Interactions Between Different Managed Lane Systems, A Comparative Analysis

Master‘s Thesis of Asadullah Faizi

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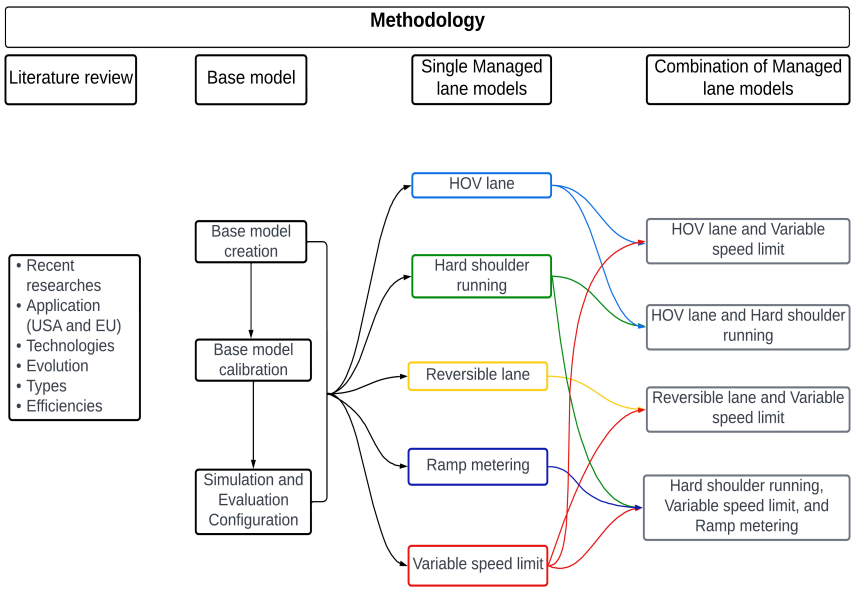

Fig. 1: Methodology for Creations and Analyzes of the Interaction Between Different Managed Lane Systems

Results:

• The study examines the efficiency of single MLS as well as their combination. In case of carpooling lanes such as HOV lanes and Reversible lanes, their efficiency is influenced by the percentage of HOV share on these lanes. At 10% HOVs, the underutilized capacity happens which reduces traffic efficiency, while at 40%, overcrowding happens which makes these carpooling lanes unattractive. Optimal efficiency occurs with a 20-30% HOV share. Furthermore, higher HOVs percentage correlate with more passengers carried.• The introduction of VSL positively affects traffic speed and travel time, especially when VSL exceeds the average speed. Cars travel time is reduced by 5.52%, and trucks benefit significantly, with a 15.7% reduction in travel time.• Opening the hard shoulder during peak hours reduces cars travel time by 11.18%.• Ramp metering enhances safety but doesn't notably increase system-wide efficiency.• Combining HOV lanes with VSL adversely affects flow, speed, and travel time but increases passenger numbers.• Interaction between HOV lanes with HSR improves efficiency across all KPIs.• Combining Reversible lanes and VSL enhances GPL efficiency, but VSL implementation in the Reversible lane slightly reduces efficiency.

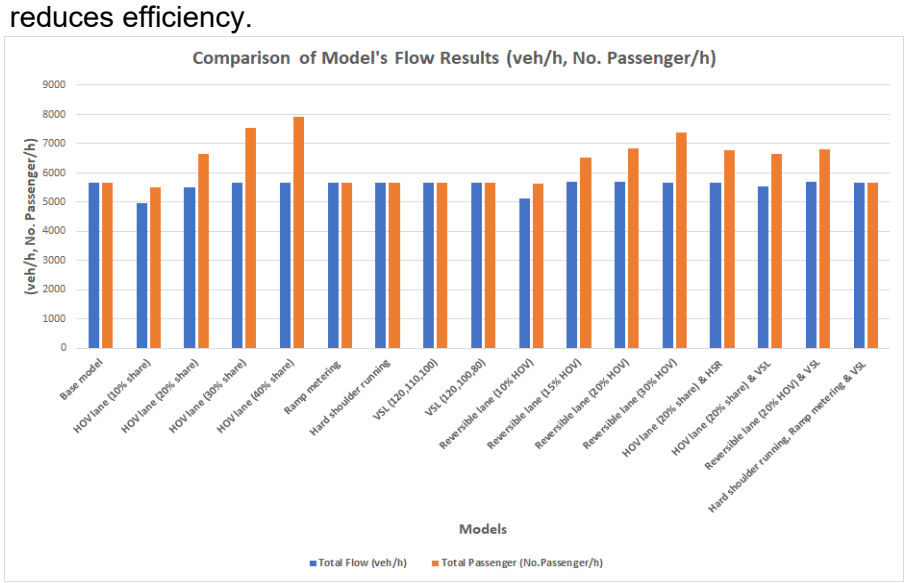

Fig. 2: Comparison of Models' Flow Results

Background:

Managed lanes are a cost-effective solution to enhance transportation networks by implementing various traffic control strategies on existing roadways. Recent developments in managed lanes have led to intricate, multi-controlled traffic systems. When various types of managed lanes are used, they can either enhance or diminish each other's effectiveness. This master's thesis explores the interactions between different managed lane systems (MLS) through simulation.

Methodology:

The study begins with literature review on the recent research, development, evolution, and efficiency of various type of MLS specially in USA and EU. Followed by creating a synthetic base model in Vissim which includes 15km section of a freeway with four interchanges in between. This model is designed based on HBS manual and it represents the network without any MLS. Subsequently, single ML models and combination, including HOV lanes, HSR, reversible lanes, ramp metering, and VSL, are created. These are then comparatively analyzed with the base model and relevant managed lane models using KPIs such as traffic flow, speed, and travel time. The analysis aims to determine the impact of each MLS and their combination on each other as well as on the network efficiency.

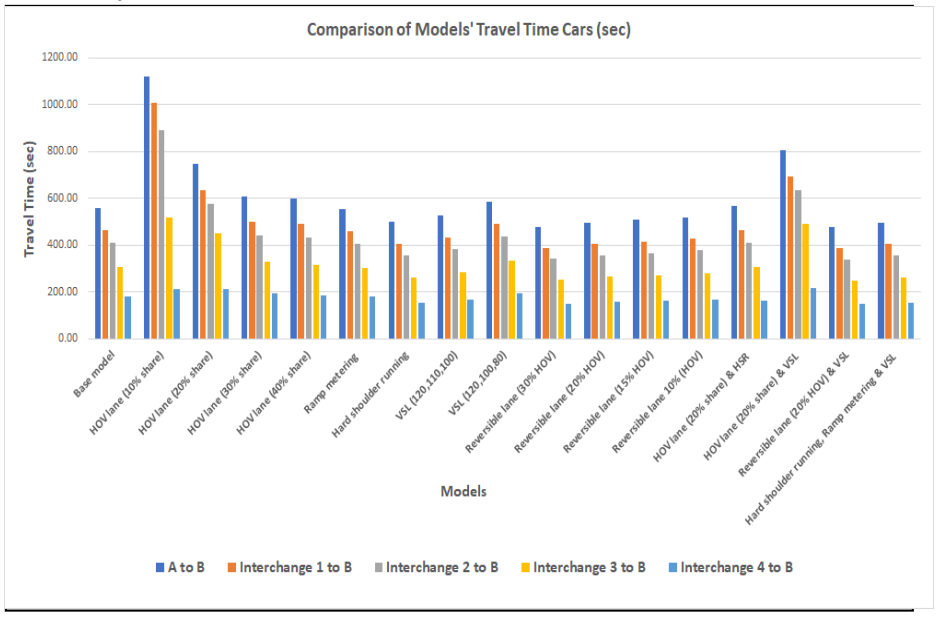

Fig. 3: Comparison of Models' Travel Time Results

Discussions:

The assumptions made in this study give rise to certain limitations in the research. Due to the unavailability of real-world data, the models used are synthetic and approximate the behavior characteristics of general freeways. Additionally, default driving behavior parameters were employed for model calibration. To address these limitations, future research should involve applying these models to real-world freeway systems with observed parameters, allowing for the calibration of driving behavior parameters. It is also recommended to adopt dynamic traffic assignments, explore the impact of various vehicle compositions, such as autonomous and CACC vehicles, on managed lane models, and integrate adaptive VSL systems through VisVAP software.