



Predictive Analytics for Roadway Maintenance: A Review of Current Models, Challenges, and Opportunities

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Abstract

With the pressing need to improve the poorly rated transportation infrastructure, asset managers leverage predictive maintenance strategies to lower the life cycle costs while maximizing or maintaining the performance of highways. Hence, the limitations of prediction models can highly impact prioritizing maintenance tasks and allocating budget. This study aims to investigate the potential of different predictive models in reaching an effective and efficient maintenance plan. This paper reviews the literature on predictive analytics for a set of highway assets. It also highlights the gaps and limitations of the current methodologies, such as subjective assumptions and simplifications applied in deterministic and probabilistic approaches. This article additionally discusses how these shortcomings impact the application and accuracy of the methods, and how advanced predictive analytics can mitigate the challenges. In this review, we discuss how advancements in technologies coupled with ever-increasing computing power are creating opportunities for a paradigm shift in predictive analytics. We also propose new research directions including the application of advanced machine learning to develop extensible and scalable prediction models and leveraging emerging sensing technologies for collecting, storing and analyzing the data. Finally, we addressed future directions of predictive analysis associated with the data-rich era that will potentially help transportation agencies to become information-rich.

Keywords: Roadway Maintenance; Predictive Maintenance; Asset Management; Roadway Asset; Deterioration Model.

1. Introduction

United States is globally ranked among the top two countries for its excellence in financial systems, business dynamism, and innovation capability by the global competitiveness report of world economic forum [1]. However, this report ranked the United States 11th for road quality. Maintenance, repair, and rehabilitation (MR&R) strategies, significantly influence the condition of our roadway infrastructure, which was scored D, consistent with WEF report, on 2017 infrastructure report card of American Society of Civil Engineers [2]. During past decades, the importance of transportation infrastructure maintenance has significantly grown due to its contribution to economic growth. Well-maintained transportation systems (a) better-connect geographical locations, (b) lower transportation and transaction costs—through decreased vehicle maintenance, reduced delays, and lowered fuel consumption, and (c) enhance the safety of transportation systems [1, 2].

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