

Research on the Optimization Path of the Operation Mechanism of the Old City Reconstruction in Shanghai Based on Building Information Model

Yuhe Xie

Shanghai Starriver Bilingual School, Shanghai, China

xieyuhe2004@163.com

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Abstract: At present, all over the world are facing the problem of Old City reconstructions and urban renaissance, and many transformation and development activities have been carried out, making Old City reconstructions a hot spot in urban construction worldwide. In this paper, based on the study of The optimization path of the operation mechanism of the old city reconstructions in Shanghai, the construction model based on BIM technology is proposed, and the three-dimensional (3D) data model is generated by integrating various related information of the construction project with BIM technology. It can provide a three-dimensional visual model consistent with the building entity. At the level of interest coordination mechanism, the government should define its own position, become the defender of the interest expression mechanism of Shanghai Old city reconstruction and the coordinator of the balanced distribution of interests, and promote the diversified development of interest coordination. At last, the paper puts forward the exploration of Old city reconstruction in China, which provides reference and basis for the implementation and further research of old city reconstruction operating mechanism.

1. Introduction

At present, China has become one of the largest construction markets in the world, with a large market share and rapid growth. However, in the process of construction and development, energy and environmental issues are more prominent, and how to maintain rapid development while adopting a conservation and efficient development model is particularly important [1]. BIM can provide strong technical support for improving the productivity of the construction industry, increasing the communication between the parties involved in the construction project, and reducing energy consumption and pollution. BIM technology has received rave reviews in the global construction industry once it was launched. According to statistics, in 2010, 80% of the top 300 large-scale construction companies in the United States used BIM technology [2]. China's Beijing Olympic project and Shanghai Expo project also have a certain degree of BIM application. In 2010, the Shanghai center of 632m, the first high-rise building in China, announced that BIM technology was used in the whole process of its design, construction and operation management, and was the first BIM application project in China [3]. At present, Shanghai's urban construction is advancing steadily and the economy and society are developing at a high speed. As a necessary stage of urban construction, old city reconstruction is not only related to the modernization of the city and the construction of a harmonious society, but also closely related to the daily life of each resident [4]. There are three types of actors involved in Old city reconstruction: government, developers and owners. In order to safeguard their own interests, they perform their duties in the process of transformation [5]. The main actors in the implementation of Old city reconstruction include: 1) the question between the government and the developers. 2) Between the government and the owners. 3) between the developer and the owner [6]. In March 2014, the State Council put forward the concept of people's urbanization in the National New Urbanization Plan (2014-2020), which provided an opportunity to strengthen the benign interaction between Old city reconstruction and urban

construction, and put forward higher requirements for the improvement of the Old city reconstruction process in Shanghai [7]. On this basis, the current theoretical construction of Old city reconstruction in China is lagging behind actual development, and the process of China's Old city reconstruction is facing difficulties. The Shanghai government has studied and learned the experience of Old city reconstruction in domestic and foreign cities to find an Old city reconstruction operating mechanism adapted to the local area. In the current situation, this paper proposes a BIM-based path optimization study of Shanghai Old city reconstruction Operating mechanism. At the level of the scheme planning mechanism, the planning of the reconstructed area should be incorporated into the development process of the entire city of Shanghai for consideration, and the formulation of the Old city reconstruction plan should be carried out, and the concept of scientific development should be established. A sustainable path that takes into account economic benefits.

2. Related Concepts of Bim and Old City Reconstruction

2.1 Bim

BIM is a method to integrate and manage information related to construction projects based on digital technology and visualization technology. BIM model can be established by using BIM Technology, integrating 3D information models such as buildings, structures and building equipment, as well as other information related to construction projects [8]. The use of BIM technology can effectively realize the 3D expression of construction project information, help all project participants to intuitively and effectively understand the design of construction projects, check design space conflicts, assist in quantity analysis, structural analysis, etc., and can be used for post-project maintenance management; Combined with simulation technology, it can effectively analyze and optimize the construction process and resource allocation in advance, thus ensuring the smooth progress of real construction [9]. BIM is a management method that can be applied to the entire life cycle of a project. It has been well applied in the construction industry in developed countries and has greatly improved the production efficiency of the industry. For the domestic engineering construction industry, the application of BIM will surely bring a qualitative leap.

Information is the core of BIM, which is a three-dimensional or multi-dimensional building model rich in project information. At present, the most effective way to solve the low efficiency of information interoperability in the construction industry is recognized as the use of Bim in the whole life cycle of the project. Efficient information interoperability is the core value of BIM. With the development of BIM, information interoperability has attracted more and more attention in the construction industry [10]. When BIM users acquire more professional knowledge and technology, the corresponding attention to information interoperability will also increase. As more and more users quickly gain BIM experience, the demand for information interoperability solutions will become more significant. BIM of the designer is a relatively early application mode of BIM in construction projects. In this mode, the designer takes the lead, and the influence of contractors and construction units is very small [11].

In order to win the fierce competition, the designer uses 3D technology for architectural design and display, especially for large and complex projects, to better express the design plan of the unit and win bids. Based on this starting point, the designer's BIM is usually only used for the early design of the project. Once the design plan is awarded and the construction unit has no clear requirements, the designer is likely to no longer refine it, and no longer carry out the corresponding structure and consumption. It can be analyzed that the application of BIM in the construction and maintenance phases is minimal. Therefore, the designer's BIM application model has accelerated the development of BIM, but it is only limited to the initial stage, and the main functions of BIM have not been applied to the full life cycle of the project.

2.2 Old City Reconstruction

With the rapid development of China's economy and society, urbanization has entered a new stage. In this process, old city reconstruction is not only related to the modernization of the city and the construction of a harmonious society, but also closely related to the daily life of each resident [12]. As far as the practice of Old city reconstruction in Shanghai is concerned, since the promulgation of the Measures for Paid Transfer of Land Use Rights in Shanghai in 1980s, Shanghai has been actively exploring the operation mechanism of Old city reconstruction around different stages of urban development and construction and the new problems faced by Old city reconstruction in each stage, and has experienced a tortuous and long practice course of Old city reconstruction [13].

“Old city reconstruction is a planned urban reconstruction and construction implemented in aging urban areas according to the needs of urban development. It includes three aspects: redevelopment, restoration, and protection.” A large-scale urban transformation and construction that changes the appearance of the area. Restoration is a medium-scale urban transformation and construction that partially changes the appearance of the original urban area according to the overall urban plan. Protection is a small-scale transformation and construction of the original urban appearance according to the urban plan.[14].”

With the increasing attention to old city reconstruction at home and abroad and the acceleration of the pace of old city reconstruction, the research results of old city reconstruction are remarkable. However, if you want to carry out more in-depth research on the practice of old city reconstruction in Shanghai from the perspective of operating mechanism, you need to deeply analyze the theoretical basis of old city reconstruction. At each stage of urban development and construction, due to the differences in its economic development level and urbanization process, various types of development problems emerge one after another. Therefore, for the planning and Management Department of old city reconstruction, it should constantly update the urban development policies for these problems to ensure the smooth progress of the old city reconstruction process.

Since 1950s, the concept of urban development has undergone five changes, namely, “urban reconstruction” in 1950s, “urban revitalization” in 1960s, “urban renewal” in 1970s, “urban redevelopment” in 1980s and “urban regeneration” in 1990s. In many old urban areas that have been transformed, the buildings have been unable to meet the growing and rich needs of residents in the region due to many problems, such as old age, poor quality and imperfect supporting facilities, which runs counter to the high standards of modern cities for urban appearance and facilities. How to improve the living standard and living environment of the residents in the old city is the inevitable requirement of transforming the urbanization development mode and realizing the urbanization of people [15].

3. Bim's Shanghai the Optimization Path of the Operation Mechanism of the Old City Reconstruction

3.1 Driven by Economic Interests

The special position of the government in social life and economic life makes it often take advantage of the self-interest of institutions in the name of social interests when formulating and implementing public policies. In urban renewal, it is inevitable to demolish some old buildings and blocks. The government can use its administrative power to expropriate land from the original land users at a low price on the grounds of “public interest”. The compensation for house demolition is mostly the benchmark price guided by the government, because if the rights and interests of relocated households are completely and reasonably compensated according to the relevant regulations of the state, it is likely that this part of the cost will be higher than the constructive cost. It is impossible to reduce costs from such rigid expenses as construction costs, but it is possible to make “savings” in demolition compensation with the help of the government's compulsory orders. The land requisitioned by the government is then sold to the developer at a high price in the form of a contract. Not to mention that in this process, government officials took the opportunity to set rents,

rent-seeking, and developers would pay bribes to relevant officials in order to obtain the right to develop. Even if it is a completely open and fair tender, the government can control a large amount of selling money.

The economic benefits of local governments in promoting urban renewal and real estate development. In the process of real estate development, the income of the local government comes from two links: one is the land transfer income brought by the “bidding, auction and listing” of the development land, which is used to represent the other is the tax from the development and transfer process, which is used to represent the real estate development income function of the local government, as shown in formula (1):

$$I = n + t \quad (1)$$

Among them, n completely depends on the quantity n and price p of local government's annual land supply, and the state and local governments have strong control over land. Assuming that the average annual land price increases by 0, the government land transfer income function in formula (1) can evolve into the following formula (2):

$$n = NP(1 + r) \quad (2)$$

In formula (1), t is the tax revenue generated during the development of commercial housing in the circulation link. At present, domestic taxation mainly includes 14 types of taxes and fees. Taking into account the actual operation of the enterprise and the actual collection of taxation departments, it mainly includes the items in Table 1.

Table 1 Main Taxes In the Circulation of Real Estate Development

Tax category	Tax basis and tax rate	Tax object
Business tax	Paid at 5% of turnover	Developer
urban maintenance and construction tax	It is calculated and paid at 7% of the payable turnover tax	Developer
Surcharge for Education	It is calculated and paid according to 3% of the payable turnover tax	Developer
income tax	According to 33% of the taxable income,	Developer
increment tax on land value	According to the progressive tax rate of the value-added amount	Developer
Deed tax	Pay according to 3 ~ 5% of turnover	Buyers

According to table 1, t is about 8 ~ 10% of sales revenue, calculated as an average of 9%. In order to facilitate relevant discussion, we have a hypothesis summarized according to the domestic real estate operation, that is, the land price $C1$, construction cost cm and sales gross profit of the real estate industry P It accounts for about 1 / 3 of the total sales revenue Q , i.e. $CI \approx cm \approx P \approx Q / 3$. In this way, the government tax function of commercial housing development and circulation can be obtained, as shown in formula (3):

$$t = Q / 3 * 9\% \quad (3)$$

By substituting formula (3) into formula (1), the local government revenue function can be simplified into formula (4):

$$I = n + Q / 3 * 9\% \quad (4)$$

Substituting formula (2) into formula (4), the final expression (5) of local government revenue function can be obtained:

$$I = NP(1 + r) + Q / 3 * 9\% \quad (5)$$

The conclusions drawn from formula (5) are: First, the local government directly benefits from land transfer and taxation in real estate development, and this benefit directly affects the growth level of local fiscal revenue. Second, the income that local governments get from real estate development depends on the amount of land supply and the increase in land prices. An obvious example is that the old urban areas of many cities have limited land supply, and their fiscal revenue growth is much lower than that of new urban areas.

3.2 Establishment of Bim Model

The establishment of BIM model is the basis of BIM application. Through the establishment of BIM model, different project participants and different professionals can exchange information and transfer data on this common platform, so as to greatly improve production efficiency. Different from the traditional two-dimensional CAD design, the establishment of BIM model is 3D. However, a single 3D image is not BIM, at best, it can only be regarded as an effect picture. BIM model is a data model integrated with a large amount of specific data information and presented in 3D form. For example, each column and beam must contain specific data information such as dimensions and materials. The framework of BIM model mainly includes three majors: architecture, structure and electromechanical, among which the electromechanical part is the most complex, including a large number of subsystems: power, telecommunications, air conditioning and smoke extraction, water supply, drainage and fire protection. A large number of equipment and pipelines are prone to position conflicts during the design and construction process, which can be visually displayed through the establishment of BIM3D models, and they can be corrected in time after conflicts occur. This is difficult to completely solve in the traditional two-dimensional design. Many pipeline collision conflicts only found in construction need to be reworked, which wastes a lot of manpower, material and financial resources.

Figure 1 shows the organizational structure of a large construction unit. According to the traditional organizational structure of the construction unit, the unit can be divided into engineering management department, contract management department, business department, design management department, material procurement department and information management department. In the past, most departments operated independently. Only in the handover process of each stage, collaborative operation will occur, and the communication mode of two-dimensional drawings and documents is mostly used, resulting in poor information communication and affecting work efficiency. Nowadays, engineering projects have the characteristics of complex structure, many professional design processes, large quantities and many three-dimensional interactive operations, which requires closer contact between departments. The traditional organizational structure can no longer meet the current needs.

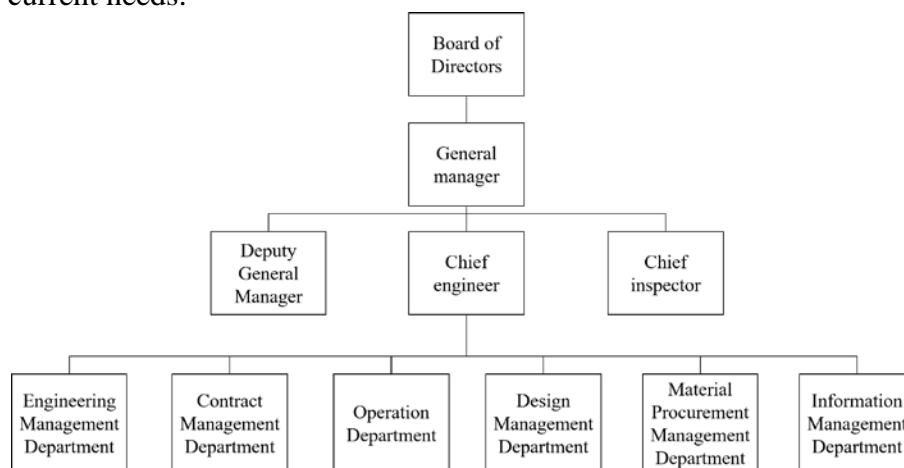


Fig.1 Organizational Structure of Traditional Construction Unit

To solve this problem, BIM technology gives an effective solution. As shown in Table 2. Under the working mode of BIM technology, construction enterprises can realize integrated management of project information. BIM technology integrates all kinds of relevant information of construction projects to generate 3D data models. Based on this model, project participants can share resources and work together through the network. Under this new technology application mode, the construction unit can realize a series of innovations and changes from design, bidding, construction and maintenance brought by BIM.

Table 2 Bim Solutions

Department name	Job responsibility	BIM Solutions
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Sales department and contract management department	Project bidding and contract management	Material calculation analysis, 4d progress simulation
Design management department	Scheme design and deepening design	Design model establishment, collision detection and analysis, parameter detection and accounting
Material procurement management department	Procurement of equipment and materials	Material calculation analysis
Engineering management department	Undertake construction tasks directly, and control project quality, progress and safety	Collision detection analysis, 4D progress simulation
Information management department	Maintenance, sharing and confidentiality of information	Manage project information of all parties on the same model by using network

3.3 The Optimization Path of the Operation Mechanism of the Old City Reconstruction, Shanghai

The Old city reconstruction Operating mechanism guided by the government and invested by developers is the current mainstream, aiming to achieve a win-win situation for all parties, and strive to seek the unity of economic, social and environmental benefits. Using this mode to carry out Old city reconstruction is mainly divided into two stages, as shown in Figure 2.

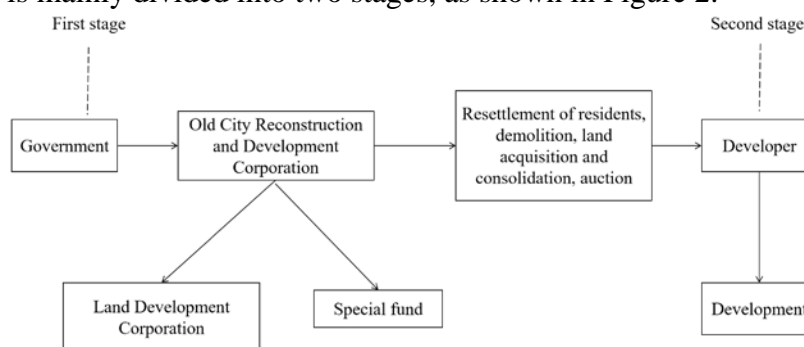


Fig.2 Mode of Operation

With the development of BIM, contractor's BIM application technology is maturing. The application party is usually a large contractor, mainly for the purpose of assisting bidding and construction management. In the fierce market competition, the contractor wins the bid, uses BIM technology and simulation technology to visualize the proposed bidding project. The construction process, schedule, resource allocation, etc. in the construction process of the project can be displayed dynamically and visually, and it is also easy to optimize the construction scheme. Especially for large-scale construction projects, the application of BIM technology and visualization technology can make the construction process show clearly, help construction optimization, reduce rework, save costs and improve the winning rate. Through simulation analysis, we can discuss with subcontractors to refine the construction scheme of subcontracted projects and put forward practical guidance.

The Shanghai Municipal Party Committee and the Municipal People's Government formulated the "Combination of residential construction and urban construction, the combination of new district construction and Old city reconstruction, and the combination of new housing construction and renovation and repair of old houses" at the housing construction work conference held in March 1980. For the Old city reconstruction work, the principle of "relative concentration and mass reconstruction" was determined, which opened the process of large-scale demolition and reconstruction in Shanghai.

In November 1987, the Shanghai People's Government promulgated the Measures for the Compensated Transfer of the Right to the Use of Land in Shanghai, which clearly stipulates many rules for the economic activities of real estate management through the compensated transfer of the right to the use of land and the transfer of the right to the use of land. In August 1988, the Shanghai

municipal land administration department publicly conducted the first land tender and started the practice of the land pilot system.

With the reform of land use system in 1980s, Shanghai also began to explore the process of Old city reconstruction. The land in shanty towns and simple houses with poor living conditions, unsound environmental facilities and high population density in the center of the city was transferred in the form of overall lease, and the residents in these old city areas were moved out as a whole. The land use right after the move-out was transferred to the developers with relevant qualifications according to the legal provisions and reconstruction plan, and the developers will carry out the reconstruction and redevelopment of the old city.

The process of large-scale demolition and reconstruction of the Old city reconstruction greatly promoted the advancement of Shanghai's urban construction and the improvement of residents' living conditions at the end of the 20th century. On the one hand, the overall demolition of the old city provides residents with opportunities to improve their living environment and improve their living standards, and provides a new solution for the government to solve social housing problems, such as Tanziwan and Panjiawan, which occupy a large area. , Wangjiazhai renovation project construction. On the other hand, the paid transfer of the right to the use of land also alleviates the shortage of funds in Old city reconstructions, brings new urban landscapes such as urban centers and modern communities to the old city, and achieves a win-win between the government's urban construction goals and the economic benefits of developers.

Old city reconstruction is not to build a new city blindly, but to give full play to the advantages of the old city. The main purpose of urban reconstruction is to give full play to the urban functions of the old city. There is no fixed copy model and blueprint for Old city reconstruction. It must combine the historical features, humanities, customs and living customs of the city with the development direction and industrial structure of modern city economy and culture. At present, large-scale overall transformation and small-scale gradual transformation are widely used in China, as shown in Table 3:

Table 3 Comparison of Two Transformation Modes

	Large-scale overall transformation	Small-scale gradual transformation
Goal focus	Economic development	Social harmony
Degree of improvement of infrastructure	Thoroughly improve	Gradually improve
Improvement of living environment	One-off improvement	Gradually improve
The interests of the residents of the old city	Basically do not protect, or even damage	Adequate protection
Attraction to developers	Big	Small
Participation of residents	No	Yes
Operation difficulty of transformation	Easy accessibility	Easy accessibility
Sources of funds	Government, developers	Government, developers and residents
Application of funds	One-time, high risk and single channel	Staged investment, low risk and many channels
Economic benefit	Fast results and strong feasibility	Long cycle, slow results
Social Network and Ecological Environment	Sabotage	Progressive development
Urban sustainable development	Do not have	Have

The more national, the more global. The historical features of the old city are not only a valuable asset in the process of urban development and construction, but also the accumulation of the historical development and cultural features of the old city. The process of Shanghai Old city reconstruction is bound to be inseparable from the protection of historical and cultural features, and July 1, 2008 The “Regulations on the Protection of Famous Historical and Cultural Cities, Towns and Villages” (Order No. 524 of the State Council of the People's Republic of China), which came into effect today, also provides strong regulatory guidance and support for the protection of historical and cultural cities, towns and villages. In the process of Old city reconstructions, how to coordinate the interests of different stakeholders such as the demolished and the developers, and safeguard the legitimate rights

and interests of all parties, plays a crucial role in maintaining social stability, improving the living environment of the old city, and promoting the process of Old City reconstructions in Shanghai. Define the role of the government and implement effective supervision. Improve the system arrangement of interest expression and promote the diversified development of interest coordination.

4. Conclusions

In this paper, the optimization path of the operation mechanism of the old city reconstruction in Shanghai is studied based on BIM. In the traditional urbanization mode of Chinese cities, including Shanghai, there is a phenomenon of sticking to the expansion of real estate and the construction of buildings, ignoring the development of people, which leads to the rapid development of urbanization in Shanghai, but it is difficult to improve qualitatively. In March 2014, in the “National New Urbanization Plan (2014-2020)” issued by the Central Committee of the Communist Party of China and the State Council, it was proposed to “accelerate the transformation of the urbanization development mode, with the urbanization of people as the core, and orderly promote the agricultural migration population. change”. This plan puts forward higher requirements for the improvement of the Old city reconstruction process in Shanghai, requiring that the goals and development process of Old city reconstruction be returned to the people themselves, strengthening the role of the human factor in Old city reconstruction, and promoting urban and rural areas. The integration of social resources and the improvement of urban residents' self-worth will realize the establishment of modern cities. In this context, through the analysis of Old City reconstructions in Shanghai, this paper attempts to optimize the Operating mechanisms of Old City reconstructions in Shanghai, accelerate the rational development of cities, and promote the urbanization of people. The popularization and application of BIM in the construction field is conducive to the modernization, industrialization and informationization of China's construction industry. At present, the promotion and application of BIM in China is not deep enough. Considering the current situation and comparison of BIM application modes, more efforts should be made to promote the owner's BIM application, promote the tripartite interaction of project participants, make best efforts to play the role of BIM in construction projects, and promote the development of construction industry. The ultimate goal of Old city reconstruction is to serve the gradual improvement of urban comprehensive social functions. Old city reconstruction should not only serve the economic development, but also adhere to the people-oriented principle, transform the urban living environment according to the standard of comfort per capita, and maintain the sustainable development of the city. At the same time, we should pay attention to the historical quality and cultural connotation of the city, adhere to the social fairness of the city and realize the all-round development of the urban society.

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