



# The Exploration of the Path of Long-Term Mechanism of Enterprise Empowering Rural Revitalization Based on Mapping Knowledge Domain and Coupling Coordination Model—Taking Three Districts and Three Prefectures of Sichuan Province as an Example

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**Abstract.** Enterprise subject is an important driving force to establish a long-term mechanism for rural revitalization which is compatible with China's rural market economy. This paper uses Python crawler technology to form a mapping knowledge domain and builds a coupling coordination model. In view of the problems of “less participation and lagging development” in the process of enterprises participating in rural revitalization, this paper puts forward a long-term mechanism of “one strengthening, two encouraging and three building” for enterprises to empower rural revitalization.

**Keywords:** rural revitalization · three districts and three states · enterprise · long-term mechanism

## 1 Introduction

The Party and the state attach great importance to the rural revitalization strategy, which is not only the ballast stone of high-quality development, but also an important component of the new development pattern. The “three districts and three prefectures” in Sichuan Province is a deep poverty area at the national level, including Ganzi Tibetan Autonomous Prefecture, Aba Tibetan and Qiang Autonomous Prefecture and Liangshan Yi Autonomous Prefecture. The in-depth study of the three districts and three prefectures is beneficial to further consolidate the achievements of poverty alleviation and promote rural revitalization and development.

Basis on a comprehensive victory in poverty alleviation in 2020, the focus of the work on agriculture, rural areas and farmers has achieved a historic shift from poverty

alleviation to rural revitalization. The depth, breadth and difficulty of rural revitalization is no less than that of poverty alleviation.

Targeted poverty alleviation is a top-level design oriented to solving absolute poverty. Rural revitalization is a sustainable strategy involving comprehensive rural development and innovation of relevant systems and mechanisms, which requires a long-term endogenous force. Therefore, it is imperative to explore a long-term mechanism that is more suitable for the laws of rural markets, which may help ensure the ability of “independent hematopoiesis” in poverty-stricken areas.

## 2 Literature Review

At present, the existing literature on the long-term mechanism of rural revitalization in China can be roughly divided into the following three categories: First, studies based on macro-level research such as the state and the government. Huang Zuhui and Wang Haibin believe that the key to implementing the rural revitalization strategy is to give full play to the role of the government in top-level design, policy guidance and promotion of reform [1, 2]. Second, research based on the meso-level of enterprises. Rural revitalization is difficult to be achieved by government’s power alone, and must be promoted by close cooperation and joint promotion of multiple subjects, including social organizations and enterprises [3]. Xiu Xinggao pointed out that building leading enterprises and building a common mechanism are two of the widely recognized industrial poverty alleviation models [4, 5]. Third, research based on micro-level research such as the masses. Kang Han proposed that to achieve long-term rural revitalization, residents and foreign talents are of equal importance. On the one hand, for the residents, the relevant departments should try to carry forward the positive and enterprising excellent traditional culture, innovate the ways and methods of helping, and improve the education level of the residents [6]. On the other hand, the salary attraction, the welfare guarantee, the inspiration of promotion and the preferential policies can be used to attract foreign talents to create a multi-level and multi-faceted talent structure [7].

In summary, the academic community has conducted extensive research on the long-term mechanism of rural revitalization from macro, meso and micro levels, which has indicative price and guiding significance. However, for the second level, most of the literature research tends to make qualitative analysis such as concept interpretation, phenomenon description and policy recommendations, and there are still some gaps in quantitative analysis and specific paths of the system. Industrial prosperity is the first requirement of rural revitalization. It is an important driving force to stimulate the endogenous power of rural areas. It covers the largest area and the largest population, which is also the most sustainable way [8]. Enterprise is often the backbone of promoting rural industrialization and related marketization, so the study about enterprises is of great research value.

In addition, the comprehensive analysis of rural revitalization is difficult, and there may be subjective cognition in the research induction [9]. The knowledge mapping knowledge domains can clearly show the participation of multiple subjects in the process of rural revitalization in China. At the same time, the relationship between the enterprise and the countryside is constantly evolving and developing, and “coupling” refers to the

synergy phenomenon caused by the interaction between multiple systems [10]. Therefore, this paper uses a mapping knowledge domain and builds a coupling coordination model to explore the long-term mechanism of rural revitalization in poverty-stricken areas in China.

### 3 Data Acquisition and Model Building

#### 3.1 Construction of the Mapping Knowledge Domain

Through Python crawler technology, the data was extracted from the official websites of the National Rural Revitalization Bureau and Sichuan Rural Revitalization Bureau. Combined with the textual data acquired from the keywords such as “three regions and three prefectures”, “rural revitalization” and so on, the initial data and the database were established. Then, the data matching was conducted in the format of “subject”, “helping relationship” and “subject”, and finally we obtained the cooperative relationship between different subjects in the rural revitalization of “three regions and three prefectures”, and established the mapping knowledge domain with professional software such as Neo4j (Fig. 1).

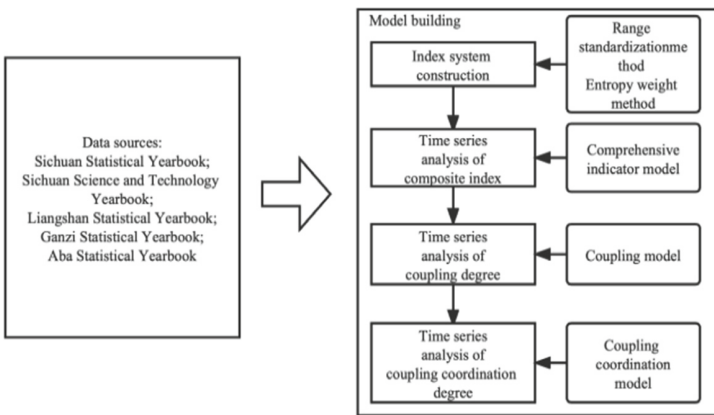


Fig. 1. Construction route of the coupled coordination model

#### 3.2 Construction of the Coupling Coordination Model

##### 3.2.1 Data Source

The indicators related to enterprise development and rural revitalization from 2010 to 2020 are mainly selected from Sichuan Provincial Statistical Yearbook, Sichuan Science and Technology Yearbook, etc.

### 3.2.2 Extreme Standardization Method

In the study, when the index is a positive indicator or a negative indicator, the standardized formula is  $x'_{ij} = \frac{x_j^{max} - x_j}{x_j^{max} - x_j^{min}}$  or  $x'_{ij} = \frac{x_{ij} - x_j^{min}}{x_i^{max} - x_j^{min}}$ .

Among this,  $x_{ij}$  is the normalized values,  $x_j^{max}$  is the maximum value of the  $j$  th index in year  $i$ ,  $x_j^{min}$  is the minimum value of the  $j$  index in year  $i$  ( $i = 1, 2, \dots, n$ ).

When the index is a moderate index, the standardized formula is:

$$x'_{ij} = 1 - \frac{|x_{ij} - d_i|}{\max |x_{ij} - d_i|}$$

Among this,  $d_i$  is for the standard value of the determined value, it also performs the non-negative translating process:  $x'_{ij} = h + x'_{ij}$ .

### 3.2.3 Entropy Right Method

First, the construction matrix, in the  $x_{ijmn}$  formula,  $m$  is the specific year, and  $n$  is the specific number of indicators.

Second, calculate the proportion of index  $j$  in year  $i$ :  $y_{ij} = \frac{x'_{ij}}{\sum_{i=1}^n x'_{ij}}$

Third, calculate the entropy value of the  $j$  th index:  $e_j = -\frac{1}{\ln n} \sum_{i=1}^n \ln y_{ij}$

Fourth, calculate the difference coefficient of the  $j$  th index:  $g_j = -e_j$

Fifth, calculate the weight of the  $j$ th index:  $\omega_j = \frac{g_j}{\sum_{j=1}^p g_j}$

### 3.2.4 Comprehensive Exponential Model

The comprehensive index model is used to measure the comprehensive level of enterprise development and rural revitalization in the three regions. Set the positive number  $U_1, U_2, \dots, U_m$  to describe the  $m$  indicators of enterprise development, the positive number  $W_1, W_2, \dots, W_n$  describes the  $n$  indicators of rural revitalization:  $f(U) = \sum_{j=1}^m a_j U_j$   
 $g(W) = \sum_{j=1}^n b_j W_j$

Among them,  $f(U)$  is the comprehensive index function of enterprise development;  $g(W)$  is the comprehensive index function of rural revitalization;  $a_j, b_j$  is the weight of each indicator;  $U_j, W_j$  is for the data processed after standardization.

### 3.2.5 The Coupling Degree Model

The coupling degree model is as follows:

$$C = \{U_1 U_2 / [(U_1 + U_2) * (U_1 + U_2)]\}^{\frac{1}{2}}$$

Among them,  $C$  is the coupling degree of enterprise development and rural revitalization, and the range of  $C$  is  $[0, 1]$ ;  $U_1$  is the enterprise development index,  $U_2$  is the rural revitalization index.

### 3.2.6 The Coupling Coordination Degree Model

The formula of the coupling coordination measure is as follows:

$$T = \alpha U_1 + \beta U_2 D = \sqrt{C * T}$$

$T$  is the composite index, since the enterprise development system and the rural revitalization system are quite important in the whole complex system, the undetermined parameters  $\alpha$  and  $\beta$  are 0.5;  $D$  is the coupling coordination degree. The values of  $T$  and  $D$  all range from [0, 1].

### 3.2.7 Construction of the Index System

Referring to Cai Wenbo and Yang Qing [11, 12], the study constructs the index system by taking the overall requirements of the rural revitalization strategy “thriving industry, livable ecology, rural civilization and ecological livable” as the first-level indexes, according to the availability of data and the scientific nature of the index system construction, the evaluation index system of rural revitalization in the three regions and three prefectures of Sichuan is constructed. For the enterprise development system, it is constructed from three aspects: industrial enterprises, large operating enterprises and consumer enterprises (Tables 1 and 2).

## 4 Analysis of the Empirical Results

### 4.1 Analysis of the Mapping Knowledge Domain

The knowledge graph is established by visualizing the cooperative relationship between subjects. Through analysis, we can know that:

1. In the process of rural revitalization in the three regions and three prefectures, the government still assumes most of the responsibilities, and the enterprises have problems such as low participation and little power.
2. There is uneven distribution of resources in the process of rural revitalization in the three regions and three prefectures.
3. Most of the supporting behaviors of enterprises relatively rest on the single and basic level, such as technology teaching and one-sided donation, enterprises do not really participate in the practice of rural entrepreneurship and the process of marketization (Fig. 2).

**Table 1.** Index evaluation system of rural revitalization

| system level   | Subsystem layer     | Index layer  | The indicator weight is (%) |
|--|---------------------|--|-----------------------------|
| Comprehensive evaluation system for rural vitalization | thriving industry   | The number of minimum living allowances for rural residents in all cities and states | 1.328                       |
|  |                     | Per capita expenditure of the rural residents in each states                         | 2.516                       |
|  |                     | Per capita household income of rural residents in all cities and states              | 1.913                       |
|  |                     | Number of people employed in each city and state                                     | 7.908                       |
|  |                     | The average salary of all employees in all units in each city and state              | 2.652                       |
|  | Industry prosperity | The GDP of the primary industry in all cities and states (100 million yuan)          | 6.658                       |
|  |                     | The GDP of the secondary industry in all cities and states (100 million yuan)        | 5.953                       |
|  |                     | The GDP of the tertiary industry in all cities and states (100 million yuan)         | 5.76                        |
|  |                     | Per capita GDP of each city and state  | 1.923                       |
|  | Rural civilization  | Total import amount of each city and state (one million RMB)                         | 10.88                       |
|  |                     | Total exports of each city and state   | 4.344                       |

*(continued)*

**Table 1.** (continued)

| system level | Subsystem layer    | Index layer  | The indicator weight is (%) |
|--------------|--------------------|--|-----------------------------|
|              |                    | Internal expenditure of R & D funds for research and experimental development of various cities and states (ten thousand yuan)   | 7.834                       |
|              |                    | Number of personnel in health institutions in each city and state  | 5.252                       |
|              |                    | Number of health institutions per city and state   | 4.924                       |
|              |                    | The total revenue of municipal and prefectural government departments at or above the county level are research and development institutions and information literature agencies | 1.508                       |
|              | Ecological livable | Total output value of agriculture, forestry, animal husbandry and fishery  | 6.664                       |
|              |                    | Crop sown area in all cities and states  | 9.598                       |
|              |                    | Total grain output of each city and state  | 9.211                       |

**Table 2.** Index evaluation system of enterprise development

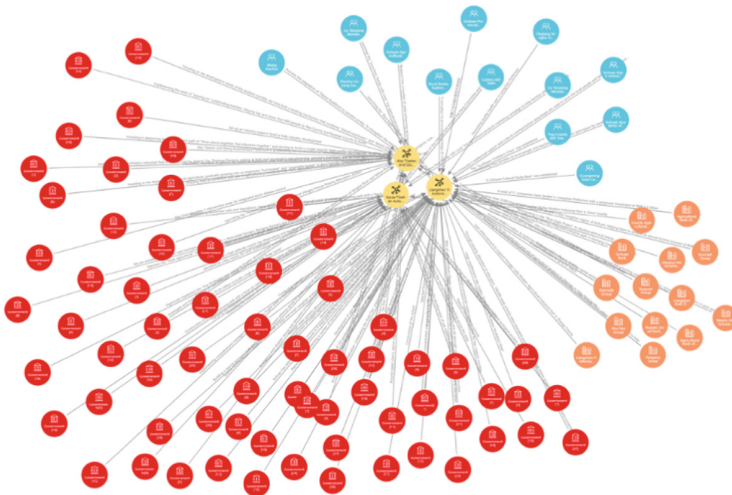
| system level   | Subsystem layer             | Index layer   | The indicator weight is (%) |
|--|-----------------------------|---|-----------------------------|
| Comprehensive evaluation system for enterprise development | Industrial enterprises      | Total profits of industrial enterprises above designated size in each city and state                                  | 6.338                       |
|  |                             | Operating income of industrial enterprises above designated size in each city and state                               | 7.932                       |
|  |                             | The total assets of industrial enterprises above designated size in each city and state                               | 4.936                       |
|  | Large operating enterprises | The number of real estate development enterprises in each city and state  | 6.313                       |
|  |                             | Number of employees in real estate development enterprises  | 8.183                       |
|  |                             | Number of construction enterprises in each city and state   | 10.912                      |
|  |                             | Total output value of construction enterprises in each city and state   | 9.626                       |
|  |                             | Adding value of private economy in all cities and states  | 6.932                       |
|  | Consumer enterprises        | Operating profit of accommodation and catering enterprises with limit above each city and state                       | 0.783                       |
|  |                             | Operating profit of wholesale and retail trade legal enterprises above designated limit in all cities and prefectures | 9.606                       |

*(continued)*



**Table 2.** (continued)

| system level | Subsystem layer | Index layer   | The indicator weight is (%) |
|--------------|-----------------|---|-----------------------------|
|              |                 | Retail sales of wholesale and retail trade legal enterprises above quota in cities and prefectures  | 6.125                       |
|              |                 | The number of employees in wholesale and retail trade, accommodation and catering corporate enterprises above designated size in each city and prefecture | 5.671                       |
|              |                 | Total retail sales of social consumer goods in all cities and states  | 7.698                       |
|              |                 | The number of wholesale and retail trade, accommodation and catering legal entity enterprises above designated size in each city and state                | 3.341                       |



**Fig. 2.** The Knowledge Atlas

## 4.2 Time Sequence Analysis of the Comprehensive Index of Enterprise Development and Rural Revitalization

As shown in Tables 3, 4 and 5, from the perspective of time, the upward trend of enterprise development comprehensive index and rural revitalization comprehensive index in the three regions is obvious from 2010 to 2020, indicating that the new drivers of rural revitalization and enterprise development in the three regions are improving. However, the comprehensive index of enterprise development is basically smaller than the comprehensive index of rural revitalization, indicating that the development of enterprises still lags behind the level of rural development.

## 4.3 Temporizing Analysis of Coupled Coordination

From the perspective of time sequence changes, the coupling and coordination degree of the three regions has the characteristics of “stable development and short-term fluctuation”, referring to Li Fangfang. According to the different coupling and coordination, degrees are judged as different system development types, and the coupling degree of enterprise development and rural revitalization gradually tends to the optimal coupling state.

Based on the above analysis, China has promoted the development of enterprises in the three regions and three prefectures and achieved initial results.

However, the most worthy discovery of our study from the lagging indicator is that the whole area of the three states of Sichuan province is still in the enterprise development hysteresis except the slight fluctuation in the Liangshan Yi Autonomous Prefecture, so in the context of rural revitalization, only by improving the level of enterprise development so can we further enhance the coupling coordination, and the level of enterprise development is a comprehensive concept, which needs the combination of a variety of approaches for cooperation to make it powerful and effective for the development of rural revitalization.

**Table 3.** Coupling and coordination degree of rural revitalization and enterprise development of Liangshan

| year | Village develop vigorously | Enterprise development | Coupling coordination degree (D) | Lagging indicator      |
|------|----------------------------|------------------------|----------------------------------|------------------------|
| 2020 | 0.824                      | 0.916                  | 0.995                            | rural revitalization   |
| 2019 | 0.784                      | 0.876                  | 0.950                            | rural revitalization   |
| 2018 | 0.731                      | 0.772                  | 0.859                            | rural revitalization   |
| 2017 | 0.712                      | 0.688                  | 0.792                            | Enterprise development |
| 2016 | 0.704                      | 0.653                  | 0.761                            | Enterprise development |
| 2015 | 0.670                      | 0.615                  | 0.708                            | Enterprise development |
| 2014 | 0.643                      | 0.599                  | 0.675                            | Enterprise development |
| 2013 | 0.627                      | 0.547                  | 0.613                            | Enterprise development |
| 2012 | 0.520                      | 0.529                  | 0.494                            | rural revitalization   |
| 2011 | 0.491                      | 0.496                  | 0.422                            | rural revitalization   |
| 2010 | 0.424                      | 0.408                  | 0.1                              | Enterprise development |

**Table 4.** Coupling and coordination degree of rural revitalization and enterprise development of Aha

| year | Village develop vigorously | Enterprise development | Coupling coordination Degree (D) | Lagging indicator      |
|------|----------------------------|------------------------|----------------------------------|------------------------|
| 2020 | 0.257                      | 0.154                  | 0.995                            | Enterprise development |
| 2019 | 0.207                      | 0.142                  | 0.899                            | Enterprise development |
| 2018 | 0.225                      | 0.124                  | 0.862                            | Enterprise development |
| 2017 | 0.203                      | 0.110                  | 0.785                            | Enterprise development |
| 2016 | 0.182                      | 0.123                  | 0.805                            | Enterprise development |
| 2015 | 0.175                      | 0.124                  | 0.798                            | Enterprise development |
| 2014 | 0.213                      | 0.109                  | 0.791                            | Enterprise development |
| 2013 | 0.172                      | 0.091                  | 0.654                            | Enterprise development |
| 2012 | 0.062                      | 0.093                  | 0.428                            | rural revitalization   |
| 2011 | 0.062                      | 0.081                  | 0.381                            | rural revitalization   |
| 2010 | 0.041                      | 0.064                  | 0.1                              | rural revitalization   |

**Table 5.** Coupling and coordination degree of rural revitalization and enterprise development of Ganzi

| year | Village develop vigorously | Enterprise development | Coupling coordination degree (D) | Lagging indicator      |
|------|----------------------------|------------------------|----------------------------------|------------------------|
| 2020 | 0.185                      | 0.129                  | 0.995                            | Enterprise development |
| 2019 | 0.170                      | 0.118                  | 0.931                            | Enterprise development |
| 2018 | 0.153                      | 0.085                  | 0.785                            | Enterprise development |
| 2017 | 0.151                      | 0.076                  | 0.739                            | Enterprise development |
| 2016 | 0.140                      | 0.051                  | 0.574                            | Enterprise development |
| 2015 | 0.135                      | 0.051                  | 0.563                            | Enterprise development |
| 2014 | 0.121                      | 0.049                  | 0.510                            | Enterprise development |
| 2013 | 0.109                      | 0.049                  | 0.475                            | Enterprise development |
| 2012 | 0.095                      | 0.045                  | 0.380                            | Enterprise development |
| 2011 | 0.075                      | 0.042                  | 0.170                            | Enterprise development |
| 2010 | 0.085                      | 0.035                  | 0.174                            | Enterprise development |

## 5 Conclusions and Recommendations

The research selects the relevant statistical data of rural revitalization in the three districts and three prefectures of Sichuan Province from 2010 to 2020, and analyzes the main problems existing in the process of existing enterprises participating in rural revitalization from the horizontal and vertical perspectives-less participation and lagging development. Aiming at building a more robust multi-subject cooperation mechanism and further improving the coupling and coordination degree between enterprises and rural areas, a long-term mechanism for enterprises to empower rural revitalization is explored (Fig. 3).

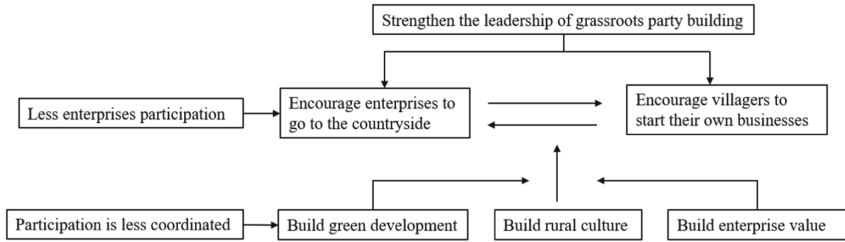


Fig. 3. Long-term mechanism logic

### 5.1 Strengthen the Leadership of Grassroots Party Building

On February 15, 2021, the National Poverty Alleviation Summary and Commendation Conference was successfully held. The conference gave priority to “upholding the leadership of the Party and providing strong political and organizational guarantees for poverty alleviation” as an important experience.

Realizing rural revitalization is an important component of the Party’s second centenary goal. The Party committees and governments at all levels should continue to strengthen the management system of central coordination, provincial responsibility, and implementation of cities and counties, and create a number of grassroots teams with clear management, ability and management.

### 5.2 Encourage Enterprises to Enter the Countryside

Relevant departments should continue to give full play to the advantages of the socialist system, quickly introduce attraction policies, and have “points” and “sides” to accelerate the implementation. The “Point” is to select comrades who are familiar with the policy and good at telling rural stories. The so-called “sides” is to provide opportunities for the majority of business managers and job seekers in combination with technology incubators and MBA colleges.

### 5.3 Encourage Villagers to Start Their Own Businesses

The entrepreneurial model that matches the rural revitalization policy with farmers self-employment should be improved as soon as possible. Specifically, we should expand from four aspects: enriching the spiritual and cultural life of villagers, building a good publicity and promotion platform for entrepreneurs, improving the ability and competitiveness of entrepreneurs, cultivating leading talents and leading enterprises, and then create a mutual interactive mode of win-win between the government and villagers.

### 5.4 Build Rural Culture

In the process of deeply participating in rural revitalization, enterprises should follow the rules of rural development in poverty-stricken areas, rather than simply copy the successful methods of other areas.

Only by adhering to the protection of rural traditional culture can we continue the historical context, build cultural nostalgia, forge a confident village, give full play to its advantages based on its own characteristics, and make more excellent national heritage be widely disseminated. Only in this way can enterprises go steadily and far in the process of promoting rural revitalization.

### 5.5 Build Enterprise Value

Corporate values determine the business philosophy and management behavior of enterprises, and are related to the rise and fall of enterprises. Propaganda workers in relevant departments should go to the front line, to the grassroots level, and to the general public.

Similarly, rural enterprises should also adhere to the correct corporate culture values, stand firm at the grassroots level, take it as their own responsibility to build Chinese style, empower rural revitalization, uphold the spirit of innovation, have an international perspective, and integrate it into the core value of the enterprise.

### 5.6 Build Green Development

The construction of carbon neutral new villages is an important way to achieve carbon peaking and carbon neutrality goals, and it is also one of the inherent requirements of the rural revitalization strategy. Therefore, in the process of attracting enterprises to the countryside and encouraging the development of rural entrepreneurial teams, it is necessary to gradually slow down the development of high-energy-consuming industries in accordance with the requirements of carbon peak, and shift the development to low-carbon industries that rely on clean energy development. In addition, it is a good idea to encourage enterprises to strengthen their exploration in the field of new energy, and gradually realize the optimization of energy consumption structure of rural enterprises with technology as the core.

According to the situation of carbon emission accounting and carbon trading mechanism in China, we should consider the green development as a whole and find power points in all aspects. The government should strictly control the carbon emission intensity of rural enterprises, actively promote the marketization of carbon sinks in local core industries, and put the improvement of the carbon tax system and the carbon emission trading system on the agenda.

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