Research Article

Research on Incentive Policy Evaluation of Prefabricated Buildings Based on Grey Relational Analysis

Sunmeng Wang [1], **Chengjun Wang,**[1] **and Wenlong Li**[2]

[1]*School of Management, Xi'an University of Architecture and Technology, Xi'an 710055, Shaanxi, China*
[2]*School of Civil Engineering, Xi'an University of Architecture and Technology, Xi'an 710055, Shaanxi, China*

Correspondence should be addressed to Sunmeng Wang; hzwsm1991@yeah.net

We examine if the incentive policies of prefabricated buildings in China are well distributed and if the policies reasonably match the development of prefabricated buildings. In applying a policy tools perspective, we will establish an indicator evaluation system of incentive policies of prefabricated buildings, which includes area award and construction link, financial, land, link, and technical support. We then use the Grey Relation Analysis Method to establish the evaluation model, which we then apply to evaluate and analyze the text data of incentive policies for prefabricated buildings in various provinces in the period 2016–2018. In drawing on the results of the evaluation model, we put forward policy suggestions that will promote the high-quality development of the prefabricated construction industry. These include the following: provinces should reasonably select or formulate incentive policies in accordance with their own actual conditions; governments at all levels should improve demand policies that are currently absent; they should also pay attention to the balance of incentive policies at all levels of the industrial chain and also increase the policy support that is currently available to the management personnel and operators of prefabricated construction.

1. Introduction

China's prefabricated buildings were first constructed in the first five-year plan [1]. Over the last few decades, prefabrication has significantly impacted the development of the construction industry around the world. It guarantees durability, positive economic outcomes, and environmental sustainability, which makes it preferable to the onsite building. This is a method that makes it possible to quickly construct large numbers of low-cost building units. Off-site construction and the fabrication of some structural parts in manufacturing plants are followed by their transportation to and installation at the building site, where even the building to be built is referred to as "off-site building and fabrication". The prefabricated building system has been described as one of the alternatives to rapidly changing the velocity of traditional construction processes. However, in recent years they have stagnated as a result of the gradual decline of the demographic dividend and the increasing awareness of sustainable development, along with other factors (including the traditional cast-in-situ model of low efficiency, high energy consumption, and high pollution) that have made it difficult to meet development requirements. Cast-in-place pavement, which is also known as reinforced concrete, is a self-compacting concrete that is positioned in, or is even part of, the completed situation of the structural member. In the case of concrete blocks and basements, elements like beams, pillars, sidewalls, roofing, and cast-in-place ceramic, it provides the best option. The concrete is usually delivered to the job site in an epoxy coating condition, usually by a fully prepared mini excavator. The concrete is placed in the desired spot or into a middle of a divorce or pumping via a funnel that first emerges from the back of the vehicle. In February 2016, the State Council issued a declaration that made prefabricated buildings a national strategic priority.

The rapid construction of the Huoshenshan hospital in the pandemic demonstrated that prefabricated buildings

have significant advantages that include high efficiency and quality and low energy consumption and pollution [2].

Statistics published by the Ministry of Housing and Urban Rural Development show that in 2015, the newly built prefabricated building area was about 72.6 million square meters; one year later, it had increased by 57 percent to 114 million square meters; this then increased to 152 million square meters in 2017 (33.7 percent increase on the previous). And in 2019, it increased to 420 million square meters (an increase of 45 percent from the previous year). Over the four years, an average annual growth rate of 55 percent was recorded (see Figure 1).

Although the construction of prefabricated buildings in the country has made some progress toward developed counterparts, the penetration rate still falls short [3]. Data suggest that the 2018 rate in major developed countries (including Japan, Singapore, and the US) was 70 percent, far in advance of China's rate of 9 percent (see Figure 2). China, therefore, has a huge amount of prefabricated building space.

The high level of national attention and the establishment of objectives that seek to achieve the environmental protection and social benefits of prefabricated buildings have resulted in various policies being produced by government departments across all levels. These include preferential land policy, plot ratio award, optimization of the approval process, and other incentives that seek to encourage enterprises to adopt prefabricated buildings for industrial upgrading [4]. But the country's development and promotion of prefabricated buildings have not been smooth. An immature technical system and lagging supporting standards mean that the efficiency advantages of prefabricated buildings are not obvious, which has produced additional costs. A technology that is labeled immature has defects that prevent consumers from fully utilizing it. It also might apply to something that has not been broadly applied but that has an excellent scientific training in some cases. This means that new projects are still traditionally present. The pouring construction technology is mainly used, and the assembly rate of most prefabricated projects is generally low [5]. In deep foundation building, onsite cement casting is a typically applied method. "In-situ concrete" and "cast-in-place aggregate" are other terms applied to the site-poured pavement. The invention is directed to a topping dumping technique for building construction structures and falls in the domain of building project techniques. The construction duration advantages have not matched expectations, and some enterprises' building times exceed those of the traditional procedure. Because the investment of funds with such expenditure is driven by customer demands or changing expectations, the facilities are intended to attend to particular goals while remaining inside employee and regulatory limits [6]. Great changes have taken place in the design, construction, project delivery, and operation of prefabricated building projects. The traditional project management personnel lack industrialized management thinking and systematic understanding of the design, production, and construction process related to prefabricated buildings. In addition, the industrialization of component

production and the application of many new technologies have created great challenges for traditional workers, and there are few incentive policies that are currently in place. This shows that the current development of prefabricated buildings in the country depends more strongly on policy support and guidance. It is essential to establish if the distribution of incentive policies for prefabricated buildings is in place and if the policies map onto the development of prefabricated buildings [7].

2. Policy and Research

2.1. Current Research into the Policy of Prefabricated Building. A policy development perspective highlights that many foreign developed countries supported and guided the rapid development of prefabricated buildings by applying related government policies [8, 9]. But they also always focused on market objectives to determine development priorities. The early development of prefabricated buildings in these countries, and their relatively refined policy system has resulted in a smaller policy research literature [10–12]. Simcoe observes that government procurement policy has a positive impact on suppliers, and then proposes to use government policy to accelerate the standard diffusion effect [13]. In order to achieve a better distribution of improvements in development, it is necessary to examine the possible facilitators and barriers. The ultimate goal of this article is to gain a better understanding of the elements that influence management efficiency and the deployment and introduction of new ideas in the building industry. It has been found that acting in accordance with the conceptual framework increases the likelihood of effective diffusion. Steinhardt and Manley extract statistics from the actual data to study how the influence mechanism of different countries' policy environment in different countries impacts the development of prefabricated housing [14].

In China, policy research of prefabricated buildings mainly engages at the level of policy carding and places more emphasis on qualitative analysis [15–17]. Wang Lei identifies that policy is an influencing factor that promotes the development of prefabricated buildings, and observes how screening out these factors restricted the development of prefabricated buildings in Cangzhou. He then applies the DEMATEL model to conduct a quantitative analysis of the influencing factors, identifies the key ones and, on this basis, puts forward six suggestions for promoting the development of prefabricated buildings. The DEMATEL approach is used to determine the location of each element in the system and the strength of their impact on each one, which makes it possible to identify the most important green technology factors. Many scientific disciplines contain inaccurate and unpredictable knowledge, and DEMATEL has been developed to drive improvements in many situations [18]. Pan Yue constructs a three-dimensional (economy, policy, and technology) system dynamics model of the factors that affect the development of prefabricated buildings, and uses Jiangsu Province data as a sample to conduct simulation and sensitivity analysis. This enables him to conduct an in-depth study of the dynamic influence path that various factors
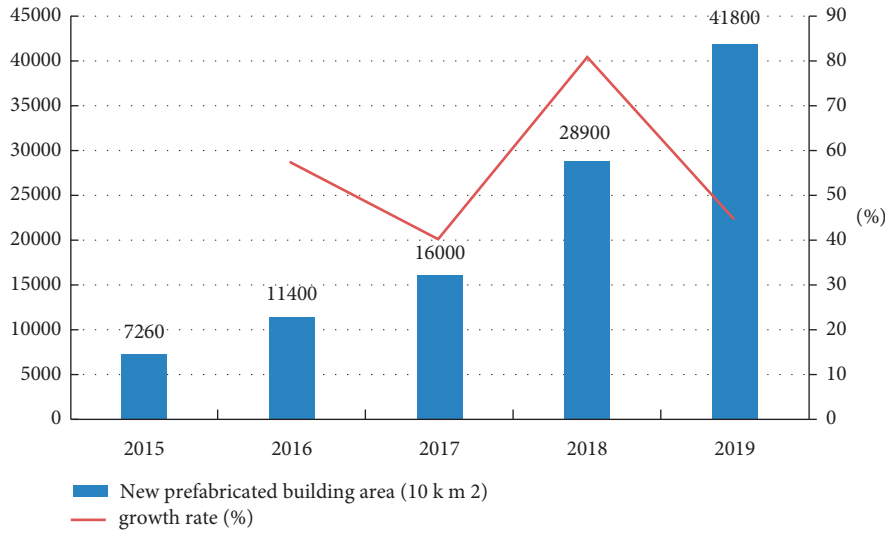
FIGURE 1: New construction area of prefabricated buildings in China: 2015–2019.
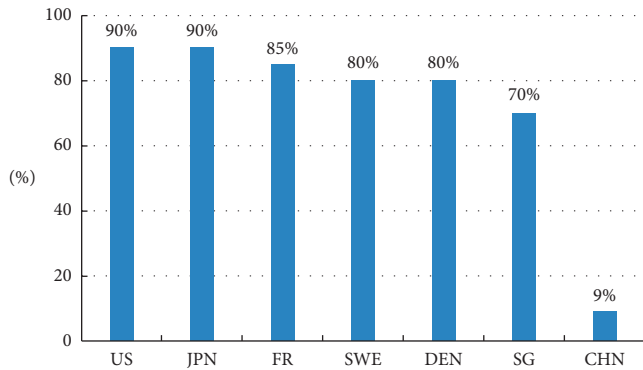

FIGURE 2: Penetration rates of prefabricated buildings in major developed countries: 2018.
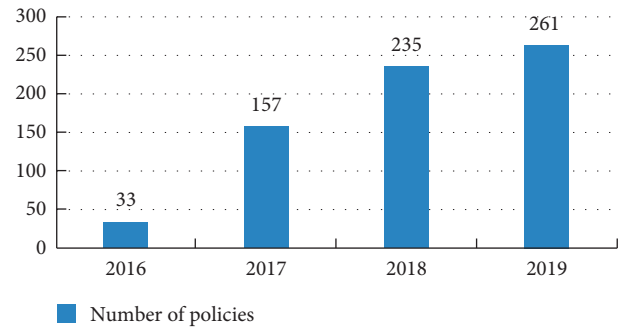

FIGURE 3: Number of prefabricated building policy documents: 2016–2019.

exert on the development of prefabricated buildings [19]. Zhang Yu conducts policy analysis on the basis of the logic of the time axis, uses content analysis to analyze prefabricated building policy texts produced by the central government in the period 1950–2018, and finds that the current policy of the central government emphasizes regulatory policy tools [20]. Chen Zhenji briefly describes the policy evolution of China's construction industrialization over a period of more than 60 years [21]. Yan and Meixia discuss economic policy research on the development of prefabricated buildings and refine, analyze, and evaluate policies and measures issued by local governments [22]. Wang Hongting, meanwhile, proposes incentive policies based on a summary of the external economic incentive principles of prefabricated buildings [23].

The analysis of the existing research results suggests there is a relatively strong basis for regarding policy as one of the influencing factors that promote the development of prefabricated buildings in the country. Policy has developed and so has economic policy research based on the time axis analysis. However, the evaluation of incentive policies for prefabricated buildings remains relatively underdeveloped, and this needs to be urgently resolved.

2.2. Policies on Domestic Prefabricated Buildings. In the period since 2016, the General Office of the State Council has promulgated a series of important documents, including the Outline for the Modernization of the Construction Industry and Guiding Opinions on Vigorously Developing Prefabricated Building. The Ministry of Housing and Urban-Rural Development, meanwhile, published the 13th five-year plan for prefabricated buildings.

In the past few years, 31 provinces, cities, and autonomous regions have issued specific implementation opinions, plans, and action plans for prefabricated buildings [24, 25]. Data retrieved from major government websites, CNKI, and related newspapers and magazines published in the period 2016–2019 show that 31 provinces, municipalities, and autonomous regions published materials related to prefabricated buildings (see Figure 3). Various incentive policies provide institutional guarantees that promote the development of prefabricated buildings.

This study researches policy texts and related literature produced by all levels of government and divides the incentive policy types of prefabricated buildings into area award, construction link, economic, land, tax, and technical
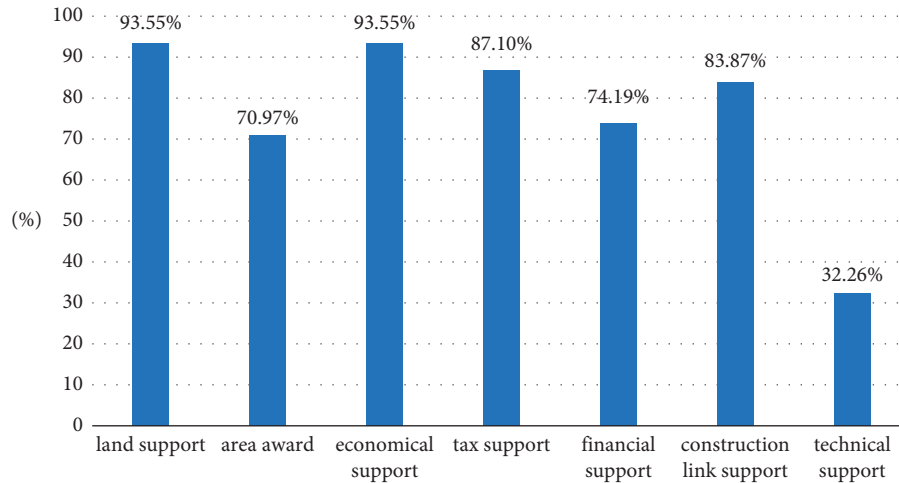
FIGURE 4: Different types of incentive policies.

support. Figure 4 sets out their respective application situations. It shows that more than 90 percent of the land and financial support policies were used; and area award, construction, financial, and tax support all exceeded 70 percent; meanwhile, the proportion of technical support was 32.26 percent.

The provinces and cities, with the exceptions of Hubei, Shanghai, and Tianjin, applied land use support. Many regional policies clearly state that the construction land needs of prefabricated building industrial bases (parks) should be guaranteed. In land supply, the relevant requirements for the development of prefabricated buildings can be incorporated into the planning and design conditions and land supply schemes, and then implemented in the land use contract [26]. In the case of area award, the policy mainly focuses on: (1) the horizontal projection area of the sandwich insulation wall's outer leaf plate, which is not included in the building area if the sandwich insulation is used for the building's external wall; (2) the floor area ratio of the voluntary implementation of prefabricated building projects, on the condition that it does not exceed 3 percent [27].

In the case of economic support, various provinces and cities mainly establish special funds or use the original special funds to subsidize projects. With regard to tax support, the preferential policy of levying and refunding value-added tax to enterprises is also most frequently used. Some provinces and cities in Southwest China have also proposed that prefabricated construction enterprises should be included in the tax preferential scope of western development [28].

There are two levels of financial support policy:

(i) The first prioritizes loans and discount interest given to prefabricated construction enterprises.

(ii) The second seeks to increase loans provided to consumers and expand their terms. The supporting policies of construction link mainly include: the preferential bidding system (PBS) is a software application for crew scheduling that allows crew members to demand periodical working hours on the basis of their weighted preferences. It is used to solve airline's workforce schedules and includes specific aircraft and specified competent crew members [29]; it also opens up green channels for administrative examination and approval; and makes it possible to apply for a real estate pre-sale license in advance. Sichuan and other regions have also launched a policy that prioritizes participation in the evaluation of prefabricated construction projects.

3. Methods

3.1. Construction of Evaluation Index System for Prefabricated Buildings Incentive Policies. Establishing a scientific, reasonable, and comprehensive evaluation index system is key to evaluation, which directly affects the accuracy and reliability of evaluation results [30]. Using decision-making processes, it was possible to weight signals at various stages in the calculation of the evaluation of index schemes. It assists in the development of the construction corporation's structure and provides a model that makes it possible to support increases in production growth.

3.1.1. Establishment of Index System. The definition of management establishes that motivation seeks to generate enthusiasm for working and encourages employees to realize their full ability [31]. Motivation should produce employees who are enthusiastic when they enter the workplace. Incentive policy-making should use administrative means to guide enterprises and individuals to work in the desired direction [32]. Li Jinhua uses Demand Theory to divide corresponding policy support into supply side and demand side incentive and then constructs the supply and demand side incentive index system. The demand model is an important idea that determines the relationship between consumer marketing and brand pricing for services and products. When a product or service becomes accessible, prices decrease and the optimum price also falls. Some

TABLE 1: Evaluation index system for prefabricated building incentive policy.

Primary index	Secondary index
Land support	Incorporate prefabricated building requirements into land transfer conditions. Include prefabricated buildings in the land auction. Penalize companies that fail to meet the required requirements after enjoying the land policy. Prioritize the annual construction land index. The land transfer price can be paid in installments.
Area award	The prefabricated part of the external wall is not included in the construction area. Give floor area ratio rewards.
Economic support	Construction incremental cost is included in construction cost. Set up special funds to subsidize prefabricated construction projects. Use the original special fund policy to expand the scope of use. Provide funding support for research related to prefabricated buildings. Implement preferential policies for investment promotion. Subsidies (e.g., rent subsidies) are given to enterprises. Preferential policies are put in place (including social security, security measures, quality assurance deposit, and urban construction supporting fees).
Tax support	Separate tax calculations for production and construction. Introduce this support into high-tech industries so they benefit from relevant industrial policies and tax preferences. Receive a VAT refund upon collection. Included in the preferential tax range of western development.
Financial support	Priority lending Subsidized interest Open up green channel and increase credit support. Increase the amount and duration of loans to consumers.
Construction link support	Bidding policy preference. Apply for the "real estate pre-sale permit" in advance. Go through the procedures of construction application, approval, pre-sale, and acceptance, in anticipation of opening up a green channel. Prefabricated construction sites cannot stop working in heavy-pollution weather. For the participating units of prefabricated construction, prioritize the qualification upgrade and other procedures. Provide transportation support to components transportation.
Technical support	Supporting policies related to component management. Encourage scientific and technological innovation and award.

researchers also divide incentive policies into different categories that include the financial system, fiscal and taxation policy, land policy, and technology research. They eventually set any fiscal conditions stipulated by the building contract and the execution of sound macroeconomic processes in accordance with best business practices. Financial implementation of the strategy might involve a wide range of tasks. The use of government spending to impact business is known as fiscal and monetary policy. The authorities use monetary policy to control the amount of aggregate supply with the aim of promoting stable prices, high employment, and economic expansion. In operating in this technological and economic context, land development seeks to meet specific needs [33, 34].

In engaging with the literature and policy texts on prefabricated buildings from across all levels [35, 36], this study divides incentive policies related to prefabricated buildings into area award and construction link and economic, financial, land, tax, and technical support (see Table 1).

3.1.2. Index Quantification Standard. Zardo quantifies the public health policy text by undertaking content analysis and illustrates the importance of quantitative research in the policy field [37]. Policy text analysis has also been widely used in environmental protection policy research, education policy research, and science and Technology Policy Research [38]. We wish to carry out quantitative research on policies and learn from other scholars' evaluation methods and policy ideas [39], and therefore propose the following. In accordance with the index system in Section 3.1.1, the refinement of various policies and detailed policy description, we give 7 first-level indicators 1–5 points. We seek to ensure the scientificity and authenticity of the quantitative process by collecting and screening incentive policies for prefabricated buildings that were put in place after the establishment of the People's Republic of China. We then establish a database of incentive policies for prefabricated buildings. We then select incentive policies for prefabricated buildings issued in the period 2016–2018 as the basis for the quantification of data. Table 2 shows the specific standards.

TABLE 2: Quantitative rules of policy indicators.

Policy indicators	Description	Scores
Land support	Put forward a number of policies with clear implementation subjects and measures.	5
	Put forward four policies.	4
	Put forward three policies.	3
	Put forward two policies.	2
	Propose only one policy.	1
Area award (including plot ratio)	Put forward a number of area incentive policies, with clear implementation subjects and measures.	5
	Two area incentive policies are proposed, with implementation entities and certain measures.	4
	Area incentive policy is proposed, there is an implementation subject and the implementation measures are clear.	3
	Proposed area incentive policy, and an implementation entity.	2
	Only propose area incentive policy; no clear measures.	1
Economical support	Complete fiscal policy, clear implementation subject, and clear implementation measures.	5
	Put forward four policies.	4
	Put forward three policies.	3
	Put forward two policies.	2
	Only propose a policy without clear measures.	1
Tax support	Complete taxation policies, clear implementation subjects, and clear implementation measures.	5
	Put forward four policies.	4
	Put forward three policies.	3
	Put forward two policies.	2
	Only propose a policy without clear measures.	1
Financial support	Complete financial policies, clear implementation entities, and clear implementation measures.	5
	Put forward four policies.	4
	Put forward three policies.	3
	Put forward two policies.	2
	Only propose a policy without clear measures.	1
Construction link support	Improved support policies for the construction link, clear implementation subjects, and clear implementation measures.	5
	Put forward four policies.	4
	Put forward three policies.	3
	Put forward two policies.	2
	Only propose a policy without clear measures.	1
Technical support	The technical support policy is perfect, the implementation subject is clear and the implementation measures are clear.	5
	Two policies are proposed, there is a subject to implement and there are certain implementation measures.	4
	Propose a policy, there is a subject to implement and the implementation measures are clear.	3
	Propose a policy; there is an implementation subject.	2
	Only propose technical support policies without clear measures.	1

3.2. Grey Relational Analysis Method. The analytic hierarchy process and fuzzy evaluation are more statutory and subjective. The artificial neural network method has a number of disadvantages, including slow convergence, limited optimal solution, and low accuracy. And Game Theory is mostly used to analyze the game relationship between multiple subjects and is not suited to evaluating the incentive policy of prefabricated building. On this basis, this study uses the Grey Relational Analysis Method to evaluate the incentive policy of prefabricated buildings. The optimal control parameters that generate particulate microstructure and excellent mechanical properties are determined by using grey relational modeling. We uncover the primary variables that impact the construction period by using grey relational analytics. The goal is to develop a platform built on grey relational analysis that will help the general public and advisors to predict or compare construction periods [40]. This can reduce the influence of subjective factors and help to ensure that the evaluation process and results are more valid [41–43].

3.2.1. Weight Analysis. The weight Determination Method can be divided into subjective and objective evaluation methods. The former uses the experience of experts and scholars to determine the weight value. The entropy approach is used to evaluate the weights of the target elements, and this has the comparative benefit of deciding. It establishes a class of three-dimensional weighted judgment procedures for solving functionality-informed choice issues in the development of the construction system. The entropy weight approach, which is one of the subjectively weighted least approaches, uses the quantity of knowledge to calculate the benchmark index strength. It is used to verify heaviness and is a type of structural analysis model that incorporates

descriptive and analytical study. The Structural Entropy Weight Method is an objective evaluation method, which is calculated by referring to the difference between the index observation values. Its weight setting is more objective [44, 45]. In decision-making, the entropy weight method is a widely utilized weighting approach that is used to measure value distribution. When the dispersal is wider, the distinction is larger, and more knowledge can be extracted. In the meantime, the ranking should be given equal importance, and conversely [46]:

(1) Determine the initial evaluation matrix in accordance with the quantitative rules of policy indicators:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}. \tag{1}$$

Where n is the number of evaluation arrays; m is the number of evaluation indicators; and x_{ij} is the score value.

(2) Calculate the weight of each score for each indicator p_{ij}:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}. \tag{2}$$

(3) Calculate the entropy value of the jth indicator:

$$e_j = -k \sum_{i=1}^{n} p_{ij} \ln p_{ij}. \tag{3}$$

Where: $k = 1/\ln n$.

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{m} \left(1 - e_j\right)}. \tag{4}$$

(4) Calculate the entropy weight of the jth index.

3.2.2. Evaluation Steps

(1) Data standardization. In accordance with the weight of each index $w = (w_1, w_2, \cdots, w_m)$, the weighted processing is carried out.

$$X' = \begin{bmatrix} x_{11}w_1 & x_{12}w_2 & \cdots & x_{1m}w_m \\ x_{21}w_1 & x_{22}w_2 & \cdots & x_{2m}w_m \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1}w_1 & x_{n2}w_2 & \cdots & x_{nm}w_m \end{bmatrix}. \tag{5}$$

The dimensions of the indicators may be inconsistent and the original data are therefore processed without dimensions.

$$Y_{ij} = \frac{\left(x_{ij}w_j - \min_{1 \leq i \leq n} x_{ij}w_j \right)}{\left(\max_{1 \leq i \leq n} x_{ij}w_j - \min_{1 \leq i \leq n} x_{ij}w_j \right)}, \tag{6}$$

$$Y_{ij} = \frac{\left(\max_{1 \leq i \leq n} x_{ij}w_j - x_{ij}w_j \right)}{\left(\max_{1 \leq i \leq n} x_{ij}w_j - \min_{1 \leq i \leq n} x_{ij}w_{ij} \right)}. \tag{7}$$

Formula (6) is suitable for benefit-based indicators, and Formula (7) is suitable for cost-based indicators.

(2) Establish positive and negative ideal solutions. Refer to a positive ideal solution: if the indicator is a cost-type indicator, the minimum value is taken; however, if the indicator is a benefit-type indicator, the maximum value is taken; accordingly, $Y^+ = (y_1^+, y_2^+, \cdots, y_m^+)$ is a positive ideal solution. Refer to negative ideal solutions if the indicator is a cost-type indicator, the maximum value is taken; but if the indicator is a benefit-type indicator, the minimum value is taken; accordingly, $Y^- = (y_1^-, y_2^-, \cdots, y_m^-)$ is a negative ideal solution.

(3) Calculation of grey correlation coefficient. The grey correlation amount is a measurement of the correlation between the two elements or groups. The grey correlation degree programs' operating policies, magnitude, and velocity determine the current change of elements in the implementation phase. For the positive ideal solution, let $R = |y_i^+ - y_{ij}|$, then,

$$\xi_{ij}^+ = \frac{\min_i \min_j R + u \max_i \max_j R}{R + u \max_i \max_j R}. \tag{8}$$

Where ξ_{ij}^+ is the correlation coefficient and u is the resolution coefficient, usually 0.5. Similarly, the correlation coefficient matrix of the negative ideal solution Y^- is ξ^-.

(4) Calculate the correlation degree. When the correlation coefficient is large, the information is more scattered. Calculate the average to get the correlation degree between Y_i and Y^+.

$$r_i^+ = \frac{1}{n} \sum_{k=1}^{n} \xi_i^+ (k). \tag{9}$$

In the same way, the correlation degree of the negative ideal solution is r_i^-.

(5) Determine the evaluation coefficient. Sort in accordance with the degree of closeness between the evaluation results and the ideal solution: so when closeness C_i is greater, the policy is stronger.

$$C_i = \frac{r_i^+}{r_i^+ + r_i^-}, 0 < C < 1; i = 1, 2, \cdots, n. \tag{10}$$

TABLE 3: Preliminary evaluation data of incentive policies for prefabricated buildings in 2016.

	Land support	Area award	Economical support	Tax support	Financial support	Construction link support	Technical support
Zhejiang	4	5	3	5	5	3	1
Hubei	3	3	3	4	4	5	1
Sichuan	5	4	4	3	3	2	1
Hainan	3	1	3	4	5	3	2

TABLE 4: Normalization of initial evaluation data of incentive policy for prefabricated buildings in 2016.

	Land support	Area award	Economical support	Tax support	Financial support	Construction link support	Technical support
Zhejiang	0.266667	0.384615	0.230769	0.3125	0.294118	0.230769	0.2
Hubei	0.2	0.230769	0.230769	0.25	0.235294	0.384615	0.2
Sichuan	0.333333	0.307692	0.307692	0.1875	0.176471	0.153846	0.2
Hainan	0.2	0.076923	0.230769	0.25	0.294118	0.230769	0.4

4. Empirical Analysis

In accordance with the quantitative rules of policy indicators set out in Section 3.1.2, evaluate and score policy texts published in the period 2016–2018. In the three years, 4 (2016), 28 (2017), and 4 (2018) provinces published incentive policy texts for prefabricated buildings. A large amount of data was calculated, and so we will only focus on the 2016 evaluation process.

4.1. Grey Relational Analysis Method

(1) To determine the initial evaluation data for 2016, see Table 3.

(2) According to formula (2), the evaluation indexes are normalized, see Table 4.

According to Formula (3), calculate the index's entropy. This is a metric for measuring inequality. Within a mapping organizational agency of this kind, zero denotes absolute equality, while larger prices indicate rising amounts of disparity.

$$e_1 = -\frac{1}{\ln 4} \left(p_{11} \ln p_{11} + p_{12} \ln p_{12} + p_{13} \ln p_{13} + p_{14} \ln p_{14} \right)$$

$$= 0.982798.$$

$$(11)$$

The same can be obtained: $e2 = 0.913123$, $e3 = 0.993887$, $e4 = 0.988609$, $e5 = 0.985668$, $e6 = 0.961012$, $e7 = 0.960964$.

According to formula (4), the entropy weight is calculated:

$w1 = 0.080405$, $w2 = 0.406081$, $w3 = 0.028575$, $w4 = 0.053246$, $w5 = 0.066992$, $w6 = 0.182239$, $w7 = 0.182461$.

The entropy and entropy weight of 2017 and 2018 can also be calculated (see Table 5).

4.2. Comprehensive Evaluation

In accordance to the quantitative rules of policy indicators in Section 3.1.2, we evaluate and score policy texts from 2016–18. 4 (2016), 28 (2017), and 4 provinces (2018) issued incentive policy texts for prefabricated buildings. A large amount of data were calculated, and so we will focus on the 2016 evaluation process.

(1) In accordance with formulas (5) and (6), the initial evaluation data for 2016 are standardized, and the processed data are shown in Table 6.

(2) Establish a positive ideal solution and a negative ideal solution.

$$\{y^+\} = \{1, 1, 1, 1, 1, 1, 1\} \{y^-\} = \{0, 0, 0, 0, 0, 0, 0\}. \quad (12)$$

(3) The absolute difference is calculated according to $R = |y_i^+ - y_{ij}|$ (see Table 7).

(4) Calculate the gray correlation coefficient.

$$\min_{i=1}^{n} \min_{j=1}^{m} |y^+(k) - y_i(k)| = 0 \max_{i=1}^{n} \max_{j=1}^{m} |y^+(k) - y_i(k)| = 1.$$

$$(13)$$

After substituting the value into the grey correlation coefficient calculation formula, we get:

$$\xi_1^+(1) = \frac{0 + 0.5 \times 1}{0.5 + 0.5 \times 1} = 0.5, \xi_1^+(2) \frac{0 + 0.5 \times 1}{0 + 0.5 \times 1} = 1, \xi_1^+(3) \frac{0 + 0.5 \times 1}{1 + 0.5 \times 1} = 0.333333,$$

$$\xi_1^+(4) = 1, \xi_1^+(5) = 1, \xi_1^+(6) = 0.428571, \xi_1^+(7) = 0.333333.$$

$$(14)$$

TABLE 5: Entropy calculation results of incentive policies for prefabricated buildings (2016–18).

	Years	Land support	Area award	Economical support	Tax support	Financial support	Construction link support	Technical support
Entropy	2016	0.982798	0.913123	0.993887	0.988609	0.985668	0.961012	0.960964
	2017	0.934490	0.895624	0.952446	0.928984	0.847120	0.889111	0.950284
	2018	0.929278	0.960964	0.952820	0.905639	0.921185	0.959148	0.921185
Entropy weight	2016	0.080405	0.406081	0.028575	0.053246	0.066992	0.182239	0.182461
	2017	0.108831	0.173399	0.079002	0.117978	0.253979	0.184219	0.082592
	2018	0.157237	0.086789	0.104897	0.209793	0.175229	0.090827	0.175229

TABLE 6: Standardization of initial data of incentive policy for prefabricated buildings in 2016.

	Land support	Area award	Economical support	Tax support	Financial support	Construction link support	Technical support
Zhejiang	0.5	1	0	1	1	0.333333	0
Hubei	0	0.5	0	0.5	0.5	1	0
Sichuan	1	0.75	1	0	0	0	0
Hainan	0	0	0	0.5	1	0.333333	1

TABLE 7: The absolute difference between the 2016 evaluation data and the positive ideal solution.

	Land support	Area award	Economical support	Tax support	Financial support	Construction link support	Technical support
Zhejiang	0.5	0	1	0	0	0.666667	1
Hubei	1	0.5	1	0.5	0.5	0	1
Sichuan	0	0.25	0	1	1	1	1
Hainan	1	1	1	0.5	0	0.666667	0

(5) Calculate the correlation degree.

$$r_1^+ = \frac{1}{7} \sum_{k=1}^{7} \xi_1^+(k) = 0.656463, r_2^+ = \frac{1}{7} \sum_{k=1}^{7} \xi_2^+(k) = 0.5, r_3^+ = 0.571429, r_4^+ = 0.561224. \tag{15}$$

The same can be obtained:

$$r_1^- = \frac{1}{7} \sum_{k=1}^{7} \xi_1^-(k) = 0.585714, r_2^- = 0.690476, r_3^- = 0.723810, r_4^- = 0.680952. \tag{16}$$

(6) Calculation of evaluation coefficient.

$$C_1 = \frac{r_1^+}{r_1^+ + r_1^-} = 0.528478, C_2 = 0.42, C_3 = 0.441176, C_4 = 0.451807. \tag{17}$$

Similarly, the evaluation data of 2017 and 2018 can be obtained, and the evaluation coefficient from 2016 to 2018 is shown in Table 8.

4.3. Comprehensive Evaluation

4.3.1. Evaluation Steps. Table 5 notes the entropy weight of each policy indicator changes from 2016 to 2018 and

suggests that this reflects the evolution process of policy tools. In 2016, the area award was the policy with the highest proportion, followed by construction and technical support. For example, Sichuan Province separately lists plot ratio award as an important policy in *Guidance on Promoting the Modernization of Construction Industry*, which clearly states that the building area of the prefabricated part of the external wall (no more than 3 percent of the total planned building

TABLE 8: Evaluation coefficient results of incentive policy for prefabricated buildings in 2016–2018.

Years	Province	r_i^+	r_i^-	C_i	Rank
2016	Zhejiang	0.656463	0.585714	0.528478	1
	Hubei	0.5	0.690476	0.42	4
	Sichuan	0.571429	0.723810	0.441176	3
	Hainan	0.561224	0.680952	0.451807	2
2017	Beijing	0.452603	0.627603	0.418997	19
	Tianjin	0.508246	0.613531	0.453072	17
	Hebei	0.596524	0.501286	0.543376	11
	Shanxi	0.617914	0.503863	0.550835	10
	Inner mongolia	0.556318	0.485792	0.533838	13
	Jilin	0.569004	0.498478	0.533034	14
	Liaoning	0.462593	0.604927	0.433334	18
	Shanghai	0.428571	0.904762	0.321429	27
	Jiangsu	0.423521	0.723665	0.369182	21
	Zhejiang	0.673469	0.487845	0.579920	6
	Anhui	0.419501	0.834166	0.334619	24
	Shandong	0.624106	0.524485	0.543367	12
	Guangdong	0.746032	0.541126	0.579596	7
	Guangxi	0.658050	0.439760	0.599420	5
	Hainan	0.460317	0.688312	0.400754	20
	Fujian	0.854875	0.365301	0.700616	1
	Henan	0.412698	0.779221	0.346247	22
	Hubei	0.399245	0.770150	0.341412	23
	Hunan	0.547928	0.529115	0.508734	16
	Jiangxi	0.389721	0.817770	0.322753	26
	Chongqing	0.382395	0.858586	0.308140	28
	Sichuan	0.391919	0.810967	0.325816	25
	Guizhou	0.676871	0.403297	0.626635	3
	Yunnan	0.607710	0.494705	0.551253	9
	Shaanxi	0.648526	0.487379	0.570933	8
	Gansu	0.556174	0.533555	0.510378	15
	Qinghai	0.709380	0.447330	0.613273	4
	Ningxia	0.799320	0.381319	0.677023	2
2018	Chongqing	0.619048	0.714286	0.464286	2
	Guangxi	0.547619	0.738095	0.425926	3
	Shandong	0.714286	0.619048	0.535714	1
	Tianjin	0.404762	0.785714	0.340000	4

area) cannot be included in the plot ratio accounting of the transaction plot when planning is approved. There is an obvious change in 2017, namely that the difference in the importance of various policy instruments gradually shortens. The proportion of financial support is the highest, followed by construction link support. In 2018, financial support is replaced by tax support policies.

The evolution process of the prefabricated building incentive policy tools is actually the process through which the prefabricated building system gradually improves. The importance of fiscal support policies gradually increases, the effects of financial and tax support policies become more obvious and the role of support policies in the construction link becomes irreplaceable. Of these, the effect of applying in advance for the "Real Estate Pre-sale License" is the most obvious. Regrettably, most of the current incentive policies tend to stimulate the supply side, and there are few effective policies focused on the demand market, namely consumers. There is only one aspect of provident fund loan support.

4.3.2. Evaluation of the Application Effect of Incentive Policies for Prefabricated Buildings. Table 8 shows that Zhejiang ranks first among the four provinces that issued prefabricated building incentive policies in 2016. In the following year, of the 28 provinces that issued prefabricated building incentive policies, the top five were Fujian, Ningxia, Guizhou, Qinghai, and Guangxi; and in 2018, Shandong ranked first among the 4 provinces that issued prefabricated building incentive policies. Analysis [2] shows all provinces responded positively, and the largest number of provinces issued incentive policies for prefabricated buildings in 2017.

The ranking shows that the incentive policies of provinces in Beijing, Tianjin, Hebei, and the Yangtze River Delta are not at the top of the list. But Ningxia, Guizhou, and other regions with relatively low levels of economic development seem to be contrary to the actual situation. The sample that this study selects is the prefabricated building incentive policies issued in 2016–2018, and incentive policies issued by Beijing, Shanghai, Yangtze River Delta, and other economically developed regions come earlier. For example, by as early as 2010, Beijing issued guiding opinions on promoting the city's housing industrialization, and Jiangsu Province issued the provincial government's opinions on accelerating the modernization of the construction industry. It then issued an opinion on the transformation and upgrading of the construction industry in 2014.

13 prefecture-level cities in the province successively issued specific implementation rules, and 15 provincial-level departments participated in the provincial construction industry's modernization work At the meeting, the rights and responsibilities of incentive policies for prefabricated buildings were clearly defined, and the division of labor was set out. It can be seen that prefabricated buildings in developed areas such as Beijing and Shanghai have developed extensively, rather than simply relying on economic incentive policies.

Most provinces in China have therefore formulated incentive policies for prefabricated buildings. But in economically backward areas such as Tibet, the introduction of relevant incentive policies has not been accompanied by a clear statement of rights and responsibilities and operability is not strong. Prefabricated building policies in Beijing, Tibet, Tianjin, Hebei, Yangtze River Delta, Pearl River Delta, and other regions have entered the level of coordinated development of technical standards and management mechanisms; meanwhile, in provinces and cities between the two, incentive policies are currently most active.

5. Conclusion

(1) Provinces should choose or formulate incentive policies in accordance with their own actual situation. It is necessary to formulate policies at the levels of housing price and population level, but not in relation to economic development. For example, in underdeveloped western regions, the government should focus on formulating economic incentive policies, and the policies should be operable rather than comprehensive. In developed areas such as

Beijing and Shanghai, the incentive policy should be combined with improvements in technical standards and management system as this will help to promote the further development of prefabricated buildings [47].

(2) Perfect the vacancy demand policy, and gradually develop the prefabricated construction market [48]. At present, incentive policies for prefabricated buildings are more inclined to the supply side market. The Government aims to stimulate the rapid development of the prefabricated building market through a series of incentive policies. However, most consumers lack knowledge of prefabricated buildings and blindly develop the supply side while ignoring the demand side, which is not conducive to the market's healthy development. In working toward the gradual development of the prefabricated construction market, governments across all levels should release vacancy demand-oriented policies in a planned way. Efforts could be made to encourage the implementation of prefabricated construction mode in shantytowns reconstruction projects and should also be directed toward relocating projects from other places, promoting the influence of prefabricated buildings, and expanding market demand.

(3) Pay attention to balancing incentive policies across all levels of the industrial chain. "Financial support" applied at the provincial and municipal levels are all economic incentives. There are many participants in the prefabricated construction industry chain (including design, Research & Design (R & D) institutions, and university research teams) who are insufficiently recognized by current incentive policies. We should therefore consider providing special support to prefabricated building design and R & D units; increasing the integration of scientific research resources (including universities); enabling the integration of production, teaching, research, and application; strengthening the construction of the whole industrial chain; improving the industry's communication mechanism; breaking down barriers; and continuously promoting the transformation and upgrading of the industrial chain.

(4) Increase the policy support for prefabricated building management personnel and operators. The rapid development of prefabricated buildings will inevitably bring new changes in the talent structure of the industry. At present, the market urgently needs a large number of professional and technical personnel and industrialized workers. Governments at all levels shall carry out training and certification of prefabricated architects in accordance with the requirements of prefabricated buildings, and guide construction enterprises to strengthen the application of prefabricated construction models. At the same time, universities and industry experts should be encouraged to jointly carry out the construction of prefabricated construction personnel training bases to cooperate with the training and education of prefabricated architectural talents.

In engaging from a pragmatic perspective, this study provides a complete analysis of China's present incentive policies for boosting prefabricated components, and could offer valuable guidance to other places interested in undertaking similar innovations. Rather than addressing a country with disparate problems as a single coherent entity, future studies should focus upon areas of sustainable development with comparable features and attributes.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare no conflicts of interest.

Authors' Contributions

S. W. and C. W.conceptualized the study; S. W. and W. L. curated the data; S. W. and W. L. investigated the study; S. W. developed the methodology; S. W. wrote the original draft; S. W. and C. W. wrote, reviewed, and edited the data.

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