Received: March 5, 2018
Revision received: August 7, 2018
Accepted: August 10, 2018

www.estp.com.tr
DOI 10.12738/estp.2018.6.193 ♦ December 2018 ♦ 18(6) ♦ 2941-2948

Research Article

Public-Private Partnership Project Risk Management in Education Industry*

Jinglei Meng[1]
Harbin University of Science and Technology

Guoyi Xiu[2]
Harbin University of Science and Technology

Fan Qian[3]
Harbin University

Abstract

With the continuous expansion of education industry in China, the construction of PPP project in education field draws more and more attention. In view of the complex financing structure of PPP project, numerous participants and large potential risks, this paper puts forward the method of expert review and analytic hierarchy process. The scheme of this paper starts with the structural organization of PPP project, analyzes the development of PPP model in education industry, and establishes a set of strict process for PPP project in education industry to evaluate the importance of risk factors in the project and monitor the management. The results show that the scheme can strictly control the risk coefficient of the project, ensure the interests of the investors, and improve the overall benefit of the project.

Keywords

PPP in Education Field • Expert Review • Analytic Hierarchy Process • Risk Coefficient

* Relevant conflicts of interest/financial disclosures: The authors thank the Philosophy and Social Sciences Research Funds in Heilongjiang Province for financial support (Project No. 16GLB06; Project No.17JYE405).
[1] **Correspondence to:** School of Economics and Management, Harbin University of Science and Technology, Harbin, 150080 China; School of Economics and Management, Harbin University, Harbin, 150086 China; Email: mengjinglei420@126.com
[2] School of Economics and Management, Harbin University of Science and Technology, Harbin, 150080 China. Email: xiugy@126.com
[3] School of Economics and Management, Harbin University, Harbin, 150086 China. Email: fq9090@163.com

Citation: Meng, J. L., Xiu, G. Y., & Fan, Q, Research on PPP Project Risk Management in Education Industry. *Educational Sciences: Theory & Practice, 18(6),* 2941-2948. http://dx.doi.org/10.12738/estp.2018.6.193

Public-Private Partnership (PPP) is a partnership between government and non-public enterprises and a model of project operation for jointly participating in the construction of public infrastructure (Bettignies & Ross, 2004). This model is that based on the market competition, the government chooses the private enterprise with excellent investment operation ability to cooperate, in order to achieve less government expenditure and lower investment amount of enterprises. In November 2017, the Asian Development Bank released its first test report on government and social cooperation, which analyzes in detail the types of PPP project cooperation and the size of funds in member countries.

In September 2018, according to the data released by the Ministry of Finance, there were 7,867 PPP projects in China with the investment amount of RMB 11.8 trillion, of which 7,867 projects were implemented with contract with value of RMB 6.1 trillion. At present, with the continuous expansion of the educational industry, the capital cost of educational infrastructure has become higher and higher, and the quantity and quality of educational infrastructure construction cannot be guaranteed with the government's financial resources alone. As a result, many private enterprises are starting to play a more and more role in basic education services, and the PPP mode through which private enterprises enter the infrastructure construction in the education field becomes a kind of mainstream form (Narrod *et al*., 2009).

Although the infrastructure construction under PPP mode can solve the financial problems of the government, most PPP projects have the characteristics of complicated financing structure, long construction duration and huge investment scale, which bring some risks to the projects. The PPP model in the education field develops relatively late in China, and its risk management level is lower (Verger, Bonal, & Zancajo, 2016). The risk management level largely determines the success of PPP projects. Therefore, how to carry on the risk management, establish risk indexes and identify risks in the project construction process has become a very important topic in PPP projects of education field.

Current situation of PPP risk management in education field

Implementation of PPP projects in educational field in China

On the basis of drawing lessons from the successful experience of other countries and combining with the actual situation of education in China, the PPP projects in education field in China mainly develop an education infrastructure investment and financing system of multi-channel operation with the market mechanism as the main body, the government support as the auxiliary body, and government, individuals, and private enterprises jointly undertaking the financing (Pillay, Watters, & Hoff, 2013). The main roles of PPP projects in China are as follows: 1) Government investment. In China, although the government's investment in educational infrastructure is no longer the only main body to support the operation of educational infrastructure, it is still an important source of funds and plays a leading role. 2) Private enterprises. By introducing a competition mechanism, the government allows qualified private enterprises to participate equally in the project management of educational infrastructure, and allows the market mechanism to decide the most suitable partner, and in the actual implementation process, enterprises usually strive for projects in the form of open bidding,

binding the rights and obligations of the parties with contracts, taking on their respective risks and sharing the corresponding benefits (Miller, 2013).

Overview of PPP risk in education field

According to the stage of PPP projects, risks can be divided into establishment risk, construction risk and operation risk. The establishment risk mainly refers to the construction cost exceeding the budget, which results from the in accurate estimation of technical difficulty and investment amount of the project in the process of project establishment. In general, the government departments do not undertake the main responsibility for cost overruns, but in order to maintain the service, the government departments in China will also bear the cost brought by the budget risk to a certain extent. The construction risk mainly refers to risks of over-expenditure and delay of construction duration in the process of construction. The operation risk mainly refers to the fact that the revenue profit in the actual operation of the project does not reach the overdue target (Hart, 2003).

Table 1
Government and Enterprise Risk Taker

Risk type	Risk factor	Risk taker
project initialization	Project selection, technical difficulty	Share
construction	Design change, overcost	Enterprise
market	Market competition, market change	Share
operation	Operation cost overspending, profit not enough.	Enterprise
finance	Government finance policy,	Government
Nature and environment	Environment, climate	Enterprise
cooperation	Power divison, organization problem	Enterprise

PPP Risk Management Scheme

In the stages of operation and construction, the educational PPP projects have great uncertainties. By analyzing the risk factors of the educational PPP projects, risk indexs at the macro, meso and micro levels are set up with the analytic hierarchy process in combination with expert review, the weight of each influencing element is analyzed with the analytic hierarchy process, and a plan to strengthen risk management and control is put forward.

Expert review

The risk management of PPP projects is divided into several stages, in which expert review is in the early stage of project establishment. Due to the relatively late start of educational PPP projects in China, there is not enough statistical data and raw materials, and the prior knowledge of experts can make up for the shortcomings of insufficient data. The accuracy of expert evaluation mainly depends on the experience of experts and the breadth and depth of knowledge (Paavilainen Paavilainen, Korhonen, & Saarenpää, 2012), which requires experts to have a high academic level and rich practical experience of the evaluation system. Experts need to be strictly screened during the selection. The expert review scheme proposed in this paper differs from the

conventional PPP project in that the authoritative experts in this field form groups to conduct cross-review of the project, and after detailed analysis and comparison, the experts decide the risk management scheme of the project after several rounds of deletion or consolidation. The specific steps are as follows: first, collect relevant risk points. On the one hand, the various aspects of the construction of education projects are analyzed in detail through a large number of research literature, and main risk points are finally summarized, merged and analyzed according to the concept connotation of the items; then, the authoritative experts in educational PPP projects are screened out through comparative analysis for the review; finally, the project evaluated by experts should be compiled into an evaluation scale, and the whole research should be tested. The experts' opinions should be consulted anonymously, and the results should be statistically analyzed to obtain the corresponding risk management structure model (Prati, Guagliumi, & Mintz, 2012).

Expert review has the advantages of simplicity and intuitionism, but it also has some shortcomings. On the one hand, in the selection of experts, how to ensure the authority of experts and the reasonableness of the composition of expert groups is an issue to be solved in practical research; on the other hand, the risk management by experts must have certain subjective tendencies. Therefore, in order to avoid the shortcomings of expert review, the analytic hierarchy process is introduced again to establish a more robust risk management scheme.

PPP analytic hierarchy process

Analytic Hierarchy Process (AHP) is a kind of decision analysis method, which adopts multiple schemes and index system to carry out structural analysis and establish decision model in the decision process. It has the advantages of simplicity, efficiency and practicality (Ho, 2008). The core steps of AHP proposed in this paper: 1) decompose the PPP project into several sub-projects, and then decompose the sub-projects into several hierarchical structures according to the dependency subordination relationship, 2) compare the two sub-projects to determine the relative importance of each factor, score according to the expert estimation of 3.1, and establish a comparison matrix; 3) the weight coefficients of each index are calculated by the pre-established mathematical model as the basis of decision-making.

Comprehensive analysis of PPP project risk management

The main risk of educational PPP projects is that the uncertain factors in the process of project management and construction have an adverse impact on the operational objectives and construction results of the project, thus resulting in losses (Saaty, 2007). In this paper, the educational project risk is divided into three kinds: 1) Macro risks, the uncontrollable external factors will bring unexpected risks to PPP projects. Such risks are often caused by some socio-economic emergencies, such as the economic crisis caused by the SARS in 2003 and the higher threshold of financing access to some projects raised by the Ministry of Education, which are all macroscopic risks. 2) Meso risks, which generally exist in the project and the main incentive is also caused in the project. Typically, the technical difficulty of the project is greater than expected and the quality of the finished product is not up to the requirements. They mainly refer to the technical risks and construction duration

risks, in which technical risks refer to the unreasonable construction or design resulting in poor quality of PPP projects upon the completion and construction duration risks refer to the occurrence of construction accidents resulting in the failure completion of project as scheduled, which delays delivery operation time, results in construction failure if severe, and even brews quality or safety accidents. 3) Micro risks, which mainly result from the disagreements between government departments and private enterprises on the distribution of power and benefits. Because of the complexity of the shareholders, educational PPP projects often have the unreasonable organizational structure and the high cost of communication management, which results in the information asymmetry and poor management and often affects the smooth progress of the educational PPP projects.

Establishment of risk management model of educational PPP projects

This paper synthesizes the research of domestic and foreign scholars on educational PPP projects, takes the scientificity, systematicness and integrity of the indexes as the principle, and combines with the actual situation of education infrastructure construction in China, to conduct a comprehensive study and selection of various indexes, and construct the risk management index system of educational PPP projects. There are three levels: target level, criterion level and index level.

Educational PPP project risk management evaluation case

The comprehensive risk management scheme proposed in this study is used to manage the risk of an educational PPP project in Zhejiang Province in 2016. According to the actual construction of the project and the current production conditions, the risk identification of the project is carried out. Experts from the construction and education industries are invited to evaluate the project first, assessing the technical difficulty, construction difficulty and environmental cost of the project, and classifying the importance of each indicator.

Construct model matrix

After the risk evaluation system is established, the risk elements are compared one by one, and then the correlation degree of risk elements is confirmed by analysis and judgment. The correlation degree is established using a scaling method (as shown in Table 1) that scores individual elements in the range of values from 1 to 9. For example, five experts are invited to score the correlation degree of the three sub-risks in the project, and the judgment matrix is as follows:

$$A_2 = \begin{bmatrix} 1 & \frac{1}{2} & \frac{3}{4} \\ \frac{1}{4} & 1 & \frac{2}{3} \\ \frac{2}{3} & \frac{1}{2} & 1 \end{bmatrix} \quad (1)$$

Table 2
Importance Relevant

importance	value
Two factor the same important	1
light	3
obvious	5
important	7
Very important	9

Eigenvector normalization

According to the judgment matrix obtained in 4.1, the eigenvector is calculated. Calculate the satisfying eigenvalue λ_{max}, normalize the vector, calculate the eigenvalue and eigenvector satisfying $\mathrm{AW} = \lambda_{max}\mathrm{W}$, and finally get the weights of $\mathrm{W} = [W_1, W_2, W_3 \ldots W_n]$ as elements. The analytic hierarchy process is a layer-by-layer analysis from top to bottom. According to the comprehensive judgment of the experts, the eigenvalues of the judgment matrix of the PPP project: $\lambda_{max} = 2.35$, the corresponding eigenvectors are [0.45, 7, 0.253, 0.346, 1], the eigenvalue of macro risk matrix is 3.15 and the corresponding eigenvector A_1 is [0.645 2, 0, 0.265 2.9, 0.273 3.5]; the eigenvalue of meso risk matrix is 3.52 and the corresponding eigenvector A_2 is [0.75, 0.23]; the eigenvalue of micro risk matrix is 2.0 and the corresponding eigenvector is [0.23,0.75];

Comprehensive assessment

The experts are grouped, and each expert group repeats the above process. Finally, the results of each expert group are averaged to obtain the final eigenvectors as the final weights. The weights calculated according to this method are as follows:

Table 3
Educational PPP Project Risk Evaluation

Target layer	Principle layer	Aim layer
Macro risk (0.459)	Government risk (0.277)	Politics static 0.145, credit (0.129)
	Finance risk (0.102)	Finance way (0.079), inflation (0.18）
	Nature risk (0.080)	Pollution (0.017), climate (0.056)
Medium risk (0.275)	Tech risk (0.305)	Tech reliable (0.156), tech stablility (0.051)
	Deadline risk (0.067)	Overdue (0.015), delay (0.032)
Micro risk (0.336)	Organize risk (0.336)	Communication (0.208), profit distribution (0.23)

According to the final weight of expert analysis and analytic hierarchy process, it's known that the macro risk probability is (0.459), the meso risk probability is (0.275) and the micro risk probability is 0.336. From this result, we can see that the educational PPP projects, as the public welfare infrastructure constructed under the leadership of the government, is most affected by macro-policy control and followed by micro-organizational structure risks, which are usually caused by the complex relationship among the project shareholders and the distribution of profits and power.

Based on the above analysis and conclusions, this paper puts forward three risk management schemes of educational PPP projects in Zhejiang Province. 1) According to relevant laws and policies, confirm the

reasonable protection of the project that can be obtained under the framework of national legal framework, and write relevant cooperation clauses into contracts. At the same time, employ a third-party accounting firm to audit the project and supervise the financial situation. 2) Perfect the project risk management system, set up special risk management department for risk identification and early warning according to the actual situation of the educational PPP project, perfect the risk control system, carry out more scientific and precise risk management of the project, turn the risk management into the daily link in the project construction, and strengthen the internal risk awareness training. 3) Perfect the organizational structure and clarify the responsibilities, obligations and interests of both parties. In the project contract, the project company is required to provide performance bond, insurance purchase and corresponding safeguard measures to ensure the implementation of the project. In the stage of project establishment, the risk management is fully prepared with the proposed scheme herein. In the implementation process, the risk control management department strictly checks the risk index of each link, so that there are no disputes between the enterprise and the government, and no macro-policy risks. The project is completed on time, and receives high praise from all sectors of society.

Conclusions

In view of the complicated financing structure of educational PPP projects, longer construction duration, greater macro and micro risks, and based on the in-depth study of the current situation of PPP projects in education industry, this study puts forward the method of expert review in combination with analytic hierarchy process for risk management, intervenes in the project risk management at an early stage, constantly updates the risk coefficient, and puts forward early warning, which has played a good effect in the specific implementation of an educational PPP project in Zhejiang Province. The results show that the scheme can strictly control the risk coefficient of the project, ensure the quality and construction duration of the project and the interests of investors, and improve the success rate of the project.

References

Bettignies, J. E. D., & Ross, T. W. (2004). The economics of public-private partnerships. *Canadian Public Policy*, *30*(2), 135-154. http://dx.doi.org/10.2307/3552389

Hart, O. (2003). Incomplete contracts and public ownership: Remarks, and an application to public-private partnerships. *Economic Journal, 113*(486), C69–C76. http://dx.doi.org/10.1111/1468-0297.00119

Ho, W. (2008). Integrated analytic hierarchy process and its applications – A literature review. *European Journal of Operational Research, 186*(1), 211-228. http://dx.doi.org/10.1016/j.ejor.2007.01.004

Miller, A. D. (2013). The importance of public-private partnerships in education. *ACM Inroads, 4*(4), 36-38. http://dx.doi.org/10.1145/2537753.2537767

Narrod, C., Roy, D., Okello, J., Avendaño, B., Rich, K., & Thorat, A. (2009). Public-private partnerships and collective action in high value fruit and vegetable supply chains. *Food Policy, 34*(1), 8-15. http://dx.doi.org/10.1016/j.foodpol.2008.10.005

Paavilainen, J., Korhonen, H., & Saarenpää, H. (2012). Comparing two playability heuristic sets with expert review method: A case study of mobile game evaluation. In *Media in the ubiquitous era: Ambient, social and gaming media* (pp. 29-52). IGI Global. http://dx.doi.org/10.4018/978-1-60960-774-6.ch002

Pillay, H., Watters, J. J., & Hoff, L. (2013). Critical attributes of public-private partnerships: A case study in vocational education. *International Journal of Adult Vocational Education and Technology (IJAVET), 4*(1), 31-45. http://dx.doi.org/10.4018/javet.2013010103

Prati, F., Guagliumi, G., & Mintz, G. S. (2012). Expert review document part 2: Methodology, terminology and clinical applications of optical coherence tomography for the assessment of interventional procedures. *European Heart Journal, 33(20),* 2513-2520. http://dx.doi.org/10.1093/eurheartj/ehs095

Saaty, T. L. (2007). Highlights and critical points in the theory and application of the analytic hierarchy process. *European Journal of Operational Research, 74*(3), 426-447. http://dx.doi.org/10.1016/0377-2217(94)90222-4

Verger, A., BonaL, X., & Zancajo, A. (2016). What are the role and impact of public-private partnerships in education? A realist evaluation of the Chilean education quasi-market. *Comparative Education Review*, *60*(2), 223-248. http://dx.doi.org/10.1086/685557