TRB 95th Annual Meeting Paper #16-6961

Transportation Cost Index as a Performance Measure for Transportation and Land Use Systems: New Approaches and Applications

Liming Wang Huajie Yang Jenny Liu
Portland State University

❖ MOTIVATIONS

This research aims to fill gaps in existing multi-modal performance measures for transportation and land use systems:

1. As a supplement/replacement of traffic-centric measures such as LOS, travel delay;
2. Recent federal and state legislations put more emphases on using of performance measures in transportation planning & operation: MAP-21, Oregon Job and Transportation Act (OJTA);
3. Existing performance measures for transportation and land use systems, although now numerous, have their own limitation (Table 1), and leave important aspects and policy areas uncovered, for example, the balance of transportation investment between different modes and across geographical areas as mandated by OJTA.

TABLE 1. Summary of existing performance measures for LU & T systems

Type of Measures	Examples	Pros	Cons
Market Potential Measures	Employment accessible within 30 minutes by public transit during a.m. peak	• Easy to interpret/understand • Sensitivity to chosen mode, time-of-day, and specific opportunities	• Opportunities, mode, time-of-day and time budget specific; • Potentially many measures to look at
Utility-based Measures	Logsum as an accessibility measure	• Elegant, composite measures for all modes; • possible to derive net user benefit between scenarios	• Hard to interpret by itself; unable to compare across regions/times
Weighted Indices	Walk-score ®; Generalized cost weighted access to employment	• Location-specific composite measures for a chosen mode	• Hard to interpret by itself; • Focuses on a single mode
Person-specific measures	Time-space prism measures	• Detailed realistic measure	• Data availability; • too many measures to examine
Generalized Costs Indicator	Generalized costs indicator for private car by type of trips	• Easy to interpret/understand; able to monitor trends and compare scenarios	• per distance costs for motorized trips ignoring land use system; mode, time-of-day specific

❖ METHODOLOGY

We propose a Transportation Cost Index (TCI) performance measure for transportation and land use systems, inspired by the popular Consumer Price Index (CPI), which measures changes in the price level of a market basket of consumer goods and services purchased by households. In analogy to CPI, a TCI measures the cost of transportation for meeting daily needs. It can be:

- A Comprehensive measure of transportation and land use systems;
- Easy to interpret/understand;
- Based on widely available data sources, possible to use it to monitor trends and project scenario outcomes;
- Able to serve as an indicator for policy areas including transportation and land use system compatibility and balance.

To build a TCI in the spirit of CPI to track transportation costs, it involves two steps:

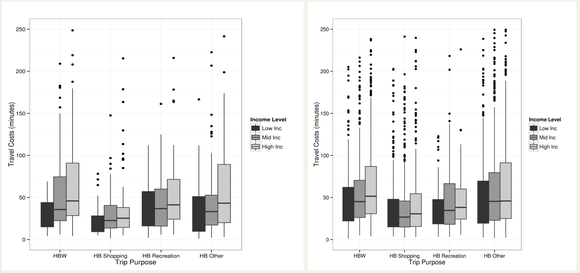
Identify a basket of destinations based on pre-defined groups (e.g. trip purpose categories) → **Track the costs of accessing destinations in the basket**

FIGURE 1. Steps of computing TCI

❖IMPLEMENTATIONS & APPLICATIONS

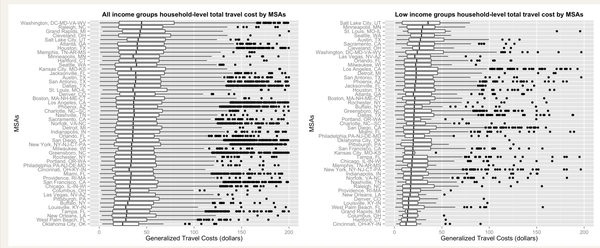
Two current implementations utilize different data sources and are suitable for different use cases:

- **Survey-based Approach** utilizes travel survey data to calculate travel costs for each trip and each household, and then aggregates trip-level and household-level costs by geography (e.g. TAZ, district), trip purpose and/or income group.
- **Cluster-based Approach** first identifies activity centers in a study area with spatial clustering of activities and uses them as travel market baskets; the transportation costs are then computed for every geography (TAZ), trip purpose and income group as the costs of accessing the destinations in the travel market baskets.



2 (a) 2 (b)

FIGURE 2 (a). 2011 household' average transportation cost (minutes) by trip purpose and income; (b) 1994 household' average transportation cost (minutes) by trip purpose and income. Data sources: 2011, 1994 Oregon Household Activity Survey (OHAS).



3 (a) 3 (b)

FIGURE 3. Transportation Costs by MSA: 3(a) for all households, 3(b) for low income households. Data source: NHTS, 2009

Travel Costs Calculation for travelers from income group *i* using mode *m* from original TAZ *k* to access to TAZ *j* in for purpose *p*

$$TC_{pimkj} = C_m + TTime_{pimkj} * VOT_{pim} + TDist_{pimkj} * MC_m$$

Where C_m Constant for mode *m*; $TTime_{pimkj}$ and $TDist_{pimkj}$ Travel time and distance; VOT_{pim} is the value of time; and MC_m is distance-based monetary cost for mode *m*

4 (a) 4 (b)

FIGURE 4. Compare 2010 base year transportation costs (4a) with 2030 RTP scenario (4b) for Corvallis, OR. Data source: ODOT JEMnR TDM for Corvallis

❖CONCLUSION AND FUTURE WORK

This paper presents the results of our project aiming to develop a Transportation Cost Index (TCI) as a comprehensive multimodal performance measure for transportation and land use systems, to address certain limitations of existing similar measures and fill gaps in policy areas. It was adopted by the Accessibility Indicator Development Team (IDT) as one of the indicators for the Oregon Least Cost Planning process mandated by OJTA. Some ongoing and future work include:

- Verify patterns of transportation costs with information from alternative data sources;
- Test TCI usage in public engagement and policy making process.

❖ACKNOWLEDGEMENTS

• **Oregon DOT** for funding support through Grant # SPR-760;
• **National Institute of Transportation and Communities** for funding support through Grant # 2015-758;