Developing a Proactive Fuzzy-Logic Model for Optimizing Winter Road Maintenance Measures in Cold Urban Areas Using Real-time Data

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Background

Multiple factors are involved in providing effective maintenance for roads in the cold season and the interaction between them makes it difficult to identify the most effective solutions. Reviewing the literature indicates that following issues and the demand for enhancing the current approach in optimizing winter road maintenance:

1. Budget constraints that will limit the corrective action and require identifying the most influential measures within the budget limits
2. Time constraints that call for a prompt response and immediate action to retain serviceability in emergency cases
3. Resource constraints that allow limited resources in the service zone they have been assigned to and requires optimized distribution of available resources
4. Unpredictability which requires addressing the factors that reduce the predictability of conditions and hinders a proactive and well-planned approach
5. Sustainability challenges that can create unwanted negative side-effects for each decision and calls for considering the impacts of all decisions in the long run
6. Selecting between numerous scenarios, strategies, and alternatives to maximize efficiency which is challenging due to the advantages and disadvantages of each decision.

This research attempts to address these issues in the comprehensive approach it introduces by utilizing a fuzzy-logic that simulates the human's decision-making system.

Research Project

This research will introduce a method to comprehensively optimize winter road maintenance in urban areas where transportation quality can significantly be impacted by adverse climatic conditions. The research will aim at 1) detecting the exiting gaps in winter road maintenance, 2) maximizing the efficiency of the investments in maintaining the quality of transportation during the cold season, and, 3) contributing to the safety, comfort, and economy of the residents of the affected areas.

The method is based on creating a proactive, rather than reactive, approach that can monitor road conditions, evaluate maintenance options using a fuzzy logic model, and prioritize preventive or maintenance measures to retain the safety and serviceability of urban roads during the cold season.

The proposed research will provide a comprehensive approach for optimizing maintenance measures and is expected to have the following outcomes:

- It enables decision-makers to make comparisons between different possible scenarios based on the criticality score for maintenance.
- It prioritizes the maintenance measures for each facility based on the fuzzy score it has received after collecting data. This mitigates bias and human judgment in selecting between various alternatives.
- The suggested solutions are cost-effective, sustainable and will not compromise the durability of the pavement

ABOUT THE AUTHORS
The research team consisted of Tommy Tafazzoli of Washington State University.

ABOUT THE FUNDERS
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EXPECTED DATE OF COMPLETION
August 2022

FOR MORE INFORMATION
http://depts.washington.edu/pactrans/research/projects/developing-a-proactive-fuzzy-logic-model-for-optimizing-winter-road-maintenance-measures-in-cold-urban-areas-using-real-time-data/