An Update on the TLUMIP Program in Oregon

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Outline
Provide Summary of TLUMIP Generations

• Introduction

• Generation 1
  • Model Structures
  • Applications

• Generation 2
  • Model Structure
  • Development

• Conclusions
Introduction
TLUMIP

• Incremental approach
  • Gen1: proof-of-concept, multi-scale
  • Gen2: development for application
  • Gen3: enhancements

• Modified, with experience and opportunities ...
  • Gen1: pressed into application, enhanced
  • Gen2: extended

Generation 1
Urban Level

• UrbanSim
  • year-by-year
  • micro-simulation of space development
  • logit allocations of employment and households with willingness-to-pay

• Lane County, mostly Eugene-Springfield

• Parcel-level development history data
Generation 1
State-wide Level

- TRANUS
  - spatial input-output
  - aggregate, equilibrium
  - integrated transport, land use, economy

- Oregon & Clark County Washington, 122 zones

- Obtained data and assembled model

- Pressed into application

Generation 1 State-wide Model
Model Structure

- Economic Model determines growth of state economy
- Location Model allocates production and transactions
- Transport Model allocates trips to routes
- Model components are linked in space and time
### PRODUCING SECTORS (Note: Re-Orientation)

Industries | Households | Land
---|---|---
AGFF | | |
CONS | | |
OMFG | | |
WOOD | | |
PRINT | | |
TECH | | |
TCPU | | |
WLSE | | |
RETL | | |
FIRE | | |
SERV | | |
GOVT | | |
HH_Lo | | |
HH_Mi | | |
HH_HI | | |
IND | | |
COM | | |
URBRES | | |
RURRES | | |

### TRANSPORT FLOWS (Z-Z)

#### Transport Categories

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<th>AGFF</th>
<th>CONS</th>
<th>OMFG</th>
<th>WOOD</th>
<th>PRINT</th>
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#### Path Building by Mode

#### Trip Generation

#### Mode Choice

#### Path Choice (Assignment)

#### Capacity Restriction

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### Generation 1 State-wide Model

Transport Model Structure

- **PASOS**: Path Building by Mode
- **COST**: Transport Costs & Disutilities
- **TRANS**: Trip Generation
- **MODES**: Mode Choice Path Choice (Assignment)
- **Capacity Restriction**
Generation 1 State-wide Model Applications

Long-Range Visioning
Willamette Valley Alternative Transportation Futures

The model was used to help big-picture brainstorming on possible transportation and land use futures for Oregon’s most populous and agriculturally productive region.
Investment Analysis

Legislative Directive to Study a New Freeway in Eastern Oregon

The model was used to evaluate the potential for a new freeway to divert development and traffic from Western Oregon to Central and Eastern Oregon.

Induced Growth Analysis

Environmental Impact Statement for Proposed Highway Bypass

- A by-pass of two towns was proposed on a major recreation route within commuting distance of Portland metropolitan area.

- The model was used to examine the potential effects on the growth of population, jobs and travel in the affected area.
Infrastructure Prioritization

Oregon Bridge Deficiency Analysis

- There is a major bridge deterioration problem in Oregon, especially on freeways.
- The model was used to examine:
  - The impacts of limiting truck weights on transport costs, economic production and jobs, and
  - Impacts on travel and land use patterns.

Converting Industry Flows to Heavy Goods Flows

<table>
<thead>
<tr>
<th>Industry Code</th>
<th>Total Goods (Tons/$M)</th>
<th>% Shipped by Truck Weight</th>
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<tr>
<td></td>
<td>Over 80,000 lbs.*</td>
<td>64,000-80,000 lbs.</td>
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<tr>
<td>AGFF</td>
<td>6,150</td>
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<td>CONS</td>
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<tr>
<td>OMFG</td>
<td>2,100</td>
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<td>WOOD</td>
<td>6,000</td>
<td>48</td>
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<td>PRNT</td>
<td>1,500</td>
<td>14</td>
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<td>TECH</td>
<td>250</td>
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<td>TCPU</td>
<td>10</td>
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<td>WISE</td>
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<tr>
<td>GOVT</td>
<td>0</td>
<td>0</td>
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Sources: Special Weights data, Oregon CFS and IMPLAN 1999
Transportation Network

- Bridges tied to network links
- Judgment of bridge deterioration from crack data (no formal model)
- Detour links added
- Close specific links to certain truck types based on weights.
- Assume construction of OTIP/STIP projects

<table>
<thead>
<tr>
<th>Max. Crack Width</th>
<th>Stage 1: Cracks near bents</th>
<th>Stage 2: Cracks in 1/3 span</th>
<th>Stage 3: Cracks throughout</th>
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<tr>
<td>≥ 0.025&quot;</td>
<td>5 years</td>
<td>3 years</td>
<td>1 year</td>
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<tr>
<td>&lt; 0.025&quot;</td>
<td>10 years</td>
<td>7 years</td>
<td>4 years</td>
</tr>
<tr>
<td>Hairline (&lt;0.013&quot;)</td>
<td>15 years</td>
<td>10 years</td>
<td>8 years</td>
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Industry Impacts

2000-2025 Growth in Production of Goods & Services

- Services
- Finance, Insurance, etc.
- Other Manufacturing
- Construction
- Retail
- Transport, Comm., Utilities
- Wood Products
- Equipment, Tech.
- Government, Education
- Wholesale
- Agriculture, Forestry
- Printing

- Flat Funding/64,000 lbs.
- Flat Funding/80,000 lbs.
- Flat Funding/Buy Time
- Investment/Fix All Bridges
- Investment/Recommended
Tax & Spend Outputs

- Stimulus from spending, dampened over time from taxes
- 2050 Economy typically smaller with Tax-Spend scenarios
- 2000-2050 NPV benefit except with Buy Time scenario

NPV of Production Difference
- $17 B
- $-6 B
- $30 B
- $44 B
- $0

Flat Funding/80,000 lbs.
Flat Funding/Buy Time
Investment/Fix Interstates
Investment/Fix All Bridges
Fix All (no tax-spend)
Construction Period

Generation 2 Remit

- Establish integrated state-wide modeling system
  - draw on Generation 1 experience

- Specified:
  - modular design
    - modifications for staging
    - team approach
  - some dynamic process rather than equilibrium
  - some micro-simulation rather than aggregate
• Utilities (and generalized costs) used in
  • logit models
  • hazard - duration models
  • ordered utility models
  • rules
  • parameterized technical coefficients

• Used for
  • allocations in aggregate components
  • probabilities in Monte Carlo selections in micro-simulation components

Generation 2 Structure
Utility Signals

Generation 2 Structure
Modules and Interactions
Generation 2 Structure
Regional Economics and Demographics

- Data store
  - Regional economics and demographics
  - Transport loadings
  - Production allocations and interactions
  - Commercial movements
  - Household allocations
  - Land development
  - Household travel

Generation 2 Structure
ED Framework

- Forecast From External National Econometric Model (e.g., DRI Trendlong)
  - North
  - South
  - East

- Trade Model
  - North
  - South
  - East
  - Rest of World

- Regional Model
  - Consumption Demand
  - Investment Demand
  - Government Demand
  - Input-Output Structure
  - Output
  - Employment
  - Incomes

- Employment-Related Migration
Generation 2 Structure
Production Allocations and Interactions

- regional economics and demographics
- production allocations and interactions
- household allocations
- land development
- commercial movements
- household travel
- transport loadings

Generation 2 Structure
PI Treatment of Space

works at zone level
PI Production - Exchange - Consumption

- **buying allocation process**
- **total consumption**
- **commodity flows**
- **exchange zone**
- **selling allocation process**
- **total production**

Generation 2 Structure
Household Allocations

- **data store**
- **regional economics and demographics**
- **production allocations and interactions**
- **household allocations**
- **land development**
- **household travel**
- **commercial movements**
- **transport loadings**

HA
Household Allocations
Processes and Sub-modules

Synthetic population
- births
- aging
- career
- deaths
- leave household
- income
- move to find work
- household move
- in migrating households

updated synthetic population
- jobs
- dwelling type & size
- location choice
- moving pool
- yes
- no

new household pool
- join new households

next year

Household transitions example

<table>
<thead>
<tr>
<th>TAZ</th>
<th>income</th>
<th>dwelling type &amp; size</th>
<th>location choice</th>
<th>moving pool</th>
<th>new household pool</th>
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<tr>
<td>1 auto</td>
<td>26560/yr</td>
<td>TAZ 1550</td>
<td>no</td>
<td>must stay</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>64yo</td>
<td>Female</td>
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<td>30yo</td>
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<td>11th grade</td>
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<td>66yo</td>
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<td>no occupation</td>
<td>high</td>
<td>not in school</td>
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<tr>
<td>32yo</td>
<td>Male</td>
<td>emp ft</td>
<td>6th</td>
<td>11th grade</td>
<td>not in school</td>
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Household transitions example
### Household transitions example

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<th>5 autos</th>
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<td>7yo</td>
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### Generation 2 Structure

**Land Development**

- regional economics and demographics
- production allocations and interactions
- transport loadings
- commercial movements
- household travel
- household allocations
- land development

**data store**

LD
Generation 2 Structure
LD Treatment of Space

works at cell level

Land Development Module
Considering Transitions Cell-By-Cell

- commercial
- residential low
- residential medium
- industrial
- vacant

Floorspace quantity
**Generation 2 Structure**

Household Travel

Diagram showing the structure with nodes representing different data sets and processes:
- Regional economics and demographics
- Production allocations and interactions
- Household allocations
- Land development
- Households
- Transport
to
- Home-based tour list
- Intermediate stops list
- Home-based primary destination zone
- Work-based primary destination zone
- Dependent tour mode
- Intermediates stop pattern
- Trip list
- Trip mode
- Trip start time
- Trip end time
- Stop cell
- Activity durations
- Synthetic population in zone
- Activity pattern "word"

**Household Travel Processes and Sub-modules**

Diagram showing the processes and sub-modules:
- Home-based tour list
- Work-based tour list
- Intermediate stop zone
- Work-based primary destination zone
- Home-based primary destination zone
- Intermediate stops list
- Dependent tour mode
- Intermediate stop pattern
- Trip list
- Trip mode
- Trip start time
- Trip end time
- Stop cell
- Activity durations
- Synthetic population in zone
- Activity pattern "word"
Generation 2 Structure
Commercial Movements

Data store

- Regional economics and demographics
- Production allocations and interactions
- Household allocations
- Land development
- Household travel
- Commercial movements
- Transport loadings

Generation 2 Structure
Transport Loadings

Data store

- Regional economics and demographics
- Production allocations and interactions
- Household allocations
- Land development
- Household travel
- Commercial movements
- Transport loadings

CT

TS
**Transport Loadings**

Processes and Sub-modules

- Trip list
- Public transport trip list
- Once for each trip in list
- Optimal strategies path selection
- Updated times and costs for links
- Updated times and costs for trips
- Minimum path for trip
- Updated link volumes
- Expected times and costs for links
- Expected times and costs for trips
- Resolve into trip tables by time period
- Personal travel module for same year
- Private vehicle trip list
- Once for each trip in list
- Equilibrium assignment
- Transport Loadings Processes and Sub-modules

**Conclusions**

**Generation 1 Development and Application**

- Calibration challenging
  - Data needs
  - Complexity and interconnectivity
  - Some experience, but paucity of theory

- Big step from prototype to production
  - Complex, a steep learning curve
  - Essentials:
    - Training
    - Good documentation
    - Continuing support
  - Reality that model enhancements ongoing
Conclusions
Generation 1 Development and Application

• Imparting results can be difficult
  • comparatively little experience and exposure
  • results sometimes unexpected
  • not everyone wants the information
  • model runs take time, but policy-makers want answers immediately

• Results must be a logical story
  • people want to know why things happen the way they do
  • need to look at results in many ways:
    • do multiple runs
    • sort through large amounts of data
    • involve different people and agencies in analysis and interpretation

Conclusions
Generation 1 Development and Application

• Aids in communication
  • technical credibility
  • logical story critical
  • visual presentation of results important, but challenging

• Allows change in use of modeling
  • beginning to see
  • from linear, segregated approach
  • to iterative, interactive, integrated approach
Change From A Linear Approach

Policy Question | Technical Analysis | Results | Decision/Action

To An Interactive and Iterative Approach

Policy Question | Results

POLICY

POLICY/TECHNICAL

Refine Question | Technical Analysis

TECHNICAL/POLICY
Conclusions
Generation 2 Development

• Pushing the envelope

• Still in progress

• Critical elements include
  • micro-simulation with heterogeneous agents
    • behavioural dispersion successful
    • more consideration of what is emerging
  • object-oriented perspective

• Team approach working so far

• Run times straining practicality
  • move to parallel treatment of land use and transport components

Acknowledgements

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<tr>
<th>Module or Component</th>
<th>Modeller</th>
<th>Programmer</th>
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<td>Regional Economics and Demographics</td>
<td>Carl Batten</td>
<td>Abe Dunn</td>
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• Tara Weidner
• Bill Upton
• Brian Gregor