DEVELOPMENT OF A RISK MITIGATION FRAMEWORK FOR PPP HIGHWAY INFRASTRUCTURE PROJECTS IN INDIA

by

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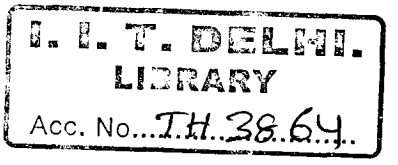

Dedicated

to

the memory of my late parents

Usman and Kamalamma

CERTIFICATE

This is to certify that the thesis entitled "**Development of a Risk Mitigation Framework for PPP Highway Infrastructure Projects in India**" being submitted by Mr. Mohammed Sagheer to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy is a bonafide record of the research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the required standard, fulfilling the requirements of the said degree. The results contained in the thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

In the recent years, reliance on public financing mechanisms for road transportation infrastructure have diminished as these have proved to be grossly inadequate to keep pace with the escalating demand. Public Private Partnerships are increasingly viewed as a part of the solution to this problem. Such partnership between public and private sector is mutually beneficial as the financial engineering skills, innovation and efficiency of the private sector is leveraged for the provision of public infrastructure. In a scenario where PPP projects with long gestation period have come to be largely relied upon for infrastructure development, it is necessary that risk mitigation mechanisms be designed to ensure stakeholders' security. This situation presents a research opportunity to study and develop new risk mitigation mechanisms, which provide more flexibility to the project participants.

A review of the Model Concession Agreement (MCA) applicable for Build-Operate-Transfer (BOT) road projects in India identifies that development phase risks, length of concession period, financing decisions and traffic risks during operational phase are the most vital elements affecting the project viability. A total of 17 risks affecting the development phase of a BOT project are identified and analyzed to determine their extent of criticality. Time overrun, cost overrun and delay in financial closure are found to be the most critical risks in the development phase. Since time and cost overrun can adversely affect the financial viability of a BOT project, a framework based on Kalman filter has been developed to assess the time and cost overruns in the development phase that enables timely corrective action. An optimal concession duration is a prerequisite to ensure that the concessionaire earns a reasonable return

on investment, while averting windfall gains. A simulation model incorporating the deterministic and stochastic parameters has been developed to determine an optimal concession period for a BOT project. To aid a faster financial closure, a genetic algorithm based multi objective constrained optimization model has been developed to arrive at an optimal capital structure for projects. This model also facilitates to improve the bid winning potential of the prospective concessionaire. To mitigate traffic risks during the operations phase, a real options based method has been developed to design traffic guarantee mechanisms. The models have been demonstrated through a live BOT road project in India.

Keywords: *Build Operate Transfer, PPP risks, Interpretative structural modeling, Kalman filter, Monte Carlo simulation, capital structure decision, Genetic Algorithm, Real options.*

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