Chapter 16
Impacts of Transportation Systems on Land-use
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Land Use Impacts – Are they for real?

Consider Monroe county in Indiana
Does not have an interstate passing through
Interstate 69 is planned to pass through the state
Expected construction completion: Year 2015
Between 2015 and 2025, would you expect any changes in:
- % agricultural land
- number of shops per acre
- number of people per acre, etc.?
Transportation-Land Use Relationship

Key past studies:

1826 – Johann Henrich von Thunen
   Studied relationship between price of land and accessibility to activity centers

1960 – Alonso
   Studied relationship between rent and transportation availability

1996-2003 – Cervero
   Studied 2-way relationships between transportation and land-use

1999 – Parsons (NCHRP Report 423A)
   Summarized land-use impacts of highway and transit investments
Performance Measures for Land-use Impact Assessment

Transportation can affect Land-use in many ways:

Land-use fractions (land-areas)
- % agricultural
- % residential
- % commercial
- % industrial
- other

Land-use intensities
- price of land ($ per acre)
- residential density (nr. pf people per sq. mile)
- commercial density (nr. of businesses per sq. mile)
- etc.
Transportation-Land Use Relationship

Is Transportation a result of Land-use Patterns?

*Does the transportation system determine the ultimate growth and shape of the land use patterns within its area of influence?*

OR

Are Land-use Patterns a result of Transportation system?

*Do land use patterns determine the form of the transportation system in an area?*
Actually, relationship occurs in both ways:

Transportation facilities determine the land-use patterns in an area

AND

Land-use patterns determine the types and number of transportation systems in an area
Transportation-Land Use Relationship

Change in Activity Patterns

TRANSPORTATION

LAND USE

Change in Accessibility, and Mobility.
How does transportation affect land-use?

Generally:

- By providing or increasing **accessibility** to and from activity centers 
  *(opening up formerly inaccessible areas)*

- By increasing **mobility** 
  *(faster, more convenient travel between areas)*

Specifically:

- depends on type of transportation intervention (next slide)
## Transportation-Land Use Relationship

by type of transportation intervention

<table>
<thead>
<tr>
<th>Transportation Intervention</th>
<th>Land Use Impact</th>
</tr>
</thead>
</table>
| New facilities (i.e. highway corridors, interchanges) | Redistribution of metropolitan growth to highway corridors. 
Decentralization of population and employment. 
Increased land values and concentration of development around interchanges. |
| Added lanes, intersections/ | Same as above, but to a lesser degree. |
| System management | None likely. |
| Congestion pricing | Unknown. 
Possible shift of population and jobs toward more accessible locations. 
Possible shift of population and employment to exurban areas. |
| Parking pricing, management | Unknown 
Possible increased development of major employment centers. 
Likely increased development density. |
| Vehicle, fuel tax | More compact development if cost of driving high enough to encourage use of other modes. |
| Transportation demand management | None likely |
| Safety improvements | None likely |

(Modified from: Parsons, 1990)
Transportation impacts on land-use: Are they large or small?

Depends on:

- type of the transportation intervention
- scale of the transportation intervention
- maturity (level of development) of existing transportation system
- maturity of existing land-use system
- the land-use performance measure of interest
Transportation-Land Use Relationship

Influence of Intervention type - example:

Highways

- impacts are more diffused
  Direct impacts: ROW (acquisitions, displacements)
  Indirect or induced impacts: attraction of new development

Transit

- impacts are more localized
  Direct impacts: ROW, terminals (acquisitions, displacements)
  Indirect or induced impacts: attraction of new development
Transportation-Land Use Relationship

Do other factors (besides Transportation) Affect Land-use?
Other Land-use factors besides Transportation
What is “Land-use Elasticity” with respect to transportation supply?

Is the % change in some land-use performance measure with respect to a unit % change in transportation supply

*Examples: Increase in area of commercial activities for every mile of new road
Increase in residential density after building new transit line*

What is “Land-use Elasticity” with respect to transportation demand?

Is the % change in some land-use performance measure with respect to a unit % change in transportation demand

*Examples: Increase in area of commercial activities for every 1% increase in VMT
Increase in number of businesses in an area for every 1% increase in passenger-trips*
Transportation-Land Use Relationship - Elasticities

Land-use Elasticities: Are they important?

Help calculate the land-use impacts in response to incremental changes in transportation supply or demand

LU elasticities can vary widely

What are the influential factors of Land-use elasticities?

- type and scale of the transportation system intervention
- maturity (level of development) of existing transportation system before the intervention
- maturity of existing land-use system before the intervention
- the land-use performance measure of interest
## Transportation-Land Use Relationship - Elasticities

<table>
<thead>
<tr>
<th>Transportation System Action</th>
<th>Elasticity of its Impact on Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>New facilities (i.e. highway corridors, interchanges)</td>
<td>high</td>
</tr>
<tr>
<td>Added lanes, intersections</td>
<td>high</td>
</tr>
<tr>
<td>System management</td>
<td>low</td>
</tr>
<tr>
<td>Congestion pricing</td>
<td>high</td>
</tr>
<tr>
<td>Parking pricing, management</td>
<td>high</td>
</tr>
<tr>
<td>Vehicle, fuel tax</td>
<td>moderate</td>
</tr>
<tr>
<td>Transportation demand management</td>
<td>low</td>
</tr>
<tr>
<td>Safety improvements</td>
<td>low</td>
</tr>
</tbody>
</table>

Parsons, 1990
How do we estimate Impacts of a proposed Transportation project on Land-use?

- Identify the type, scope, etc. of the transportation intervention
- Define desired time and spatial scopes of the impacts
- Define performance measures of interest
- Establish existing transportation and land-use conditions (base conditions)
- Establish post-intervention land-use conditions
- Repeat for other transportation alternatives
Transportation-Land Use Relationship – The Steps

1. Define Temporal Scope
   Define the Region of Influence or the Area of Potential Effects

2. Identify Data Requirements
   Identify Land-use Performance Measures

3. Establish existing transportation system supply and demand

4. Carry out Inventory of Transportation Systems

5. Establish existing patterns and intensities of land-use

6. Carry out Inventory of Land-use Systems

7. Land-use Models, Interviews of Land-use Experts, etc.

8. Determine the Land-use Impacts of the Proposed Transportation Action

9. Field Visits, GIS, Questionnaire Surveys, Focus Groups, etc.

10. Repeat for Other Transportation Alternatives
Temporal Dimension of Land-use Impacts

Time Dimension (short-term/long-term)
- Short-term (a few days-months)
- Long-term (many years)

Land-use impacts are mostly long-term – only a few LU performance measures change in the short term.

Spatial Dimension (may be small or very large)
Determining the Existing (Base-Case) Conditions

- Collect data on:
  - Demographics
  - Housing and Public Policies
  - Travel patterns
  - etc.,

- Tools for the data collection:
  - Surveys, statistical analysis, GIS
Impact Assessment—Tools for the Analysis

Qualitative Tools
- Expert panels
- Interviews/Surveys
- Case studies
- Etc.

Quantitative Tools
- Allocation Rules
- Decision rules
- Statistical methods
- Computer Models
- Etc.
Analysis for Impact Assessment—Qualitative Tools (continued)

- Expert panels
  - Delphi

- Interviews / Surveys

- Case studies
  - Comparable situations
Analysis for Impact Assessment—Quantitative Tools (continued)

- Allocation rules
  - Constant share
    - Same growth to all zones
  - Share of growth / shift-share
    - Based on recent growth trends
  - Gravity model
    - See example 16-1
Analysis for Impact Assessment—Quantitative Tools (continued)

- **Decision rules**
  - Rules of thumb

- **Statistical methods**
  - Regression analysis (Tables 16.9/16.10)
    - Property values or commercial development
  - Discrete choice models
    - Household or business location decisions
Analysis for Impact Assessment—Quantitative Tools (continued)

- **Computer models**
  - Travel demand
    - Change in travel patterns
  - Economic (e.g., REMI)
    - Change in population/employment
  - Land-use (e.g., METROSIM, TELUS)
    - Change in land use patterns and development
  - Integrated models (e.g., MEPLAN, TRANUS)
4. Land Use Impacts after the Transportation Intervention

- **Forecasts:**
  - New travel patterns
  - Change in accessibility
  - Population & employment growth
  - New land use patterns

- **Tools:**
  - Expert interviews
  - Statistical analysis
  - Travel demand & freight models
  - Integrated transportation and land use models
Mitigation of Adverse Land-use Impacts

When?
- In case of any undesirable or environmentally adverse land use changes

What?
- avoiding
- minimizing
- rectifying
- reducing and/or
- compensating with a substitute
Useful Resources for Land-use Impact Analysis

1. NCHRP Report 423A
2. WisDOT (1996)
3. Urban Land Institute
4. Victoria Transport Policy Institute
5. Cervero’s studies (see text for 4 of these)
6. I-69 & DART examples
Assessing the Impacts of All Non-user Impacts: Legal Background

- 1969 - NEPA
  - EIS

- 1990’s and 2000s - Transportation Bills
  - ISTEA (1991)
  - TEA (1998)
  - SAFETEA-LU (2005)
Summary of Key Points

1. The Transportation/Land-use Relationship
2. Elasticities
3. Tools for LU Impact Assessment
   - Qualitative/Quantitative
4. Impact Framework
   - Steps
   - State-of-the-practice
5. Legislation
Questions?