

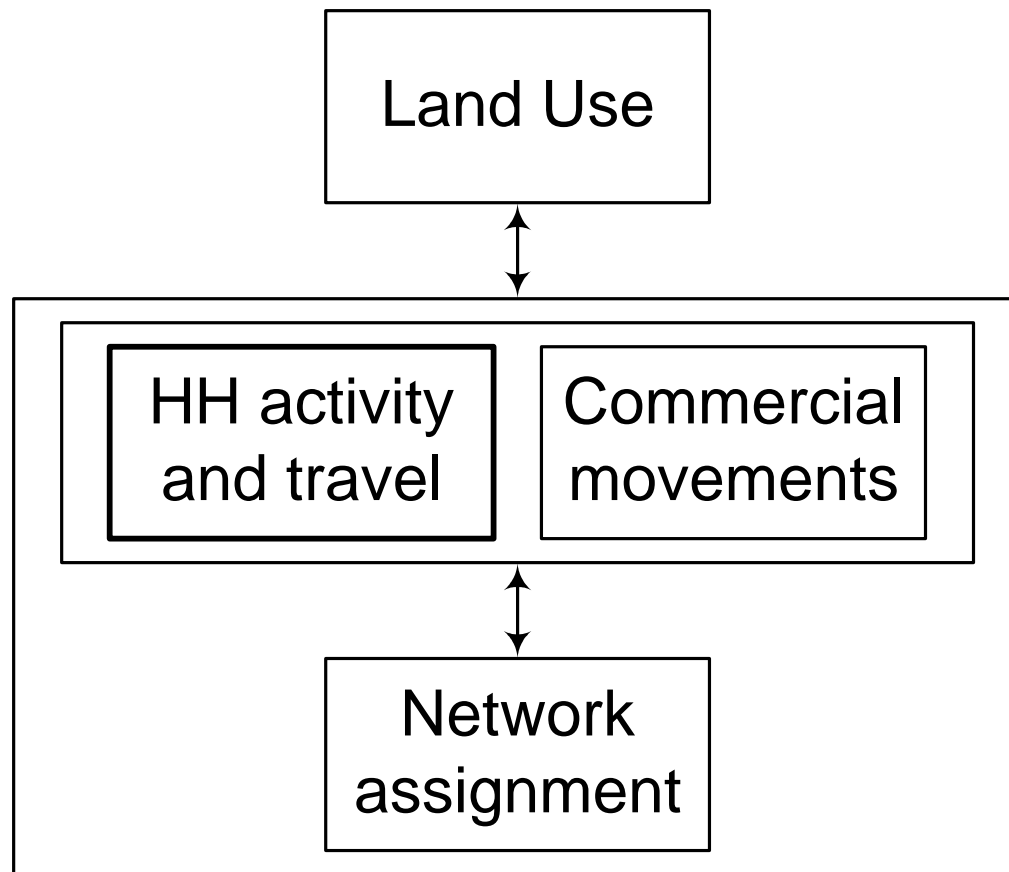


Innovations in Travel Demand Modeling: Activity-based Modeling

presented at Workshop 111
Innovative Travel Models: Proof of Concept TRB
84th Annual Meeting
January 9, 2004

John L. Bowman, Ph.D.
(with thanks to Mark Bradley and Peter Vovsha)

Activity-based models in context



Two types of activity-based models

■ Outcome models

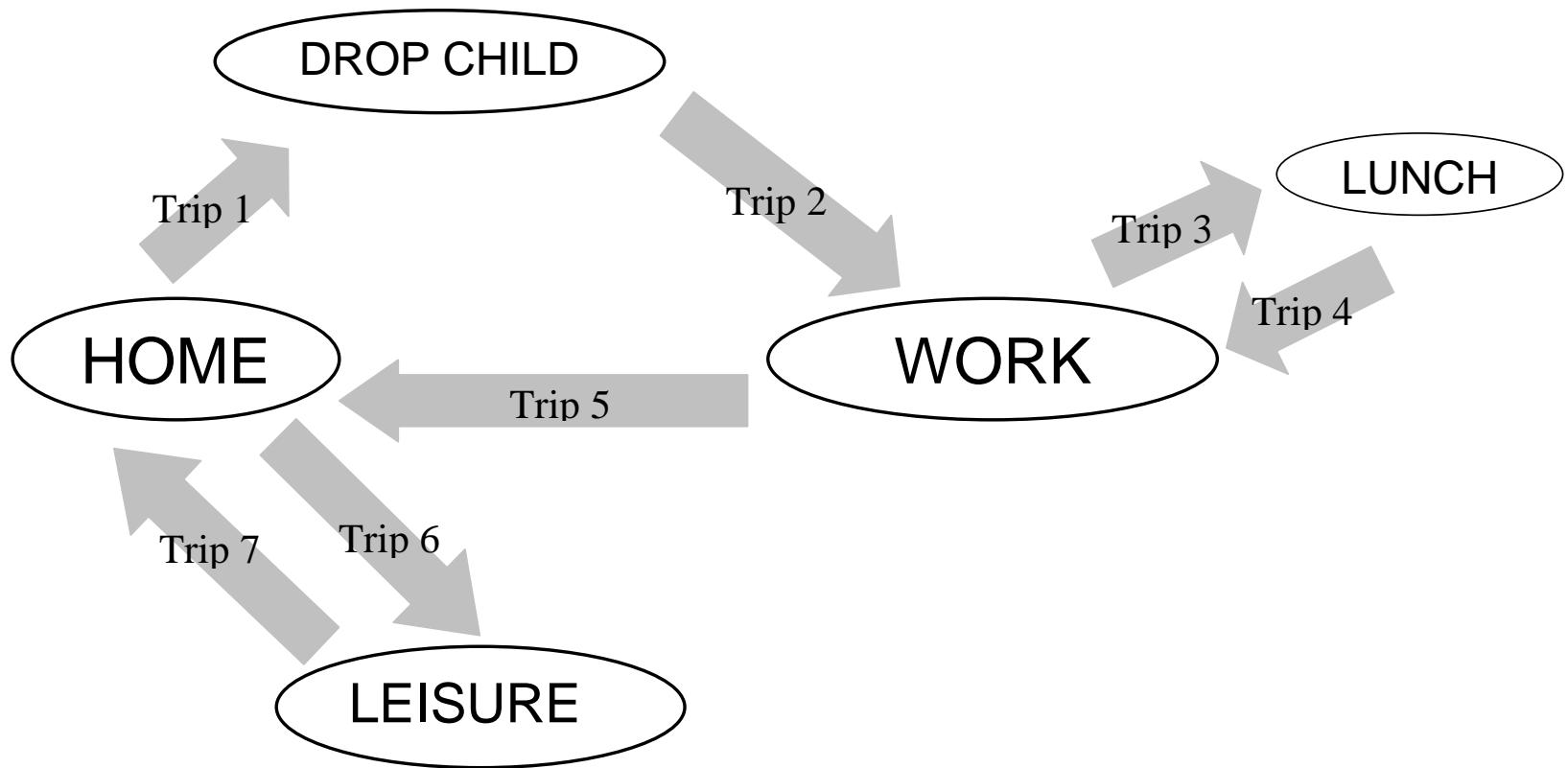
- What activities and travel occur?
- How do they fit in time and space?

■ Process models

- How do they come about?

Activity-based model output

Itinerary meets time/space constraints



How they work

- Outcome models—stable relationships among outcomes and external factors
 - evaluated statistically
 - assumed
- Process models—representation of the scheduling process itself, leading to the implemented itinerary

State of implementation

- Outcome models—a few are in use by public agencies
 - Sessions 158, 387

- Process models—in the research lab
 - Session 281

Key Features

of activity-based outcome models

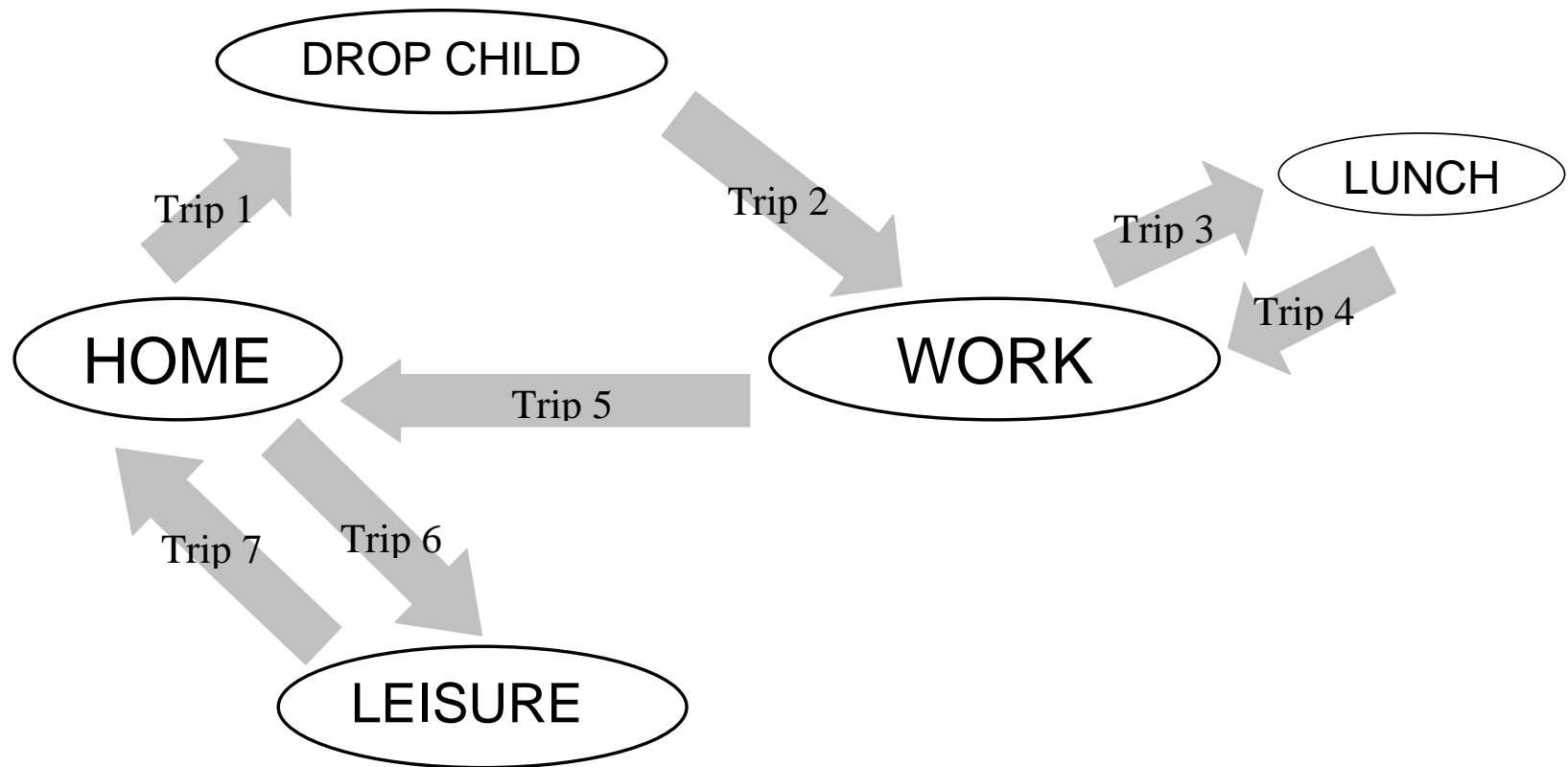
■ Integration

- Intra-person
- Intra-household

■ Disaggregation

- Demographic
- Spatial
- Temporal

Intra-person integration



Intra-person integration

Example result

Portland Activity-based Model \$.50/ mile Peak Period Toll Predicted Change in Number of Tours	
Work	-2.5%
Maintenance	-.3%
Leisure	+.8%

Key Features

of activity-based outcome models

■ Integration

- Intra-person
- Intra-household**

■ Disaggregation

- Demographic
- Spatial
- Temporal

Intra-household integration

- Joint activities
- Shared travel
- Escort activity
- Coordinated timing
- Allocation of household tasks
- Allocation of vehicles



Intra-household integration

- Individual choice models affected by HH characteristics
- Explicitly model intra-household behavior

Intra-household integration

Carpooling example

- Two types of carpooling
 - Intra-household for shared activities
 - Insensitive to carpooling incentives
 - Inter-household
 - More sensitive to carpool incentives
- Separating these (model intra-household sharing explicitly)
 - more accurate model sensitivity to carpool incentives
 - change aggregate predictions for HOV lanes

Key Features

of activity-based outcome models

■ Integration

- Intra-person
- Intra-household

■ **Disaggregation**

- Demographic
- Spatial
- Temporal



Demographic disaggregation

- Model's prediction depends on many characteristics of the person and their household

Demographic disaggregation— why?

- personal characteristics strongly affect activity and travel behavior
- Example
 - Young woman living with parents
 - Single working mother

Demographic disaggregation— result

- reduce aggregation bias
- predict aggregate travel effects of demographic changes
- predict policy effects on subsets of population

Key Features

of activity-based outcome models

■ Integration

- Intra-person
- Intra-household

■ **Disaggregation**

- Demographic
- Spatial**
- Temporal

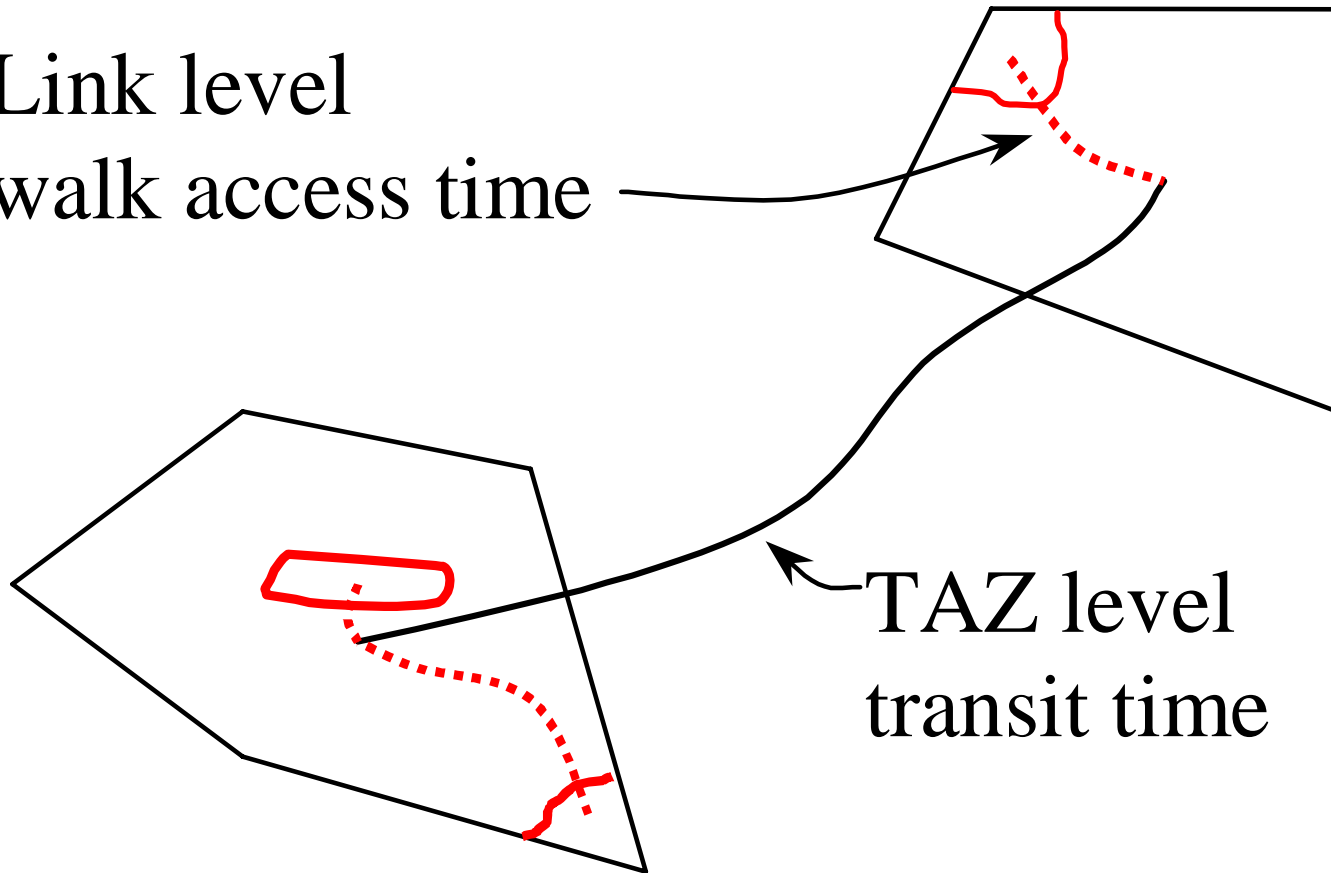
Spatial disaggregation

- Thousands of small traffic analysis zones (TAZ)
- TAZ subdivided further (block faces, grid cells, or parcels)
 - Activity attractors
 - Ease of transit access and walking

Spatial disaggregation

Example—Transit LOS

Link level
walk access time



TAZ level
transit time

Spatial disaggregation

Result—work mode choice

	TAZ-based	Link-based
Log-likelihood	-4637	-4607
<u>Values of time</u>	<u>\$/hr (T)</u>	<u>\$/hr (T)</u>
Car- drive alone	2.2	4.6
Transit- in vehicle	1.4	1.9
Transit- wait	5.9	5.3
Transit- walk	0.9 (0.2)	12.2 (6.1)

Key Features

of activity-based outcome models

- Integration
 - Intra-person
 - Intra-household
- **Disaggregation**
 - Demographic
 - Spatial
 - **Temporal**

Temporal disaggregation

- Break the day into time slices
 - Four or five basic periods (early AM, AM peak, midday, PM peak, evening)
 - Or much shorter periods (5 to 60 min)

Temporal disaggregation

Result

- Allows intra-personal temporal integration
- Can handle time-specific scenarios
 - Peak toll or parking policies
 - Business opening or closing hours
- Can capture temporal demand variations
 - within-the-peak
 - peak shoulders

Key Features

of activity-based outcome models

■ Integration

- Intra-person
- Intra-household

■ Disaggregation

- Demographic
- Spatial
- Temporal

Where are we today?

According to one minimum standard

- Models used by US public agencies
- Intra-person integration
 - Model the components of a person's entire day in an integrated way
 - Model the effects of travel attributes on all components of the day
 - Models with a behavioral basis

Users (U.S.)

- **Portland (Metro)**
- San Francisco County (SFCTA)
- New York (NYMTC)
- Columbus (MORPC)

Users (U.S.)

- Portland (Metro)
- **San Francisco County (SFCTA)**
- New York (NYMTC)
- Columbus (MORPC)

Users (U.S.)

- Portland (Metro)
- San Francisco County (SFCTA)
- **New York (NYMTC)**
- Columbus (MORPC)

Users (U.S.)

- Portland (Metro)
- San Francisco County (SFCTA)
- New York (NYMTC)
- **Columbus (MORPC)**

Nibblers

- **Developed**

- Florida (FDOT)

- **In development**

- Atlanta (ARC)
- Texas (TxDOT)

- **On the drawing board**

- Sacramento (SACOG)
- Denver (DRCOG)
- Seattle (PSRC)

Nibblers

- Developed
 - Florida (FDOT)
- **In development**
 - Atlanta (ARC)
 - Texas (TxDOT)
- On the drawing board
 - Sacramento (SACOG)
 - Denver (DRCOG)
 - Seattle (PSRC)

Nibblers

- Developed
 - Florida (FDOT)
- In development
 - Atlanta (ARC)
 - Texas (TxDOT)
- **On the drawing board**
 - **Sacramento (SACOG)**
 - **Denver (DRCOG)**
 - **Seattle (PSRC)**

Management issues

■ Political risk

- Nonconformity
- Other political fallout

■ Cost

■ Effectiveness

- “Will they really work better than current trip-based models?”

Management issues

- Political risk

- Nonconformity
- Other political fallout

- **Cost**

- Effectiveness

- “Will they really work better than current trip-based models?”

Management issues

- Political risk

- Nonconformity
- Other political fallout

- Cost

- **Effectiveness**

- “Will they really work better than current trip-based models?”**

Technical Issues

- **Backcast validation**
- Simulation variability
- Improved integration and disaggregation
- External integration
 - Network models
 - Land use models
- Transferability

Technical Issues

- Backcast validation
- **Simulation variability**
- Improved integration and disaggregation
- External integration
 - Network models
 - Land use models
- Transferability

Technical Issues

- Backcast validation
- Simulation variability
- **Improved integration and disaggregation**
- External integration
 - Network models
 - Land use models
- Transferability

Technical Issues

- Backcast validation
- Simulation variability
- Improved integration and disaggregation
- **External integration**
 - Network models
 - Land use models
- Transferability

Technical Issues

- Backcast validation
- Simulation variability
- Improved integration and disaggregation
- External integration
 - Network models
 - Land use models
- **Transferability**

Technical Issues

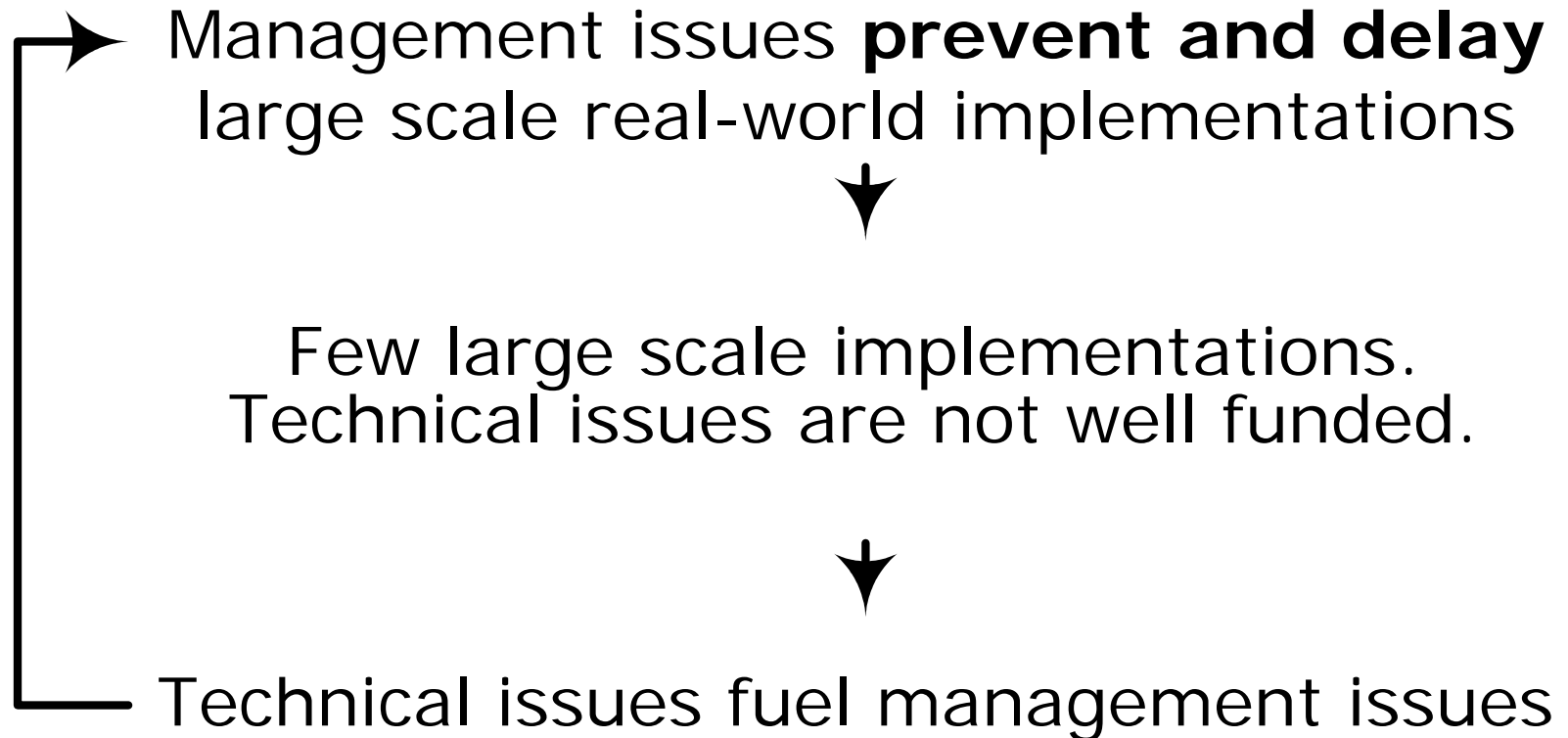
- Backcast validation
- Simulation variability
- Improved integration and disaggregation
- External integration
 - Network models
 - Land use models
- Transferability



Technical issues

- Need large scale real-world implementations
- With extra resources devoted to the technical issues

We have a problem and it's hindering progress



Breaking the cycle

Management issues **motivate and shape**
large scale real-world implementations



More large scale implementations;
address technical and management issues.



Achieve wide-spread activity-based benefits