ABSTRACT

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The trade-off analysis is one of the principles in transportation asset management. It can help decision makers understand how the resource allocation affects the system performance and the relationships between performance measures in the decision-making process. However, the trade-off analyses in transportation asset management have not been well studied. In this dissertation, a general methodology was proposed for the trade-off analyses for the project selection problem of transportation asset management. A general trade-off based multiobjective optimization framework for transportation asset management was first established. Next, a hybrid NSGA II method was developed to generate Pareto frontiers to conduct trade-off analyses between the cost and performance measures and also between different performance measures. The chance-constrained programming was then applied to incorporate performance measure uncertainties into the multiobjective optimization. Using field data, the proposed methodologies were applied to conduct various trade-off analyses under the deterministic and uncertainty situations. It was found that the proposed hybrid NSGA II method converges faster and generates better-distributed Pareto frontiers compared to the traditional NSGA II method. It was also found that the trade-off relationships between performance measures are different at different budget levels. Further, at the same budget level, the trade-off relationships between two performance measures are influenced by the specified levels of other performance measure(s). Under the uncertainty situation, trade-off relationships at different confidence levels are different; typically, a high confidence requirement results in lower performance at same cost level; the dissertation also quantified the extent to which high costs are needed to achieve high confidence levels at a given level of pre-specified performance.