



# Research on the Innovative Application of Big Data Financing Model in University Infrastructure Projects

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**Abstract.** In this paper, the author starts with the theoretical analysis, based on the theory of educational economics and project management, comprehensively summarizes the experience of BOT financing mode at home and abroad, and on the basis of fully understanding and grasping the guidelines and policies issued by the State Council, the Ministry of education and governments at all levels BOT financing mode is a successful mode in general enterprises. It actively explores the necessity and feasibility of its application in university infrastructure, discusses its implementation steps, scope and other specific operation problems, and puts forward some feasible suggestions for the problems and difficulties that may be encountered. This paper attempts to explore a new way for the popularization of higher education and the socialization of logistics construction in Colleges and universities, and also hopes to improve the theory of financing diversification in Colleges and universities and expand the scope of project management financing theory.

**Keywords:** University · BOT financing mode · Infrastructure construction

## 1 Introduction

Since the rise of BOT investment and financing in the 1980s, it has gradually become the focus of international investment boom. BOT means The English abbreviation of build operate transfer is a project financing mode. Its typical mode is: “the government signs a concession agreement with a project company of non-governmental departments for an infrastructure project, and grants the project company the responsibility for investment, financing, construction, operation and maintenance of the project. Within the term of the concession agreement, the project company will be granted the right to undertake the project The project company shall charge appropriate fees to the users of the facilities, so as to repay the debts, recover the costs used for the construction, operation and maintenance of the project and obtain profits. After the expiration of the concession period, the project company must transfer the ownership of the project to the local government departments free of charge according to the agreement.” [1].

①After China's accession to the WTO, it has more and more close ties with other countries in the world, and the cooperation and exchanges with other countries are becoming more and more frequent. Besides the cooperation in economy and other aspects, the cooperation and exchanges in education are also increasing. China's higher education industry presents the international situation, from elite education to mass education, and the trend of marketization is increasing. Because the vast majority of colleges and universities in our country are public institutions, which are of public welfare nature, single financing mode and short of channels, almost all major colleges and universities in our country are facing a serious shortage of funds in infrastructure construction. This also forces colleges and universities to raise funds from the society through various channels and ways to alleviate the pressure of fund shortage. But after all, colleges and universities are institutions whose main task is to cultivate talents. They can't only pursue economic benefits and take great risks. So what kind of financing methods should colleges and universities take to solve the problem of shortage of funds for infrastructure construction in Colleges and universities, and ensure that it can be carried out in a relatively safe and stable environment has become a series of problems to be solved. In order to solve these problems quickly and efficiently, we can introduce BOT financing mode into colleges and universities. This is not only conducive to the construction and development of university infrastructure, but also conducive to the development of social economy. So can colleges and universities introduce this kind of project financing method which is usually used in enterprises? What are the similarities and differences between the BOT mode in enterprises and that in Colleges and universities? What kind of operation steps should be followed in the specific operation process and what problems should be paid attention to in the application of BOT financing mode in Colleges and universities are the focus of this paper.

## 2 BOT Mode

### 2.1 The Definition, Characteristics and Forms of BOT Financing Mode

#### (1) The definition of BOT financing mode

BOT is the abbreviation of Build Operate Transfer, which means build operate transfer. Also known as "public works concession". According to the international practice, the connotation of the typical BOT investment mode is that the government and the private sector project company sign a contract, and the project company is responsible for financing, designing and constructing the infrastructure service project. After the completion of the project, the project company will repay the project debt and obtain the return on investment through the operation of the project within the concession period specified in the concession agreement signed with the government. At the end of the concession period, the property right of the project will be transferred to the government of the country where the project is located free of charge. Specifically speaking, the so-called B, that is, build (construction), refers to the project company to raise funds for the construction of the project. The project company is generally composed of construction company, finance company, equipment and raw material supply company, international syndicate, etc. As for the qualification of the project company in BOT investment mode, if the

credit rating of the project sponsor is relatively high, the investor shall form the project company alone; if the credit rating of the project sponsor is relatively low, the project sponsor and the investor shall form the project company together. The so-called “O”, namely “operate”, refers to that the project company, through the operation and management of the project, recovers the investment, repays the loan and gains profits within the specified franchise period [2]. The so-called “t”, namely transfer, refers to that the project company needs to transfer the property right of the project to the government of the country where the project is located free of charge after the expiration of the franchise period. To sum up, BOT is a financing mode to attract capital investment in government or collective project construction. It was proposed by Turkish Prime Minister Ozar in 1984, and then formed in North America in the late 19th century. In the 1980s, with the rapid development of social economy in developing countries, the demand for infrastructure construction of the state and government has been increasing. Obviously, their development is restricted by backward technology and shortage of funds. Therefore, attracting private capital and private capital has become a possible and inevitable choice, and BOT financing mode emerges as the times require. After more than 20 years of development, BOT financing mode has become an effective way to solve the problem of national public infrastructure construction funds. At home and abroad, there are many built and under construction projects have introduced BOT mode. For example: Sydney Harbour Tunnel in Australia, channel tunnel in England and France, Erythrina bridge in Quanzhou, Fujian Province, etc. In the construction of 2008 Olympic facilities in China, more than 30 Olympic venues and the main “bird’s nest” gymnasium project adopt the typical BOT financing mode (Figs. 1 and 2).

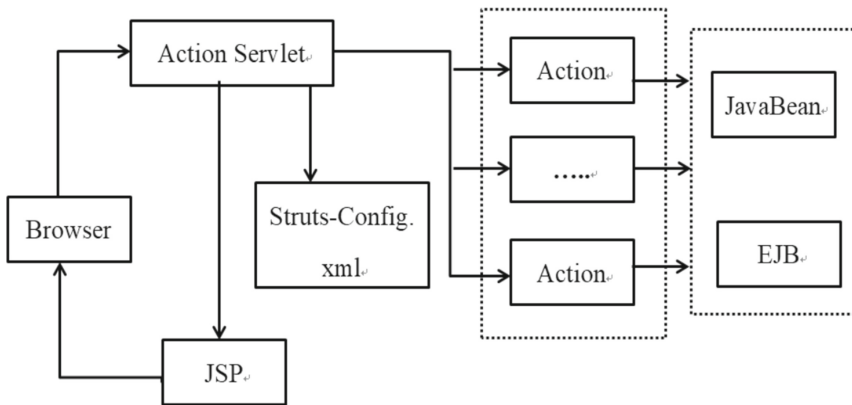


Fig. 1. Struts frame structure

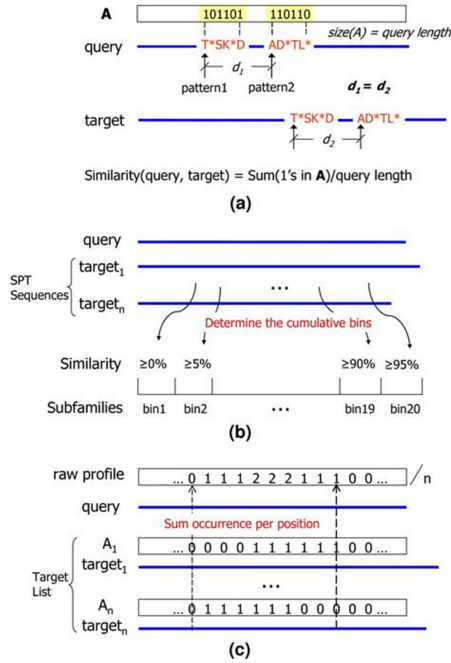


Fig. 2. Query algorithm

## 2.2 Characteristics of BOT Financing Mode

BOT financing projects usually have a large amount of one-time investment. This is because BOT projects are generally used in large-scale public works projects, such as power plants, urban water supply systems, highways, airports, etc., and the investment of these projects is often very large. Therefore, the construction and financing of large-scale projects usually combine the traditional equity investment and project financing, in which equity investment usually accounts for less than 30% of the total investment, and most of the remaining funds come from project financing. BOT is one of the more typical and effective project financing methods.

There are many participants in BOT financing projects. Generally, a BOT project must include the project sponsor, government departments, project construction units, users, equipment and raw material suppliers, among which the project company is the most important participant and executor. But all the participants may affect the progress of the project. The operation cycle of BOT financing project is long. Because of the large scale of BOT financing projects, the time span from project bidding negotiation, feasibility study to the end of the business cycle and the final realization of project transfer often takes more than ten years, decades or even longer.

BOT financing project has great risk. The investment scale, the number of participants and the business cycle of BOT project jointly determine that there are various risks in the whole implementation process, such as the risk of government policy change, the risk of financial market interest rate or exchange rate and institutional change, engineering

construction risk, irresistible risk, raw material or equipment supply and price risk, tax risk, etc. However, there is a basic principle in the risk allocation of BOT project, that is to allocate the risk to the party who has the most ability to control or bear a certain risk. BOT financing project has strict and complex contract provisions. Due to the above characteristics of BOT projects, BOT projects generally have a set of long-term, complex and strict contract arrangements for avoiding, transferring risks and facilitating management. This kind of contract is different from the general economic contract. First of all, there must be a concession agreement of the government or the public sector. This concession agreement stipulates the operation period of the project company, which is very important in BOT financing projects, that is, the concession period. The project company is only allowed to operate and manage the project within this period.

BOT financing projects must have predictable and stable sources of income. The investors of BOT project usually get income by charging the facility usage fee after the completion of the project, so the price must be included in the contract.

The basic content of financial supervision and control. BOT project must be transferred free of charge. After the end of the concession period, unless both parties intend to continue cooperation on the BOT project, the whole property right and the project itself shall be transferred to the local government or public management department free of charge.

### **3 Necessity and Feasibility Analysis of BOT Financing Mode in Colleges and Universities**

- (1) **The present situation of infrastructure construction in Colleges and Universities**  
 In recent years, the rapid development of China's economy has also brought the development of higher education into a rapid development era. In 1998, the number of colleges and universities in China was 1020, and the number of colleges and universities in this college was only 3.41 million. By 2006, there were 1867 universities, more than twice that in 1998. However, the number of students in this college reached 17.388 million, which was 5 times that of 1998. However, due to the relative shortage of the overall education funds, the conditions of running a university to different degrees are tight, which seriously affects the expansion and growth of the scale of the school. This is mainly reflected in the following aspects:
  1. **The shortage of funds hinders the rapid development of Higher Education**  
 Since the reform and opening up, the state has paid more and more attention to education. In the meantime, the national product has been increasing year by year due to the rapid development of national economy, and the state has increased its investment in education cost. From 1978 to 1985, the average annual added value has been increased every year. The annual growth rate of RMB 1.694 billion is 6.31 billion yuan, which is nearly 9 times that of 1980 in 1994. ⑤ Although the scale of higher education is expanding rapidly, the public finance investment of governments at all levels has not increased in the same proportion in time, so the average education funds of students are still in a downward trend. For most universities, especially non key universities, the relative shortage of state funding, coupled with the rapid

increase of the number of universities, the surge in the number of students and the rise in prices, the university funds are still very tight. The statistics announcement of the implementation of national education funds of Ministry of education, the State Bureau of statistics and the Ministry of Finance in 2005 pointed out that in 2005, the expenditure on the public service expenses in the national average budget of ordinary colleges and universities was 5375.94 yuan, down 3.18% from 5552.50 yuan last year. The expenditure of public funds in the national average budget of higher education is 2237.57 yuan, down 2.65% from 2298.41 yuan last year [3].

2. The dormitory and classroom are short and the teaching equipment is old  
 Due to the rapid growth of the number of students in school, the school building conditions have declined. According to the statistics of the development and research center of Shanghai Academy of education and Sciences, the three-year expansion of Chinese universities and colleges and universities, the statistics show that: “in 1999, the national ordinary university schools occupied an area of 626000 mu, the building area of the school buildings was 174.5 million square meters, and the average teaching administrative room was 12.3 m<sup>2</sup>. The average student dormitory area is 5.4 m<sup>2</sup>. In 2000, the national ordinary university schools occupied an area of 76000 mu, the building area of the school buildings was 204.4 million square meters, and the average teaching administrative room for students was 11.2 m<sup>2</sup>. The average student dormitory area is 5.4 m<sup>2</sup>. In 2001, the national ordinary university schools occupied an area of 906000 mu, the building area of the school buildings was 2557 million square meters, and the average teaching administrative room for students was 11.1 m<sup>2</sup>. The average student dormitory area is 5.8 m<sup>2</sup>. ⑥At the same time, many colleges and universities lack of classroom quantity or the equipment in the classroom is old, which can not meet the needs of modern teaching. On the one hand, the total value of teaching equipment in many universities can not meet the relevant national standards, on the one hand, many old and outdated experimental equipment can not be updated and scrapped in time. All of these have seriously affected the improvement of the quality of higher education and the development of higher education.
3. Low efficiency of educational funds  
 For a long time, the higher education funds in China are facing a very awkward situation. On the one hand, the investment in higher education funds is relatively insufficient, on the one hand, the efficiency of the use of educational funds is very low. For example, the utilization rate of teaching facilities, sports equipment and experimental equipment in the school is too low. According to the official statistics released by the Ministry of education in 2007, by the end of 2006, the number of staff and staff in general colleges and universities in China was 1872601 and 1179168 full-time teachers in general universities. Then, the number of administrative logistics in ordinary universities was 693433, accounting for 37% of the total number of teachers and staff. The above data can be seen clearly that due to the cross and replacement of institutions, the proportion of managers is relatively large, which causes the proportion of the expenditure of management personnel in the funds of colleges and universities is too large, and the redundancy of personnel also increases the friction in daily management and reduces the efficiency.

The scale of higher education has accelerated its expansion at the turn of the century. In 1999, the State Council decided to expand the scale of college enrollment. For a period of time, the scale expansion has become the theme of the development of higher education in China, and the size of college students has grown rapidly. By 2006, the number of Chinese higher education students in school reached 25 million, and the gross enrollment rate of higher education was 23%. The number of students enrolled in the college in China has increased from 1080000 in 1998 to 54.46 million in 2006. The size of students in the college has increased from 34.41 million in 1998 to 17.39 million in 2006. The number of graduate students in school has also increased from 200000 in 1998 to 111 million in 2005. ⑦From the quantity, China has become the largest country in the world higher education, and has successfully achieved the leap from elite education to higher education popularization. But in the aspect of logistics facilities in Colleges and universities, the following problems are also faced:

(1) Logistics base conditions are relatively poor

With the rapid development of higher education in China, the elite education in the past is also transforming into mass education. The main problem faced by this process is insufficient funds, and the logistics basic conditions seriously restrict the development of colleges and universities. In recent years, the state and universities continue to promote the process of socialization of university logistics, although the number of new student apartments and canteens in Colleges and universities has increased more than in the past, however, the number of students relatively expanded, there are still more students in the accommodation conditions have not been significantly improved [4]. This phenomenon is caused by the expansion of enrollment in Colleges and universities, the increase of students; on the other hand, the lack of funds in Colleges and universities in China is a long-standing historical problem, too much debt, and the total amount of logistics facilities in many universities is far from the quantity required by the state. However, the limited funds can only maintain the basic operation, and cannot increase the construction and development of logistics facilities. The construction of infrastructure lags behind the requirements of higher education development in China.

(2) Unclear property rights

The property right of the legal person of the logistics group is caused by the unclear property right. In law, it cannot operate independently, bear the profit and loss and bear the relevant civil liability. This causes the school as the parent of the logistics group to bear a great joint and several liability; because the logistics group is not using the full cost accounting method, the latter is not used for the accounting of the full cost. Qin group is not a company in strict sense, so it can not participate in market competition according to the requirements of market economy, and follow the internal development law of the enterprise to participate in market competition, and give full play to the characteristics of the enterprise, and it is not in line with the development law of accounting system and market economy. As the property of the school, logistics facilities are leased unconditionally to the logistics group for operation, but at the same time, the logistics group does not reflect such assets in their accounts, which makes the equipment being used have no loss and depreciation

on the book, and the funds in use have no interest, and the collective and national ones are suffering from the losses.

- (3) The substantive separation of ownership and management right  
 “The separation of school and enterprise, the separation of ownership and management right” is the basic principle of socialization of logistics in Colleges and universities in China. This requires that colleges and universities should simplify the functions of institutions, transform and independent institutions, and avoid administrative functions and business services.

The interweaving and confusion of the functions of affairs. However, in the actual operation process, due to human reasons, ownership and management rights are often integrated, weakening or even ignoring the economic contract relationship between school and enterprise, which makes the financial unclear, difficult to manage, and return to the difficulties at the beginning of reform.

- (2) Analysis of the current situation of University financing  
 Facing the reality of insufficient funds, the state, society and universities are trying to find ways to raise funds through various channels to try to solve the problems that colleges and universities are facing. There are several practical ways to do so:

1. Play the basic role of government financial allocation.  
 For a long time, in view of the nature of university service, it has been to obtain financial allocation from the state as an institution, how much rice to cook in a large pot. However, with the beginning of the reform of colleges and universities, colleges and universities try to implement charge education to increase their income to promote the development of colleges and universities, and end the previous era of “big package”. However, with the rapid development of our economy, science and technology are changing day by day, people’s living standards are increasing, and the requirements for education are also increasing. This puts forward objective requirements for the human and facilities of colleges and universities. However, due to the lack of funds, the development of colleges and universities is difficult. However, according to the relevant statistics of UNESCO, the proportion of higher education funds in China in the national education funds has ranked the top in the world. In 2001, the financial education funds of China broke through the 300 billion yuan for the first time, reaching 305.7 billion yuan. On this basis, the annual increase of education investment was maintained. By 2005, the financial investment in education had exceeded RMB 500 billion, reaching 516.11 billion yuan, doubling in five years, with an annual growth rate of 15%. Therefore, the main channel of the source of funds is still the government financial allocation, so it must play its basic role in the financing of colleges and universities.
2. The income of tuition and miscellaneous expenses is another source of college funds.  
 In the past long time, compulsory education in China has no obligation and is still charging. But higher education in the non compulsory education stage is not only free of all costs, but also arranged by the state. This not only distorts the stage of compulsory education, but also is not conducive to the development of education



in China, but also to the long-term and rapid development of our economy. From the mid-1980s, China began to try to implement part of the students pay fees to attend school. Besides the public fee students in the plan, the students who are self-employed and the students appointed by the employing units need to pay for the tuition. Then, the reform of “parallel track” began in the early 1990s, and by 1997, all the students in Colleges and universities had to pay for school. The charge is based on the principle of reasonable sharing of education cost, comprehensively measuring the interests and bearing capacity of the country, society, University and family, and adopting the upper limit of the university charge according to the education subjective departments in the region where the university is located. The specific standards are the policies determined by the university itself, which makes the university charge not only reasonable but also feasible. The proportion of tuition and miscellaneous expenses in the financing of colleges and universities has increased significantly, among which central universities rose from 10.4% in 1998 to 19.9% in 2006, while local universities rose from 17.9% in 1998 to 40.1% in 2004. By 2006, the total income of ordinary colleges and universities in China was 85.75 billion yuan, accounting for 29.2% of the total income. It can be said that the majority of students’ families have made great contributions to make the tuition and miscellaneous income become another important source of financing and the development of colleges and universities.

#### **4 Research on the Application of BOT Financing Mode in Colleges and Universities**

The application of BOT financing mode in the infrastructure construction of colleges and universities should include project determination, bidding and tendering, signing of franchise agreement, construction, operation and transfer.

##### **(1) Determination of project**

The infrastructure construction of colleges and universities should be based on the development plan of the University, and select a number of projects from the projects that may or need project financing for feasibility demonstration. Based on the approval of the feasibility study of the project, this paper focuses on the feasibility of adopting BOT financing mode to meet the needs of the project, and makes corresponding decisions to determine the project to implement BOT financing.

##### **(2) Project bidding**

After passing the project feasibility study, the project bidding notice shall be released to the whole society, and the bidding documents shall be issued to the independent bidders or bidding consortia who have passed the qualification examination. The bidding documents are generally composed of instructions to bidders, franchise agreement, technical requirements, reference materials, etc. Colleges and universities should open their bids at the deadline. At the time of bid opening, information such as the submission time of the bid, whether the seal of the bid is in good condition, the name of the bidder (list of members of the bidding consortium), the unit

price of the construction facilities charge bid, whether the bid guarantee meets the requirements of the bidding documents, and the formal written authorization of the legal representative or the consortium will be disclosed and recorded. Before bid evaluation, colleges and universities should set up a bid evaluation committee according to relevant laws and regulations. The bid evaluation committee evaluates the bidding documents provided by the bidders and recommends the successful candidates to the bidders. Finally, the Management Committee of university logistics department decides the successful bidder.

(3) Sign franchise agreement

After the successful bidder is determined, colleges and universities shall issue a letter of acceptance to the successful bidder. At that time, both parties shall conduct further consultation and negotiation to confirm the contents of the tender and sign the franchise agreement according to the provisions of the bidding documents. The agreement mainly includes the time and method of the investor's capital investment, the construction period, the content and period of the investor's management and operation, and the allocation and undertaking of risks. The successful bidder shall complete the financing delivery and the registration of the project company according to the commitment period in the tender document, and both parties shall formally sign the franchise agreement after the design documents are approved.

(4) Project construction

After the franchise agreement is formally signed, the project company will carry out the design, construction and completion of the construction tasks in an organized way on the premise of complying with the relevant laws and regulations.

(5) Project operation

This phase will last until the expiration of the concession agreement. In this phase, the project company will operate the project directly or by signing a contract with the operator in accordance with the standards of the project agreement, the loan agreements and the conditions agreed with the investors. During the whole operation period of the project, the project company shall maintain the project facilities in accordance with the requirements of the agreement. In order to ensure that the operation and maintenance can be carried out in accordance with the requirements of the agreement, universities have the right to supervise and inspect the project company or operators and put forward rectification suggestions.

## 5 Conclusion

Education industry is a basic industry related to the future development of the country, and it is a sunrise industry with broad market and development prospects. But the traditional financial allocation based education funds can not meet the rapid development of the university construction funds. With China's accession to the WTO and the further development of China's education, a large number of domestic and foreign capital has poured into the higher education market in China. We must strengthen our efforts to carry out reform and innovation if we want to develop education, build a well-off society in an all-round way, and stand invincible in competition. How to deal with the

pressure of expanding enrollment to the basic school conditions and logistics service facilities of ordinary universities; how to solve the problems of the difficulty of covering investment and financing for the infrastructure of colleges and universities; how to solve the problems of low efficiency and waste in the operation of university infrastructure; in this context, BOT financing mode is presented in front of us with its unique advantages.

Through the necessity and feasibility analysis of BOT financing mode of university infrastructure, we can see that we can not only build the BOT financing mode of university infrastructure with its own characteristics, but also deeply feel the vitality and great impetus it brings to the leapfrog development and logistics reform of our country. The BOT of university infrastructure can be seen The mode of investment and financing not only solves the problem of difficulty in the investment and financing of university infrastructure, but also activates the whole logistics market of colleges and universities, which makes it go into the process of enterprise, marketization and commercialization. It provides a comprehensive guarantee for the development of higher education. But according to the current situation, the BOT mode of infrastructure in Colleges and universities is still in the initial stage, and there are still a series of problems. This paper, through the theoretical research on BOT project investment and financing mode in the construction of University Infrastructure in China, and at the same time, it also applies BOT to colleges and universities Some problems of financing mode are analyzed and corresponding countermeasures are put forward, which try to provide reference for university decision-making, and hope to provide valuable reference for the reform and innovation of the investment and financing system in Colleges and universities.

**Acknowledgements.** Science and Technology Research Project of Jiangxi Education Department in 2019, Project name: innovative Application Research of BOT financing Model in University Infrastructure Project, Project number GJJ191018.

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