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Fostering land use sustainability through construction land reduction in China: an analysis of key success factors using Fuzzy-AHP and DEMATEL

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Abstract: Construction land reduction (CLR) is an important instrument for achieving environmental sustainability by reducing intensive land use, controlling the unrestrained extension of construction land and ensuring a balance between construction and arable lands in China. Existing studies on key factors of CLR projects are rare， lacking comprehensive and systematic understanding. Key factors for ensuring the success of CLR projects have not been identified in previous studies. Based on a literature review and questionnaires, in this study, key success factors (KSFs) of CLR projects were identified and analysed. The Fuzzy-AHP and Fuzzy-DEMATEL methods were used to obtain the comprehensive causality and centrality values, whereby factors with a comprehensive causality value larger than 0 and a comprehensive centrality ranking in the top 20% were identified as KSFs. Results indicate that KSFs include the presence of a supportive policy for CLR, coordination with the original landowner, coordination with the surrounding residents, a diversity of enterprises participating in the CLR, a legal environment and land acceptance and testing standards. This paper lays a theoretical foundation for CLR projects and provides guidelines for achieving successful project implementations.

Keywords: Construction land reduction,Key success factors, Fuzzy-AHP, Fuzzy-DEMATEL

1. Introduction

Since the new millennium, China has experienced a gradual increase in the rate of urbanization. According to Chinese Government Work Report, from 2000 to 2020, the urbanization rate has been increased from 36.2% to 60.34%, with an annual growth of 2.41% and China has faced huge pressure due to rapid urban development. With the acceleration of urbanization in China, the demand for construction land has also been increased. On one hand, the urban dependence on new construction land has resulted in decreases in the amount of arable land and impacts negatively on the ecological environment. On the other hand, this dependence has been associated with the disorganized extension of construction land, resulting in extremely low land-utilization efficiency. In April 2016, the Ministry of Land and Resources of the People's Republic of China issued *Guidelines for the 13^{h} Five-Year Plan for Land and Resources*, which proposed to decrease the total area of construction land, perform an inventory of construction land and consider construction land reduction as a national strategy. Given this background, China implemented a comprehensive integration and scientific distribution of the construction land inventory to relieve the conflict between the demand for fast growth and required construction land Also, there is a huge concentration on mantaining inventories overcome the low efficiency of construction land. CLR is

an important instrument for achieving sustainable development via improvements in intensive land use, controlling the unrestrained extension of construction land, and ensuring a requisition–compensation balance between construction and arable lands in China. How to use construction land effectively is a huge dilemma in developing economies and a complex process, that is influenced by many factors . A crucial aspect of this process is the determination of key success factors (KSFs). Today, the major problem of CLR is the lack of an established scientific and effective method for its achievement. Because studies in China and around the world have mainly focused on land redevelopment(Zhu Yuming, Tao, YU Ming-Jie) , to address this research gap, this study proposed a method for identifying KSFs of CLR projects.

KSF is one of the common methods of Information System Development planning, It was proposed by Harvard Professor William Zani in 1970, John F.Rockart（1979）. In the operation and management of a company or organization, if an enterprise can occupy an advantage in a few key areas, it can ensure its strong competitiveness in the market. Only by controlling the key points and key areas, and seriously treating these key factors, the enterprise can maintain good performance. Leidecker and Bruno (1984) indicated that KSFs are some characteristics, conditions, or variables in which an enterprise has a significant impact on market competition, need to appropriate and constant attention and management. KSFs are closely related to core competency building, It can reveal the major and universal elements and capabilities in the development of an industry or enterprise. The theoretical roots of the KSFs is to follow the Pareto principle (Wang& Zhang). That is, those with a key role are the minority, and those with a secondary role are the majority.

Considering the above-mentioned discussion, the purpose of this paper is to create a complete set of influencing factors based on the success of CLR projects. If KSFs can be identified during implementation, considerable effort and costs can be saved and the utilization rate of labor and/or costs can be greatly improved. As such, it will be extremely effective to implement the land reduction project.

To achieve study objective, a set of KSFs in CLR projects was created based on an analysis of the current construction land literature. Then, this set of influencing factors was enriched by interviews with experts from relevant enterprises. Next, the opinions of these experts were analyzed to identify a set of factors that influence service innovation. Lastly, the study results were analyzed and the contribution and significance of this study were discussed. This paper is innovative in its combination of theoretical research with real-world conditions and the classification of KSFs into subject reduction, element reduction, system reduction, and the environment. Each KSF was subdivided into many second-level influencing factors of construction land reduction projects.

2. Theoretical background

"Reduction" is an important concept in the field of solid waste management, generally refers to the reduction of resource consumption and waste generation in production, circulation, and consumption. It is widely used in the field of the circular economy. CLR is also known as land reduction, it means demolishing or reclaiming construction land that does not meet the requirements of the general plan for land use which has poor social, economic, or environmental benefits and low development efficiency. It ensures the restoration of the land for the agricultural production and

promotes ecological benefits of construction lands. In the area of land resource management, reducing the occupation of construction land involves reducing the consumption of new land resources, and increase the utilization intensity of the original construction land resources. The essence of it is to reduce intensive land use, that is Land use efficiency.

Minister of Land and Resources of China Shaoqin Zhuang (2015) regarded the construction land reduction as the key point of land incremental management.In view of the current situation of land use and its resource conditions in Shanghai, a strategy of "five-volume control" is put forward, which includes "total volume lock, increment decrease, stock optimization, quality improvement and flow efficiency increase". The land is the basis for the coordinated development of social economy, population, and natural factors. Scientific overall planning of land resources can promote the harmonious and stable development of society. As one of the ways of land resource management, construction land reduction plays an important role.

At present, the research of the CLR in China mainly focuses on the following three aspects:

Concept definition and connotation: Xiaokun Gu (2018) pointed out that the construction land reduction is similar to “Brownfield Redevelopment”.It is the only way to realize sustainable development, practice the "green development concept" and build a "green city".Yuanqing Wu (2015) pointed out that the CLR refers to the removal and reclamation of the existing construction land which is scattered, abandoned, damaged, idle and inefficient outside the built-up area, so as to reduce the amount of inefficient construction land. Hongmei Liu (2015) found that the CLR is similar to the connotation of "reclamation" or "renovation", but more emphasis is placed on the land used for construction purposes and land shall be returned in the environmentally friendly position, and to achieve the goal of reducing the total amount of construction land. It is an innovative attempt to land management policy. CLR involves two aspects: one is to save and reduce consumption, reduce the demand for new construction land resources, and control the growth of construction land. Another is to reduce inventory and increase efficiency. By compressing and reduce the existing construction land scale, improve the construction land-use intensity, to achieve the target of an intensive increase in efficiency. The connotation includes the following aspects:(1) CLR is the result of economic development to a certain level. Only when the economic growth reaches a certain level and the dependence on the input of construction land is reduced, the CLR can be implemented. (2) CLR means that after the economic growth reaches a certain level, the increment of construction land gradually decreases, and the economic growth mainly depends on the stock of construction land. (3) CLR is based on the reduction of regional land carrying capacity, In order to limit the urban extension development.

Structural operation mechanism: Xu Guo (2020) analyzed the essence and operation logic of CLR in theory. In practice, the progress, characteristics, and modes of reducing governance are summarized. An analytical framework of "corporatism - control rights - reconstruction of land interests" is proposed which analyzes the land benefit reconstruction of multiple subjects in the process of land reduction. Juying Yan (2019) introduced the smart contraction theory which studies the operation mechanism of CLR in Hongze District and puts forward the direction and strategy of optimization. This study points out that although the construction land space is expanding, the space utilization efficiency is improved and the land intensification has achieved initial results. However,

the change of smart contraction trend fluctuates, indicating that the control of reduction promotion is more unstable and there are many influencing factors, such as Farmers' activities decreased, Expansion of construction land area.

Policy optimization: Xiaojie Zhang (2015) studied the policy implementation of construction land in Tianjin, also analyzes the implementation mechanism of construction land reduction in Tianjin. Suggestions are put forward, such as establishing the multi-department linkage working mechanism, perfecting the government assessment mechanism and perfecting other supporting measures. Shoubo Gu (2015) summarized the relevant policies and specific requirements of Shanghai municipality on promoting the reduction of "198" regional construction land. The study points out that multi-sectoral policy synergy, focus on the use of funds, and strengthen comprehensive law enforcement are the need of era to facilitate CLR. To study and formulate the performance evaluation system of CLR, the remediation and treatment of soil after the removal of pollutants. It is pointed out that we should explore the financing channels of comprehensive land improvement to break the capital bottleneck.

In conclusion, the research on the CLR is mainly reflected in the concept, connotation, and structure operation mechanism, as well as how to improve the utilization efficiency of construction land. However, there is a lack of comprehensive and systematic research on the factors affecting the CLR. More importantly, most of these studies are qualitative, but very few of them use quantitative methods to systematically analyze the key factors and their interrelationships. Therefore, from the perspective of project management, this study will comprehensively and systematically explore the factors of the CLR by combining qualitative and quantitative methods to identify KSFs. To put forward, opinions and suggestions from the experts' by utilizing a mix off qualitative and quantitative methodologies will support in decision making of China's land use planning.

3. Proposed framework to identify KSFs of CLR

This study proposed a framework comprised of Delphi, FAHP, and DEMATEL to identify the KSFs of CLR project in China (Fig 1). In the first stage, Fuzzy Delphi method is used to identify the KSFs of CLR from literature. In the second stage, consensus KSFs for CLR are put forward by experts. In the third stage, the weights of success factors are assessed using the FAHP method, Fuzzy-DEMATEL method is used to better reflect the fuzziness of the relationship between factors in the system, so that KSFs can be identified accurately and directly.

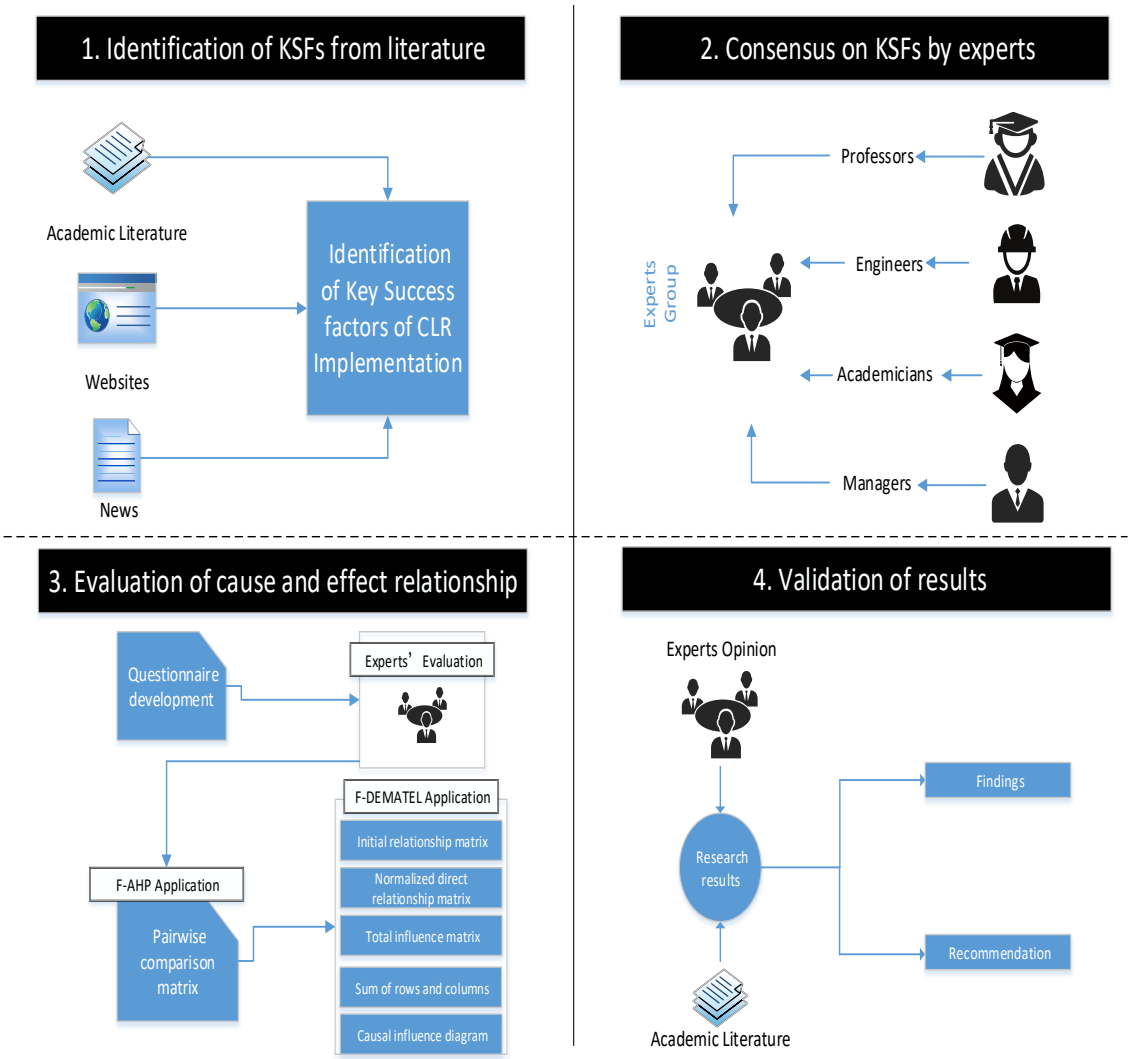

Figure1 Proposed framework of study

3.1 Identification of KSFs from literature

The index data of this paper was mainly derived from two sources. The first source is the information related to the different themes of CLR published on the website of the Chinese government platform or enterprise website. The other is the document information of periodicals, newspapers, and other documents related to the theme of "construction land" collected by CNKI (China National Knowledge Infrastructure) and Web of Science.

System theory was founded by L.V. Bertalanffy, an Austrian American theoretical biologist. In 1948, when he taught "General Systems theory" in the United States, his theory began to won academic attention. The word 'system' means the whole made up of parts. General systems theory tries to give a definition that describes the characteristics of various systems, a 'system' is usually defined as an organic whole with a certain function composed of several elements connected in a certain structural form (Yi Ding). The basic philosophy of 'system theory' is to take the object studied and dealt with it as a system, analyze the structure and function of the system, to study the relationship among 'Principal part of system' 'Key elements' and 'Environment'. Everything in the world can be seen as a system, the system is universal. Therefore, this paper regards the CLR as a system, to identify the KSFs from 'Principal part of CLR 'Key element of

CLR’ and ‘environment of CLR’.

For the acquisition of KSFs on CLR, this paper took ‘land for construction’ ‘Rural land’ and ‘Urban Construction land’ as keywords respectively in the literature search part. Relevant literature from 2010 to June 2020 was selected, a total of 262 publsihed studies in Chinese language and 186 papers were selected in the English language. Through literature review and screening, a total of 57 references with high relevance to this study were counted. The relevant influencing factors of the CLR are counted and classified with reference to the analysis writing above.

3.2 Consensus on KSFs by experts

Chinese land experts, scholars, and enterprise managers and engineers were invited for special interviews. Based on the practical investigation in Shanghai, the final set of initial relevant influencing factors was determined, and 29 influence factors were obtained.(see Tab. 1)

Table 1 Initial key success factors for construction land reduction

	Influence factors		Explanation	References
Key success factors of construction land reduction	Principal part of construction land reduction A	Development plans for the construction land reduction project	The government formulates development plans for the construction land reduction project.	Hai Jiang,Tu Lv (2016); Xiaokun Gu,Jing Liu (2018); Juan Huang (2020)
		Management system of the construction land reduction project	The government establishes and gradually improves the management system, working mode, evaluation method, and motivation mechanism used in the construction land reduction project.	Shoubo Gu,Wei Liu (2016)
		Coordination organization of the construction land reduction project	The government sets up a planning and coordination organization for the construction land reduction project.	Shuang Li,Jiang Lou (2016)
		Administrative supervision and management level	The legal sector supervises the workflow and quality of the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Shuang Li,Jiang Lou (2016)
		Qualification and certification process	Only a third-party enterprise can apply for land qualification and certification.	Yu He (2019)
		Diversity of enterprises participating in the construction land reduction project	A diverse range of enterprises participate in the construction land reduction project (sound market competition).	Yu He (2019)
		Enterprise capacity and competence	Scale, management capacity, technical capacity, and capital	Yu He (2019)

			of an enterprise participating in the construction land reduction project.	
		Enterprise rules and regulations	Rules and regulations of an enterprise participating in the construction land reduction project.	Yu He (2019)
		Coordination with original landowner	Policy awareness, understanding of, and coordination with original landowner in the construction land reduction project.	Yu He (2019)
		Coordination with surrounding residents	Policy awareness, understanding of, and coordination with surrounding residents in the construction land reduction project.	Shoubo Gu,Wei Liu (2016)
		Advance payments for land reclamation	Advance payments from town and district governments for the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Chi Zhang (2019)
		Status of construction organization for land remediation and reclamation	Technical level and capital progress of the construction organization.	Yu He (2019)
	Key element of construction land reduction project B	Standards for land acceptance and testing	Improved and consistent land acceptance and testing standards after reduction.	Xiaokun Gu,Jing Liu (2018)
		Maturity of related technologies	Maturity and innovation of applied land-reduction-related technologies (e.g., testing technology, reclamation technology).	Hai Jiang,Tu Lv (2016)
		Diversity of historical data	Diverse range of historical data obtained regarding the influences of the surrounding environment of historical enterprises.	Added by experts
		Scientific land reduction process	Scientific and operational processes used in the construction land reduction project formulated by the government and related	Ming Chen(2017);Xiaokun Gu,Jing Liu (2018)

			enterprise.	
		Stability of land reduction contract	Establishment and management of relevant contract and other dispute resolutions.	Ming Chen(2017);Yu He (2019)
		Appropriateness of land use planning after reduction	The land utilization after reduction is consistent with overall land planning in Shanghai.	Xiaokun Gu,Jing Liu (2018)
		Consumption of management costs	Consumption of management costs by each organization in the construction land reduction project.	Chi Zhang(2019)
		Consumption of capital	Consumption of capital during early testing and evaluations for the construction land reduction project and the capital available for later pollution prevention and control.	Chi Zhang(2019)
		Diversity of relevant knowledge by land reduction staff	Competence of engineers and technical staff participating in the construction land reduction project in engineering management, environmental supervision, evaluation, and pollution prevention and control.	Shoubo Gu,Wei Liu (2016); Xiaokun Gu,Jing Liu (2018)
	System and environment of construction land reduction C	Support policy regarding operations of the construction land reduction project	Establishment of system for operations performed by the construction land reduction project.	Hai Jiang,Tu Lv (2016);Shoubo Gu,Wei Liu (2016);Yu He (2019);Shuang Li,Jiang Lou (2016)
		Leadership and decision-making mechanisms of the construction land reduction project	Decision-making authority, organizational form, institution responsible, adjustment mechanisms, and supervision methods established for each sector during decision-making process for the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Shuang Li,Jiang Lou (2016)
		Coordination mechanism of the construction land	Establishment of various systems for coordinating and adjusting the relationship	Hai Jiang,Tu Lv (2016);Shoubo Gu,Wei Liu (2016)

		reduction project	between the administrative system and external environment, including the horizontal and vertical relationships in the administrative system for the construction land reduction project.	
		Supervision and evaluation mechanisms of the construction land reduction project	Establishment of supervision and evaluation systems for the construction land reduction project.	Shoubo Gu,Wei Liu (2016)
		Financial policies for the construction land reduction project	Financial allocation, construction, and development of various systems for resolving financial-allocation-related conflicts of the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Shuang Li,Jiang Lou (2016)
		Land policy for the construction land reduction project	Establishment and development of systems for resolving various conflicts related to land ownership in the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Shuang Li,Jiang Lou (2016)
		Legal environment of the construction land reduction project	Development and implementation of laws, rules, and regulations for the construction land reduction project.	Shoubo Gu,Wei Liu (2016);Shuang Li,Jiang Lou (2016)
		Cultural environment of the construction land reduction project	Cultivation of public involvement and coordination with the construction land reduction project.	Added by experts

4. Evaluation of cause and effect relationship

There are multiple methods to identify KSFs in the previous research, such as customer and management interviews, expert opinion, literature research, case analysis, etc. And the tools for identifying factors are also various, such as fishbone diagram, Interpretative structural model (ISM), Analytic hierarchy process, etc. In this paper, Fuzzy Analytic hierarchy process (FAHP) and Fuzzy-DEMATEL (Decision Making Trial and Evaluation Laboratory) are combined to construct a model for KSFs of CLR. In this model, the Fuzzy-DEMATEL method is used to prioritize the factors following their influence on the system. At the same time, combined with the factor weight

determined by the FAHP method, the key success factors of CLR are finally identified. The advantages of mixed methodology of FAHP and DEMATEL are as follow:

(1) The integrated methodology combining fuzzy theory with traditional AHP and DEMATEL is more advantageous where the absolute value 0 or 1 is replaced by a corresponding membership function in the subjective judgment data, which is more scientific as it reflects the fuzziness of human being's subjective judgment.

(2) Although the KSFs can be identified on the basis of the factor weight determined by the traditional AHP method, the relationships between the factors and their attribute status in the system cannot be analyzed.

(3) By combining the factor weight data determined by FAHP with the influence degree data of factors in the system obtained by Fuzzy-DEMATEL method, more information can be integrated, making the conclusions more reliable.

4.1 Weights calculation of influencing factors based on FAHP method

4.1.1 Calculation process of FAHP method

The analytic hierarchy process (AHP) is a systematic method that regards a complex multi-objective decision-making (MODM) problem as a system. By decomposing the goals into multiple objectives or criteria and several levels of multi-index, it can provide multi-scheme optimization decisions in accordance with both hierarchical single ranking and total ranking. Because of its systematic, concise, flexible, and practical features, AHP can effectively measure the judgment and comparison of decision-makers and is widely used in various fields. However, it also has some obvious disadvantages, such as:

1. The membership degree in the judgment matrix can only be 0 or 1, which is too absolute to reflect the fuzziness of experts' subjective judgment.
2. It is rather difficult to check the consistency of the judgment matrix which needs to be adjusted and tested repeatedly and blindly.
3. Taking CR < 0.1 as the only standard to test the consistency of judgment matrix is considered as a lack of scientific basis by some scholars.
4. A large judgment matrix will increase the difficulty of calculating the maximum eigenvalue of the judgment matrix as well as testing the consistency.

In order to solve the above shortcomings, FAHP - a method that utilizes triangular fuzzy numbers to make fuzzy comparison and judgment between indexes, was proposed by Van Loargoven in 1983. Based on the calculations of triangular fuzzy numbers and the principle of the least square method, the ranking and weights of factors can be obtained. The specific process of the FAHP method are as follows:

(1) Define the triangular fuzzy number and determine the membership function of the fuzzy set.

Assuming the fuzzy number on the domain of discourse R is $\hat{B}$, if by making R→[0, 1], the membership function $\mu_{\hat{B}}(\mathrm{x})$: R → [0,1] is expressed as

$$\mu_{\hat{B}}(\mathrm{x}) = \begin{cases} \frac{x}{m-l} - \frac{l}{m-1}, & l \le x \le m \\ \frac{x}{m-u} - \frac{u}{m-u}, & m \le x \le u \\ 0, & x < l \ or \ x > u \end{cases} \quad (4\text{-}1)$$

In the above formula, assuming that l and u are the lower and upper bounds of $\hat{B}$ respectively,

a triangular fuzzy number $\hat{B}$ can be denoted by a triplet (l, m, u) where l ≤ m ≤ u. For the situation of l=m=u, $\hat{B}$ is a definite value in the traditional AHP method.

As shown in Fig. 2, $\mu_{\hat{B}}$ is a trigonometric fuzzy function, and l,u represent the upper and lower bounds of fuzzy numbers respectively.

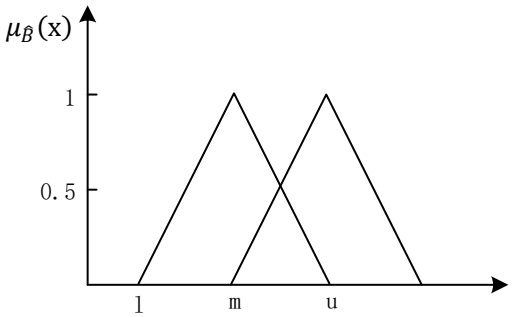

Figure 2 Triangular fuzzy correspondence diagram

(2) Establish the relationship between semantic scale and triangular fuzzy numbers.

Generally, the scaling 1-9 commonly used in AHP, can be employed for reference in the semantic scale of expert evaluation. Considering the fuzziness of subjective judgment, the usual conversion relationship for transforming the determined value into the triangular fuzzy number is shown in Fig. 3.

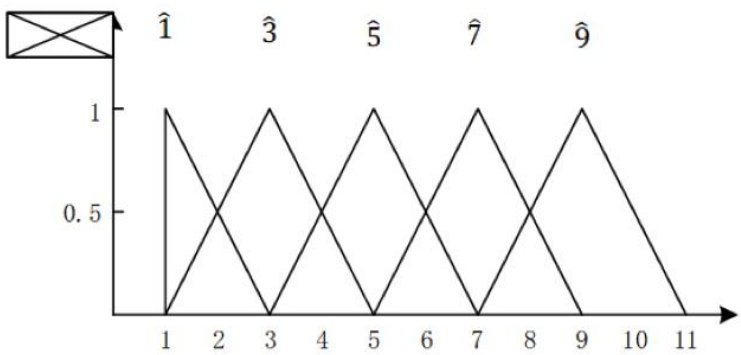

Figure 3 Transforming the determined value into triangular fuzzy number

Triangular fuzzy number $\widehat{B}_1$, $\widehat{B}_3$, $\widehat{B}_5$, $\widehat{B}_7$, $\widehat{B}_9$ are used to replace the general values 1, 3, 5, 7, 9, while $\widehat{B}_2$, $\widehat{B}_4$, $\widehat{B}_6$, $\widehat{B}_8$ are the median values of above adjacent judgments. The trigonometric function transformation relationship of FAHP is shown in Tab. 2.

Table 2 Trigonometric function transformation relationship

score by expert	Triangular fuzzy number	definition	numerical representation
1	B_1	equally important	（1，1，1）

3	B_3	weakly important	（2，3，4）
5	B_5	Obviously important	（4，5，6）
7	B_7	very important	（6，7，8）
9	B_9	Extremely important	（8，9，11）
2、4、6、8	B_2、B_4、B_6、B_8	Median	

(3) Determine the synthetic fuzzy value and define its operation method.

Define a set: $X = \{x_1, x_2, \ldots, x_n\}$ as a group of objects and $U = \{u_1, u_2, \ldots, u_m\}$ as a set of goals. After analyzing each object aiming at each target, the triangular fuzzy numbers can be obtained in conformity with step (2).

$$B_{ij}^1,\ B_{ij}^2,\ \cdots,\ B_{ij}^M$$
$$i = 1,2,\cdots,n; j = 1,2,\cdots,n \tag{4-2}$$

$$\widehat{B} = (b_{ij})_{n\times m},\ b_{ij} = (l_{ij}, m_{ij}, u_{ij}),\ k = 1,2,\cdots,M. \tag{4-3}$$

When there are m experts making the judgment together, the comprehensive triangular fuzzy number b_{ij} can be expressed as

$$b_{ij} = \frac{1}{M}(b_{ij}{}^1 \oplus b_{ij}{}^2 \oplus b_{ij}{}^3 \oplus \ldots b_{ij}{}^M) \tag{4-4}$$

The fuzzy value (initial weight) of the ith element in the kth layer is defined as D_i^k:

$$D_i^k = \sum_{j=1}^n B_{ij}^k * (\sum_{i=1}^n \sum_{j=1}^n B_{ij}^k)^{-1} \tag{4-5}$$

The basic operation method of 3 fuzzy numbers in FAHP method is defined as

$$\widehat{B}_1 = (l_1, m_1, u_1) \tag{4-6}$$
$$\widehat{B}_2 = (l_2, m_2, u_2) \tag{4-7}$$
$$\widehat{B}_1 + \widehat{B}_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \tag{4-8}$$
$$\widehat{B}_1 * \widehat{B}_2 \approx (l_1 l_2, m_1 m_2, u_1 u_2) \tag{4-9}$$
$$\widehat{B}_1{}^{-1} \approx \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1}\right) \tag{4-10}$$

(4) Single weights of hierarchy to determine the standard weight.

In order to determine the weight vector, the fuzzy sets composed of comprehensive fuzzy value sets are compared. More specifically, the fuzzy numbers $\widehat{B}_1 = (l_1, m_1, u_1)$ and $\widehat{B}_2 = (l_2, m_2, u_2)$are compared to specify the possible degree of $\widehat{B}_1 \geq \widehat{B}_2$ and $\widehat{B}_2 \geq \widehat{B}_1$. The possibility degree of $\widehat{B}_1 \geq \widehat{B}_2$ is defined by the triangular fuzzy function as

$$\vartheta(\widehat{B}_1 \geq \widehat{B}_2) = \mu(d) = \sup_{x\geq y}[\min(u_{\widehat{B}_1}(x), (u_{\widehat{B}_2}(y))] \tag{4-11}$$

$$\vartheta(\widehat{B}_1 \geq \widehat{B}_2) = \begin{cases} 1 & m_1 \geq m_2 \\ \dfrac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)} & m_1 \leq m_2, u_1 \geq u_2 \\ 0 & \text{otherwise} \end{cases} \tag{4-12}$$

$$\vartheta(\widehat{B} \geq \widehat{B}_1,\ \widehat{B}_2,\ \cdots,\ \widehat{B}_k) = \min\vartheta(\widehat{B} \geq \widehat{B}_i) \quad i = 1,2,\cdots,k \tag{4-13}$$

Where d corresponds to the ordinate of the highest intersection point D of two convex membership degrees $\mu_{\widehat{B}_1}$and $\mu_{\widehat{B}_2}$.

Define the standard weight of one factor as: the possibility degree that a fuzzy number is larger than the other k-1 fuzzy numbers. By comparing all possible fuzzy value $B_i(i = 1,2,\ldots,k)$ and weight vector $\vartheta(\widehat{B} \geq \widehat{B}_1, \widehat{B}_2, \ldots, \widehat{B}_k)$ to obtain the standard weight of this factor.

(5) Total weights of hierarchy to determine the final weight.

$$W_{ij} = \omega_{ij} * W_i \tag{4-14}$$

By multiplying ω_{ij}—the standard weight corresponding to the influencing factor at the lowest level, and W_i—the weight of the corresponding factor at the upper level, the final weight of the factor in the hierarchical structure W_{ij} is obtained.

(6) Determine the final ranking in accordance with the final weight.

4.1.2 Implementation process of FAHP method

(1) Establishment of hierarchical structure.

According to the above results, the first level factors of the AHP model can be determined asthe KSFs of CLR; the second level factors consist of Principal part of CLR, Key element of CLR projects and System and environment of CLR; and there are 29 third level factors, as shown in the Tab. 3.

(2) Questionnaire survey in the expert group.

At the stage of using FAHP, this study conducted a questionnaire survey and make statistics on the evaluation results of expert data. Initially, an expert group was established consisting of five members, including two university researchers in the field of CLR, two non-governmental organizations (enterprise) personnel of CLR project, and one staff of a government agency. In order to facilitate the experts to understand and fill in the questionnaire, this study decided to go with a paper questionnaire rather than a digital questionnaire. The questionnaire first introduces the background, purpose, and scoring rules of this survey, and should be filled in by experts to compare the importance of factors at the same level. After overcoming concerns of experts and maintaining their confidentiality, questionnaires were started to filled in respectively.

(3) Construction of fuzzy judgment matrix and data processing.

Based on experience and knowledge, the expert should fill in the questionnaire with the comparison result of the importance of the factors at the same level. After collecting the questionnaires, firstly, the expert semantics is transformed through the triangular fuzzy number conversion relationship table to construct the fuzzy judgment matrix. Secondly, in conformity with the steps in section 4.1.1, defuzzification of the comprehensive triangular fuzzy number corresponding to each factor was performed in the fuzzy judgment matrix, and later, single-level sorting and total sorting were performed to obtain the final weight of the factors. Taking the secondary factor reduction factor B as an example, the fuzzy judgment matrix can be obtained, as shown in Tab. 4.

Table 3 Initial success factors hierarchical structure model

Serial number		Level-2 Index	Level-3 Index	Factors
1		Principal part of construction land	Development plans of the construction land reduction project	A1
2			Management system of the construction land reduction project	A2
3			Coordination organization of the construction land reduction project	A3
4			Administrative supervision and management level	A4
5			Qualification and certification process	A5

6	Key success factors of construction land reduction	reduction A	Diversity of enterprises participating in the construction land reduction project	A6
7			Enterprise capacity and competence	A7
8			Enterprise rules and regulations	A8
9			Coordination with original landowner	A9
10			Coordination with surrounding residents	A10
11			Advance payments for land reclamation	A11
12			Status of construction organization for land remediation and reclamation	A12
13		Key element of construction land reduction project B	Standards for land acceptance and testing	B1
14			Maturity of related technologies	B2
15			Diversity of historical data	B3
16			Scientific land reduction process	B4
17			Stability of land reduction contract	B5
18			Appropriateness of land use planning after reduction	B6
19			Consumption of management costs	B7
20			Consumption of capital	B8
21			Diversity of relevant knowledge by land reduction staff	B9
22		System and environment of construction land reduction C	Support policy regarding operations of the construction land reduction project	C1
23			Leadership and decision-making mechanisms of the construction land reduction project	C2
24			Coordination mechanism of the construction land reduction project	C3
25			Supervision and evaluation mechanisms of the construction land reduction project	C4
26			Financial policies for the construction land reduction project	C5
27			Land policy for the construction land reduction project	C6
28			Legal environment of the construction land reduction project	C7
29			Cultural environment of the construction land reduction project	C8

Table 4 Fuzzy judgment matrix

Factors	B1	B2	B3	B4	B5	B6	B7	B8	B9
B1	(1.0000,1.0000,1.0000)	(3.4000，4.0000，4.8000)	(1.6500，2.2667，2.9000)	(1.8000，2.4000，3.0000)	(2.8000，3.6000，4.4000)	(0.8500，0.8667，0.9000)	(1.4286，2.2333，3.0400)	(3.0400，3.6500，4.2667)	(3.8000，4.6000，5.6000)

B2	(0.4915, 0.5122, 0.5417)	(1.0000,1.0000,1.0000)	(2.2500, 3.0667, 3.9000)	(0.8500, 0.8667, 0.9000)	(2.0900, 2.7167, 3.3667)	(0.7500, 1.0067, 1.3500)	(1.4900, 2.1167, 2.7667)	(2.1500, 2.6067, 3.1500)	(2.4667, 3.1000, 3.8000)
B3	(0.7500, 1.0067, 1.3500)	(0.5833, 0.8467, 1.2000)	(1.0000,1.0000,1.0000)	(0.9167, 1.1667, 1.5000)	(2.0000, 2.6000, 3.2000)	(0.9167, 1.1667, 1.5000)	(2.0000, 2.6000, 3.2000)	(2.2500, 3.0667, 3.9000)	(0.7000, 1.1333, 1.6000)
B4	(0.5500, 0.6067, 0.7500)	(1.2000, 1.4000, 1.6000)	(1.0500, 1.4667, 1.9000)	(1.0000,1.0000,1.0000)	(2.0000, 2.5000, 3.0667)	(1.3167, 1.7667, 2.3000)	(2.6333, 3.2400, 3.8500)	(2.8667, 3.7000, 4.6000)	(2.8000, 3.6000, 4.4000)
B5	(0.3650, 0.4119, 0.5000)	(1.1250, 1.5619, 2.0333)	(0.5400, 0.5900, 0.7167)	(0.5452, 0.8000, 1.1400)	(1.0000,1.0000,1.0000)	(2.9000, 3.5333, 4.2000)	(1.8667, 2.5000, 3.2000)	(3.0500, 3.6667, 4.5000)	(2.4500, 2.8667, 3.5000)
B6	(1.2000, 1.4000, 1.6000)	(1.6500, 2.2667, 2.9000)	(1.0500, 1.4667, 1.9000)	(0.8900, 1.3167, 1.7667)	(0.8917, 1.3086, 1.7333)	(1.0000,1.0000,1.0000)	(3.4000, 4.4000, 5.4000)	(4.0000, 4.8000, 5.8000)	(3.0000, 3.6000, 4.4000)
B7	(1.2167, 1.5000, 1.9000)	(1.1500, 1.6067, 2.1500)	(0.5333, 0.5733, 0.6500)	(1.1083, 1.3352, 1.5833)	(0.5400, 0.7900, 1.0833)	(0.2083, 0.2752, 0.4333)	(1.0000,1.0000,1.0000)	(1.9833, 2.2667, 2.8400)	(2.2917, 2.9286, 3.8333)
B8	(0.8917, 1.1086, 1.3333)	(1.4583, 2.0686, 2.6833)	(0.5733, 0.8233, 1.1167)	(0.3500, 0.5867, 0.8500)	(0.6982, 0.9222, 1.1583)	(0.3248, 0.3522, 0.3917)	(1.2182, 1.6222, 2.2250)	(1.0000,1.0000,1.0000)	(2.2667, 2.8800, 3.5000)
B9	(0.3432, 0.3841, 0.4583)	(0.5250, 0.7686, 1.0833)	(1.1333, 1.6000, 2.2000)	(0.3750, 0.4352, 0.5833)	(0.8682, 1.0889, 1.3250)	(0.5182, 0.5622, 0.6750)	(1.5348, 1.9889, 2.5250)	(1.7150, 2.1452, 2.6000)	(1.0000,1.0000,1.0000)

Similar to the steps above, the final weights of 29 success factors of CLR projects can be calculated. Tab. 5 shows the result of the final weights.

Table 5 Result of the final weights

	Level-2 Index	weight	Level-3 Index	weight	The total weight
Key success factors of construction land reduction	Principal part of construction land reduction A	0.5795	A1	0.171061677	0.099132
			A2	0.161142704	0.093384
			A3	0.131149117	0.076002
			A4	0.095007074	0.055057
			A5	0.077099477	0.044680
			A6	0.044798431	0.025961
			A7	0.032872266	0.019050
			A8	0.001016952	0.000589
			A9	0.075044813	0.043489
			A10	0.082723132	0.047939

			A11	0.095416741	0.055295
			A12	0.032667614	0.018931
	Key element of construction land reduction project B	0.1147	B1	0.140247256	0.016081
			B2	0.107174196	0.012289
			B3	0.102713049	0.011777
			B4	0.153595963	0.017612
			B5	0.131557509	0.015085
			B6	0.17492784	0.020058
			B7	0.073978495	0.008482
			B8	0.076537427	0.008776
			B9	0.039268265	0.004503
	System and environment of construction land reduction C	0.3058	C1	0.226615112	0.069306
			C2	0.17298431	0.052904
			C3	0.07037363	0.021522
			C4	0.145067316	0.044366
			C5	0.221723191	0.067810
			C6	0.068478091	0.020943
			C7	0.075646625	0.023135
			C8	0.019111725	0.005845

4.2 Analysis of Success Factors Based on Fuzzy-DEMATEL

The DEMATAL method was used to deal with complex social issues by making full use of the expert's knowledge and experience, which simply and purposefully screen out the key factors. After extending the DEMATEL method to the fuzzy field through the triangular fuzzy semantic scale, it retains the practical and effective advantages of the traditional DEMATEL method. It can not only make the expert's language information be appropriately expressed, but also better reflect the fuzziness of the relationship between factors in the system. Moreover, KSFs can be identified accurately and directly, which improves the credibility of the analysis results.

4.2.1 The Calculation Steps of Fuzzy-DEMATEL

The calculation steps of the Fuzzy-DEMATEL method are as follows:

(1) KSFs are constructed by literature references and expert groups, which is set as $B_1, B_2, \cdots, B_n$.

(2) Explain the transformation rules of the triangular fuzzy function expert semantic scale.

Through a questionnaire survey, the initial direct impact matrix is determined. According to the degree of influence, the semantic scale used for the expert evaluation is divided into five levels: no influence (N), very low influence (VL), low influence(L), high influence (H), and very high influence (VH). Transform the original scale into a triangular fuzzy number by the semantic transformation. The triangular fuzzy number is generally expressed as (l, m, u), in the above

formula $l \leq m \leq u$, l, and u are the lower and upper bounds of the trigonometric function, and m is the value closest to the actual value. The corresponding relationship between specific semantic evaluation and the triangular fuzzy number is shown in Tab. 6.

Table 6 The conversion relationship between expert semantic evaluation and triangular fuzzy numbers

Semantic Expression of Level of Impact Grade	Semantic Evaluation Value	Triangular Fuzzy Number
No influence(N)	0	（0,0,0.25）
Very low influence(VL)	1	（0,0.25,0.5）
Low influence(L)	2	（0.25,0.5,0.75）
High influence(H)	3	（0.5,0.75,1）
Very high influence (VH)	4	（0.75,1,1）

(3) According to the conversion rules of expert semantic evaluation and trigonometric function in Tab. 6, the expert semantic evaluation in the DEMATEL questionnaire is transformed into the triangular fuzzy numbers, and to obtain a fuzzy matrix $\widetilde{B}_{ij} = [\tilde{a}_{ij}]_{n*n}$, $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ is the triangular fuzzy number in which factor i affects factor j.

(4) Use the CFCS (Converting Fuzzy Data into Crisp Scores) method to defuzzify and weight the left and right scores of the average membership function $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij})$. The direct impact matrix of the total score and its composition is obtained. Assuming that that there are K experts to evaluate the factors of a system by DEMATEL questionnaire, the CFCS method converts triangular fuzzy numbers into accurate values. The steps are as follows.

1) Standardized the triangular fuzzy numbers:

$$xl_{ij} = \frac{\left(l_{ij} - \min_{0 \leq k \leq K} l_{ij}^{k}\right)}{\Delta_{min}^{max}} \quad (4\text{-}15)$$

$$xm_{ij} = \frac{\left(m_{ij} - \min_{0 \leq k \leq K} l_{ij}^{k}\right)}{\Delta_{min}^{max}} \quad (4\text{-}16)$$

representing,

$$\Delta_{min}^{max} = \max_{0 \leq k \leq K} u_{ij}^{k} - \min_{0 \leq k \leq K} l_{ij}^{k} \; xu_{ij} = \frac{\left(u_{ij} - \min_{0 \leq k \leq K} l_{ij}^{k}\right)}{\Delta_{min}^{max}} \quad (4\text{-}17)$$

2) Standardize the left and right values separately:

$$xLs_{ij}^{k} = \frac{xl_{ij}^{k}}{1 + xm_{ij}^{k} - xl_{ij}^{k}} \quad (4\text{-}18)$$

$$xUs_{ij}^{k} = \frac{xu_{ij}^{k}}{1 + xm_{ij}^{k} - xl_{ij}^{k}} \quad (4\text{-}19)$$

3) Calculate the clarity value after the expert scores to remove the ambuguity:

$$x_{ij}^{k} = \frac{xLs_{ij}^{k}\left(1 - xLs_{ij}^{k}\right) + xUs_{ij}^{k} * xUs_{ij}^{k}}{1 - xLs_{ij}^{k} + xUs_{ij}^{k}} \quad (4\text{-}20)$$

$$z_{ij}^{k} = \min_{0 \le k \le K} l_{ij}^{k} + \mathrm{m}_{ij}^{k} * \Delta_{min}^{max} \quad (4\text{-}21)$$

Among them, z_{ij}^{k} is the clear value obtained after the expert is graded and blurred.

4) Calculate the average clear value scored by K experts, that is, the average impact value:

$$\mathrm{z}_{ij} = \frac{1}{n}\left(z_{ij}^{1} + z_{ij}^{2} + \cdots + z_{ij}^{k}\right) \quad (4\text{-}22)$$

5) Standardize the direct matrix to obtain the standard direct impact matrix X:

$$\mathrm{X} = \left[x_{ij}\right]_{n*n}, 0 \le \mathrm{x}_{ij} \le 1 \quad (4\text{-}23)$$

6) Calculate the comprehensive impact matrix T:

$$\mathrm{T} = \mathrm{X}(I - X)^{-1}, T = \left[t_{ij}\right]_{n*n}, (i, j = 1,2,3, \cdots, n) \quad (4\text{-}24)$$

7) Calculate the influence degree, affected degree, center degree and cause degree of each factor.

The influence degree (D) refers to the comprehensive influence value of the factors corresponding to each row in the matrix T on all other factors. The affected degree (R) means that the factors corresponding to each column in the matrix T are affected by all other factors.

$$\mathrm{D} = \left[\sum_{i=1}^{n} t_{ij}\right]_{n*1} = [t_i]_{n*1} \quad (4\text{-}25)$$

$$\mathrm{R} = \left[\sum_{j=1}^{n} t_{ij}\right]_{1*n} = \left[t_j\right]_{1*n} \quad (4\text{-}26)$$

$$\mathrm{M_i} = \mathrm{D_i} + \mathrm{R_i} \quad (4\text{-}27)$$

$$\mathrm{N_i} = \mathrm{D_i} - \mathrm{R_i} \quad (4\text{-}28)$$

Where, the centrality M_i represents the sum of the influence degree and the affected value of factor i, which is used to judge the influence degree of factor i on other factors in the whole system. The greater the centrality, the stronger the driving effect of this factor on other factors. Cause degree N_i refers to the influence trend of factor i on the entire system, $N_i > 0$ indicates that this factor is the cause factor, that is, it will have an active impact on other factors. $N_i < 0$ indicates that this factor is the result factor, that is, this factor will be affected by other factors.

8) Take the factor centrality degree M and the cause degree R as the Cartesian coordinate system, and mark the position of each factor. Then analyze the importance of each factor and the relationship between them, and put forward practical suggestions.

4.2.2 Implementation Steps of Fuzzy-DEMATEL

(1) Determine the expert group: which is consistent with the expert group members of the FAHP questionnaire survey. At this stage, the a questionnaire was used to obtain information through face-to-face interaction. First of all, the questionnaire introduces the background, purpose and scoring rules of the questionnaire survey. After the experts have no objections, according to the corresponding influence degree codes in Tab. 3, they filled in the questionnaires and evaluated the mutual influence degree of factors at all levels.

(2) Collect questionnaire data and data processing: According to the Tab. 6 of the transformation relation of expert semantic trigonometric function in DEMATEL method, the expert semantics is transformed into the initial fuzzy matrix composed of triangular fuzzy numbers. After defuzzification, the direct impact matrix corresponding to 19 KSFs is obtained.

(3) From the matrix calculation formula, the standard direct impact matrix is calculated, as shown in Tab. 7.

(4) Perform matrix operations by using MATLAB R2017 software, and the comprehensive impact matrix T is calculated from the standard direct impact matrix X,as shown in Tab. 8.

$$\mathrm{T} = \mathrm{X} * (\mathrm{INV}(\mathrm{EYE}(25) - \mathrm{X})) \tag{4-29}$$

Table 7 Standard Direct Impact Matrix X

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	B1	B2	B3	B4	B5	B6	B7	B8	B9	C1	C2	C3	C4	C5	C6	C7	C8
A1	0.0089	0.0484	0.0419	0.0404	0.0292	0.0279	0.0197	0.0215	0.0219	0.0209	0.0301	0.0353	0.0404	0.0243	0.0307	0.0234	0.0209	0.0331	0.0316	0.0390	0.0270	0.0419	0.0382	0.0279	0.0279	0.0425	0.0419	0.0367	0.0219
A2	0.0484	0.0089	0.0316	0.0367	0.0316	0.0316	0.0197	0.0200	0.0425	0.0270	0.0264	0.0301	0.0441	0.0390	0.0224	0.0484	0.0307	0.0353	0.0301	0.0354	0.0261	0.0307	0.0422	0.0425	0.0404	0.0382	0.0382	0.0389	0.0151
A3	0.0419	0.0316	0.0089	0.0419	0.0316	0.0264	0.0151	0.0215	0.0343	0.0234	0.0228	0.0301	0.0145	0.0173	0.0160	0.0197	0.0209	0.0234	0.0279	0.0294	0.0173	0.0374	0.0346	0.0422	0.0367	0.0367	0.0279	0.0191	0.0136
A4	0.0404	0.0367	0.0419	0.0089	0.0441	0.0390	0.0353	0.0316	0.0389	0.0307	0.0243	0.0353	0.0441	0.0451	0.0191	0.0353	0.0270	0.0270	0.0374	0.0451	0.0255	0.0367	0.0331	0.0367	0.0404	0.0422	0.0367	0.0441	0.0173
A5	0.0292	0.0316	0.0316	0.0441	0.0089	0.0307	0.0441	0.0331	0.0209	0.0224	0.0224	0.0337	0.0313	0.0419	0.0127	0.0301	0.0255	0.0118	0.0261	0.0261	0.0410	0.0182	0.0219	0.0234	0.0234	0.0197	0.0173	0.0255	0.0133
A6	0.0279	0.0316	0.0264	0.0390	0.0307	0.0089	0.0404	0.0467	0.0255	0.0246	0.0292	0.0353	0.0316	0.0484	0.0255	0.0270	0.0404	0.0219	0.0338	0.0467	0.0467	0.0270	0.0191	0.0264	0.0389	0.0270	0.0322	0.0178	0.0136
A7	0.0197	0.0197	0.0151	0.0353	0.0441	0.0404	0.0089	0.0473	0.0276	0.0230	0.0142	0.0224	0.0160	0.0457	0.0151	0.0219	0.0406	0.0255	0.0404	0.0484	0.0564	0.0298	0.0173	0.0173	0.0164	0.0209	0.0164	0.0164	0.0107
A8	0.0215	0.0200	0.0215	0.0316	0.0331	0.0467	0.0473	0.0089	0.0136	0.0127	0.0118	0.0200	0.0136	0.0279	0.0164	0.0301	0.0292	0.0127	0.0404	0.0395	0.0395	0.0164	0.0164	0.0136	0.0127	0.0164	0.0164	0.0173	0.0164
A9	0.0219	0.0425	0.0343	0.0389	0.0209	0.0255	0.0276	0.0136	0.0089	0.0182	0.0219	0.0255	0.0173	0.0118	0.0373	0.0219	0.0209	0.0197	0.0285	0.0285	0.0142	0.0209	0.0380	0.0365	0.0307	0.0322	0.0209	0.0200	0.0209
A10	0.0209	0.0270	0.0234	0.0307	0.0224	0.0246	0.0230	0.0127	0.0182	0.0089	0.0219	0.0234	0.0066	0.0089	0.0230	0.0224	0.0224	0.0219	0.0224	0.0224	0.0133	0.0270	0.0261	0.0261	0.0298	0.0313	0.0261	0.0200	0.0246
A11	0.0301	0.0264	0.0228	0.0243	0.0224	0.0292	0.0142	0.0118	0.0219	0.0219	0.0089	0.0283	0.0136	0.0145	0.0234	0.0191	0.0255	0.0303	0.0301	0.0374	0.0173	0.0353	0.0301	0.0301	0.0301	0.0353	0.0338	0.0219	0.0219
A12	0.0353	0.0301	0.0301	0.0353	0.0337	0.0353	0.0224	0.0200	0.0255	0.0234	0.0283	0.0089	0.0224	0.0410	0.0222	0.0374	0.0409	0.0255	0.0316	0.0389	0.0441	0.0343	0.0219	0.0264	0.0264	0.0322	0.0292	0.0255	0.0219
B1	0.0404	0.0441	0.0145	0.0441	0.0313	0.0316	0.0160	0.0136	0.0173	0.0066	0.0136	0.0224	0.0089	0.0564	0.0380	0.0451	0.0380	0.0219	0.0219	0.0270	0.0301	0.0246	0.0261	0.0261	0.0261	0.0283	0.0298	0.0374	0.0187
B2	0.0243	0.0390	0.0173	0.0451	0.0419	0.0484	0.0457	0.0279	0.0118	0.0089	0.0145	0.0410	0.0564	0.0089	0.0209	0.0390	0.0390	0.0234	0.0404	0.0404	0.0441	0.0285	0.0151	0.0173	0.0173	0.0292	0.0197	0.0307	0.0182
B3	0.0307	0.0224	0.0160	0.0191	0.0127	0.0255	0.0151	0.0164	0.0373	0.0230	0.0234	0.0222	0.0380	0.0209	0.0089	0.0365	0.0301	0.0307	0.0255	0.0292	0.0219	0.0246	0.0200	0.0200	0.0215	0.0224	0.0209	0.0209	0.0209
B4	0.0234	0.0484	0.0197	0.0353	0.0301	0.0270	0.0219	0.0301	0.0219	0.0224	0.0191	0.0374	0.0451	0.0390	0.0365	0.0089	0.0358	0.0441	0.0243	0.0319	0.0279	0.0389	0.0322	0.0307	0.0279	0.0234	0.0234	0.0270	0.0209
B5	0.0209	0.0307	0.0209	0.0270	0.0255	0.0404	0.0406	0.0292	0.0209	0.0224	0.0255	0.0409	0.0380	0.0390	0.0301	0.0358	0.0089	0.0307	0.0307	0.0307	0.0209	0.0246	0.0209	0.0209	0.0209	0.0224	0.0246	0.0246	0.0246
B6	0.0331	0.0353	0.0234	0.0270	0.0118	0.0219	0.0255	0.0127	0.0197	0.0219	0.0303	0.0255	0.0219	0.0234	0.0307	0.0441	0.0307	0.0089	0.0422	0.0422	0.0285	0.0160	0.0197	0.0243	0.0206	0.0316	0.0353	0.0219	0.0153
B7	0.0316	0.0301	0.0279	0.0374	0.0261	0.0338	0.0404	0.0404	0.0285	0.0224	0.0301	0.0316	0.0219	0.0404	0.0255	0.0243	0.0307	0.0422	0.0089	0.0517	0.0239	0.0224	0.0261	0.0261	0.0224	0.0343	0.0234	0.0173	0.0136
B8	0.0390	0.0354	0.0294	0.0451	0.0261	0.0467	0.0484	0.0395	0.0285	0.0224	0.0374	0.0389	0.0270	0.0404	0.0292	0.0319	0.0307	0.0422	0.0517	0.0089	0.0270	0.0270	0.0151	0.0151	0.0188	0.0285	0.0285	0.0164	0.0107
B9	0.0270	0.0261	0.0173	0.0255	0.0410	0.0467	0.0564	0.0395	0.0142	0.0133	0.0173	0.0441	0.0301	0.0441	0.0219	0.0279	0.0209	0.0285	0.0239	0.0270	0.0089	0.0142	0.0179	0.0197	0.0188	0.0179	0.0142	0.0179	0.0215
C1	0.0419	0.0307	0.0374	0.0367	0.0182	0.0270	0.0298	0.0164	0.0209	0.0270	0.0353	0.0343	0.0246	0.0285	0.0246	0.0389	0.0246	0.0160	0.0224	0.0270	0.0142	0.0089	0.0425	0.0331	0.0367	0.0425	0.0354	0.0338	0.0173
C2	0.0382	0.0422	0.0346	0.0331	0.0219	0.0191	0.0173	0.0164	0.0380	0.0261	0.0301	0.0219	0.0261	0.0151	0.0200	0.0322	0.0209	0.0197	0.0261	0.0151	0.0179	0.0425	0.0089	0.0406	0.0367	0.0406	0.0370	0.0228	0.0182
C3	0.0279	0.0425	0.0422	0.0367	0.0234	0.0264	0.0173	0.0136	0.0365	0.0261	0.0301	0.0264	0.0261	0.0173	0.0200	0.0307	0.0209	0.0243	0.0261	0.0151	0.0197	0.0331	0.0406	0.0089	0.0219	0.0255	0.0283	0.0173	0.0133
C4	0.0279	0.0404	0.0367	0.0404	0.0234	0.0389	0.0164	0.0127	0.0307	0.0298	0.0301	0.0264	0.0261	0.0173	0.0215	0.0279	0.0209	0.0206	0.0224	0.0188	0.0188	0.0367	0.0367	0.0219	0.0089	0.0292	0.0246	0.0173	0.0107
C5	0.0425	0.0382	0.0367	0.0422	0.0197	0.0270	0.0209	0.0164	0.0322	0.0313	0.0353	0.0322	0.0283	0.0292	0.0224	0.0234	0.0224	0.0316	0.0343	0.0285	0.0179	0.0425	0.0406	0.0255	0.0292	0.0089	0.0425	0.0279	0.0228
C6	0.0419	0.0382	0.0279	0.0367	0.0173	0.0322	0.0164	0.0164	0.0209	0.0261	0.0338	0.0292	0.0298	0.0197	0.0209	0.0234	0.0246	0.0353	0.0234	0.0285	0.0142	0.0354	0.0370	0.0283	0.0246	0.0425	0.0089	0.0228	0.0191
C7	0.0367	0.0389	0.0191	0.0441	0.0255	0.0178	0.0164	0.0173	0.0200	0.0200	0.0219	0.0255	0.0374	0.0307	0.0209	0.0270	0.0246	0.0219	0.0173	0.0164	0.0179	0.0338	0.0228	0.0173	0.0173	0.0279	0.0228	0.0089	0.0338
C8	0.0219	0.0151	0.0136	0.0173	0.0133	0.0136	0.0107	0.0164	0.0209	0.0246	0.0219	0.0219	0.0187	0.0182	0.0180	0.0209	0.0246	0.0182	0.0136	0.0107	0.0215	0.0173	0.0182	0.0133	0.0107	0.0228	0.0191	0.0338	0.0089

Table 8 Comprehensive Impact Matrix T

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	B1	B2	B3	B4	B5	B6	B7	B8	B9	C1	C2	C3	C4	C5	C6	C7	C8
A1	0.1479	0.1934	0.1595	0.1927	0.1460	0.1634	0.1375	0.1235	0.1331	0.1177	0.1394	0.1650	0.1641	0.1567	0.1332	0.1545	0.1419	0.1480	0.1593	0.1745	0.1400	0.1686	0.1577	0.1421	0.1419	0.1732	0.1616	0.1447	0.1003
A2	0.1934	0.1654	0.1570	0.1990	0.1557	0.1754	0.1450	0.1283	0.1591	0.1291	0.1422	0.1684	0.1759	0.1786	0.1324	0.1863	0.1587	0.1572	0.1657	0.1793	0.1463	0.1658	0.1689	0.1629	0.1606	0.1768	0.1650	0.1532	0.0988
A3	0.1595	0.1570	0.1120	0.1725	0.1316	0.1427	0.1167	0.1089	0.1296	0.1067	0.1171	0.1416	0.1211	0.1301	0.1044	0.1317	0.1241	0.1218	0.1377	0.1459	0.1143	0.1465	0.1379	0.1398	0.1345	0.1492	0.1312	0.1120	0.0809
A4	0.1927	0.1990	0.1725	0.1801	0.1743	0.1900	0.1671	0.1457	0.1610	0.1374	0.1454	0.1799	0.1816	0.1920	0.1338	0.1801	0.1618	0.1546	0.1797	0.1960	0.1526	0.1776	0.1656	0.1626	0.1660	0.1868	0.1691	0.1633	0.1045
A5	0.1460	0.1557	0.1316	0.1743	0.1116	0.1483	0.1465	0.1223	0.1152	0.1043	0.1146	0.1453	0.1378	0.1563	0.1007	0.1417	0.1298	0.1105	0.1363	0.1439	0.1397	0.1268	0.1232	0.1202	0.1202	0.1310	0.1190	0.1179	0.0805
A6	0.1634	0.1754	0.1427	0.1900	0.1483	0.1464	0.1599	0.1494	0.1344	0.1196	0.1365	0.1649	0.1548	0.1803	0.1274	0.1568	0.1606	0.1363	0.1618	0.1825	0.1605	0.1521	0.1366	0.1381	0.1502	0.1557	0.1495	0.1246	0.0913
A7	0.1375	0.1450	0.1167	0.1671	0.1465	0.1599	0.1164	0.1383	0.1217	0.1055	0.1081	0.1366	0.1241	0.1618	0.1042	0.1352	0.1454	0.1248	0.1522	0.1672	0.1559	0.1374	0.1187	0.1144	0.1138	0.1327	0.1186	0.1092	0.0784
A8	0.1235	0.1283	0.1089	0.1457	0.1223	0.1494	0.1383	0.0893	0.0962	0.0848	0.0931	0.1186	0.1073	0.1295	0.0932	0.1273	0.1207	0.0996	0.1369	0.1428	0.1267	0.1106	0.1042	0.0980	0.0973	0.1133	0.1049	0.0975	0.0746
A9	0.1331	0.1592	0.1296	0.1610	0.1152	0.1344	0.1218	0.0962	0.0996	0.0967	0.1101	0.1299	0.1173	0.1182	0.1194	0.1271	0.1182	0.1127	0.1315	0.1378	0.1056	0.1238	0.1343	0.1283	0.1225	0.1374	0.1178	0.1070	0.0838
A10	0.1177	0.1291	0.1067	0.1374	0.1043	0.1196	0.1055	0.0848	0.0967	0.0777	0.0991	0.1147	0.0940	0.1016	0.0950	0.1139	0.1072	0.1028	0.1123	0.1180	0.0930	0.1165	0.1104	0.1061	0.1097	0.1231	0.1104	0.0959	0.0796
A11	0.1394	0.1422	0.1171	0.1454	0.1146	0.1365	0.1081	0.0931	0.1101	0.0991	0.0967	0.1316	0.1121	0.1191	0.1051	0.1228	0.1211	0.1217	0.1316	0.1448	0.1069	0.1359	0.1252	0.1203	0.1203	0.1391	0.1290	0.1074	0.0840
A12	0.1650	0.1684	0.1416	0.1799	0.1453	0.1649	0.1366	0.1186	0.1299	0.1147	0.1316	0.1339	0.1413	0.1670	0.1202	0.1610	0.1555	0.1352	0.1534	0.1684	0.1520	0.1542	0.1349	0.1340	0.1340	0.1557	0.1423	0.1280	0.0964
B1	0.1641	0.1759	0.1211	0.1816	0.1378	0.1548	0.1241	0.1073	0.1173	0.0940	0.1121	0.1413	0.1245	0.1762	0.1308	0.1635	0.1475	0.1265	0.1379	0.1505	0.1335	0.1395	0.1337	0.1285	0.1285	0.1460	0.1375	0.1355	0.0900
B2	0.1567	0.1786	0.1301	0.1920	0.1563	0.1803	0.1618	0.1295	0.1182	0.1016	0.1191	0.1670	0.1762	0.1413	0.1205	0.1655	0.1569	0.1348	0.1642	0.1731	0.1560	0.1498	0.1291	0.1262	0.1265	0.1539	0.1345	0.1350	0.0937
B3	0.1335	0.1327	0.1046	0.1341	0.1009	0.1276	0.1044	0.0934	0.1197	0.0952	0.1053	0.1204	0.1311	0.1208	0.0876	0.1347	0.1212	0.1175	0.1218	0.1317	0.1073	0.1198	0.1100	0.1056	0.1069	0.1207	0.1110	0.1024	0.0803
B4	0.1545	0.1863	0.1317	0.1801	0.1417	0.1568	0.1352	0.1273	0.1271	0.1139	0.1228	0.1610	0.1635	0.1655	0.1344	0.1351	0.1514	0.1528	0.1466	0.1616	0.1368	0.1586	0.1451	0.1385	0.1357	0.1476	0.1372	0.1303	0.0956
B5	0.1419	0.1587	0.1241	0.1618	0.1298	0.1606	0.1454	0.1207	0.1182	0.1071	0.1211	0.1555	0.1475	0.1569	0.1210	0.1514	0.1174	0.1322	0.1442	0.1521	0.1235	0.1361	0.1253	0.1207	0.1208	0.1373	0.1296	0.1199	0.0937
B6	0.1477	0.1569	0.1216	0.1544	0.1103	0.1360	0.1246	0.0994	0.1124	0.1026	0.1214	0.1349	0.1263	0.1345	0.1170	0.1526	0.1319	0.1069	0.1491	0.1563	0.1233	0.1226	0.1196	0.1192	0.1154	0.1406	0.1349	0.1119	0.0811
B7	0.1593	0.1657	0.1377	0.1797	0.1363	0.1618	0.1522	0.1369	0.1314	0.1123	0.1316	0.1534	0.1379	0.1642	0.1216	0.1466	0.1442	0.1493	0.1306	0.1796	0.1318	0.1406	0.1366	0.1316	0.1281	0.1556	0.1349	0.1179	0.0867
B8	0.1745	0.1793	0.1459	0.1960	0.1439	0.1825	0.1672	0.1428	0.1378	0.1180	0.1448	0.1684	0.1505	0.1731	0.1314	0.1616	0.1521	0.1565	0.1796	0.1477	0.1422	0.1525	0.1332	0.1281	0.1317	0.1581	0.1470	0.1237	0.0886
B9	0.1400	0.1463	0.1143	0.1526	0.1397	0.1605	0.1559	0.1267	0.1056	0.0930	0.1069	0.1520	0.1335	0.1560	0.1070	0.1368	0.1235	0.1235	0.1318	0.1422	0.1075	0.1191	0.1153	0.1130	0.1123	0.1253	0.1128	0.1074	0.0862
C1	0.1686	0.1658	0.1465	0.1776	0.1268	0.1521	0.1374	0.1106	0.1238	0.1165	0.1359	0.1542	0.1395	0.1498	0.1195	0.1586	0.1361	0.1229	0.1406	0.1525	0.1191	0.1279	0.1531	0.1384	0.1418	0.1633	0.1462	0.1334	0.0901
C2	0.1578	0.1690	0.1379	0.1656	0.1232	0.1366	0.1187	0.1042	0.1343	0.1104	0.1252	0.1349	0.1337	0.1291	0.1097	0.1451	0.1253	0.1199	0.1366	0.1332	0.1153	0.1531	0.1150	0.1400	0.1360	0.1545	0.1413	0.1170	0.0865
C3	0.1421	0.1629	0.1398	0.1626	0.1202	0.1381	0.1144	0.0980	0.1283	0.1061	0.1203	0.1340	0.1285	0.1262	0.1054	0.1385	0.1207	0.1194	0.1316	0.1281	0.1130	0.1384	0.1400	0.1047	0.1171	0.1345	0.1277	0.1071	0.0784
C4	0.1419	0.1606	0.1345	0.1660	0.1202	0.1502	0.1138	0.0973	0.1225	0.1097	0.1203	0.1340	0.1285	0.1265	0.1067	0.1357	0.1208	0.1156	0.1281	0.1317	0.1123	0.1418	0.1360	0.1171	0.1044	0.1378	0.1242	0.1070	0.0757
C5	0.1732	0.1768	0.1492	0.1868	0.1310	0.1557	0.1327	0.1132	0.1374	0.1231	0.1391	0.1557	0.1460	0.1539	0.1205	0.1476	0.1373	0.1409	0.1556	0.1581	0.1253	0.1633	0.1545	0.1345	0.1378	0.1348	0.1565	0.1310	0.0974
C6	0.1616	0.1650	0.1312	0.1691	0.1190	0.1495	0.1186	0.1049	0.1177	0.1104	0.1290	0.1423	0.1375	0.1345	0.1108	0.1372	0.1296	0.1352	0.1349	0.1470	0.1128	0.1462	0.1413	0.1277	0.1242	0.1565	0.1145	0.1173	0.0875
C7	0.1447	0.1532	0.1120	0.1633	0.1179	0.1246	0.1092	0.0975	0.1070	0.0959	0.1074	0.1280	0.1355	0.1350	0.1021	0.1303	0.1199	0.1122	0.1179	0.1237	0.1075	0.1334	0.1171	0.1071	0.1070	0.1310	0.1173	0.0954	0.0955
C8	0.1003	0.0988	0.0809	0.1046	0.0805	0.0913	0.0785	0.0747	0.0838	0.0796	0.0841	0.0965	0.0899	0.0938	0.0773	0.0957	0.0937	0.0841	0.0868	0.0887	0.0863	0.0901	0.0866	0.0785	0.0757	0.0975	0.0876	0.0955	0.0547

(5) Using Excel and MATLAB software, calculate the influence degree D and the affected degree R of each factor from the comprehensive impact matrix, and calculate the centrality and cause degree by the formula in 4.2.1. The results are shown in Tab. 9.

Table 9 Calculation results of "four degrees" of construction land reduction project

Success factors	Factor code	Influence degree D	Affected degree R	Cause degree D+R	Centrality degree D-R
Development plans of the construction land reduction project	A1	4.38152871	4.381567676	8.763096386	-0.000039
Management system of the construction land reduction project	A2	4.650493101	4.650636641	9.301129742	-0.000144
Coordination organization of the construction land reduction project	A3	3.759064461	3.75915308	7.518217542	-0.000089
Administrative supervision and management level	A4	4.872810057	4.872907354	9.745717412	-0.000097
Qualification and certification process	A5	3.751469488	3.751479743	7.502949231	-0.000010
Diversity of enterprises participating in the construction land reduction project	A6	4.349867769	4.349856907	8.699724677	0.000011
Enterprise capacity and competence	A7	3.793441595	3.793565587	7.587007181	-0.000124
Enterprise rules and regulations	A8	3.282763008	3.282744782	6.56550779	0.000018
Coordination with original landowner	A9	3.529423464	3.529260413	7.058683876	0.000163
Coordination with surrounding residents	A10	3.082749812	3.082740842	6.165490655	0.000009
Advance payments for land reclamation	A11	3.480395538	3.480471889	6.960867427	-0.000076
Status of construction organization for land remediation and reclamation	A12	4.163665142	4.163711147	8.327376289	-0.000046
Standards for land acceptance and testing	B1	3.961632019	3.961487531	7.92311955	0.000144
Maturity of related technologies	B2	4.22832039	4.228361574	8.456681964	-0.000041
Diversity of historical data	B3	3.302160472	3.292129805	6.594290278	0.010031
Scientific land reduction process	B4	4.174952296	4.175034425	8.349986721	-0.000082
Stability of land reduction contract	B5	3.874524568	3.874535062	7.74905963	-0.000010

Appropriateness of land use planning after reduction	B6	3.665280133	3.675333433	7.340613567	-0.010053
Consumption of management costs	B7	4.096091285	4.096278606	8.192369891	-0.000187
Consumption of capital	B8	4.358634255	4.358792345	8.7174266	-0.000158
Diversity of relevant knowledge by land reduction staff	B9	3.646698085	3.646771139	7.293469224	-0.000073
Support policy regarding operations of the construction land reduction project	C1	4.048819457	4.048753435	8.097572892	0.000066
Leadership and decision-making mechanisms of the construction land reduction project	C2	3.809019978	3.809027137	7.618047115	-0.000007
Coordination mechanism of the construction land reduction project	C3	3.626047071	3.626102984	7.252150055	-0.000056
Supervision and evaluation mechanisms of the construction land reduction project	C4	3.620532021	3.620539158	7.241071179	-0.000007
Financial policies for the construction land reduction project	C5	4.168876469	4.168977013	8.337853482	-0.000101
Land policy for the construction land reduction project	C6	3.81289607	3.813048024	7.625944093	-0.000152
Legal environment of the construction land reduction project	C7	3.448275424	3.448272553	6.896547977	0.000003
Cultural environment of the construction land reduction project	C8	2.516161824	2.515053676	5.0312155	0.001108

4.3 Analysis of model processing results and identification of key success factors

KSFs of CLR projects refer to the key factors that make the project implement successfully in the preparation stage, decision-making stage, design stage, construction stage and post-management stage of CLR project. Identifying and concentrating these KSFs can make the project organizer pay attention to the important success factors in the project carefully, and give priority consideration in the process of organization and management, so that the project can meet the necessary conditions for completion. Paying attention to the KSFs can bring fruitful results and greatly improve effective completion of the project.

4.3.1 Comprehensive influence degree calculation

The FAHP method described in section 4.1 is used to calculate the corresponding weight of success factors of CLR projects, and the Fuzzy-DEMATEL method explained in section 4.2 is used to calculate the "cause degree n, center degree m" of success factors. The weight corresponding to the factors is multiplied by the cause degree and center degree respectively to calculate the comprehensive cause degree and center degree of success factors of CLR projects. Tab.10 lists the

comprehensive influence relationship among the 29 KSFs of the CLR projects in detail.

$$R_i = \omega_i * N_i \quad (4\text{-}30)$$

$$O_i = \omega_i * M_i, \quad (4\text{-}31)$$

Table 10 Comprehensive influence relationship of success factors of construction land reduction project

influence factor	Factor code	Comprehensive weight（ω_i）	Comprehensive centrality（O_i）	Comprehensive centrality ranking	Comprehensive cause degree（R_i）	Comprehensive cause degree ranking
Development program	A1	0.099131656	0.86870026	1	-0.0000039	23
Management system	A2	0.093383529	0.868572321	2	-0.0000134	28
Cooperating agency	A3	0.076001998	0.571399553	3	-0.0000067	26
Administrative regulation	A4	0.055057385	0.536573716	6	-0.0000054	25
Quality certification	A5	0.044679784	0.335230153	9	-0.0000005	14
Diversity in the enterprises participating	A6	0.025961061	0.225854086	13	0.0000003	7
Enterprise competence	A7	0.01904975	0.144530589	20	-0.0000024	21
Enterprise rules and systems	A8	0.000589332	0.003869266	29	0.0000000	9
Coordination with the original landowner	A9	0.04348909	0.306975737	11	0.0000071	2
Coordination with the surrounding local residents	A10	0.047938739	0.295565847	12	0.0000004	6
Land beneficiary sector	A11	0.05529479	0.384899706	8	-0.0000042	24
Construction progress	A12	0.018931153	0.157646832	16	-0.0000009	16
Land acceptance and testing standards	B1	0.016080984	0.127411562	21	0.0000023	5
Technology maturity	B2	0.012288772	0.103922238	23	-0.0000005	15
Historical data	B3	0.01177725	0.077662602	24	0.0001181	1
Science of process	B4	0.017611569	0.147056371	19	-0.0000014	19
Contract formulation level	B5	-0.000662336	-0.005132479	22	-0.0000002	10
Land-use planning	B6	-0.005426043	-0.039830487	18	-0.0002016	29
Administration Costs	B7	-0.010189751	-0.083478207	26	-0.0000016	20
Cost of Capital	B8	-0.014953458	-0.130355674	25	-0.0000014	18
Richness of staff member knowledge	B9	-0.019717166	-0.143806541	27	-0.0000003	12
Supportive policies	C1	-0.024480873	-0.198235655	5	0.0000046	4
Leadership Decision	C2	-0.029244581	-0.222786593	7	-0.0000004	13
System construction	C3	-0.034008288	-0.246633208	17	-0.0000012	17
Coordination mechanism	C4	-0.038771996	-0.280750779	10	-0.0000003	11
Fiscal Policy	C5	-0.043535703	-0.362994313	4	-0.0000068	27
Land Policy	C6	-0.04829941	-0.368328604	14	-0.0000032	22

Legal environment	C7	-0.053063118	-0.365952339	15	0.0000001	8
Social environment	C8	-0.057826825	-0.29093922	28	0.0000065	3

In this study, the weight of each factor is determined according to FAHP method, and then the mutual influence degree of each factor is determined by Fuzzy-DEMATEL method. The two methods combine the comprehensive cause degree and comprehensive center degree of the final factors. The comprehensive cause degree indicates the degree of correlation among the various KSFs, which can be divided into cause factors (comprehensive cause degree > 0) and result factors (comprehensive cause degree < 0). The comprehensive centrality represents the importance of each factor in the whole factor system. Generally, the greater the value of comprehensive centrality, the more important this factor is. Combining the analysis of the two dimensions of comprehensive centrality and comprehensive cause, we can get KSFs of the CLR projects. With the comprehensive centrality as the horizontal axis and the comprehensive cause as the vertical axis, the Cartesian coordinate system is constructed. According to Tab. 10, the causal correlation diagram of the comprehensive influence relationship of the success factors is drawn as shown in Fig 4.

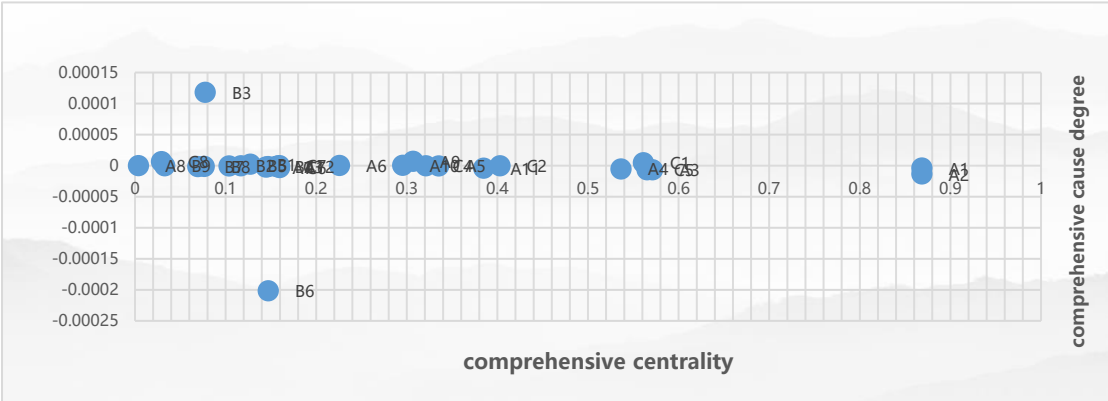

Figure 4 Comprehensive influence degree distribution map

Based on the data in Fig 4 and Tab. 10, the causes, dependence and comprehensive centrality are analyzed as follows.

4.3.2 Identification of key success factors

The identification principles of KSFs identification model for the CLR projects based on FAHP and Fuzzy-DEMATEL method are as follows:

(1) KSFs belong to the cause factor group whose comprehensive cause degree is greater than 0.

The comprehensive cause degree value of a factor represents the effect of this factor on other factors. If the comprehensive cause degree is > 0, it shows that this factor has the characteristic of active influence on other factors in the system and is the cause factor; The comprehensive cause degree is less than 0, which indicates that this factor has the influence on other factors in the system, that is, it is the result factor of the system. If a factor is the cause factor, it indicates that it will actively affect the operation of the whole system, so it is at the bottom of the factor ranking of the whole system. Therefore, if we want to find out KSFs of the CLR projects, we must start with the bottom factors, which are the root of the whole system operation.

(2) In the cause factor set, the success factor with large comprehensive centrality in the system is selected as the KSF.

The greater the value of comprehensive centrality, the greater the comprehensive influence of this success factor on the system, indicating that this factor has a very important influence in the whole system. The factors in the cause factor set are sorted by comprehensive centrality, that is, the factors at the bottom of the whole system are judged by their influence degree. The higher the comprehensive centrality, the higher the ranking, the higher the influence degree of the bottom factors on the whole system.Shown in Fig 5.

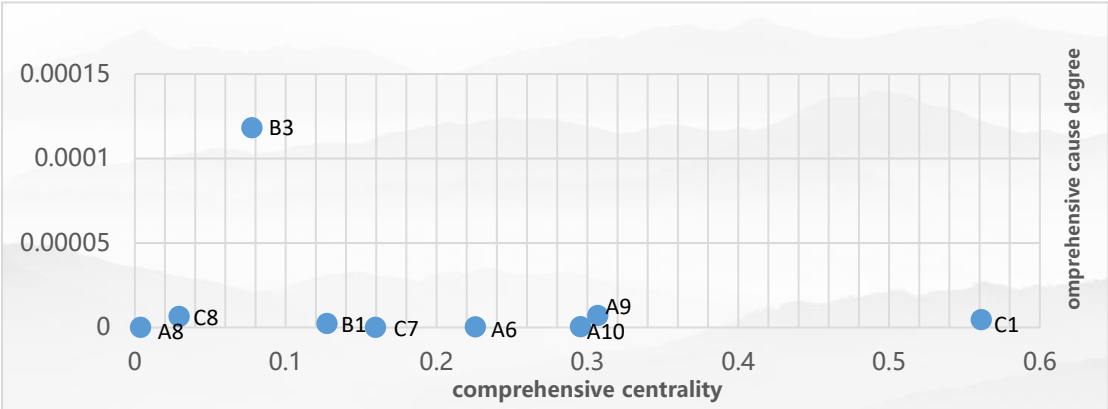

Figure 5 KSFs Comprehensive influence degree distribution map

(3) According to the Pareto rule in the field of management, the top 20% factors are selected as KSFs.

Pareto rule, that is, the 28-effect, means that in any specific group, important factors usually account for only a few, so long as a few important factors can be controlled, the whole situation can be controlled. Therefore, in the success factor system, it is sufficient to select about 20% of the factors as KSFs.

Based on the principle of data analysis and identification of KSFs, the identification results are as follows;

(1) It can be known from Tab. 10 and causality diagram that the cause factors include the following nine factors: B_3Historical data, A_9Coordination with the original landowner, C_8Social environment, C_1Supportive policies, B_1Land acceptance and testing standards, A_{10}Coordination with the surrounding local residents, A_6 Diversity of participating enterprises, C_7 Legal environment, A_8 Enterprise rules and systems.

(2) According to the comprehensive centrality ranking of 9 factors, the order of influence degree can be obtained as follows: $C_1 > A_9 > A_{10} > A_6 > C_7 > B_1 > B_3 > C_8 > A_8$。

(3) Based on Pareto rule, because there are 29 factors affecting the success of CRL projects, 20% of them are selected as KSFs, which include six success factors. According to the comprehensive centrality of the cause factors, the top six are C_1, A_9, A_{10}, A_6, C_7 and B_1. Therefore, the key success factors of the construction land reduction project are: C_1 supportive policies, A_9 coordination with the original landowner, A_{10} coordination with the surrounding local residents, A_6 diversity in the enterprises participating, C_7 legal environment, B_1 land acceptance and testing standards.

5. Key success factors interpretation

Three key success factors for construction land reduction include **coordination with the original landowner, coordination with the surrounding local residents and a diversity in the**

enterprises participating in the construction land reduction.

Implementing CLR projects successfully can maintain the total area of construction lands while achieving an optimised layout, improved functions and more intensive land use. However, it is necessary to address many problems that arise with the local residents and regional economic development. A local economy can undergo a continuous evolution from the enterprises of the original village, to those of a township, to an industrial park. Today, although many employment opportunities are provided by industrial enterprises in the scope of a 'reduction' project, many enterprises must close down increase the adoption of CLR, which results in high unemployment and an increasing range of social problems.

Although the government has devoted significant attention to the 'land reduction' activities, however, effective guidance and support are lacking for the subsequent operation of enterprises. As a result, many enterprises are no longer enthusiastic regarding 'second entrepreneurship and re-transformation' because of the lack of government compensation for land reduction and demolition, let alone the related social costs. For example, with over 200 employees and annual sales of CNY 100 million, the Junchen and Dongsheng Industry in the town of Heqing, which distributes international brands, was forced to close down after 'reduction' work and demolition because of its lack of appropriate workshop, which resulted in the loss of employment for all staff and losses in finance and taxation. Therefore, this reduction seriously influenced the livelihood of local residents and the regional economic development.

When the concept of 'land reduction' was proposed, the public generally considered it to mean a reduction in quantity of both inventory land (current status) and new land (planning). However, CLR was found to decrease the assets of original landowners and the available benefits associated with the original lands of the local residents. To address this situation, the key is to reduce the lands in the process of 'reduction' and not the benefits associated with them for the original landowners and surrounding residents. That is, with decreases in the scale of land use or improvement in land use efficiency, the benefits of the lands enjoyed by the original landowners and other interested parties cannot be decreased.

Moreover, China's land testing and reclamation institutions must solve many problems, of which the large number of institutions, their small scale, fierce competition, low competitive power, weakness and weak international competition are the most salient. Hence, it is necessary to provide policy guidance to create an environment characterised by fair competition and advanced management practices to ensure sound land development.

As such, another KSF for CLR is the establishment of **land acceptance and testing standards.**

Optimisation of the spatial layout of ecological and construction lands is a key factor in coordinating economic development and ecologically sustainable construction practices. In CLR projects, some construction land is reclaimed as arable land, thus increasing the ecological land area. In addition, the ecological quality of land is improved by improving the quality of arable lands and the reclamation of forest lands.

However, in CLR project in the Qingpu District (Shanghai), the quality of the reclaimed lands after reduction was different and crops were not planted on some of these lands. The thickness and looseness of the reclaimed land layer, the support facilities, and the soil and underground water

quality must be strictly managed in accordance with planting standards because these lands were construction lands before the reclamation, which means most may have been industrial lands that have been polluted. Lack of qualified personnel to perform land inspections and testing will negatively impact the ecological environment and can even result in the waste of land resources, and also threatening the health and safety of the surrounding residents. Therefore, the establishment of comprehensive land acceptance and testing standards is crucial for the effectiveness of a 'reduction' project.

The KSF of CLR with respect to institutions and the environment include **supportive policies** and the establishment of a **legal environment**.

In the initial stage of the 'reduction' work, the public had not completely understood or participated in the 'reduction' work, so the government has had the dominant role in advancing and regulating the 'reduction' process. In the new policy, CLR involves different governmental levels and sectors. In the initial stage of a project, the government must define the responsibilities and procedures to be followed by these sectors. In addition, due to the lack of experience in performing CLR, the distribution of benefits may have been unfair, whereby enterprises and residents that have been affected did not obtain sufficient compensation, which must be resolved by the government. As the manager of social conflicts, the government must play the dominant role in establishing an overall plan for the 'reduction' work that is comprehensive and ensures sufficient improvement in social, economic, and ecological factors through this 'reduction'. Today, the existing inventory of construction lands includes both legal and illegal construction lands. It would be inappropriate to strengthen the benefits of legal lands only while ignoring illegal construction lands. Therefore, dealing with historical problems appropriately and creating a sound legal environment is crucial for effective construction land reduction.

6. Conclusion

Construction Land Reduction (CLR) is a strategy to improve the intensive use of land and control the unlimited expansion, also to ensure the balance between the occupation and compensation of construction land and cultivated land in China. To use construction land effectively is a huge dilemma in developing economies and a complex process which is influenced by many factors. The crucial aspect of this process is the determination of key success factors (KSFs). In this study, we focused on the current development status of CLR projects and performed a literature review, conducted an expert investigation, used questionnaires and the FAHP & Fuzzy-DEMATEL methods, in order to identify major KSFs for the projects.

The results demonstrate that supportive policies, coordination with the original landowner, coordination with the surrounding residents, a diversity of enterprises participating in the project, a legal environment and the establishment of land acceptance and testing standards are the KSFs. These factors are of utmost importance, and if considered and implemented while working for any CLR, it will improve the overall working of the project. The outcomes and findings of the paper will be helpful in decision - making process for the smooth performance of the project, the government and its functional departments can use the research results to design corresponding policies and systems. Under this premise, all parties can effectively participate in the CLR project, promote the social and economic sustainable development goals.

This study may has some limitations. It established an FAHP model with 29 success factors to CLR identified through literature review and screened by expert opinion. Future research may consider other essential success factors according to their context. This study is also based on empirical data from Chinese experts only. However, these results can be generalized to similar economies.

Competing Interests

Not applicable

Ethical Approval

The authors declare that they have no conflict of interest.

Consent to Participate

The experimental protocol was established, written informed consent was obtained from individual or guardian participants.

Consent for publication

Written informed consent for publication was obtained from all participants.

Authors Contributions

Dr.Qiang Li contributed to the conception of the study;

Prof.Lifang Wang performed the experiment;

Prof.Yuming Zhu contributed significantly to analysis and manuscript preparation;

Dr.Bingxu Mu performed the data analyses and wrote the manuscript;

Dr.Naveed Ahmad helped perform the analysis with constructive discussions.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

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Figures

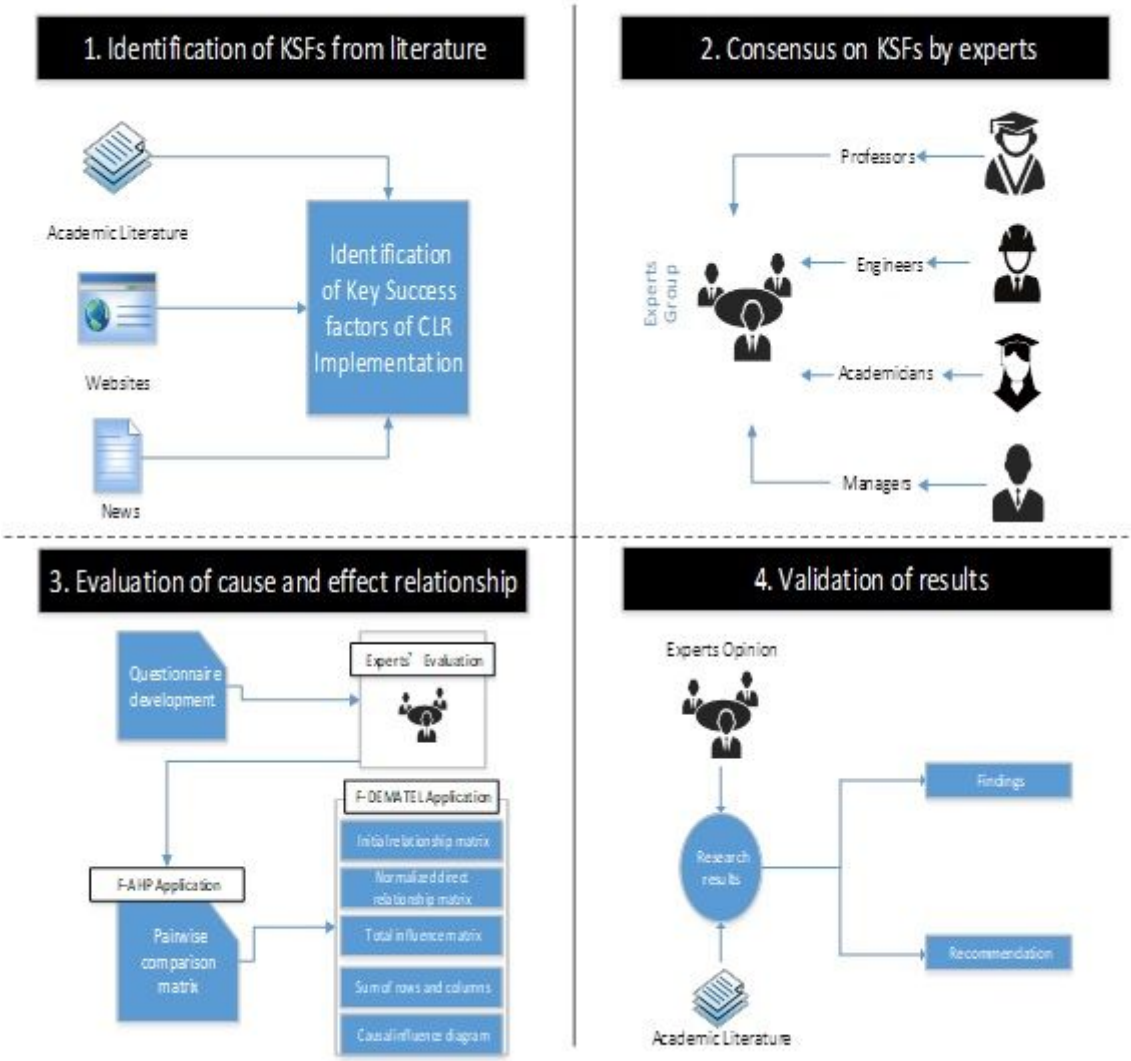

Figure 1

Proposed framework of study

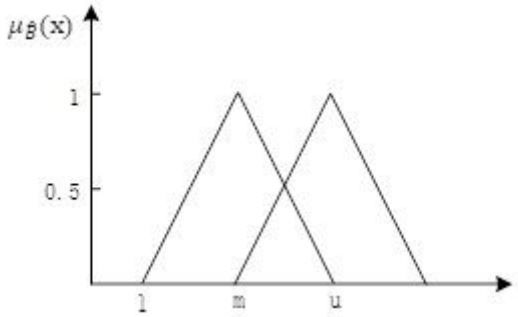

Figure 2

Triangular fuzzy correspondence diagram

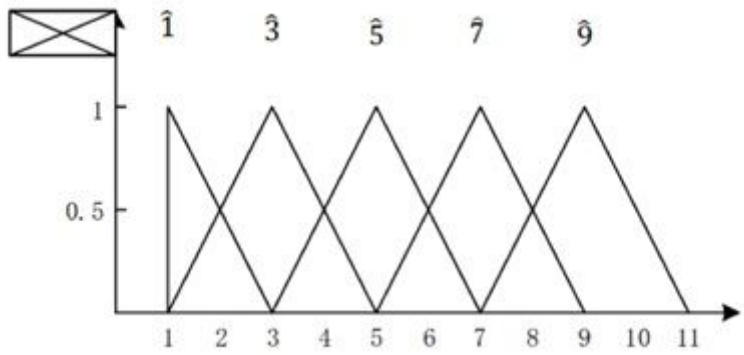

Figure 3

Transforming the determined value into triangular fuzzy number

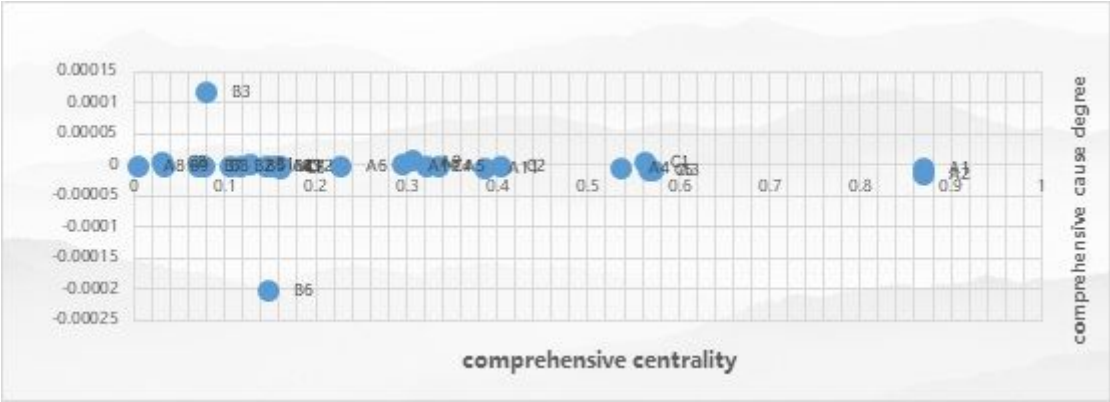

Figure 4

Comprehensive influence degree distribution map

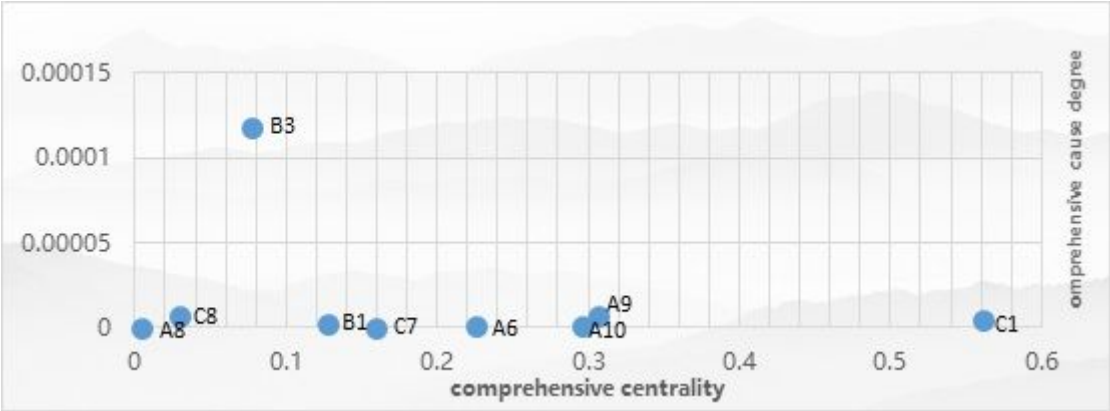

Figure 5

5 KSFs Comprehensive influence degree distribution map