

Research on the Risk Management of the Highway based on the Pattern of BOT+EPC from the Perspective of the General Contractors

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Abstract: Although the pattern of BOT + EPC utilized in the construction of highway can effectively lighten financial burden, improve the investment returns and operating efficiency of the project, it is of considerable risks due to numerous uncertainties in the highway project of BOT + EPC. The identification of risks in the highway project of BOT+ EPC is the prerequisite under which facilitates the successful transformation of the General Contract Enterprise, and the key which makes such project be carried out successfully. This article, from the perspective of the general contractors, makes an analysis of the risks such as natural risks, economic risks, construction risks, operating risks and contract risks containing in a highway project of BOT + EPC, as well as offers some suggestions on the management of some relevant risks; so that it provides a theoretical basis for the general contract enterprises to prevent risks when using the BOT + EPC.

Keywords: General contractors; BOT + EPC, Highway; Risk management

1. Introduction

With the economic development and the acceleration of urbanization, the investment on infrastructure by the government has continuously increased, and the construction of highway has also been increased, but highway construction contains such disadvantages as huge investment, long construction period, difficult technologies and complex interests. The utilization of BOT + EPC in the construction of highway can considerably lighten government's financial burden, avoid the benefit conflicts between owners and construction companies, effectively lower the construction costs and increase the investment returns and operating efficiency. The BOT financing mode is used to introduce an abundant amount of funds in the preliminary stage of the construction, while the EPC is utilized during the implementation phase so that the construction is taken over by a experienced construction companies, which radically solves the problem that investors own capital but not technologies and contractors own technologies but not capital, thus laying a foundation for implementing each stakeholder to win more. But BOT + EPC mode is introduced in the starting stage of the highway construction introduction of the highway construction is still in its infancy, and the BOT + EPC highway project is highly specialized, with complex relationship between the interests of all parties as well as numerous risks. The research on the

risk management of the BOT + EPC is the key for the highway construction to be carried out smoothly and conducted successfully. Moreover, under this pattern, the general contractor is always engaged in joint investment. Compared with the traditional EPC, contractor is an indispensable part in the whole service period of the highway project, for it not only takes on such tasks as design, purchase and construction during building period but also other missions like financing, coordination and communication as well as operation and maintenance later. Therefore, the management and control of the general contractor's risk under has become one of the key issues of urgent need.

2. The Application of the BOT + EPC in the Highway Construction

Introduction of the BOT + EPC in highway construction refers to that the government set a certain operating period, during which the companies are allowed to construct and operate the highway. In the constructing period, the EPC contracting is utilized. After the operating period, the company will hand over the highway to government without any compensation. The BOT + EPC pattern is schematically illustrated in Figure 1 below.

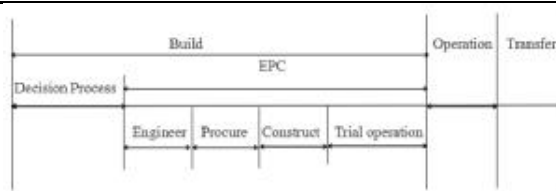


Figure 1. The schematic diagram of BOT + EPC

The researches on the highway under BOT + EPC conducted by scholars now mainly focus on the theoretical analysis and case study. In theoretical research, WNGA Yun-tao [1] carried out the research on budget compilation of the highway projects under the BOT + EPC, and noted that the depth and accuracy of the budget compilation should be increases accordingly after the construction model of highway changes. FENG Yan-yang [2], from the perspective of the integration of work, time, and participants, explored new models for investment and construction of BOT + EPC project, built the financing model of risk evaluation index system, put forward guiding suggestions by using the analytic hierarchy process (AHP). Hong Liu[3], from the Angle of supervision, expounded the necessity of the introduction of design supervision under BOT + EPC construction mode. HU Xu-hui[4], on the basis of YU RONG highway practice which used the pattern of BOT + EPC, summarized the advantages and disadvantages of the model, and put forward corresponding solving measures for faults. As for case study, TU Wan-tang [5], taking GUN YANG -DU YUN highway as an example, pointed out that the introduction of BOT + EPC can effectively control the construction schedule, cost, avoid the owner and construction units conflict of interest. Yuan Xi-man[6] on the basis of "risk map", making an identification of the highway risks under BOT + EPC mode, pointed out that the risks should be controlled, and at the same time the attention should be paid to the risk sources. CAO Xue-juan[7] on the basis of DEA, made a quantitative analysis safety performance of the BOT + EPC project, and believed that the BOT + EPC can significantly improve the construction safety of highway taking the expressway along the Yangtze river in Chongqing as an example. Through the analysis of literature, the domestic application and risk research of BOT + EPC of highway projects mainly concentrated on the theoretical aspect, the case study are dominantly conducted from the owners' perspective. Scholars seldom carry out risk research of the BOT+EPC from general contractor's perspective. So, it is of more practical significance to research the risk of the BOT+EPC from general contractor's perspective.

3. General Contractor's Risk Research of Highway Project under the BOT+EPC

At present, under the BOT+EPC of highway general contractor is subjected to many difficulties such as long constructing period, demanding a large amount of funds, prolonged payback period. This model requires a excellent capability of resources integration for contractors, involves complex relationship of interests, which lead to tremendous risks for the general contractors in the constructing project. By using some methods like literature summary, case study, expert consulting, general contractor's five major risks under the BOT+EPC are concluded after seeking advice from some experts who have practical and research experience in BOT+EPC of highway. The detailed explanation are shown in figure 2.

Natural risk. The natural risks of highway construction under the BOT+EPC, which mainly refer to debris of flow, collapse, snowstorm and so on during constructing, which result in many uncertainties to the site operation and construction of the highway and unpredictable losses. **Economic risk.** Under the BOT+EPC the economic risks of highway projects dominantly refer to the financing difficulties due to the unstable economic environment, which will influences the projects later. The whole service period is long from initiation, constructing to operation and huge fluctuations of exchange rate and interest rate and inflation will result in the prices increases in material and labor forces and constructing costs of the projects.

Constructing risks. From the general contractor's perspective, the Constructing risks of highway projects under BOT+EPC consist of four parts. 1, designing risks, which mean the deviations of designing drawing and repeated alterations because of geological survey and complicated constructing environment, lead to delay or costs increase during building. 2, purchasing risks. The suppliers' material is below the standard, will hamper later building; the irrational schedule arrangement of material purchasing and transportation to delivery, as well as the material delay will hinder the whole constructing duration. 3, construction risks. The long construction period of highway, numerous uncertainties and discrepancy between the construction design and field conditions will influence the construction schedules. 4, Subcontractor's selecting risks. The capability, fulfillment of the contract and the attention to the projects of the subcontractors are closely linked with the costs and quality of the general contractors.

Operating risks. Operation is a crucial period, in which the highway of BOT+EPC project recovers its investments and achieves expected profits. During operation, the risks imposed on the general contractors are from the numerous uncertainties and huge risks of the highway construction. The risks include operating income reduction because of the lower-than-expected traffic volume or the competitive or costs increases of regular repair due to the inferior quality.

Contract management risk. Under the BOT+EPC, the contract management risk of highway project refer to some risks in operating procedures, owners' require-

ments, workloads and prices as well as such risks caused by the incomplete contract terms or indistinct division of interests and duties in the contract.

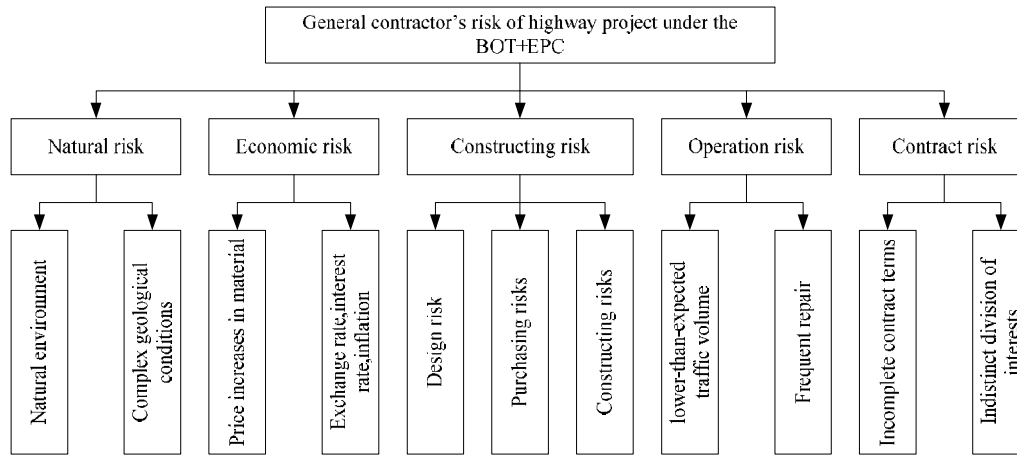


Figure 2. Resolution graph of general contractor's risks of highway projects under the BOT+EPC

Under the BOT+EPC model, the general contractor of the highway projects has a double identity of “owners + general contractor”. The general contractor get the contracting tasks with relatively a smaller amount of investment, which can not only deplete existing construction productivity but also boost other industries like supervision, design and experiment of the general contract unit and promote the transformation and upgrading of the company. So it is necessary to carry out management and control of the risks of highway project under BOT+EPC , which can provide decision-making basis for such construction project. Management of the natural risk needs correct survey and evaluation of the effect of harsh weather conditions on working conditions in the future. As for the highway geological disasters, the control plan which gives priority engineering measures, makes the biological measures as supplementary methods, and early warning surveillance and collaborative management as basis should be applied. In construction process, to manage the economic risk such measures ,for example, determining suppliers' prices in advance and giving full play to the advantages of centralized purchasing of headquarters of contractor enterprise, should appropriately be taken to weaken risks of prices increases. As for the management of constructing risks, the general contractors should make a combination of designing defects and construction site to seek an optimal scheme by real-time review survey file with the actual geological review. During construction, a feasible constructing schedule plan should be formulated and be adapted dynamically. As for the management of contract risks, the general contractors should strengthen the examination and approval of the contract risks and contract terms before negotiation, and

improve the ability of contract performance. As for the risks during operating, the company should make an accurate prediction of the traffic volume, improve quality supervision during constructing, and carry out quality check plan by PDCA to reduce the expense of maintenance and repair. This article just makes a qualitative analysis of general contractor ' s risks. To conduct risk management better, How to adopt reasonable quantitative methods, and to identify the general contractor's risk is the direction of future efforts for scholars.

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