A SYSTEMATIC APPROACH FOR QUANTIFICATION OF THE IMPACT OF TRANSPORTATION INVESTMENTS ON CONGESTION MITIGATION

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Introduction

Transportation agencies invest funds to improve the efficiency of their transportation systems. However, the effectiveness of such investment is hard to quantify. For example, during the period 2015 - 2017, the Alabama Department of Transportation (ALDOT) spent $1,087,758,072 for transportation improvements in Jefferson County alone. Still, a question remains on whether or not the investment resulted in measurable reductions in traffic congestion in the region.

Study Objective

The objective of this work is to propose a straightforward method to assess the impact of transportation investments on congestion mitigation using readily available traffic data.

Methodology

Data

Speed data for weekdays for the entire Jefferson County was taken from the National Performance Management Research Data Set (NPMRDS) for the years 2015, 2016 and 2017 and Annual Average Daily Traffic (AADT) data was obtained from the Alabama Department of Transportation (ALDOT).

Approach

The ArcGIS software was used to select the urban area of Jefferson County and organize the speed data for all freeway segments within the urban area**. Speeds for each year of study were categorized within 16 bins** using a 5 mph step, starting with speeds <2.5 mph (speed bin 1) and ending with speeds ≥ 72.5 mph (speed bin 16).

Methodology

Speed bins were further **classified in 3 states** representing congestion conditions, namely congested traffic state (speed < 22.5mph), tolerable traffic state (27.5mph ≤ speed < 57.5mph) and comfortable traffic state (speed ≥ 57.5mph).

The total travel time spent in each speed bin for each study year was calculated using the hourly average segment speed and segment length and multiplied by the AADT data for each study segment. The results were used to determine the **% travel time spent (%TTS) in each speed bin** (e.g., %TTS1, %TTS2,..., %TTS16) on an hour-by-hour basis for the years 2015, 2016, and 2017.

Results were aggregated to determine the %TTS under each one of the three traffic states (i.e., congested, tolerable, and comfortable) per year by adding the %TTSs for all bins corresponding to each traffic state for each year. Formulation for %TTS9 is summarized below as an example:

- Total time was spent in the speed bin9 (TTS9) $= (\text{ADDT1} \times \text{Distance1} \div \text{Speed1}) + (\text{ADDT2} \times \text{Distance2} \div \text{Speed2}) + (\text{ADDT3} \times \text{Distance3} \div \text{Speed3}) \ldots + (\text{ADDT9} \times \text{Distance9} \div \text{Speed9})$
- It is only taken speed >=37.5mph and speed<22 42.5mph, which is the range of speed bin9
- Total time spent in all bins (TTS) = TTS1 + TTS2 + TTS3 + TTS4 + TTS5……TTS16
- $\%\text{TTS9} = \frac{\text{Time was spent in the bin9 (TTS9)}}{\text{Total time was spent in all bins(TTS)}} \times 100$

Figures 1 and 3 illustrate the range of each speed bins for 2015, 2016 and 2017 as a percentage for morning and evening peak hours (7.00-8.00 and 5.00-6.00 pm), respectively. Furthermore, Figures 2 and 4 demonstrate the range of conditions (congested, tolerable and comfortable) for 2015, 2016 and 2017 as a percentage for morning and evening peak hours, respectively.

Sample Results

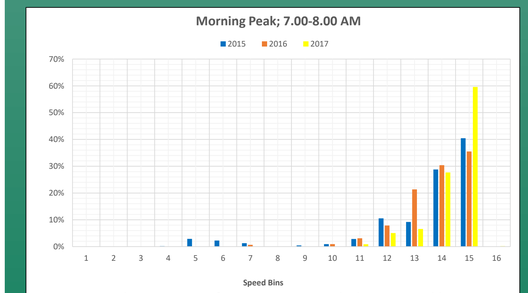

Figure 1: Total percentage of time spent on each the 16 speed bins in Jefferson County (2015-2017; 7:00-8:00 AM)

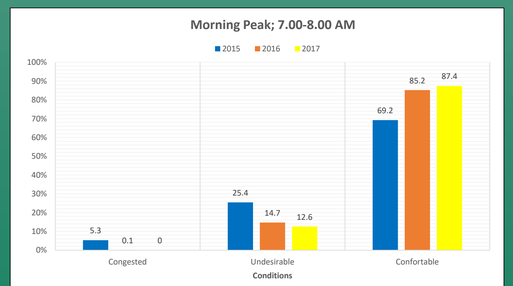

Figure 2: Total percentage of time spent on the each conditions in Jefferson County (2015-2017; 7:00-8:00 AM)

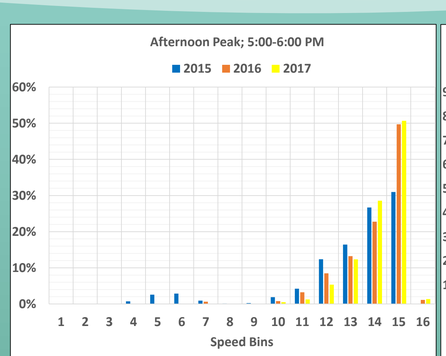

Figure 3: Total percentage of time spent on each the 16 speed bins in Jefferson County (2015-2017; 5:00-6:00 PM).

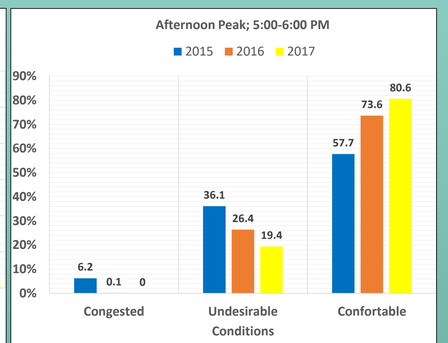

Figure 4: Total percentage of time spent on the each conditions in Jefferson County (2015-2017; 5:00-6:00 PM).

Results and Discussion

The findings show **a consistent decrease in the %TTS in speed bins associated with the congested and tolerable traffic states**, coupled with increase in %TTS in the comfortable traffic state from 2015 to 2017.

These results provide **evidence of the effectiveness of transportation improvements** in freeway segments in the Jefferson County over the 3-year study period.

Conclusion

The method demonstrated in this study provides a systematic and practical approach for quantifying the impact of transportation investments on congestion mitigation.

Transportation agencies can use the proposed method to assess highway performance of individual segments or segments within a region of interest and demonstrate potential effectiveness of implemented strategies and improvements on operational performance.

Acknowledgement

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