Optimization of Planning and Scheduling for Tunnel Construction: A State-of-the-Art Review

Geetanjali K. Lohar¹, Vrutika Patelwala¹, Ganesh W. Rathod², Ankesh Kumar³

Abstract

Tunnel construction is a complex, linear, and repetitive project characterized by long timelines, significant risks, and uncertainties related to geological conditions, construction processes, and environmental impacts. Planning and scheduling for tunnel projects are more challenging than for other types of construction due to these complexities. Traditional planning techniques, such as the Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), and Line of Balance (LOB), fall short in effectively managing tunnel construction projects. These methods fail to address the inherent complexity and uncertainty of tunnel construction and do not ensure optimal resource utilization. To address these challenges, various optimization models, including Decision Aid Tunneling (DAT), Cyclic Operations Network (CYCLONE), and Monte Carlo Simulation (MCS), have been proposed. These models offer better design strategies, optimize resources, reduce costs and project duration, and enhance overall construction project management. Among these, Monte Carlo Simulation (MCS) is particularly notable for providing more realistic results by incorporating uncertainties through repeated random sampling techniques. This paper critically reviews the broader aspects of these advanced methods for planning and scheduling tunnel construction. It also discusses current issues faced in tunnel project planning. While the focus is on tunnel infrastructure projects, the planning and scheduling approaches that account for unpredictable operating circumstances are of significant importance to researchers developing tunnel planning methodologies.

Keywords: Repetitive Construction, Tunneling, Probabilistic Simulation, Uncertainties

¹ Sardar Vallabhbhai National Institute of Technology, Surat, India, 395007 Email: lohargeetanjali@gmail.com
² University of the Witwatersrand, Johannesburg, South Africa
³ Indian Institute of Technology, Palakkad, India, 678557