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Risk Analysis and Management in Railway Project using Tunnel Design: A Literature Review

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ABSTRACT

Population growth makes public transportation needs increase, one of the needs for the availability of population growth is the need for availability of railway. However, the available land for railway construction is very limited, therefore experts design the railway using a tunnel. Risk analysis in Railway projects with tunnel design is carried out to determine the most important type of risks. The results of this research show that the railway project with tunnel design has the same risks as railway projects with other designs, there are site risk and environmental risk. After finding the most important risk, use the Multiphase risk management method to manage this risk.

Keywords:

Railway project, Tunnel construction, Railway risk factor, Risk Management.

1. Introduction

Risk management is an important impact on the organization. There is a strong link between the amount of risk management and the level of success of the project. Proper risk management implies the control of possible future events and thus it is a measure of security to the contractors who take the projects and to the owners of the projects. Risk management may be described as "a specific process of risk and consciously determining how each should be treated." "It is a management tool that identifies sources of risk and uncertainty, determines their impact, and develops appropriate management responses." A systematic process of risk management has been divided into risk classification, risk identification, risk analysis, and risk response, where risk response has been further divided into four actions, i.e. retention, reduction, transfer, and avoidance.

Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives [1]. Railway projects are inherently complex and dynamic and involve multiple feedback processes. A lot of participants - individuals and organizations are actively involved in the railway project, and their interests may be positively or negatively affected as a result of the project execution or project completion. Different competitors with different experience and skills usually have different expectations and interests. Which simply creates problems and confusion for even the most experienced project managers and contractors. Measure efficiency of maintenance activity is one way to see maintenance performance [2]. Risk management is an important part of tunnel construction management. There are many factors to influence the tunnel risk. For different tunnels, the risk types and risk sizes are different in thousand and one ways. In this research, the various aspects of railway projects using tunnel design were investigated. Reliability data was established and according to the weighted average analysis and the Relative importance index analysis results. Hence comes the requirements to define, identify, quantify and mitigate the risks in railway projects. Railway construction using tunnel design has many problems and risks such as safety, stability and environmental influence in excavation and operation, because it is generally constructed in the vicinity of existing structures and excavated at weathered soil and rock in shallow depth. Because of the stability of the tunnel, the settlement of adjacent structures and environmental influences is vibration and noise by blasting.

2. Literature review

A literature review of this paper that was reviewed along with the aspects of learning carried out is as shown in Table 1.

Table 1. Literature review.

Paper Number	Identitas Paper	Identitas Resiko				Result
		Internal		External		
		Technical	Non Technical	Technical	Non Technical	
1	Patil, et al. (2017). Risk Management in Railway Projects. *International Research Journal of Engineering and Technology, 4(6).*	v	-	v	-	According to the above analysis of collected data, it is concluded that Site risks, Material risks are most important in Railway projects.
2	Shivajirao, et al. (2014). Risk Assessment for Infrastructure Projects Case Study: Pune Metrorail Project. *International Journal of Engineering and Management Research,* 4(5), 152-155.	v	-	v	-	Most of the infrastructure projects delay in approval and design, selection of technology is a major risk which causes a delay in the project. it is recommended to study these risks through risk evaluation techniques
3	Kim, G.Y. (2010). Application of risk analysis and assessment in tunnel design. *International Journal of the JCRM, 5(1), 11-18.*	v	-	v	-	Soil stability and environment factor are the main index factor used to analysis risks in tunnels construction

4	Ruifang et al. (2011). Construction Risk Analysis of Red Clay Railway Tunnel. *American Society of Civil Engineers.*	v	-	v	-	The supporting conditions and construction methods and geological conditions are the main risk factors to the tunnel and underground projects.
5	Bai, et al. (2014). Multiphase Risk-Management Method and Its Application in Tunnel Engineering. *American Society of Civil Engineers.*	v	-	v	-	The multiphase risk-management method shows that the most appropriate and economical risk-management method can be achieved and the established objectives of construction quality and timeline can also be ensured

Note: v (discussed) - (not discussed)

Table 1. Literature review (Continue).

Paper Number	Identitas Paper	Identitas Resiko				Result
		Internal		External		
		Technical	Non Technical	Technical	Non Technical	
6	Chen, et al. (2015). Probabilistic Analytical Model for Settlement Risk Assessment of High-Speed Railway Subgrade. *American Society of Civil Engineers.*	v	-	v	-	Unavailable Equipment risk is the main risk in the railway project
7	Vishas, H.S & Gidwani, G.D. (2017). Hazards Identification and Risk Assessment in Metro Railway Line Construction Project at Hyderabad. *International Journal of Engineering Research & Technology,* 6(8).	v	-	-	v	Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives
8	Shen, et al. (2016). Railway Risk Assessment of the EPC General Contract in Ethiopia Based on the Improved Fuzzy Comprehensive Evaluation Method. *American Society of Civil Engineers.*	v	-	-	v	Effective risk management is important to improve the level of railroad engineering risk management,
9	Ma, et al. (2016). Research on the Risks of International High-Speed Railway Projects Based on the FIDIC-EPC Total Price Contract. *American Society of Civil Engineers.*	v	-	v	-	To reduce the project's risk, to improve the construction quality and to effectively control the project cost
10	Sarkar, et al. (2011) A Framework of Project	v	-	-	v	The number of major and minor risks involved

	Risk Management for the Underground Corridor Construction of Metro Rail. *Indian Institute of Management.*					during the construction of the project, from the feasibility to the completion of the execution, are large,

Note: v (discussed) - (not discussed)

Table 1. Literature review (Continue).

Paper Number	Identitas Paper	Identitas Resiko				Result
		Internal		External		
		Technical	Non Technical	Technical	Non Technical	
11	Singh, et al. (2017). Project Risk Analysis for Elevated Metro Rail Projects using Fuzzy Failure Mode and Effect Analysis (FMEA). *International Journal of Engineering Technology Science and Research, 4(11).*	v	-	-	v	Feasibility and DPR, Land hand over, Tender and award of contract, construction program planning, launching girder and obligatory span activities are found very risky in an elevated metro railway project
12	Zeng, R & Wu, D. (2015). Risk-Sharing Rationalization of an Intercity Railway PPP Project. *American Society of Civil Engineers.*	v	-	-	v	Financing and market risks should be taken by the private sector because they are more powerful in control these problems that are directly related with their profit
13	Pranjali, M & Devalkar, R. (2016). Impact of Risk in Railway Construction Management. *International Journal of Modern Trends in Engineering and Research .*	-	v	-	v	There are various impacts occurred in actual construction which is totally different from designing factors and constructing factor. Various factors are such as which is just neglected at the time of construction
14	Lin, et al. (2011). Risk Management of Railway Engineering Construction. *Elsevier. 174-180*	v	-	v	-	Simple and effective risk management is important to improve the level of railroad engineering risk management,to reduce the project's risk, to improve the construction quality and to effectively control the project cost
15	Humiras, et al. (2019). The effect of efficiency measurement to the improvement of maintenance productivity. *International Journal of Engineering & Technology,7(4),6964-6969.*	v	-	v	-	Measure efficiency of maintenance activity is one way to see maintenance performance

Note: v (discussed) - (not discussed)

3. Methodology

The writing of this article is based on a study of literature review obtained online including various scientific articles related to risk in the construction of railways using tunnel design which is then reviewed and synthesized to provide comprehensive information.

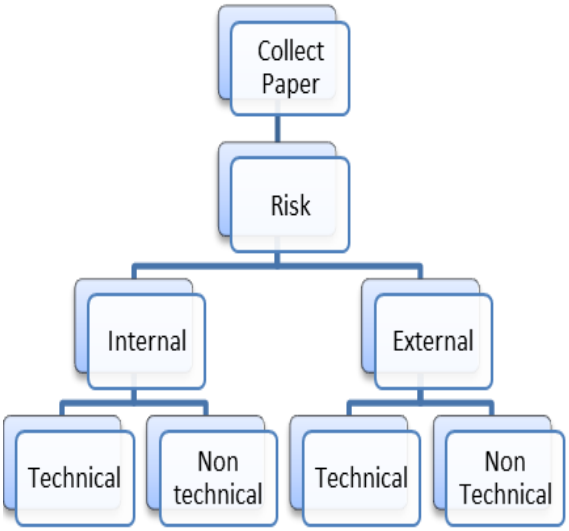

Figure 1. Research methodology.

4. Discussion

Infrastructure projects have different levels of difficulty and risk, this affects to delay in many infrastructure projects from planned time. Most of the infrastructure projects delay in approval and design, selection of technology is a major risk which causes a delay in the project [2]. For this reason, there is a need for analysis and risk control on construction projects. The purpose of risk analysis is to strengthen control for general contractors to reduce the losses of risks [3]. In this study, we analyze the risk factors found in railway projects that use tunnel design. So we can establish a sound project risk management database to reduce the risk subjective evaluation, give priority to prevention, take targeted preventive measures for high risks to reduce their occurrence probability, or risk accidents may cause huge losses. Project risk management should focus on pre-evaluation and prevention [4]. Project risk management which primarily comprises schedule and cost uncertainties and risks should be essentially carried out for complex urban infrastructure projects such as the construction of an underground corridor for metro rail operations [5]. According to analysis of collected data, there is 15 risks factors influence the railway project, which is material risk are most important in Railway projects [6].

- Site risk
- Material risk
- Design risk
- Contractual risk & exposures
- Financial risk
- Site safety
- Management risk
- Organizational risk
- Human resource risk
- Construction
- Legal risk
- External risk
- Environmental
- Political risk
- Cultural

There are a few results based on the research to know the most important risk in the railway project and financing and market risks should be taken by the private sector because they are more powerful in control these problems that are directly related with their profit [6] . According to the research, site risks and material risks are the most important in the railway project [6]. Unavailable Equipment risk is the main risk in railway projects [7]. Increased population growth is accompanied by growth in infrastructure construction, especially railways. However, limited land is one of the problems that hinder the construction of railway projects. Experts in construction try to find a solution to this problem by designing a tunnel for railway construction. In the implementation of construction, the railway project with tunnel design has its level of difficulty, especially in the construction method. Environmental conditions are the main focus in determining the work method used, where the selection of the right working method can reduce the risk of a railway project with tunnel design. Construction methods, and geological conditions are the main risk factors for tunnel and underground projects [8]. Before we do construction work, we must first research the type of soil in the area, such as research on soil stability and environmental effects arising from underground construction. Soil stability and environment factor are the main index factor used to analysis risks in tunnels construction [9].

Risks are always present in every construction project and cannot be eliminated, but we can analyze and manage these risks. Simple and effective risk management is important to improve the level of railroad engineering risk management, to reduce project's risk, to improve the construction quality and to effectively control the project cost [10]. Analysis and risk management of construction projects should be carried out at the planning and development stage. Feasibility, Land hand over, Tender and award contract, construction program planning, are found to be very risky in the railway project [11]. Analysis and regulation of risk in actual conditions is sometimes not the same as in planned conditions, especially in railway projects with tunnel design. There are

various types of actual construction which are different from designing factors and constructing factors [12]. There are several ways to manage the risk of a railway project with tunnel design, namely the Multiphase risk-management method. The Multiphase risk management method shows that the most effective risk management methods can be achieved [13].

5. Results

Based on the results of the literature review, the most important risk for railway projects using tunnel design is site risk and environmental risk. Environmental risk is focused on conditions of soil stability. Risk management is needed in the railway project using tunnel design because there are differences in risk analysis at the planning and the actual stage.

6. References

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