The Challenges of Measuring Transportation Efficiency

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The Challenges of Measuring Transportation Efficiency

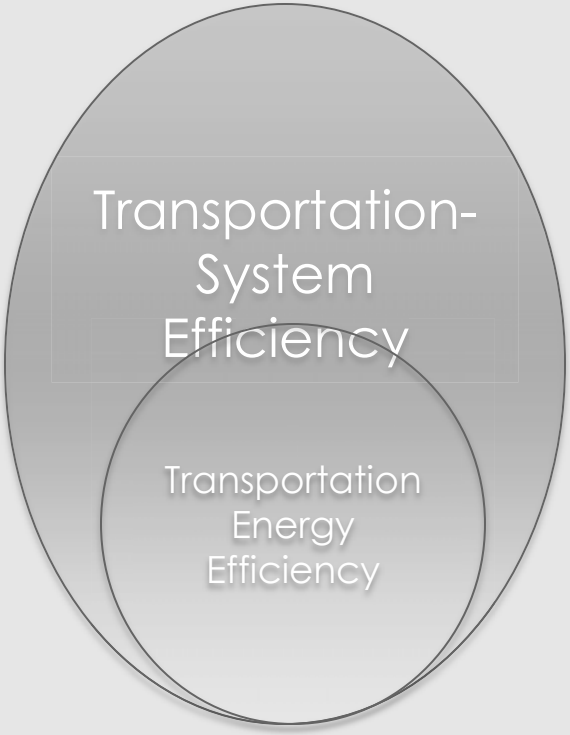
- Motivation
- Literature Review
- Definition of Transportation Efficiency (TE)
- The Challenges of Measuring TE
- Hopeful Examples
- Conclusions

Motivation

- Oil dependence and fuel prices
  - "Peak oil" and Summer 2008 gasoline prices
  - 95% of global transportation energy is oil
- Emissions and global warming
  - 28% of GHG emissions in the US in 2006
- Rural and non-traditional region applications

Literature Review

- Ambiguity in the use of term "transportation efficiency"
  - Transportation-Energy Efficiency
  - Transportation-System Efficiency
- Strategies *Associated* with TE
  - Capacity-utilization
  - Emissions reductions
  - Land-use improvements



Literature Review (cont.)

- *Derived* Measures of TE
  - Utility Models
  - Macroeconomic Models
  - Data Envelopment Analyses
  - Multiple-Criteria Analyses
  - Least-Cost Planning

Definition of Transportation Efficiency

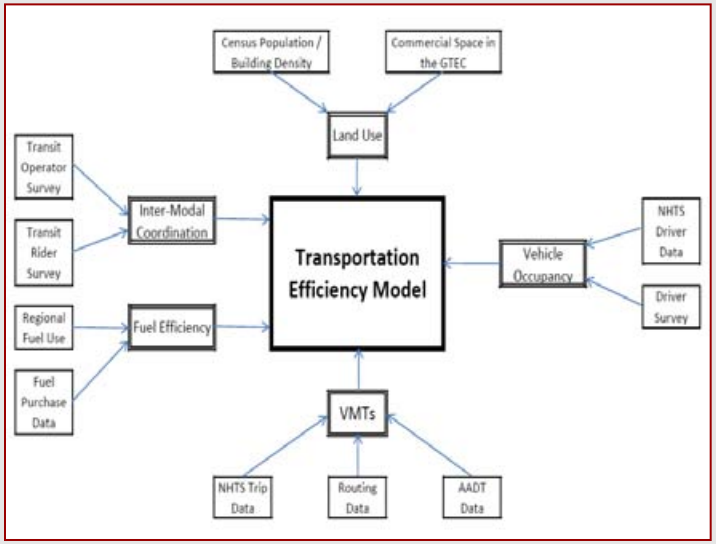
- Common Variables/Criteria
- Common Themes:
  - Maximization of *Service*
  - Minimization of *Cost*
- Derived models attempt to assimilate a variety of variables to make:
  - Spatial comparisons
  - "System" comparisons
  - Temporal comparisons

Category	"Cost" Variables	"Service" Variables
Economic	Prices for the user[5,1] Prices for the operator[11]	Cost savings[1] Economic development and productivity[2]
Environmental	Carbon emitted per mile travelled[1] GHG emissions[1] Noise[11] Fuel used per mile travelled[1]	Reduced impact on the environment [1]
Energy	BTUs per mile travelled[1] Energy used per capita[10] Energy used per person-mile of travel[11] Total energy use[10]	Decreased dependence on fossil fuels[8] Robust energy portfolio[10]
Human	Fatality[10] Serious injury[10]	Improved safety[3] Basic human needs met[11] All travel demand satisfied[11]
Operations	Time spent travelling[5] Time wasted in congested travel[1]	Lower vehicle-miles travelled[7] Fewer trips[11] Coordination between modes[9] Access[10] Choice[3] Speed[1] Convenience[6] Reliability[6] Increased vehicle capacity use[4] Level-of-Service (LOS)[5]

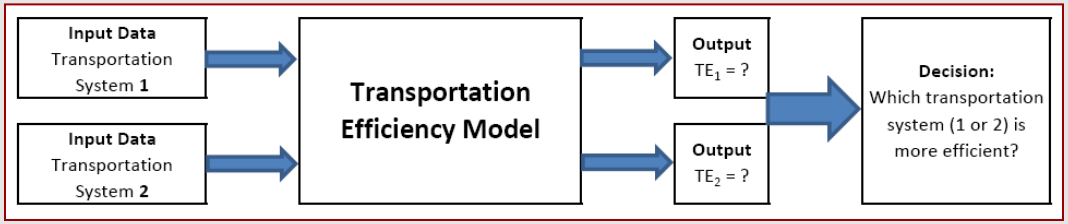
Citations

1. Manikonda et al, 2001
2. Southworth et al, 2004
3. Kavage et al, 2005
4. Barth et al, 2004
5. Moudon et al, 2005
6. Hagler, 2008
7. Johnston, 2006
8. Rubin, 2009
9. Vuchic, 1999
10. VDPS, 1998
11. Added by the authors

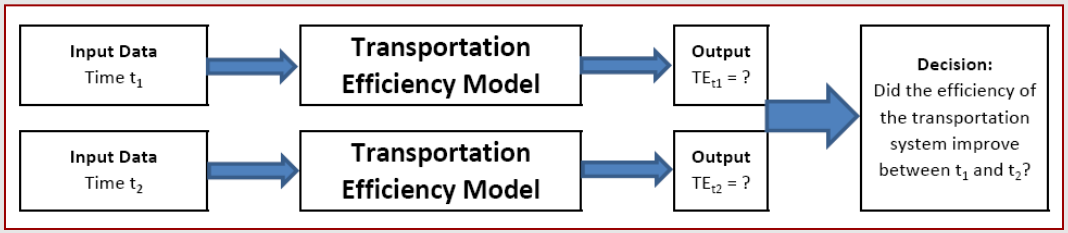
Definition of Transportation Efficiency



Spatial or "System" Comparisons:



Temporal Comparisons:



The Challenges of Measuring Transportation Efficiency

- The “Rebound” Effect
  - Energy demand
  - Transportation demand (generated traffic, or induced demand)
  - A temporal boundary problem
- The “Shifting” Effect
  - A spatial or “system” boundary problem

Hopeful Examples

- Least-Cost Planning
  - Useful parallels between electricity and transportation:
    - Critical public infrastructure
    - Efficiency is important
    - Efficiency viewed as a provider of supply
  - Complications related to LCP in transportation:
    - No single service variable, like kW
    - No central control of service, more stakeholders
- Multiple-Criteria Analysis
  - Limitless inclusiveness
  - Provides the opportunity to weight criteria
  - Flexible boundaries

Conclusions

- Importance of dealing with “rebound” effects and “shifting” effects
- Importance of using an assimilative model, like LCP or MCA

Thank You

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Questions?

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