart platform can not only realize multi-subject barrier-free information inquiry and government affairs discussion in rural communities, but also effectively supervise the governance of public affairs in rural communities, so as to achieve the purpose of democratic supervision of villagers and promote the enthusiasm of villagers and other multi-subjects to participate and enhance the scientificity and fairness of public affairs management in rural communities.

IV. Theories Related to Big Data Technology Implementation

(1) Network security situational awareness model

The tree model has strong representation ability and is easy to understand. Due to the nature of recursive divide and conquer, it is in perfect agreement with the essence of big data analysis and processing [19]. The ensemble of models, one of the most powerful types of techniques in machine learning, often outperforms other methods. Therefore, the random forest model is composed of decision trees of any size by using model ensemble technology. However, the realization of its good performance needs to pay the price of increasing the complexity of the algorithm and model.

A decision tree is formed by using the decision graph and the possible results together to construct the possible paths to the target result [20]. Using the existing conditions, the user first analyzes the existing conditions for the root node of the decision tree to determine the direction of the existing conditions. In the process of building a decision tree, there are two important concepts that need to be clarified, namely entropy and gain. In the decision tree algorithm, these two parameters are used to evaluate the correlation between categories and attributes.

The calculation expression of entropy is shown in Formula (1):

$$E(Y) = \sum_{t=1}^N -\frac{Y_t}{\text{Sum}(Y)} \log_2 \left(\frac{Y_t}{\text{Sum}(Y)} \right) \quad (1)$$

One of the values of the attribute is shown in Formula (2):

$$E(X_j) = \sum_{t=1}^N -\frac{Y_t}{\text{Sum}(X_j)} \log_2 \left(\frac{Y_t}{\text{Sum}(X_j)} \right) \quad (2)$$

The gain of the attribute is shown in Formula (3):

$$E(X) = \sum E(X_j) = \sum_{j=1}^M \sum_{t=1}^N -\frac{Y_t}{\text{Sum}(X_j)} \log_2 \left(\frac{Y_t}{\text{Sum}(X_j)} \right) \quad (3)$$

In the formula, $\text{Sum}(X_j)$ is the number of records containing X_j in the data set, and Y_t is the t th value of category Y .

(2) Bayes' theorem

Bayes' theorem is often used to calculate the probability of a condition occurring by quantifying the relationship between the two, which is shown in Formula (4):

$$p(H|x) = \frac{p(x|H)p(H)}{p(x)} \quad (4)$$

The Naive Bayes algorithm can be used to predict whether a given value belongs to the category with the largest posterior probability, and Formula (5) is as follows:

$$p(C_1|x) > p(C_j|x) \quad (5)$$

The maximization is carried out to obtain the maximum posteriori hypothesis, as shown in Formula (6):

$$p(C_1|x) = \frac{p(x|C_1)p(C_1)}{p(x)} \quad (6)$$

Among them, x represents the measurement description of n attributes; H represents a certain hypothesis.

(3) Template matching

The standardized representation of attributes in the data set is shown in Formula (7):

$$X' = \frac{X - m}{s} \quad (7)$$

The proportion of the number of records containing a specific attribute to the total is defined as shown in Formula (8):

$$S = \frac{\text{Count}(x \cup y \cup z)}{n} \quad (8)$$

Each attribute is standardized, which can effectively avoid the influence of data inconsistency and attribute distribution caused by different units on the distance calculation. The normalization process for reference and test templates are as follows:

$$r_i^* = \frac{r_i - r_m}{r_s} \quad i \in [1, 6] \quad (9)$$

$$t_j^* = \frac{t_j - t_m}{t_s} \quad j \in [1, 6] \quad (10)$$

Among them, r_m and t_m are the mean, and r_s and t_s are the standard deviation.

V. Experimental Investigation on Big Data Rural Governance Practice

First of all, the sample set is set. This paper invites 20 village representatives from 10 natural villages as experimental subjects to participate in the test and introduce the big data rural governance system in detail. The traditional rural governance system and the big data rural governance system are evaluated through questionnaires. The big data rural governance system is named T1, and the traditional rural governance system is named T2. The information of the villagers is shown in Table 1:

Table 1: Villager's information

Village name	Number of people	Number of man	Number of women
A village	10	8	2
B village	10	6	4
C village	10	6	4
D village	10	8	2
E village	10	5	5
F village	10	7	3
G village	10	8	2
H village	10	5	5
I village	10	7	3
J village	10	5	5

(1) Evaluation of rural cultural construction

Big data can strengthen the construction of rural public culture, and big data technology promotes the flow of public cultural resources to rural areas. According to the needs of norms, networks, content, and talents, the rural public cultural service system can be improved, and the development of grass-roots comprehensive cultural service centers can be strengthened. At the same time, it is necessary to continuously improve the service functions and improve the management level. The evaluation of rural cultural construction is shown in Figure 5:

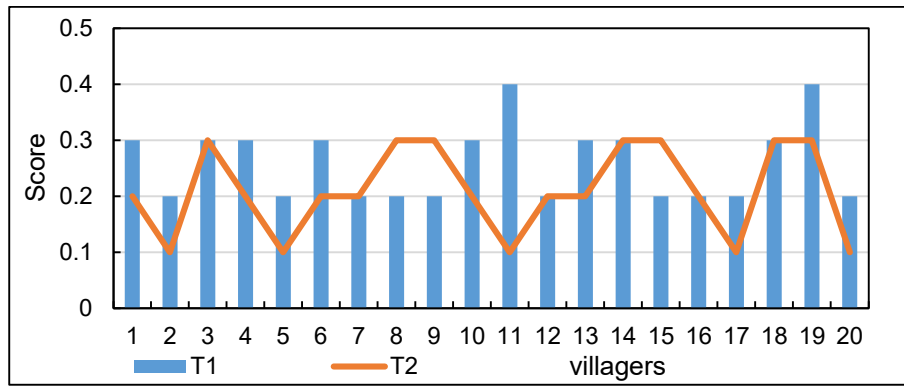


Figure 5: Evaluation of rural cultural construction

Figure 5 shows that villagers are more receptive to the construction of rural culture driven by big data. The 20 villagers give a high evaluation to the rural cultural construction driven by big data, and they give a low evaluation to the rural cultural construction of the traditional rural governance system. There is a big difference between the highest score and the lowest score, which proves that the digital system of rural governance driven by big data is good at the level of rural cultural construction.

(2) Evaluation of rural organization construction

Big data technology can enrich the value connotation of farmers' digital life and effectively strengthen top-level design, and coordinate and systematically advance, so as to attach importance to knowledge update, innovation-driven digital literacy and skill training system construction, and cultivate digital farmers with digital awareness and computational thinking. The big data rural governance system focuses on expanding the four scenarios of farmers' digital life, digital learning, digital work and digital innovation. The enthusiasm, initiative and creativity of farmers in the construction of a network power country and digital China can be mobilized, and farmers' digital adaptability, competence and creativity can be enhanced. The evaluation of rural organization construction is shown in Figure 6:

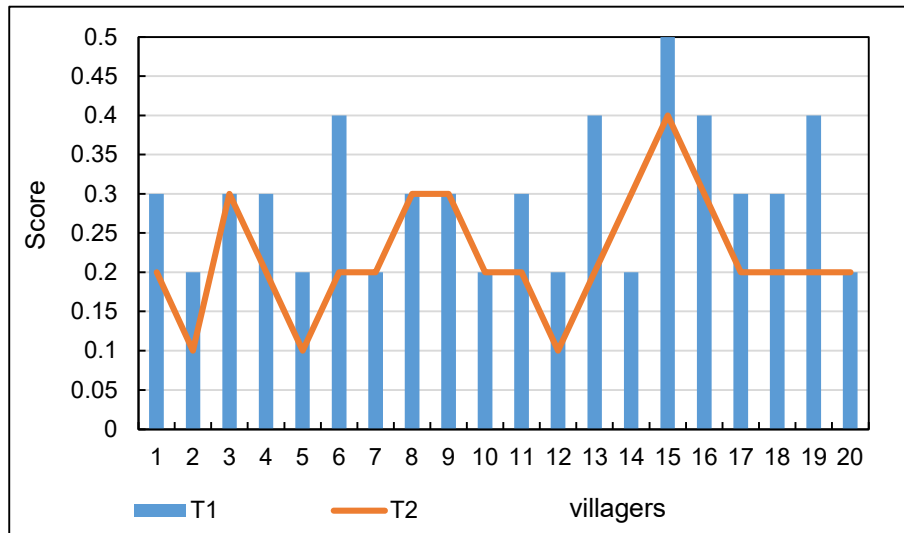


Figure 6: Evaluation of rural organization construction

Figure 6 shows that villagers are more receptive to the construction of rural organizations driven by big data. The 20 villagers have a high response to the evaluation of the construction of rural organizations driven by big data, but they have little response to the construction of rural organizations in the traditional rural governance system. The digital system of rural governance driven by big data performs well at the level of rural organization construction.

(3) Evaluation of rural service construction

The construction of rural services based on big data promotes the extension and coverage of public services, which is conducive to continuous exploration according to their own needs, and promotes the extension of public service resources at the grassroots level and the coverage in rural areas. The "Internet + Smart Rural"

comprehensive service information platform is innovatively constructed. Through online data collection, approval and certification and precise management, the process of right confirmation, registration and certification has been streamlined to improve the service experience of farmers' registration and certification. Through online data collection, approval and certification and precise management, the process of right confirmation, registration and certification is streamlined to improve the service experience of farmers' registration and certification. The comprehensive service and information management platform for rural property rights is established. The "Internet + transaction" model is used to promote the entry of rural resource assets into the market and activate idle rural resource assets. The rural practical talent management module on the innovative service platform is constructed to realize the online identification of talents, the online application of subsidies, the online organization of training and the online tracking of employment. The evaluation of rural service construction is shown in Figure 7:

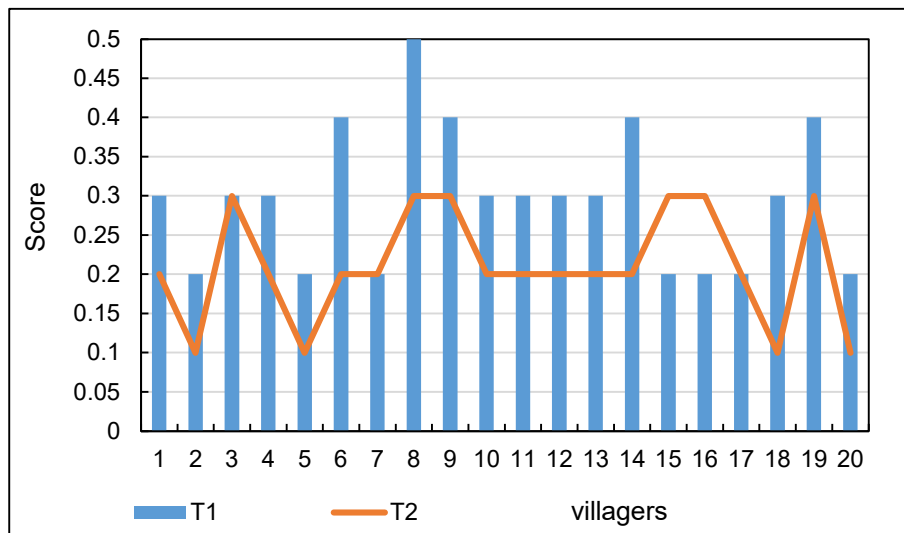


Figure 7: Evaluation of rural service construction

Figure 7 shows that villagers are very satisfied with the construction of rural services driven by big data. The 20 villagers give a high evaluation to the rural organization construction driven by big data, and the evaluation of the rural organization construction of the traditional rural governance system is average. The digital system of rural governance driven by big data has great potential in the construction of rural organizations.

(4) Comprehensive satisfaction of villagers

The three results obtained from the above experiments are comprehensively calculated to obtain the comprehensive satisfaction of the villagers. The comparison results are shown in Figure 8:

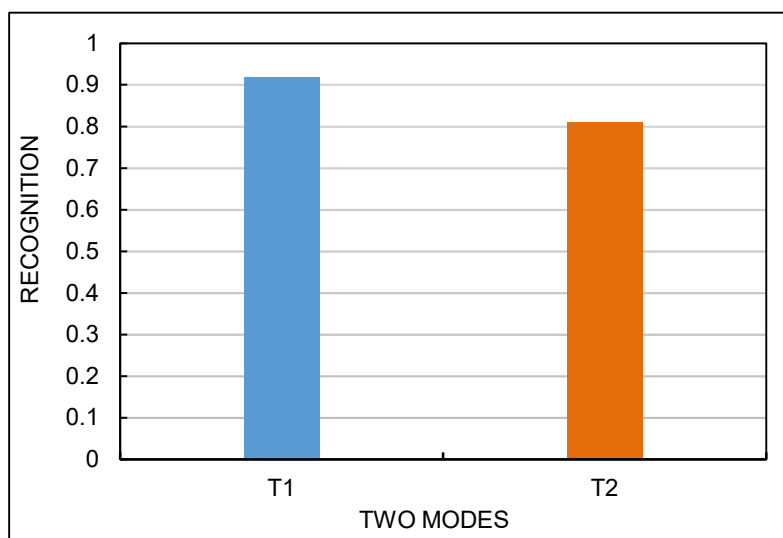


Figure 8: Villagers' comprehensive recognition

It can be seen from Figure 8 that villagers are highly satisfied with the digital system of rural governance driven by big data. According to the experimental results, the satisfaction of the villagers is increased by about 13.58%. The solution of the issue of rural governance is not only a practical responsibility for the lives of the majority of rural residents, but also a good practice for rural revitalization.

VI. Conclusions

Digital village is an important way to promote the transformation and development of agriculture and rural areas, which is a major measure to promote common prosperity. In order to solve the problem that the existing rural digital application level is not high, this paper constructed a big data rural governance digital system. The results of the experiment were as follows: the evaluation results of rural cultural construction; the evaluation results of rural organization construction; the evaluation results of rural service construction; the results of villagers' comprehensive satisfaction. The experimental results showed that the use of the digital system of rural governance driven by big data could effectively improve villagers' satisfaction with rural village governance affairs, which was conducive to rural revitalization.

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