

## ABSTRACT

Yoojung Yoon. Ph.D., Purdue University, August 2012. Planning of Optimal Rehabilitation Strategies for Infrastructure using Time Float and Multiyear Prioritization Approach, Major Professor: Makarand Hastak.

Constant monitoring, maintenance and repair activities are needed in order to maintain the infrastructure systems in good condition and extend their service lives. However, maintenance and repair activities alone cannot prevent continuous deterioration of infrastructure systems so that a rehabilitation strategy should be developed. There have been many efforts to determine the optimal rehabilitation time for infrastructure systems using the various optimization models (e.g., project level, network level, or a combination of both). In particular, the optimization models at the network and combined levels require the prioritization approaches (e.g., single year, multiyear, or yearly-based multiyear analysis) to prioritize and screen rehabilitation projects within the available budgets.

Recent research and practice focus on developing the optimization mode on the basis of the integration of the project and network level analysis over a long-term budgetary goal. However, they still have limitations as a rehabilitation planning model due to the three challenges in infrastructure management: 1) not optimum decision-making at the network level as long as the models use the fixed rehabilitation time identified at the project level analysis, 2) no considerations of non-selected rehabilitation projects within the multiyear prioritization approaches due to limited budget, and 3) incompatibility of the purpose of a multiyear budget approach with the required annual rehabilitation cost.

This dissertation suggests a new paradigm for efficient infrastructure management to overcome those challenges. That is, infrastructure management strategy should be established based on the rehabilitation time float and an annual reanalysis process within the context of maintenance, repair, and rehabilitation (MR&R) over a multiyear period in a new paradigm. The rehabilitation time float is defined as the acceptable time frame within which a rehabilitation

project can be accommodated to develop a leveled annual rehabilitation requirement cost over a multiyear analysis period.

Therefore, the research methodology consists of four processes: 1) identification of the best MR&R strategy at the project level, 2) estimation of the time float of rehabilitation projects and development of cost leveling model, 3) multiyear analysis to find an optimal set of rehabilitation projects at the network level, and 4) annual reanalysis for the selection of final rehabilitation projects at a target fiscal year. To demonstrate the research methodology, this dissertation uses concrete bridge decks as a case study in the state of Indiana. Those data can be obtained from the national bridge inventory (NBI) database. The suggested multiyear infrastructure rehabilitation strategy using the new paradigm could help public agencies do the following:

- Identify leveled annual rehabilitation costs which they should dedicate to keep their infrastructure systems in good condition.
- Establish a long-term and steady budgetary goal for rehabilitation programs.
- Make a more reliable decision for a multiyear rehabilitation program.