Ph.D. Final Examination of Panagiotis Anastasopoulos
Title: Infrastructure Asset Management: A Case Study on Pavement Rehabilitation
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ABSTRACT

Transportation agencies spend billions of dollars annually on managing a wide range of assets to meet public, legislative, and agency expectations. These assets vary from the physical transportation infrastructure, to equipment, material stocks, data and information, and human resources. The effectiveness of asset treatments in terms of their effect on the asset life is not well understood. This is further complicated by the effect that physical deterioration, load volumes, weather, geology, and other factors may have on the effectiveness of the treatment. Given the role that the treatments of physical transportation infrastructure play in infrastructure asset management, understanding the survivability of these treatments has the potential to provide improved resource allocation and more effective use of State funds. The present research extends the traditional infrastructure management framework by formulating methodologies that enable transportation agencies to evaluate the effectiveness of their assets' treatments with respect to each treatment service life. The analysis goes beyond standard performance modeling, and demonstrates a comprehensive framework to evaluate a set of asset treatments.
The end product of this research is a quantitative tool that can be used at the project development phase to estimate the effects of different types of asset treatments. To that perspective, a case study is presented, where common pavement rehabilitation treatments are evaluated for their effectiveness on pavement life for various road functional classes.

The models developed in this study are calibrated using data from the Indiana Department of Transportation. First, the asset's performance (the pavement performance) is forecasted and influential factors that affect performance deterioration are identified. A system of equations approach is introduced, to explicitly account for simultaneous relationships that potentially exist among performance indicators. Next, safety-based thresholds of the performance condition indicators, that initiate the asset (pavement) treatment, are estimated. The traditional mathematical programming approach is counterpoised to an alternative approach, and both define equally effective thresholds.
Finally, the previous two steps are used to approximate the service life of the asset (pavement) treatments, and by conducting random parameters hazard-based duration analysis, survival curves for each treatment are estimated.

A major contribution of this work is the demonstration of a general approach that can be applied for comprehensive analysis of the effects of asset treatments, while taking into account specific characteristics of the infrastructure system. The case study results set forth herein provide a better understanding of the interrelationships among pavement rehabilitation treatment, pavement condition, road functional class, safety, pavement service life, traffic loads and trucks, weather and soil condition, and rehabilitation expenditure. Moreover, this study illustrates the steps necessary to evaluate the asset treatments effectiveness and demonstrates how analysis can be carried out and ultimately improved. Given

the complexity of the problem and the limitations of available data, this study should be viewed as an incremental step toward enabling transportation agencies to make better decisions regarding a number of treatments, allowing the selection of asset treatment options that will last the longest.