

The State of the Practice in Land Use Models

Land Use Modeling Workshop

Salem, Oregon November 20-21, 1995

Objectives

- **Review State of the Practice**
- **Discuss Emerging Requirements & Approaches**
- **Recommendations**

Land Use-Transportation Interaction

Land Use Forecast

Traditional Approach:



**Travel Forecasting
Models**

Land Use-Transportation Interaction

ISTEA/CAA Requirements:

Land Use Model



Travel Forecasting
Models



Air Quality

Existing Land Use Models

- **Spatial Interaction/Lowry Gravity Models**
- **Models Using Input/Output Techniques**
- **Models based on Random Utility/Discrete Choice**
- **Linear Programming/Optimization Models**
- **Regression Models**
- **Microsimulation Models**
- **Models Integrated with GIS**

Existing Land Use Models

- Spatial Interaction/Lowry Gravity Model
 - DRAM/EMPAL (Stephen Putman)
 - PLUM (William Goldner)
 - LILT (Roger Mackett)
 - HLFM II+ (Alan Vorhees)
 - LUTRIM (William Mann)
- Models Using Input/Output Techniques
 - MEPLAN (Marcial Eschenique)

Existing Land Use Models

- **Models Based on Random Utility/Discrete Choice**
 - **Metrosim (Alex Anas)**
 - **Boyce (David Boyce)**
 - **5-LUT (Francisco Martinez)**
 - **OMPO (Paul Waddell)**
 - **RURBAN (Miyamoto and Kitazume)**
- **Linear Programming/Optimization**
 - **POLIS**

Existing Land Use Models

- **Regression Models**
 - EMPIRIC
- **Models using Microsimulation Techniques**
 - NBER HUDS (Kain and Apgar)
 - MASTER (Roger Mackett)
 - IRPUD (Michael Weggener)
- **Models Integrated with GIS**
 - CUFM (John Landis)

Existing Land Use Models: ITLUP (DRAM/EMPAL)

- Only model in widespread use in U.S. MPOs
- Spatial Interactin (Lowry Gravity)
- Cross-Sectional
- Aggregate
 - Zonal
 - Households by Income Quartile
 - Employment by 4-5 industry groups
- Non-Economic (no land market)
- Decisionmakers/Choices Not Explicit
- Workplace Choice.....

Who are the Decisionmakers in Urban Development?

- Households
- Workers
- Businesses
- Developers
- Lenders
- Municipalities
- Transportation Agencies
- School Districts
- Other Local, State, Federal Agencies

Decisionmakers in Urban Development: What choices influence development?

- **Households**
 - Residential Mobility
 - Residential Location
 - Housing Type
 - Housing Tenure
 - Housing Cost
 - Auto Ownership

Decisionmakers in Urban Development

What choices influence development?

- **Workers**
 - Labor Force Participation
 - Job Change
 - Full-time/Part-time
 - Multiple Jobs
 - Workplace Choice
 - Wage
 - Mode of Transportation
 - Travel Behavior

Decisionmakers in Urban Development: What choices influence development?

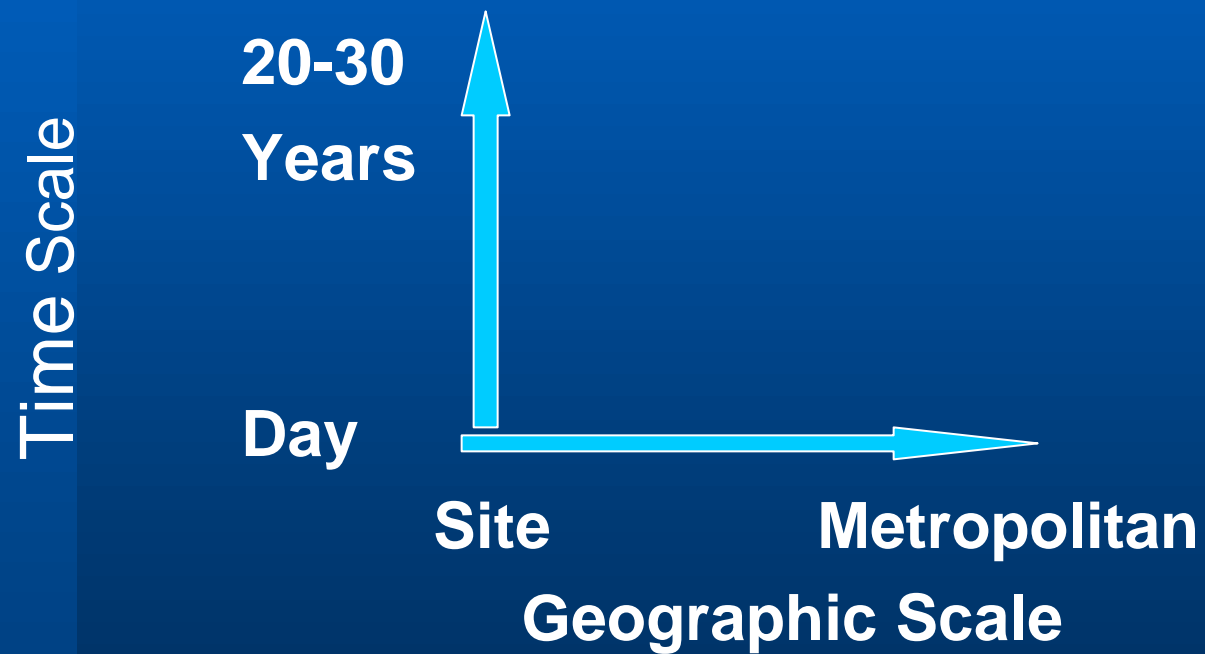
- **Businesses**
 - Birth/Death
 - Number of Employees
 - Wages
 - Type of Space
 - Tenure
 - Space Cost
 - Mobility
 - Location

Decisionmakers in Urban Development: What choices influence development?

- **Municipalities**

- Tax Rates
- Tax Abatements/Incentives
- Zoning
- Urban Design
- Development Fees
- Amenities (Park, Libraries)
- Services (Police, Fire)
- Infrastructure (Water, Sewer, Roads)

Land Use-Transportation Interaction



Land Use-Transportation Interaction

Metropolitan Scale

- **Transportation Characteristics/Policies**
 - **Travel Time/Cost by Mode**
 - **Accessibility to Households by Type**
 - **Accessibility to Employment by Type**
 - **TDM/TSM**
 - **Parking Costs**
 - **Congestion Pricing**

Land Use-Transportation Interaction

Metropolitan Scale

- **Land Use Characteristics**
 - **Urban Form/Structure**
 - **Employment Center Hierarchy**
 - **Land Use Mix**
 - **Jurisdictional Fragmentation**
 - **Economic Structure**
 - **Demographic Structure**
 - **Housing Composition**

Land Use-Transportation Interaction

Sub-Metropolitan Scale

- **Transportation Characteristics**
 - **Thoroughfare Design**
 - **Site Accessibility from Freeway**
 - **Site Accessibility from Transit**
 - **Pedestrian/Bicycle Accessibility**

Land Use-Transportation Interaction

Sub-Metropolitan Scale

- **Land Use Characteristics**
 - Land Use Mix
 - Land Use Intensity
 - Land Prices
 - Business Mix
 - Household Mix
 - Neighborhood Effects of Rail/Freeway/Street Configuration

Emerging Requirements for Land Use Models

- **Land Use-Transportation-Environmental Interaction**
- **Application at Varying Geographic Scales**
- **Disaggregation of Choosers/Choices**
- **Integration with GIS**
- **Application to:**
 - **Strategic Planning**
 - **Policy Analysis**
 - **Impact Assessment**

Emerging Approaches for Land Use Modeling

- **Discrete Choice/Random Utility**
- **Input-Output**
- **Microsimulation**
- **GIS**
- **Hybrid**

Integrating Models With GIS

- Database Mgmt. And Integration
- Visualization
- Spatial Analysis
- Embedding Models in GIS

Recommendations

- **Land Use Models With Discrete-Choice**
- **Jointly Design Land Use-Transportation Models**
- **Disaggregate Households, Businesses**
- **Explicit Representation of Land Market**
- **Maintain Database in GIS/RDBMS**
- **Explicit Accounting of Land/Buildings/Occupancy**

Recommendations

- **Link Models Directly to GIS/RDBMS**
- **Exploit GIS Raster/Network/Polygon Proximity Analysis**
- **Use Modular Software Design**
- **Explicit Policy Variables (e.g. Zoning)**
- **Evaluate Microsimulation**

Integrating Models With GIS

- **Impediments**

- GIS Network Modeling Limited**

- Linking Existing Models Cumbersome**

- Existing Models not Designed for GIS**

- GIS Software has High Overhead**

- Lack of Access to Source Code/Object Modules of Commercial GIS Software**

Integrating Models With GIS

- **Embedding Models in GIS**
 - **Maintain Database in GIS/RDBMS**
 - **Link Models Directly to GIS Database**
 - **Network Modeling**
 - **Polygon-based Discrete Choice Model**
 - **Raster Modeling**

Integrating Models With GIS

- **Spatial Analysis**
 - Polygon Adjacency
 - Proximity Analysis
 - Spatial Context Measurement
 - Spatial Autocorrelation

Integrating Models With GIS

- **Visualization**

- **Thematic Mapping:**
 - Input Data
 - Model Output
 - Prediction Errors in Calibration
 - Development Trends over Time
- **Bandwidth Display of Network**
 - Volumes
 - Speeds
- **Zone to Zone Travel Patterns**

Integrating Models With GIS

- **Database Management and Integration**
 - Land Use/Parcel Databases
 - Zonal Hierarchy and Attributes
 - Networks and Attributes