Decision support tools in transport planning: from research to practice

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Advantages and challenges of new transport models

Agent based, activity-based modeling

• New modeling paradigm
• Interdependency of trips and activities, e.g. tour based mode choice

Possible resolution for analysis:

• Individuals
• Parcel or building (or unit) as base unit
• Temporal dynamics

How to deal with the wealth of data?

• Who?
• With how much time?
• What skills?
• New questions?
Current situation I

- Displaying the network and vehicles in the application.
- Highlight one or more transit lines.
- Displaying the complete day plan of a single agent.
- Analyze different aspects, e.g., the number of passengers waiting at a transit stop.
Current situation II
Decision support system for transportation

Transport planners
  • How many trips occur where, when and what is the activity purpose?
  • What are the socio-demographic characteristics of the these persons?

Urban planners:
  • What are the temporal usage patterns of buildings and the surrounding neighbourhood?
  • What is the flow from public transport stops to surrounding buildings?

Policy-makers
  • What are the costs and benefits of a new public transport service?
  • Who are the winners and losers from constructing a new road?

Public transport operators
  • What is the breakdown of the ridership of certain bus lines?

Service industry
  • Which customers are in catchment areas, separated by mode?
Requirements for DSS in transport planning

**Functional requirements:**

- **Appraisal**
  - Cost-benefit
  - Winners and losers

- **Scope**
  - Journeys
  - Stages (but no routes)
  - Activities

- **Temporal analysis**
  - Full temporal resolution for filtering and aggregation

**Technical requirements:**

- Open source database with open interface
- Spatial queries
- Interactive front-end for analysis and visualisation
General Framework

Spatial data
- Buildings
- Land use
- Transport network
- Zoning systems

Surveys/Transport data
- Travel diary
- PT usage
- Traffic counts
- Population

Transport model
- Agent-based simulation
- Scenarios

Analysis with GIS and business analytics
- Calibration/Validation
- Location analysis
- Winners and losers
- Application specific

Spatial database

Data cubes
Case study: decision support tool for Singapore

Survey database
- Households
  - household_id
  - person_id
  - income, car availability, etc.
- Persons
  - household_id
  - person_id
  - income, license, etc.
- Journeys
  - person_id
  - journey_id
  - mode, distance, duration, etc.
- Stages
  - journey_id
  - stage_id
  - mode, distance, duration, etc.
- Transfers
  - journey_id
  - transfer_id
  - waiting time, walk time, etc.
- Activities
  - person_id
  - activity_id
  - type, duration, timing, etc.

Spatial database
- Zones/aggregations
  - zone_id
  - area name, other attributes.
- Parcels
  - parcel_id
  - land use, area, etc.
- Buildings/facilities
  - facility_id
  - activity_id
  - activity, facilities, dwelling type, number of units, etc.
- Network links
  - link_id
  - land use, area, etc.
- Transit stops
  - stop_id
  - transit_stop_id
  - bus and rail stops

MATSim database
- Households
  - household_id
  - person_id
  - income, car availability, etc.
- Persons
  - household_id
  - person_id
  - income, license, etc.
- Journeys
  - person_id
  - journey_id
  - mode, distance, duration, etc.
- Stages
  - journey_id
  - stage_id
  - mode, distance, duration (board & alight).
- Transfers
  - journey_id
  - transfer_id
  - waiting time, walk time, etc.
- Activities
  - person_id
  - activity_id
  - type, duration, timing, etc.

SQL cross-joins and aggregations

Tableau visualization
Case study applications

Explorative analysis of travel diary survey (or MATSim output)
  • Spatial selection
  • Special focus
    • Mode share
    • Commuting trips
  • Socio-demographics

Decision cockpit for calibration
  • Comparison between MATSim output and actual observations
  • Pitfalls: data consistency
    • Scope of travel diary vs MATSim, e.g. pick up and drop off
    • Definition of journeys and stages PT smart card vs MATSim
Travel survey: reported vs MATSim routed
Outlook

Decision support for calibration of MATSim Singapore

Engagement with transport planners in practice
  • Explorative analysis of travel diary survey
  • Monitoring of bus operations based on pt smart card data
  • Making MATSim results accessible

Vision:
  • Continuously updated data input
  • Living (3d) city model to be maintain and shared data across stakeholders
  • Automatic generation of MATSim ‘live’ scenarios
  • 3d city model
Appendix
Connect and edit spatial database with Quantum GIS
Connect and edit spatial database with Quantum GIS
How do other disciplines deal with the problem?

1960: First Management Information Systems
   • Interactive analysis
   • Single decision maker

1970: Computer Based Systems to aid decision making
   • Databases and models
   • Financial planning

1980: Decision Support Systems (DSS)
   • Data -> Model -> management software for end user
   • Cognitive psychology and operations research join the club
How do other disciplines deal with the problem?

1990: Group decision support system
   • Various stakeholders with different agendas

2000: Business intelligence
   • Procter&Gamble links retail scanner data to DSS
   • On-Line Analytical Processing (OLAP) for interactive analysis
   • Linkage of various data sources, e.g. from different departments

2010: Visualisation
   • Analyst circumvents data warehouse specialists
   • External, interactive visualisation tools
   • State-of the –Arte visualisation principles