A Case Study on International Engineering Risk Management Under BOT Model: The case of Yavuz Sultan Selim Bridge in Istanbul

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Abstract: Since the Turkish Prime Minister Ozal had put forward the basic concept of BOT project in the 1980s. It has become the construction mode favored by governments of most countries, especially in developing countries. The BOT mode is mainly applicable to some complex large-scale infrastructure construction projects. In China, with the continuous improvement of economic capacity, the government pays more attention to the construction of infrastructure. But owing to this kind of project’s feature, it will bring a great financial pressure to the Chinese government. So, the BOT mode is the best choice for the government. But as the BOT mode itself involved in multilateral cooperation, even include the foreign partner, and combined with the particularity of the project itself. It has the types of risk is more than conventional projects. Therefore, risk management and control of it is what we need to research and focus on. This paper takes Istanbul Yavuz Sultan Selim (hereinafter referred to as YSS Bridge) Bridge project as an example. The paper based on the basic theory of BOT project and risk management theory, analyzes the whole process of risk management in international BOT mode project, and then analyzes how to take measures to prevent possible risk events in the case of cross-border cooperation.

1. Risk identification and prevention of international engineering BOT project

At present, if BOT mode would be adopted in the construction of international engineering projects, we should pay special attention to the following aspects for risk prevention: political risk, financing risk and cultural risk.

1.1. For multinational companies investing in BOT projects, political risk is the first considerable aspect. Political risk cannot be overlooked during the early stage of risk management identification. There are some specific preventive measures can be taken: We can decide whether to sign a project contract with the government after do some detailed investigation and analysis of relevant political conditions in the early stage. Then negotiating with the government to obtain certain concessions partly offset the political risk.

1.2. Project financing is an important content throughout BOT projects
Project financing usually operated by the project company as the main body, the risk is fully borne by
the project company. Of course, if the BOT project arrested the foreign investment, you should also consider the currency exchange.

1.3. If we went to other countries, cultural risks are also a potential risk that cannot be ignored
During the international construction phase, light cultural conflict would lead to unpleasant working atmosphere and slow down the whole schedule. There are some corresponding measures, figure out the difference between outside and in and adjust it during the design phase.

2. Case introduction
Yavuz Sultan Selim is a third bridge connecting Europe and Asia in Istanbul made by Turkey's government. The bridge is located in the northern edge of Istanbul known as the third Bosporus bridge. It was took only three years to accomplish and seen as the shortest in the similar projects. For this project, the government is not directly involved in because of they adopt BOT mode. Comparing with the normal BOT project, YSS bridge project’s most part of political change risk and irresistible risk are undertook by Turkish government. And so as the financial risk. What is more, there are 74 transnational corporations involved totally coming from 21 different countries. The specific project participants relationship is shown in the figure below.

Figure 1. Relation diagram of project participants

3. The analysis of risk management process

3.1. Project risk identification
We according to relevant news and do some survey about Turkey at earlier stage, identify the overall risk and specific risk as follow.

| number | Overall risks of project | Specific risks of project |
|--------|-------------------------|--------------------------|
| 1      | National political risk in Turkey | YSS bridge project financing risk |
| 2      | National economy risk in Turkey | YSS bridge project contract risk |
| 3      | National legal risk in Turkey | YSS bridge project construction period risk |
| 4      | National social risk in Turkey | YSS bridge project completion risk |
| 5      | National natural risk in Turkey | YSS bridge project operation risk |

3.2. Project risk assessment

3.2.1. Establish a risk assessment system. The paper based on the analytic hierarchy process and fuzzy
decision method of thinking concept. It shows that the risk assessment items can be divided into the possibility of risk occurrence and risk effect level. The former divide the possibility of risk into five grades: the number 1 is nearly not possible, the number 5 is the most likely to occur. And the latter divide the risk influence degree into five grades: the number 1 on behalf of if that the risk happened, it almost had no effect; and the number 5 on behalf of when the risk occur in the event, its impact will be very large. Then we base on matrix risk management system and the experience of real construction, come to a risk rating matrix as follow.

![Risk rating matrix](image)

**Figure 2.** Risk rating matrix

3.2.2. Do a risk assessment for YSS bridge project. We according to the risk assessment system established above, sort out the risk assessment table of YSS bridge engineering project. We can see the detail table as follow.

| Risk event definition                                                                 | Probability of risk occurrence | Degree of risk effect | Risk ranking (A/B/C) |
|---------------------------------------------------------------------------------------|--------------------------------|----------------------|----------------------|
| 1. National political risk in Turkey                                                   | 5                              | 5                    | A                    |
| The Turkey’s government regime are changeable during the construction of the project. The governing ability of the government is weak,and there are wars and riots that lead to social instability. |                                |                      |                      |
| 2. National economy risk in Turkey                                                    | 4                              | 4                    | A                    |
| Turkey's Banks moved the currency and lending rates too frequent.                     |                                |                      |                      |
| 3. National legal risk in Turkey                                                      | 3                              | 4                    | B                    |
| The new governing system of the Turkish government has changed relevant construction laws, regulations and policies. |                                |                      |                      |
| 4. National social risk in Turkey                                                     | 4                              | 4                    | A                    |
| Because of the cultural difference, Turkish workers and foreign managers have different views on the quality control during the construction period. |                                |                      |                      |
5. National natural risk in Turkey

| The project had to stop during the extreme cold and hot weather. | 1 | 3 | C |

6. YSS bridge project financing risk

| Several Turkish Banks have adjusted their lending rates because of the volatility of the market economy. | 3 | 5 | B |

7. YSS bridge project contract risk

| Some rights, obligations and interests in the contracts signed between the core company and other project participants are not clearly understood. | 5 | 4 | A |

8. YSS bridge project construction period risk

| Construction site staff are lack of safe operation awareness and failure to observe safety management rules. | 4 | 3 | B |
| The environment of the construction site is not scientific and reasonable, dirty and messy. | 3 | 2 | C |

9. YSS bridge project completion risk

| The project could not be delivered on time due to Political situation in Turkey and natural factors or conflicts between stakeholders. | 3 | 4 | B |

10. YSS bridge project operation risk

| The number of vehicles passing through did not reach the expected number during the operation of the project. | 4 | 2 | B |

3.3. Project risk of response

We sorting out the three types of risks according to the risk identification and assessment of the whole BOT mode of YSS Bridge project in the early stage. And then give some appropriate countermeasures. So detailed description was shown in Table 3.

| Risk event | Sources of risk factors | Risk of response measures |
|------------|-------------------------|---------------------------|
| A | The Turkey’s government regime are changeable during the construction of the project. The governing ability of the government is weak, and there are wars and riots that lead to social instability. | Political stability risk | Purchase political risk insurance from an international insurance institution. |
| | Turkey's Banks moved the currency and lending rates too frequent. | Exchange-rate Risk Risk of loan interest rate | We can buy some insurance about how to keep the value under the currency exchange rate. |

Table 3. The list of risk response under YSS bridge project in BOT mode (a)
4. Conclusion
When we use the international BOT mode, the project would have its own particularity of a project’s transfer, construction and operation. So the influence of the risk would be more huge than other forms of construction project. So analyzing the whole process risk management of BOT project is the key to obtain the maximum economic benefit. Meanwhile it is also the premise for coordinating the interests with all parties. The practical significance about international BOT project risk management for the government's lies in: The host of governments can create conditions gradually and improve the suitable

| Risk                                | Fluctuation                        | Management                                                                 |
|-------------------------------------|------------------------------------|-----------------------------------------------------------------------------|
| Risk of cultural differences        | After understanding the system of  | The construction industry in this country, make a consultation with them to |
|                                     | To establish a series of relevant  | establish a series of relevant system.                                      |
| Adverse risk of contract terms      | When the contract is drawn up,     | Make a strict scrutiny. Filter out ambiguous clauses, then draw the line     |
|                                     | make a strict scrutiny.            | through many negotiations. So that we can clarify the rights and interests  |
|                                     | of contract are unclear             | of both parties.                                                            |
| Risk of defective law               | As far as possible to avoid the    | Purchase project delay insurance, and do the relevant investigation work in  |
|                                     | relevant disputes that cause the   | the preliminary investigation.                                              |
|                                     | provisions contained in the unsound |
|                                     | law.                               |                                                                            |
| Risk of loan interest rate          | Buy financial products such as     | Carry out safety education regularly, and formulate a series of measures for |
| fluctuation                         | swaps and hedging.                 | guarantee, reward and punishment.                                          |
|                                     |                                    |                                                                            |
| The risk of human factor            |                                    | Tidy up the construction site and inspect it regularly.                     |
| Social security risks Project delay |                                    |                                                                            |
| risk                                |                                    |                                                                            |
|                                     |                                    |                                                                            |
| Risk of insufficient operating      | Sign minimum income provisions    | Purchase project delay insurance, and do the relevant investigation work in  |
| income                              | with the Turkish government in the | the preliminary investigation.                                              |
|                                     | early stage.                        |                                                                            |
| Natural environmental risk          |                                    |                                                                            |
| Natural risk of uncontrollable      |                                    |                                                                            |
|                                     |                                    |                                                                            |
environment of BOT project investment and financing, and then establish a sound commercial legal system and BOT special regulations. For some transnational corporation, they usually figure out the risk management’s distribution rule and strengthen them.

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References
[1] Grimsey D. and Lewis M. K. (2002) Evaluating the risks of public private partnerships for infrastructure projects. *International Journal of Project Management* 20(2) pp 107–118
[2] M. Mithat Unera, Erin Çavuşgilb and S. Tamer Çavuşgilc,d,e Build-operate-transfer projects as a hybrid mode of market entry: The case of Yavuz Sultan Selim Bridge in Istanbul *International Business Review* 27(2018) pp 797–802
[3] Panwu li, Shengnan Song, Xingbing and Chen Yu Guan Application research of BOT project risk management based on SWOT analysis *Value Engineering* 2012 31(32) pp 102–103
[4] Juanjuan chen Preliminary Study on risk Management of International BOT Project *Shanxi Architecture* 2010 36(01) pp 243–245
[5] Xiaoge Zhao A brief discussion on the risk sources and control of project financing *Modern Economic Information* 2014(13) pp 362
[6] Jiangfang Hu Analysis and prevention of political risks affecting Chinese enterprises' foreign investment *Heilongjiang Foreign Trade and Economic Cooperation* 2009(04) pp 33–34