Metropolitan Travel Forecasting Models:

Trends, Possibilities and Priorities.

Vladimir Livshits
Maricopa Association of Governments
May, 2010
IBM 704 - Electronic Computer central panel used for tabulating the Survey data.
Prediction is very difficult, especially about the future.

Niels Bohr, Danish physicist

The future ain't what it used to be.

Yogi Berra, New York Philosopher

The best way to predict the future is to invent it.

Alan Kay, American Computer Scientist

Forecast is a negotiation
**MODELLING SOFTWARE TREND I:**
- Visualization
  - Towards print quality images
  - Integration with databases
  - Integration with software and seamless accommodation of different formats
  - 3rd dimension
- Modelling Paradigms 2003 (II)
  - Use of iconic, physical models in 50s
  - Dominance of mathematical models in 60s and 70s
  - Dominance of data models in 80s and 90s
  - Return of iconic models utilizing modern software (GIS, microsimulation)

**MODELLING SOFTWARE TREND II:**
- Automation
  - Information hiding: pre-prepared “black” boxes of large model blocks
  - Analysis, standardization and automation of most commonly used models and methods
  - User-friendliness of the modelling procedures, clear interfaces, following the accepted interface practices
- Planning Methods vs. Problems: coexisting movement?
  - Problems complexity
  - Methodology
    - Dynamic simulations, activity-based modelling, aggregate modelling, four steps
    - Density forecasting, aggregate modelling, four steps
    - Aggregating models, four steps
    - User evaluations, four steps
- Top issues in Transport Modelling as identified by an international survey (1995)
  - 1. Traffic Simulation
  - 2. Land use/transport relations
  - 3. Location-based choice models
  - 4. GIS in spatial database
  - 5. Revealed preference modelling
  - 6. Measures of effectiveness
  - 7. Dynamic traffic assignment
  - 8. Traffic market segmentation
  - 9. Advanced traffic choice models
  - 10. Equilibrium procedures
  - 11. Integrated modelling strategies
  - 12. Vehicle ownership models

**MODELLING SOFTWARE TREND III:**
- Paradigm Shift
  - Microsimulation
  - Dynamic Models
  - Discrete Choice States Models
  - Aggregate Static Models
  - Shift towards activity based modelling from trip based modelling
  - Shift towards simulation models for scenario and policy assessment from purely demand forecasting models
  - Wider use of multimodal multi-class models
  - Wider use of equilibrium models

**Modelling Paradigms 2003 (I)**
- Shift towards activity based modelling from trip based modelling
- Shift towards simulation models for scenario and policy assessment from purely demand forecasting models
- Wider use of multimodal multi-class models
- Wider use of simultaneous equilibrium models

**Modelling Paradigms 2003 (II)**
- Use of iconic, physical models in 50s
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Visualization
Click Here → Now Click Here

Automation

OUCH!

Now Click Here → Now Click Here
Paradigm Shift

See presentations from the Tuesday morning session
Possibilities

- Activity-based Travel Forecasting Models
- Multiyear Master Transportation Networks
- Mobile GIS
- Uncertainty Analysis
- Photo visualization
- Overlaying
- Cellular data collection
- GPS data collection
- Interactive overlay
- Small board
- Dynamic Traffic Phenomena
- Modeling of Dynamic Traffic Phenomena
Main Causality of Technical Innovations in *Regional* Planning and Modeling

Planning Needs
(necessary but not sufficient)

Technological Advancements
(sufficient, but not necessary)

New Planning Tools

New Planning Processes

- Political stratum
- Evaluation stratum
- Modeling stratum
- Data stratum
Priorities
Current Policy Issues

- Road pricing
- Air quality & greenhouse gases
- Land use policies and TOD
- Alternative mode strategies
- System operations and reliability
- Travel reduction / peaking strategies
- Evacuation / accommodation
- Economic development
- Demographic change
Are emerging planning needs threats or opportunities in achieving planning goals/regional visions?

- Climate Change and Environmental Protection Needs
- Sustainability Needs
- Needs to account for Economic Volatility and for Plan Sensitivity
- Needs to Account for Uncertainty
- Needs to Evaluate New Travel Modes and Transportation Technologies
- Needs to Evaluate New Policies and Regulations
- Needs to Reflect New Travel Behavior
Can Technological Advances help to address new challenges /threats in achieving planning goals?

- Dramatic Increase in Computing Power: multiple processors, distributed computing, cloud computing
- Dramatic Decrease in Computational and Storage Costs
- New Web Technologies
- New GIS technologies
- New GPS technologies
- New Technological Expectations
- Lack of New Technological Expertise
- Competitiveness on the HR market
What are weaknesses and strengths of proposed innovations in terms of advancing regional planning agenda?

- Future Staff Requirements and Availability of Technical Expertise
- Life Cycle of existing technologies, maintenance and support cost and availability
- Stakeholders and general public expectations
- Applicability to foreseeable tasks
- Efficiency in execution of typical technical tasks
Technical Innovations Strata in the Regional Planning Process

Core technical process strata:

• Observed data for analysis and modeling
• Models for predictions, explanations and descriptions
• Project evaluations and programming/planning

Decisions

Evaluation

Models

Data

Main Causality of Technical Innovations in Regional Planning

Planning Needs (necessary but not sufficient)

New Planning Processes

New Planning Tools

Technological Advancements (sufficient, but not necessary)
Data Stratum: Innovative Planning Tools

- Web-based GUI data access
- Visualization: GIS, Google
- Data Integration (different types of data, historic data, jurisdictional data)
- Enterprise Application Integration (e.g. integration with modeling applications - automated model validation tools, with data collection applications - QA/QC, automated data upload)
- Built-in data analysis tools
### Data Collection and Management Innovation Decision Decision Matrix

<table>
<thead>
<tr>
<th></th>
<th>Threats</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
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<td><strong>Strengths</strong></td>
<td>Urgent Not Important e.g. innovative capitalization on another ongoing project where the need can be addressed with traditional tools as well</td>
<td>Not Urgent Not Important e.g. opportunity to improve data disposal</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td>Urgent Important e.g. innovative approach to address unmet data needs from a major project or stakeholder</td>
<td>Not Urgent Important Best Time to introduce innovations</td>
</tr>
</tbody>
</table>

- data collection
- data acquisition
- data analysis
- data storage
- data security
- data retrieval
- data access and dissemination
- data archiving
- data disposal

Arrows indicate results of example project level decisions on data management innovations.
Modeling Stratum: Strengths and Weaknesses

- Modeling assumptions are inadequate for future planning needs but are in-line with existing planning processes
- Models are not integrated with each other and other parts of the planning process
Innovations in Transportation Modeling = Relaxed Modeling Assumptions * Increased Fidelity + Capitalization on Computing Technology

Four Step Trip Based Paradigm

- TG
- TD
- MS
- TA

Purpose/ User Class Prism

Activity/ Person/ Household Prism

Uncertainty & Sensitivity

Activity / Tour Based Paradigm

Long Term Choices:
- Residence Location
- Work Location
- School Location
- Car Ownership

Short Term Choices:
- Activity Choice
- Time of Day Choice
- Mode Choice
- Route Choice
### Transportation Modeling Innovation Decision Matrix

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- **Paradigm Shift** and disaggregation – Data Mining and Knowledge Management - Database Approach, ABM
- **Enterprise Application Integration and Automation** - PMDS, Geo Database, Master Network
- **Data Accessibility and Visualization** - Web-based GIS technologies, 3D

Arrows indicate results of example project level decisions on data management innovations.
Evaluation Stratum: Strengths and Weaknesses

- Disconnect between evaluation, data analysis and modeling, necessity for complex manual effort
- Insufficient accessibility of project data, ability to easily visualize and query project information
- Robust manual procedures and established guidelines
Evaluation Stratum and Process Integration Innovations

- New dimensions introduced by both political and technical nature of the process
- Process Integration Issues with other strata
- Visualization and Accessibility - web based
- Outsourcing and Cooperation – vendors
<table>
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<th>We can ask</th>
<th>Or we can ask</th>
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<td>What are the possibilities</td>
<td>What are the priorities</td>
</tr>
<tr>
<td>Where the modeling trends will take us</td>
<td>Where we will take the modeling trends</td>
</tr>
<tr>
<td>How much it cost to implement an innovation</td>
<td>What is the effectiveness of implementing an innovation</td>
</tr>
<tr>
<td>What are the development costs</td>
<td>What are the development and maintenance costs</td>
</tr>
<tr>
<td>What percentage of planning costs is in modeling</td>
<td>What percentage of planning, design and building costs is in modeling</td>
</tr>
<tr>
<td>What are the benefits of modeling advancements</td>
<td>What are the costs of planning mistakes</td>
</tr>
<tr>
<td>If a model delivers a better forecast</td>
<td>When we need a better forecast and if we need a better model</td>
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A few questions for conclusion:

- Can we hope for dissemination of innovative modeling tools without propagation of innovative planning processes?

- Can we foresee innovative planning processes without drastically different and pressing planning needs?

- Can we foresee big changes in planning needs by predicting changes in transportation systems and their environments?

- Can we predict changes in transportation systems and their environments by utilizing innovative modeling tools? (go to first question)
Thank You