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DEVELOPMENT OF A PROCEDURE FOR PRIORITIZING INTERSECTIONS FOR IMPROVEMENTS CONSIDERING SAFETY AND OPERATIONAL FACTORS

PROBLEM STATEMENT

In Florida, it is necessary for transportation planners and traffic engineers to develop an improvement program periodically to resolve safety and operational problems at intersections. However the conflict between demand for intersection improvements and limited budget often requires a reasonable prioritization and selection of intersection improvement projects with the most effective countermeasures to optimize the utilization of available funds.

The existing prioritizing method in Florida is based on benefit-cost analysis, which adopts the quotient of benefit due to improvements over project cost to evaluate safety effectiveness only but not operational effectiveness. Unfortunately, an improvement for intersections with good safety effectiveness does not insure operational effectiveness; in fact, such improvements may disadvantage traffic operations. Therefore, it is important to develop a new procedure that considers both safety and operational factors for transportation planners and engineers to make reasonable and comprehensive decisions concerning intersection improvements.

OBJECTIVES

The primary objective of this research was to develop a new procedure to evaluate the safety and operational effectiveness of proposed countermeasures in order to provide a priority list of intersection improvements that consider both factors. This priority list can be used as a reference by transportation practitioners and decision makers to make decisions concerning the short- to medium-term planning of intersection improvements.

Another objective of this research project was to develop a computer-based decision-making support system to implement the procedure developed in this research. This system provides a user-friendly interface to input data and output the priority list in a standard format.

FINDINGS AND CONCLUSIONS

A new procedure considering both safety and operational factors was generated in this research. The procedure may be described as following:

- First, a preliminary list including candidate intersections is produced based on the crash rate.
- Second, safety analysis and operational analysis are processed to evaluate the safety and operational performance of proposed improvements. Benefit-cost ratio (*B/C*) for safety, which is produced from the existing prioritizing method, is adopted as the safety criterion.

The operational criteria, estimated average control delay reduction (Δd) and existing average control delay (d_b), are derived from the operational analysis based on HCM 2000.

- Third, the Multi-Layer Prioritizing (MLP) method, which prioritizes projects in several layers, is used to combine safety and operational factors to generate an integrated priority list. A hierarchical clustering algorithm is adopted for clustering projects in each layer. Two kinds of priority sequences are developed in the MLP method: Procedure I is $B/C \rightarrow \Delta d \rightarrow d_b$, indicating that safety factor has precedence over operational factors; and Procedure II is $\Delta d \rightarrow B/C \rightarrow d_b$, representing an opposite priority.
- Finally, given budget limitations, transportation planners select the top intersection improvement projects in the priority list as the final list to implement improvements.

To assist transportation planners in implementing this new prioritizing procedure, a computer-based system, which integrates operational analysis function, was developed to produce the priority list. The first step to use this software is data collection including *B/C* for safety, traffic volume, geometric design, type of traffic control, and proposed countermeasures. The priority list is produced by the system after importing these data.

BENEFITS

This research has the potential to result in significant time and cost savings. Transportation practitioners and decision makers can use this procedure to allocate funds for improvements at intersections, based on the most cost-effective and efficient improvement projects and according to the intersection characteristics.

This procedure provides a more reasonable method for programming of intersection improvement projects; where prior procedures considered safety factors only, the developed procedure produces a comprehensive prioritization by combining both safety and operational factors. The MLP method provides a quantified process to combine safety and operational factors through a hierarchical structure, and it is easy to extend the structure of MLP, e.g., by adding/removing a criterion or exchanging the positions of two criteria (importance).

Ultimately, this research has resulted in a more flexible and more versatile approach to intersection improvement decision-making that utilizes both safety and operational factors. Because the procedure provides two priority sequences (i.e., based on safety factors or operational factors), the most appropriate sequence can be selected based on expert opinion.

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