Introduction

The impact of land-use change on transportation infrastructure and vice versa, in the St Louis region is of key importance. LEAMtrans helps in assessing the changes in travel demand in the region due to growth in region, relocation of people or introduction of new roads. The impact is measured in terms of an index 'volume-to-capacity' (V/C) ratio derived from the traffic volume and capacity of the roads. As this ratio approaches a threshold value of 0.80, we assume that the road is getting congested. This congestion then further drives a change in land-use through changed attractiveness of the affected areas.

Methodology

Impact of land-use change on Transportation

LEAMtrans uses an approach similar to the conventional four-step Travel Demand Modeling approach. In this method, 'rampsheds', as shown in *figure 1*, are utilized in lieu of 'Traffic Analysis Zones (TAZ)'. Rampsheds are areas around a chosen ramp, to which people are more likely to go than any other chosen ramp. It is developed based on travel-time friction through cells (cost-allocation method). These ramps form the nodes and the roads connecting two adjacent nodes form the links in the road network. For the analysis, US and Interstate highways only in the region were chosen.
The road network is used in the pre-processing stage to obtain the routes in the road network between all pairs of origin and destination nodes. The inputs for the LEAMtrans are:

- Land-use map (as shown in *figure 3*)
- Road network
- Rampshed map
- Trip Generation rates

These maps are processed using a programming code designed to emulate the four-steps of Travel Demand Modeling and produce traffic counts for the evening (PM) peak hour on the roads. The volumes on the roads are divided with the respective traffic capacity to obtain the V/C ratio for the road. The V/C ratio thus represents the level of

utilization of the road and indicates whether the road is running congested or approaching congestion or has un-congested flow. Thus an impact due to land-use change on transportation is measured (See *figure 6*).

Transportation as a driver for land-use change

Traffic-flows close to the design-capacity for a road cause the travel-speed on such a road to drop below the design-speed or the free-flow speed, thus, increasing the travel-time over such a road. An increase in travel-time over a road makes it less attractive for people traveling on them. People tend to choose alternative routes, which might not be the shortest path for reaching their destination. To enable perception of this change in behavior, the employment attractors for the region are changed based on the improved travel-times over the roads. These employment attractor maps are then made available for the rest of the LEAM model to generate updated land-use for the region. Thus, the impact on transportation is translated into a driver for land-use change through this mechanism.

This approach enables LEAMtrans to run parallel with the LEAM model.

Results

LEAMtrans was developed for and applied to the St. Louis Metro region. The road network in the analysis was limited to US highways and Interstates in the region. The analysis produced peak hour (evening) traffic on this road network.

Preliminary results from one scenario indicate, as might be expected, that the bridges will become heavily congested over the years. Congestion is also likely on I-270, I-70 between I-270 and the bridge, I-64, I-44 & I-55 between I-270 and the bridge. US-40 connecting I-70 and I-64 is also likely to get congested. Almost all of the roads outside of the St Louis city and on the Illinois side seem to have an un-congested flow in the year 2025 (See *figure 2* and *figure 4*).

The congestion is reflected in the reduced travel-speeds and thus reduced travel-times on these roads. This reduction in travel-times, cause a significant variation in the employment attractor in the region. The attractiveness of inner city areas declines while that of the outlying areas increases, thereby increasing sprawl (See *figure 5*).

Conclusion

The present results from LEAMtrans appear to be intuitive. This approach of modeling traffic can be further improved by extensive calibration-validation of the model in different regions. Coupling of conventional travel-demand models like CUBE and VISUM with LEAM could result in a highly flexible and robust approach.

References

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2. Institute of Transportation Engineers, 1997. *Trip Generation Sixth Edition*. Publ. No. 1R-016D. Institute of Transportation Engineers, Washington, D.C.

3. HCM (2000), *Highway Capacity Manual*, Transportation Research Record, National Research Council, Washington DC.

Appendix

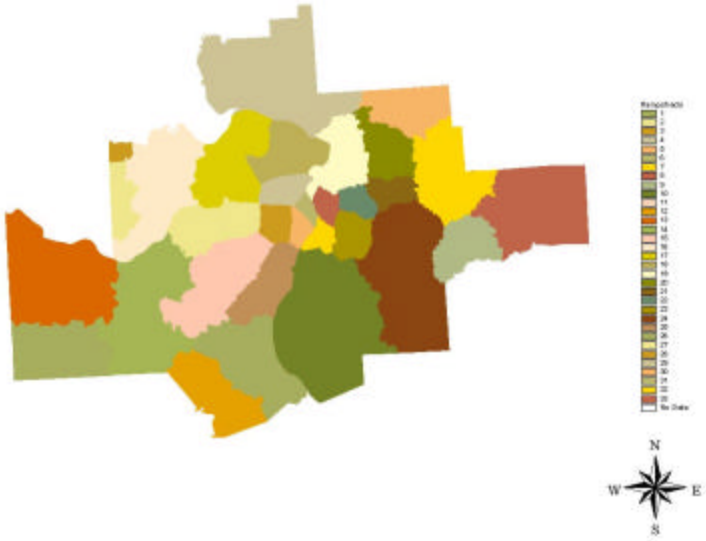

Figure 1: The rampsheds for the St. Louis region

Figure 2: The Congested speeds over the road network

Figure 3: LEAM 2025 land-use for the St. Louis region

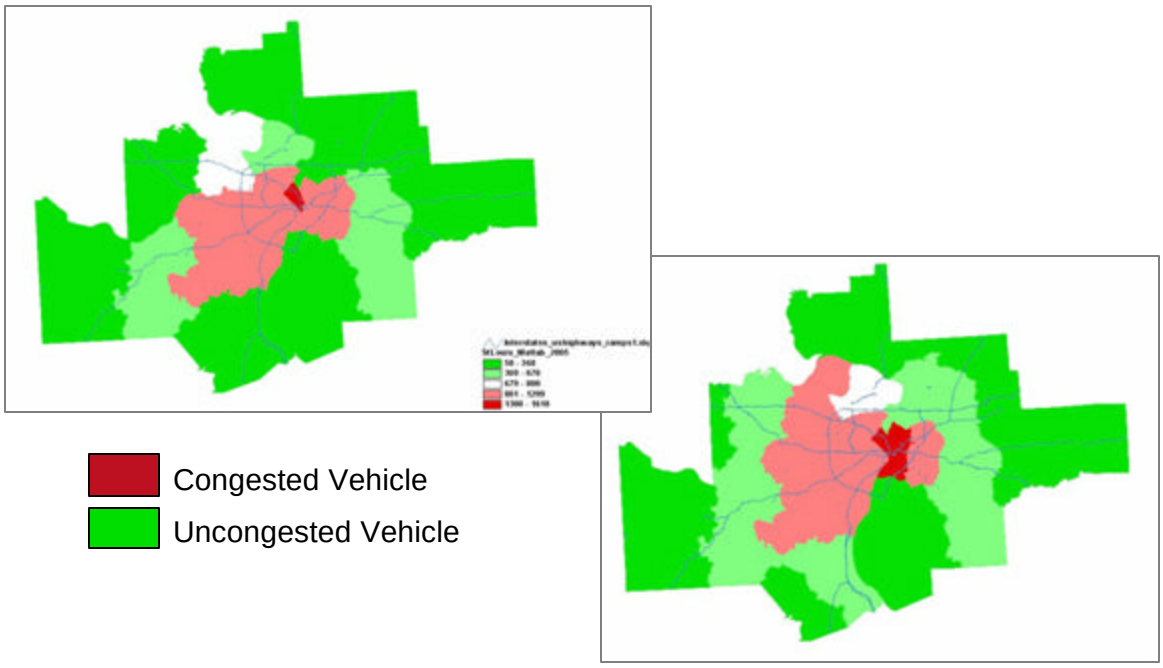

Figure 4: Congested and Un-congested Rampsheds

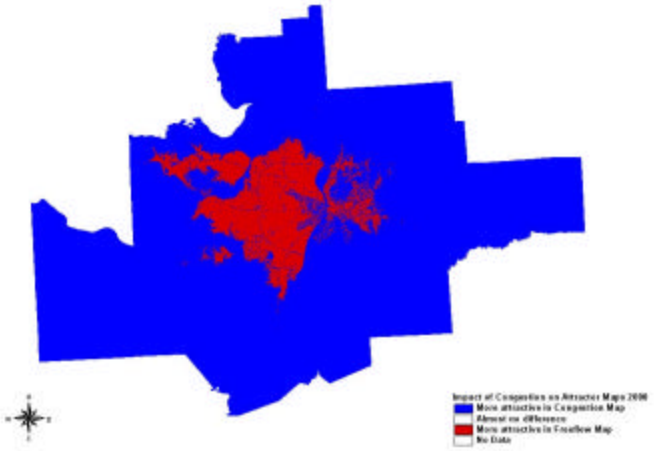

Figure 5: Impact of congestion on Employment Attractor in the St Louis region

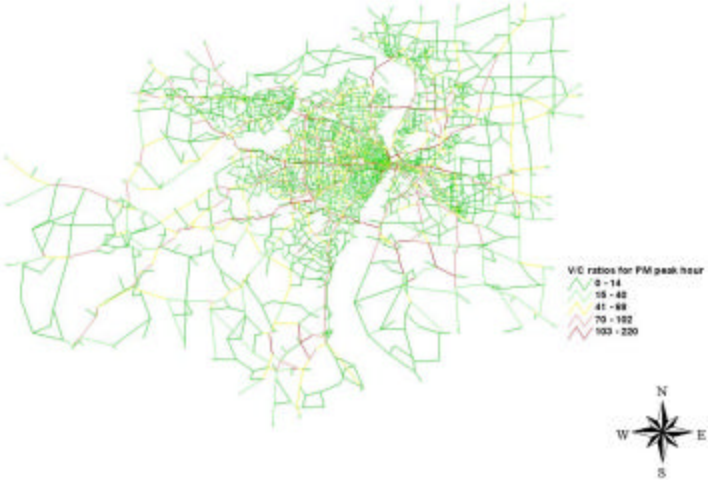

Figure 6: Volume over capacity ratios from CUBE run on LEAM 2025 land-use