TMIP Webinar

Activity Model Development Experiences

Date: Thursday, June 18, 2009

Time: 2:30pm - 4:30pm (EST)

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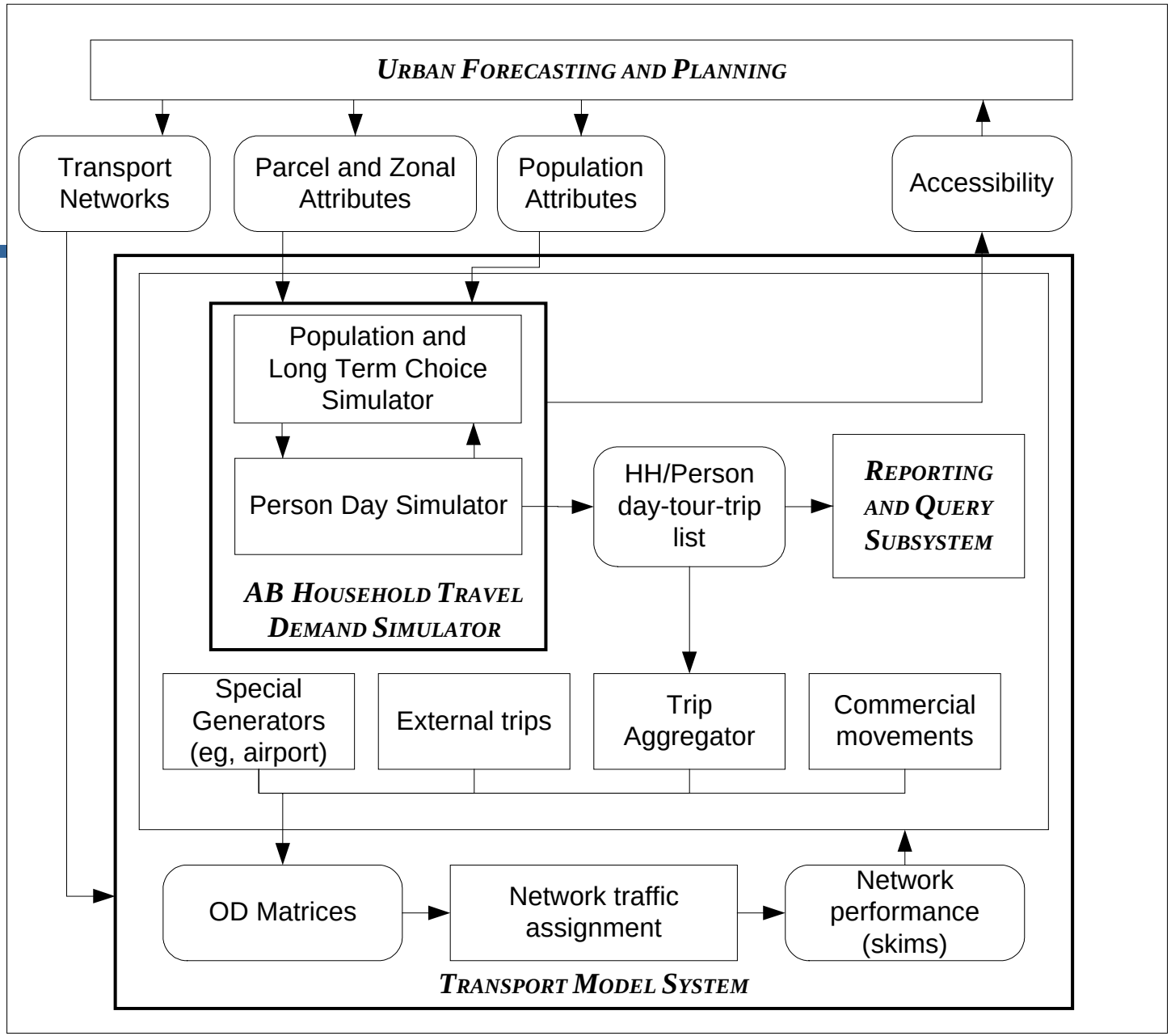
JBowman.net

interactive answers: Mark A. Bradley
Mark_Bradley@cox.net

Outline

- Activity-Based (AB) Model System
- Development Tasks
- Basic Build Approaches
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions


URBAN FORECASTING AND PLANNING
Transport Networks
Parcel and Zonal Attributes
Population Attributes
Accessibility
Population and Long Term Choice Simulator
Person Day Simulator
AB HOUSEHOLD TRAVEL DEMAND SIMULATOR
HH/Person day-tour-trip list
REPORTING AND QUERY SUBSYSTEM
Special Generators (eg, airport)
External trips
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Commercial movements
OD Matrices
Network traffic assignment
Network performance (skims)
TRANSPORT MODEL SYSTEM

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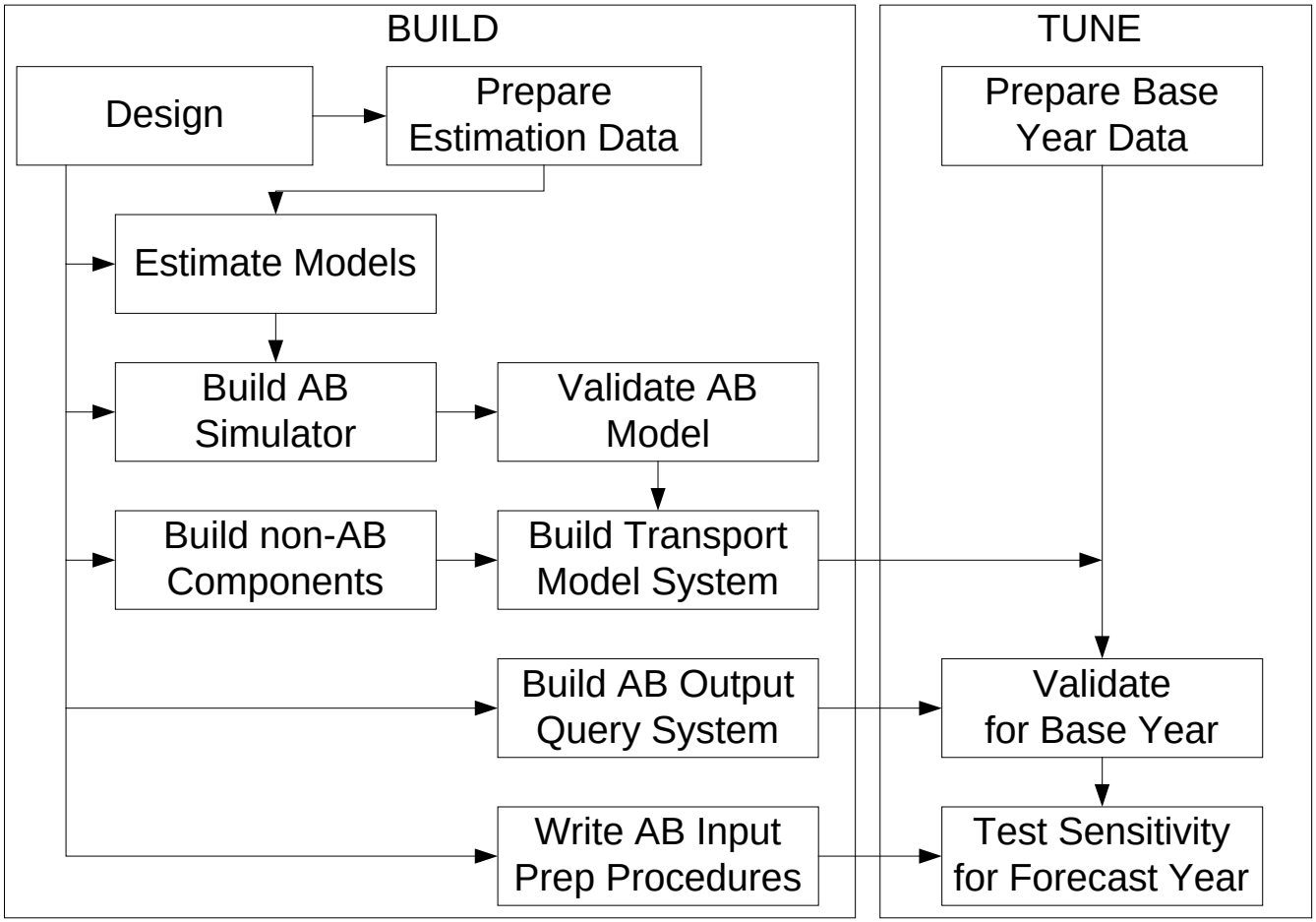
The Tasks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Write AB Input Prep Procedures
Test Sensitivity for Forecast Year

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Basic Build Approaches

- Invent
- Adapt
- Adopt

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Development Roles

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

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Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

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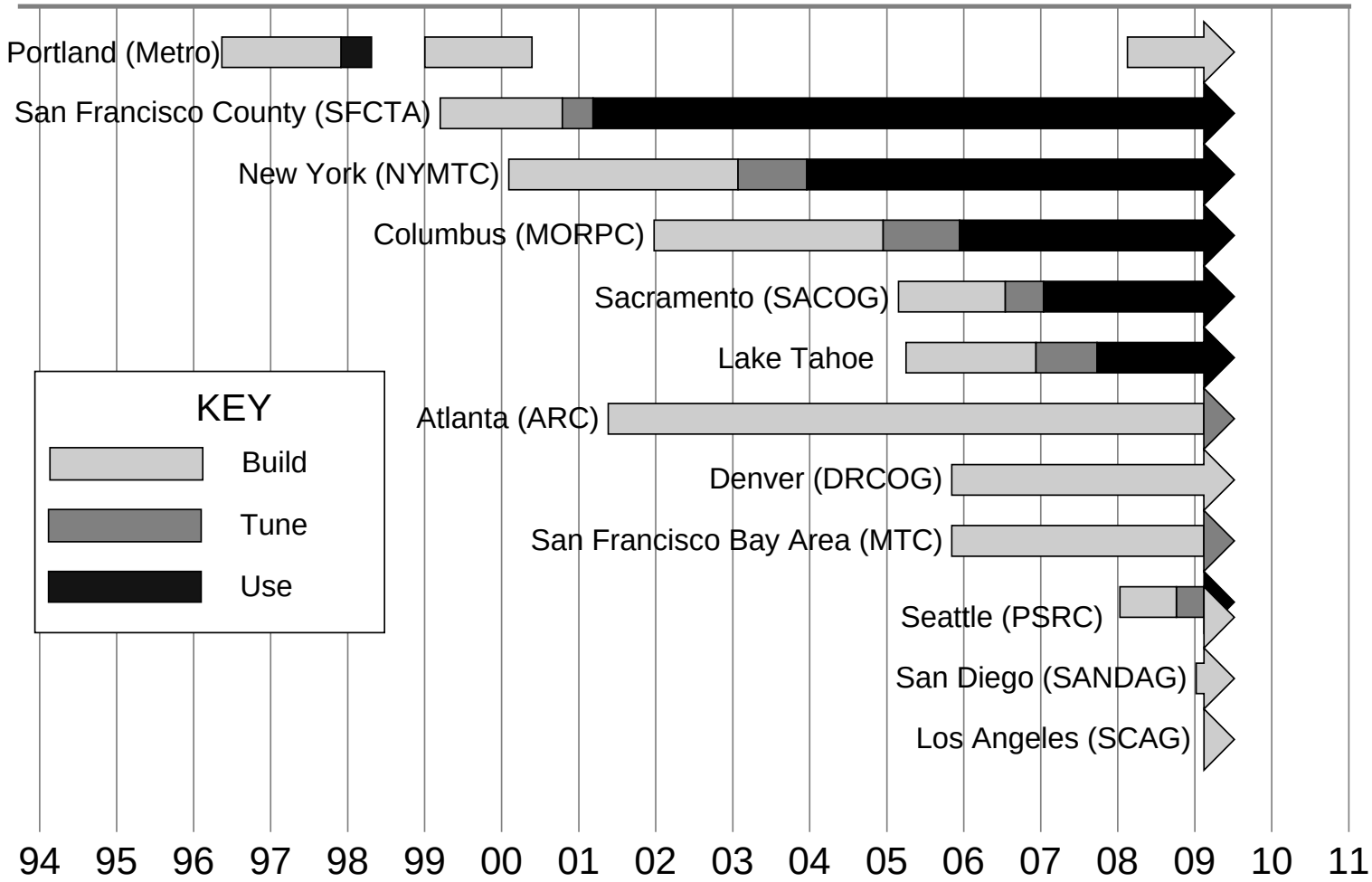
U.S. Projects


Portland (Metro)
San Francisco County (SFCTA)
New York (NYMTC)
Columbus (MORPC)
Sacramento (SACOG)
Lake Tahoe
Atlanta (ARC)
Denver (DRCOG)
San Francisco Bay Area (MTC)
Seattle (PSRC)
San Diego (SANDAG)
Los Angeles (SCAG)
KEY
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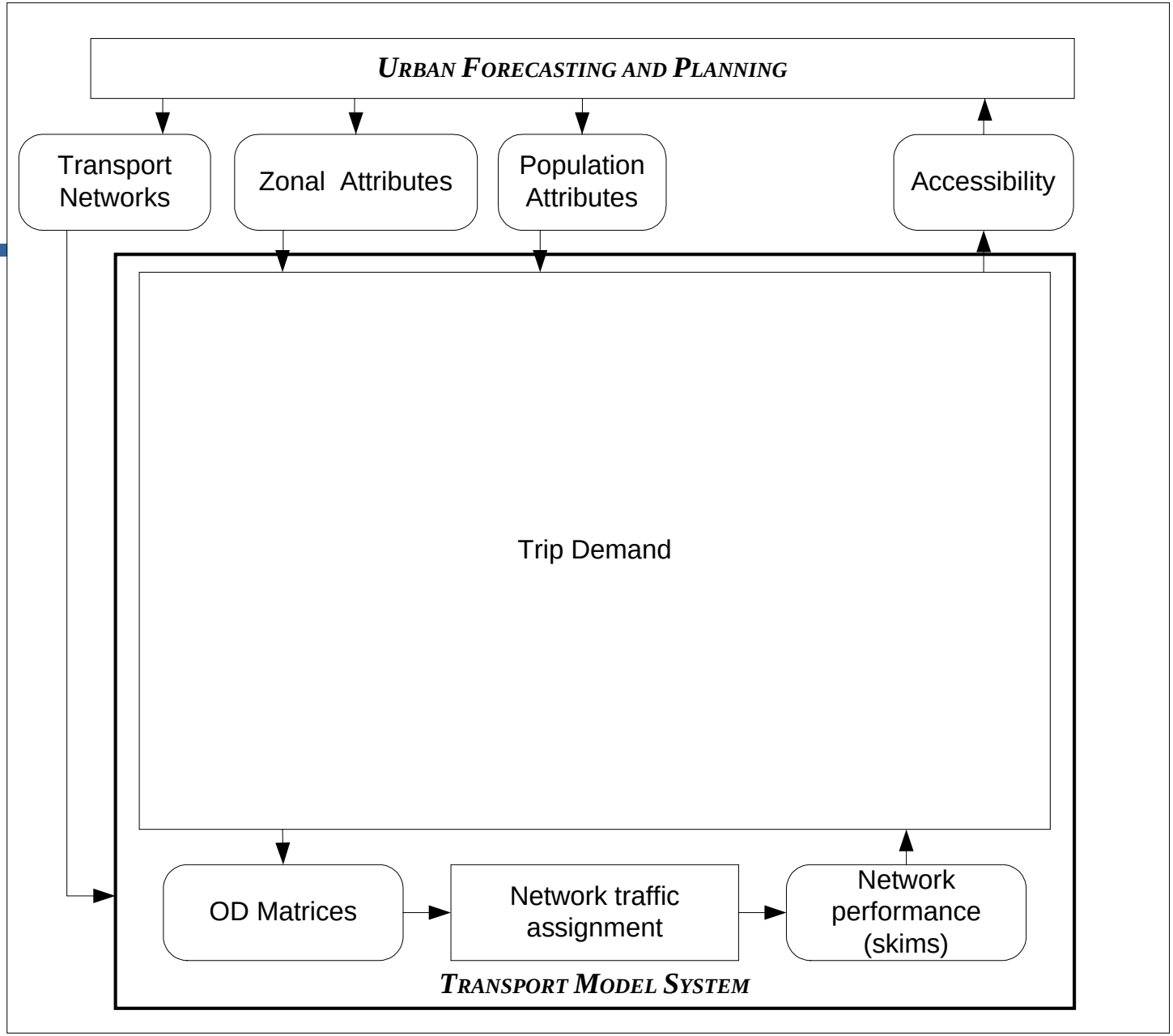
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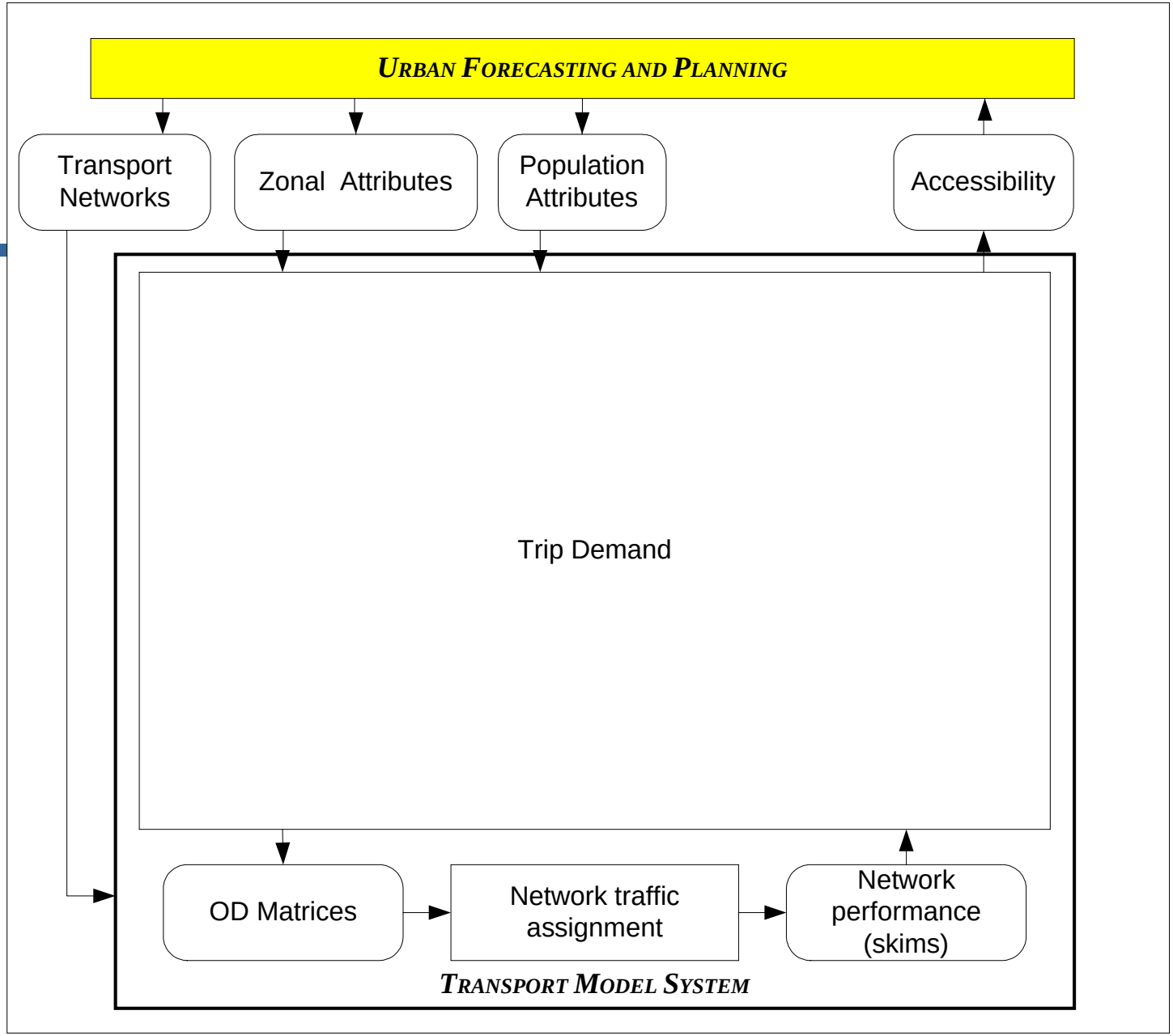
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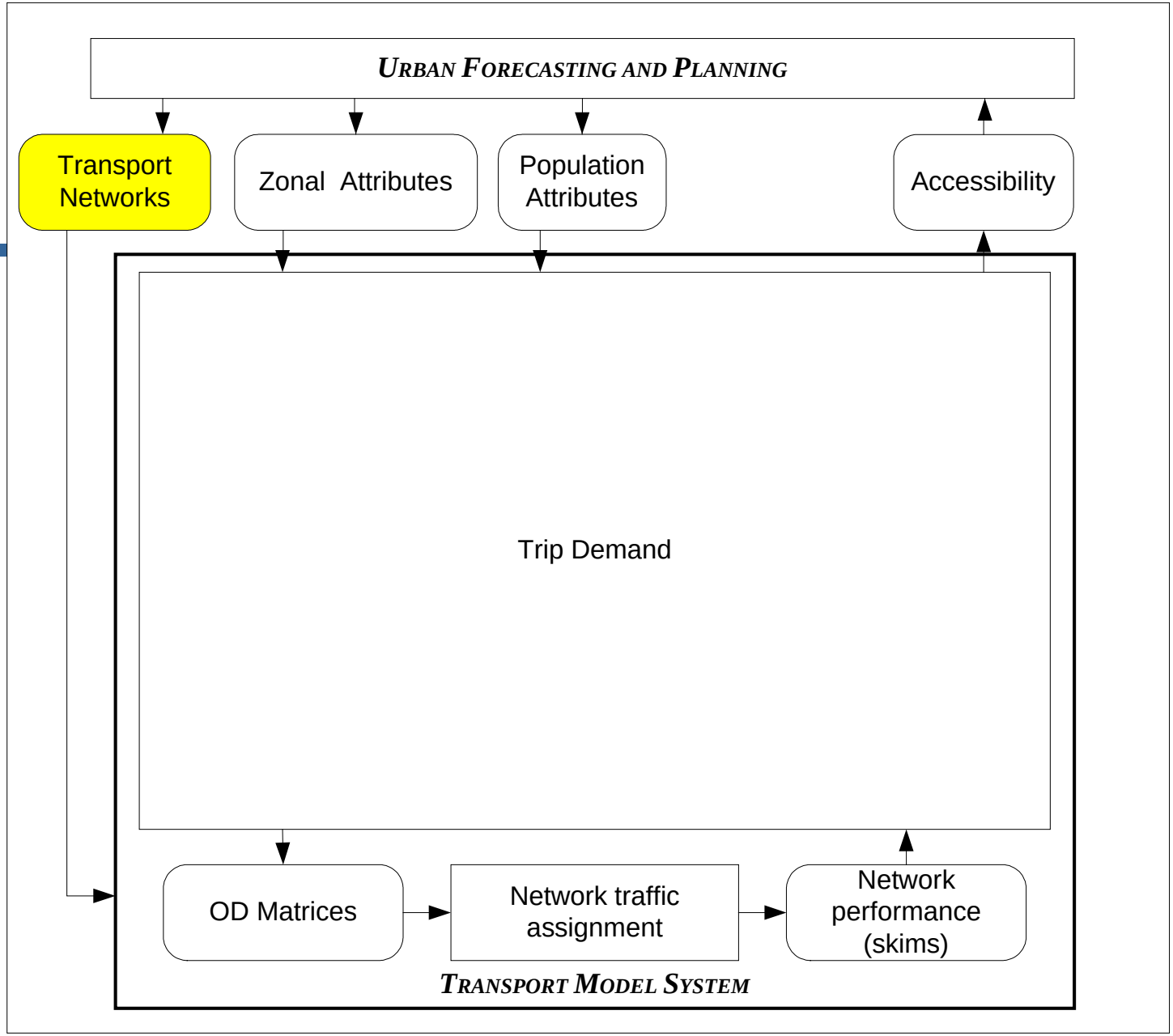
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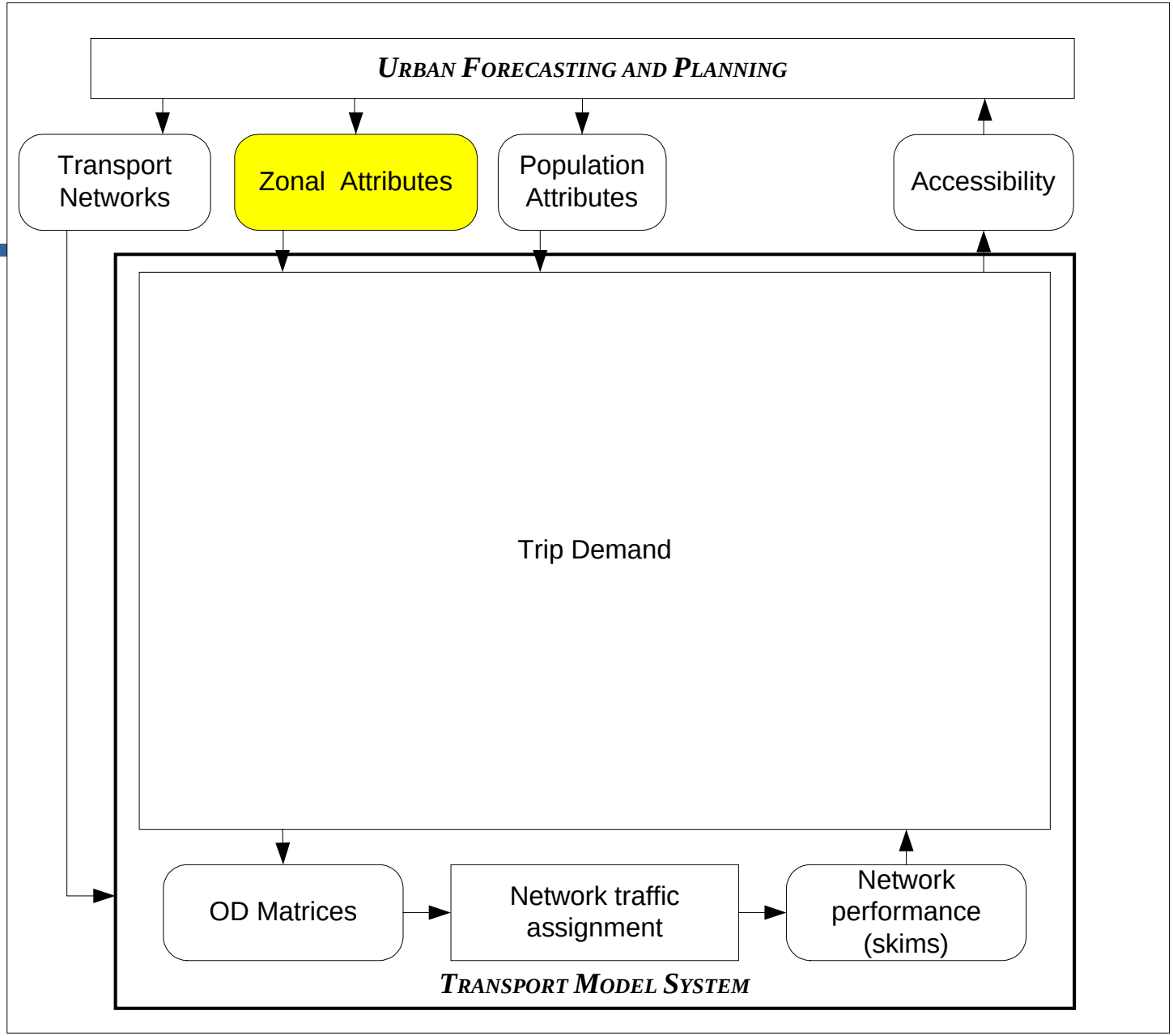
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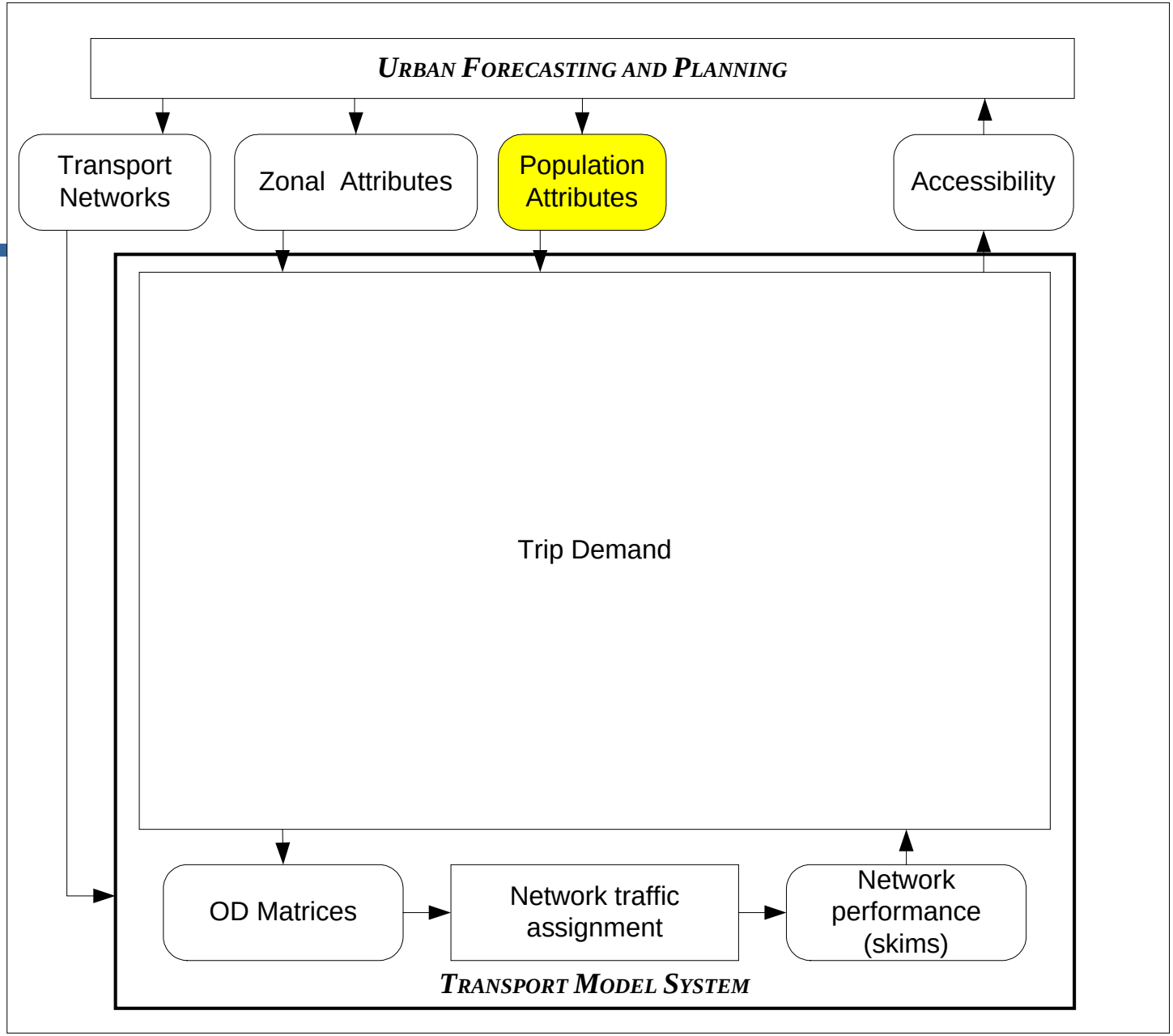
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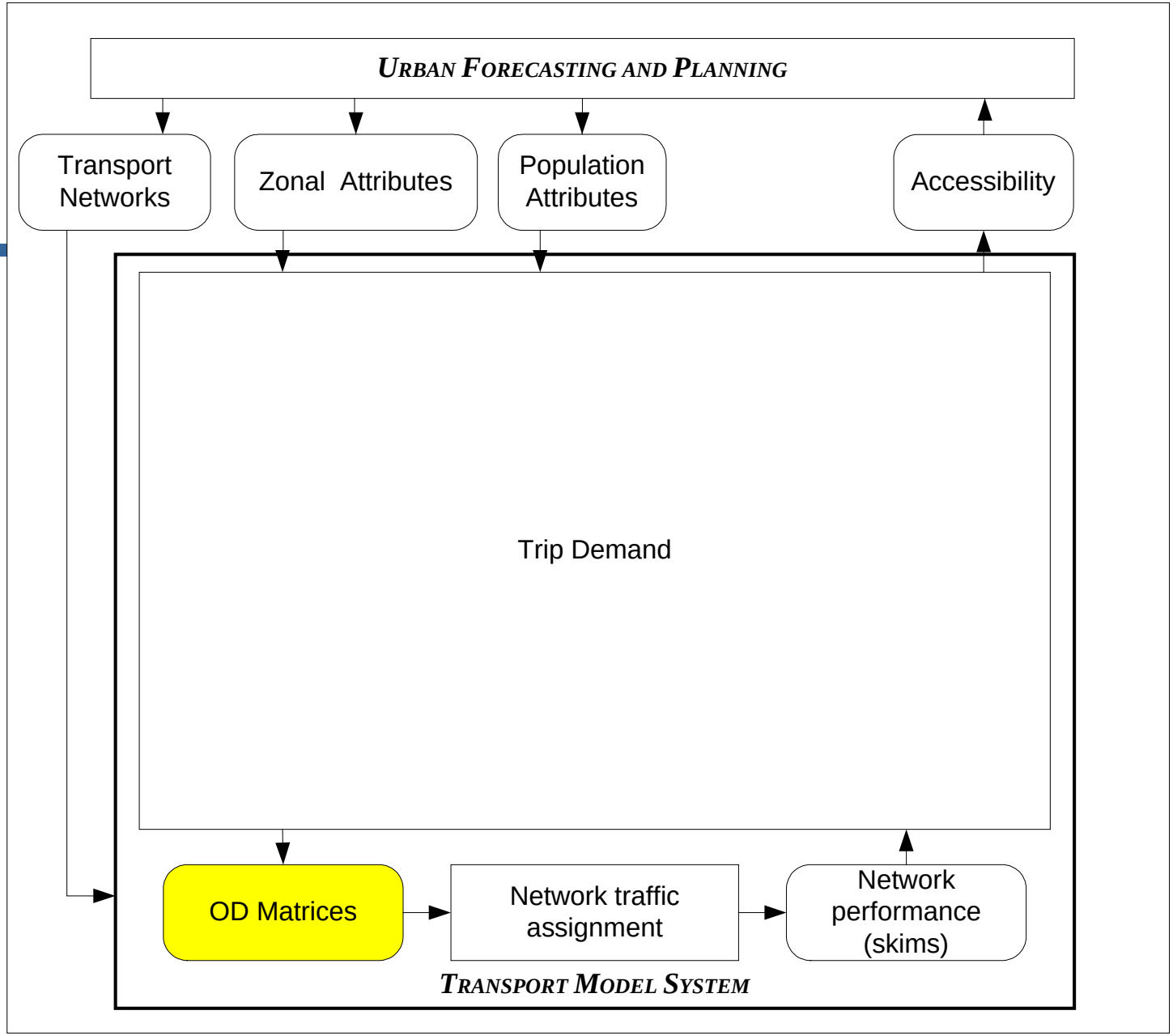
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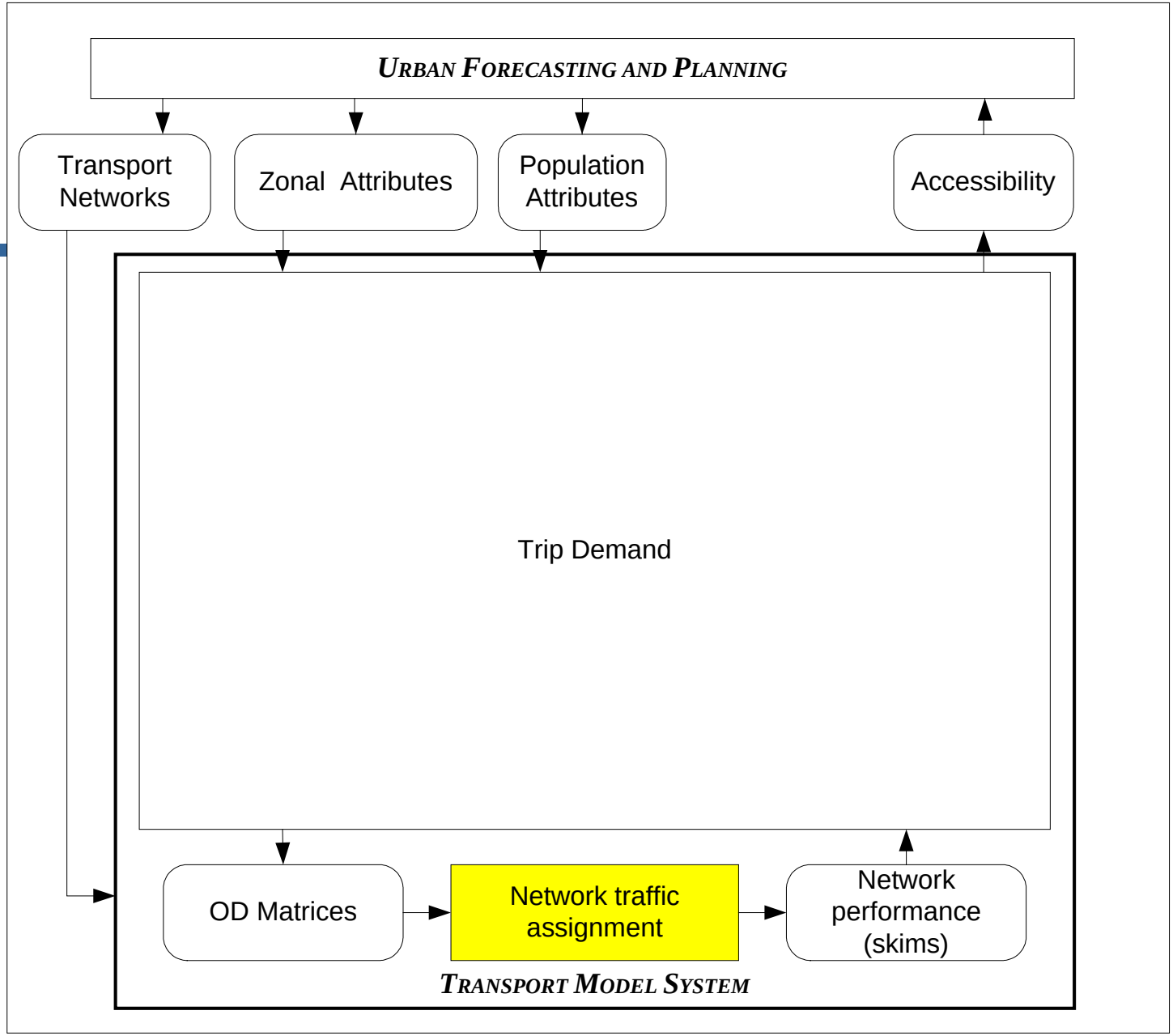
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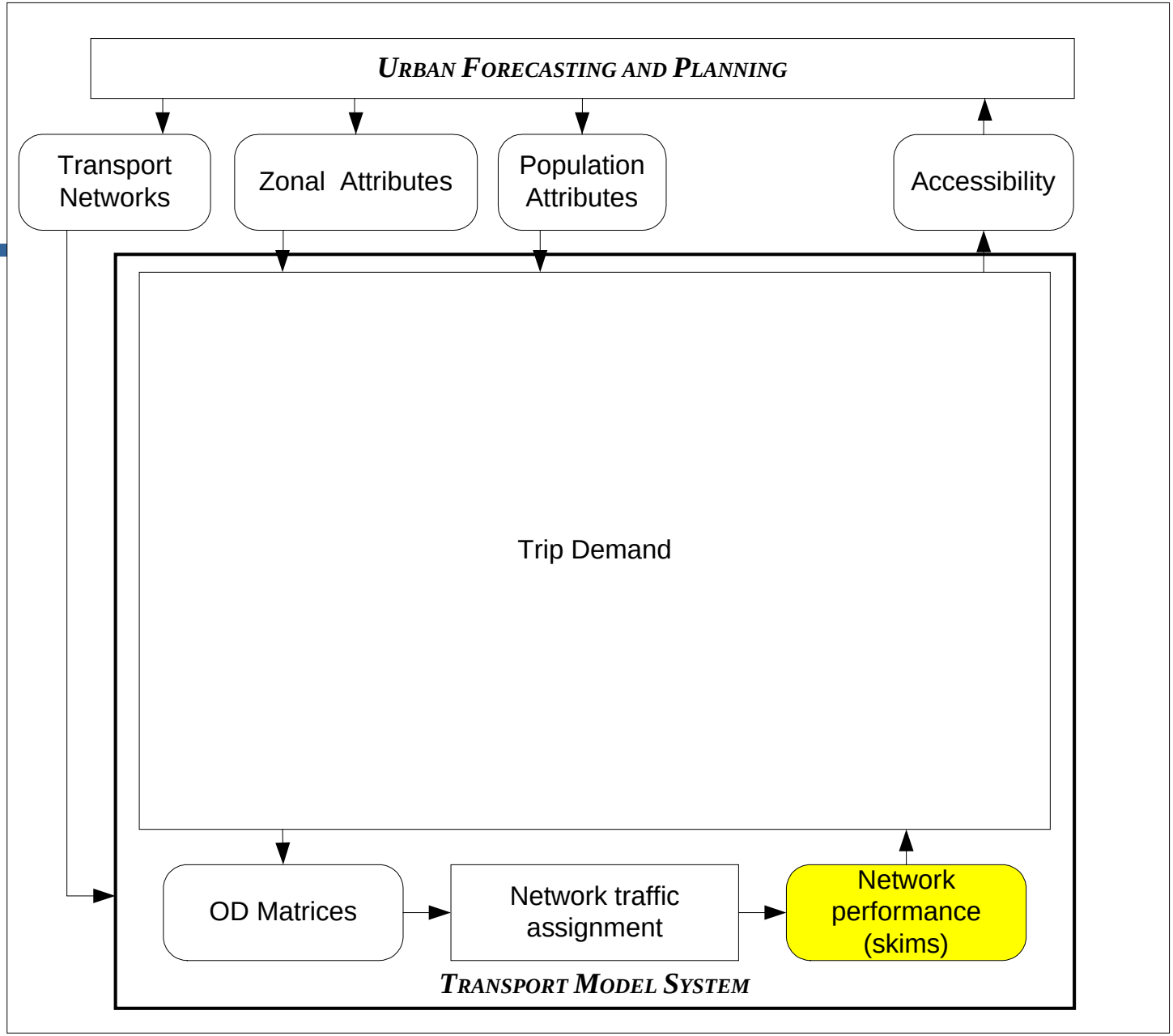
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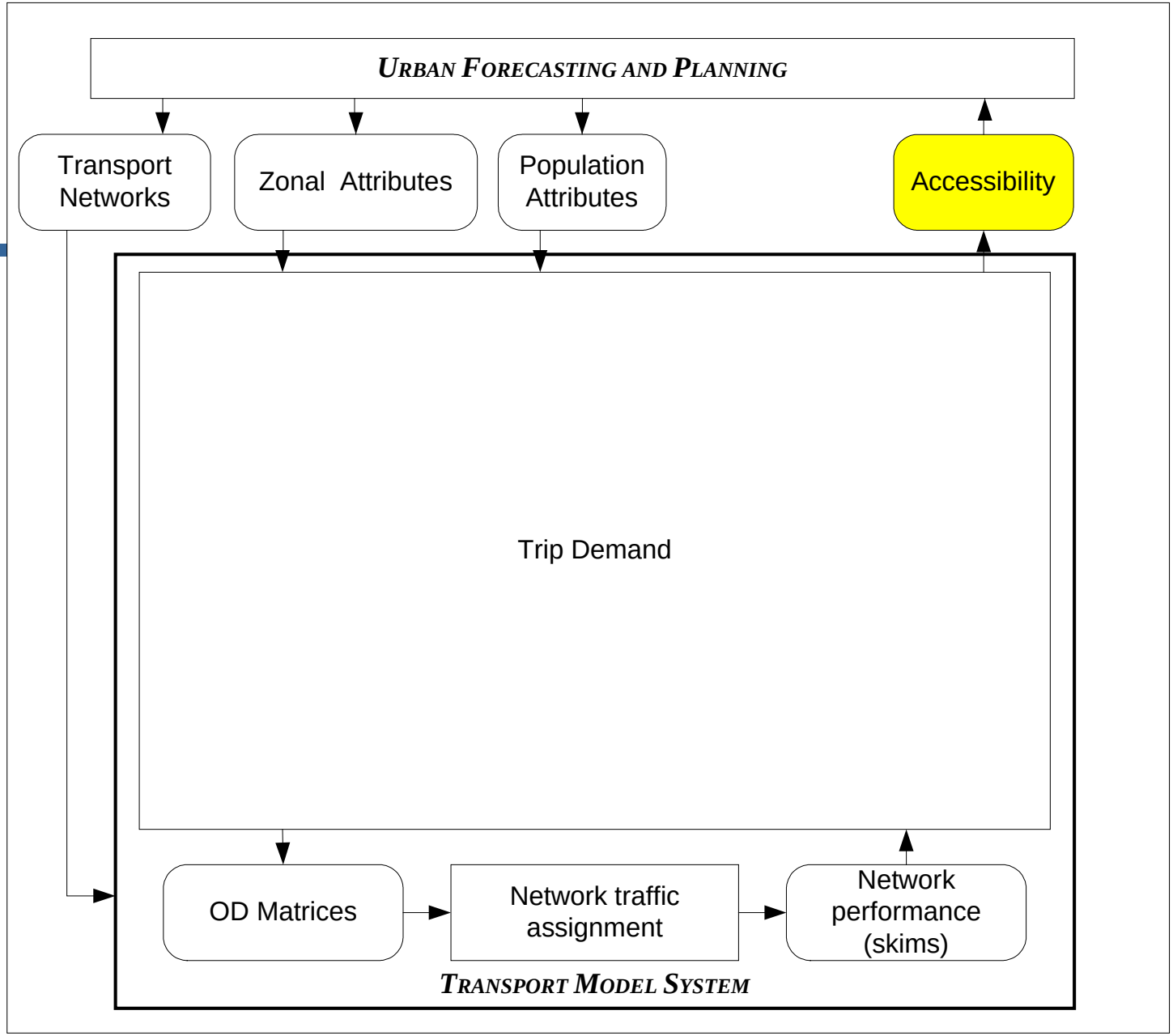
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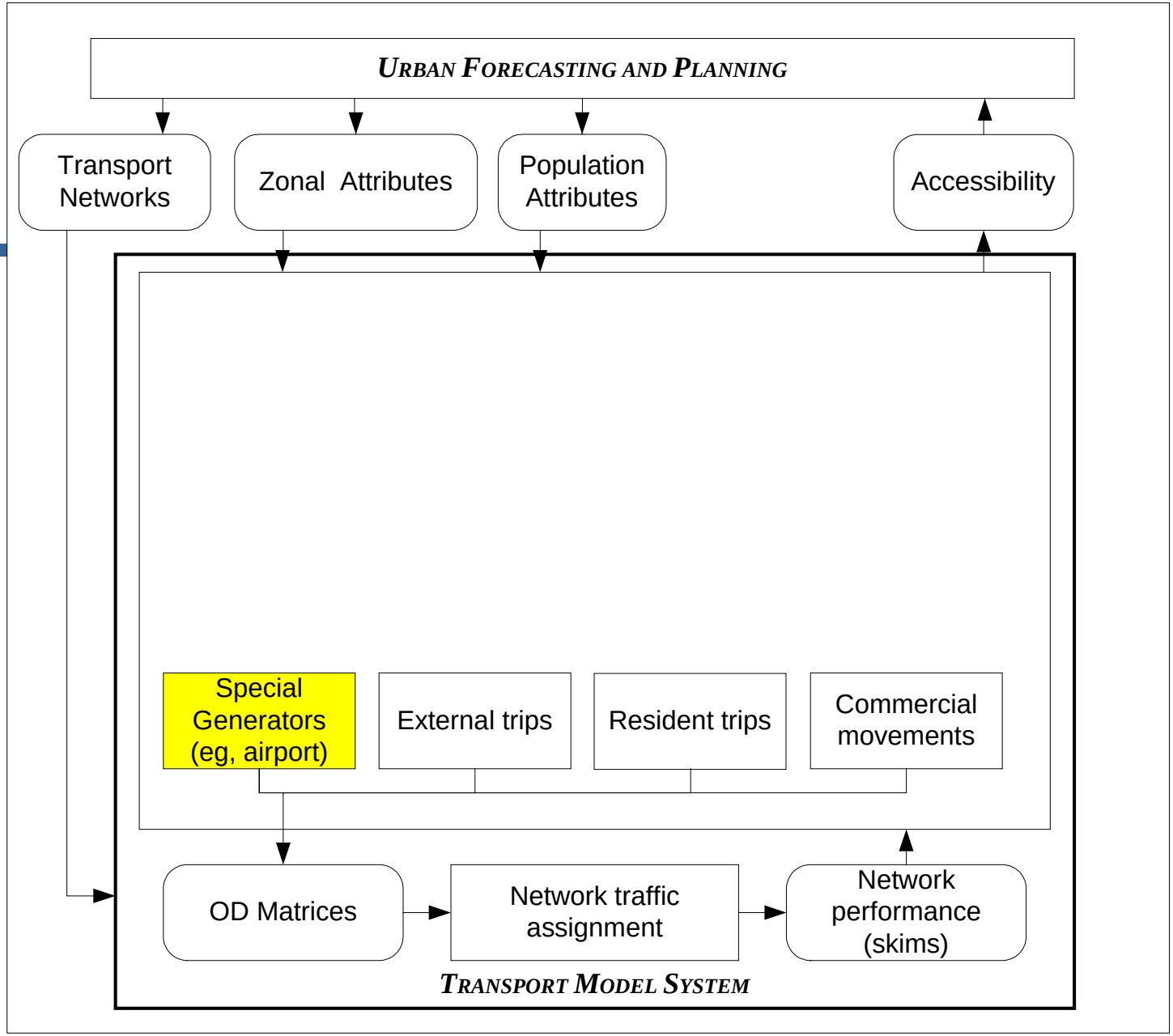
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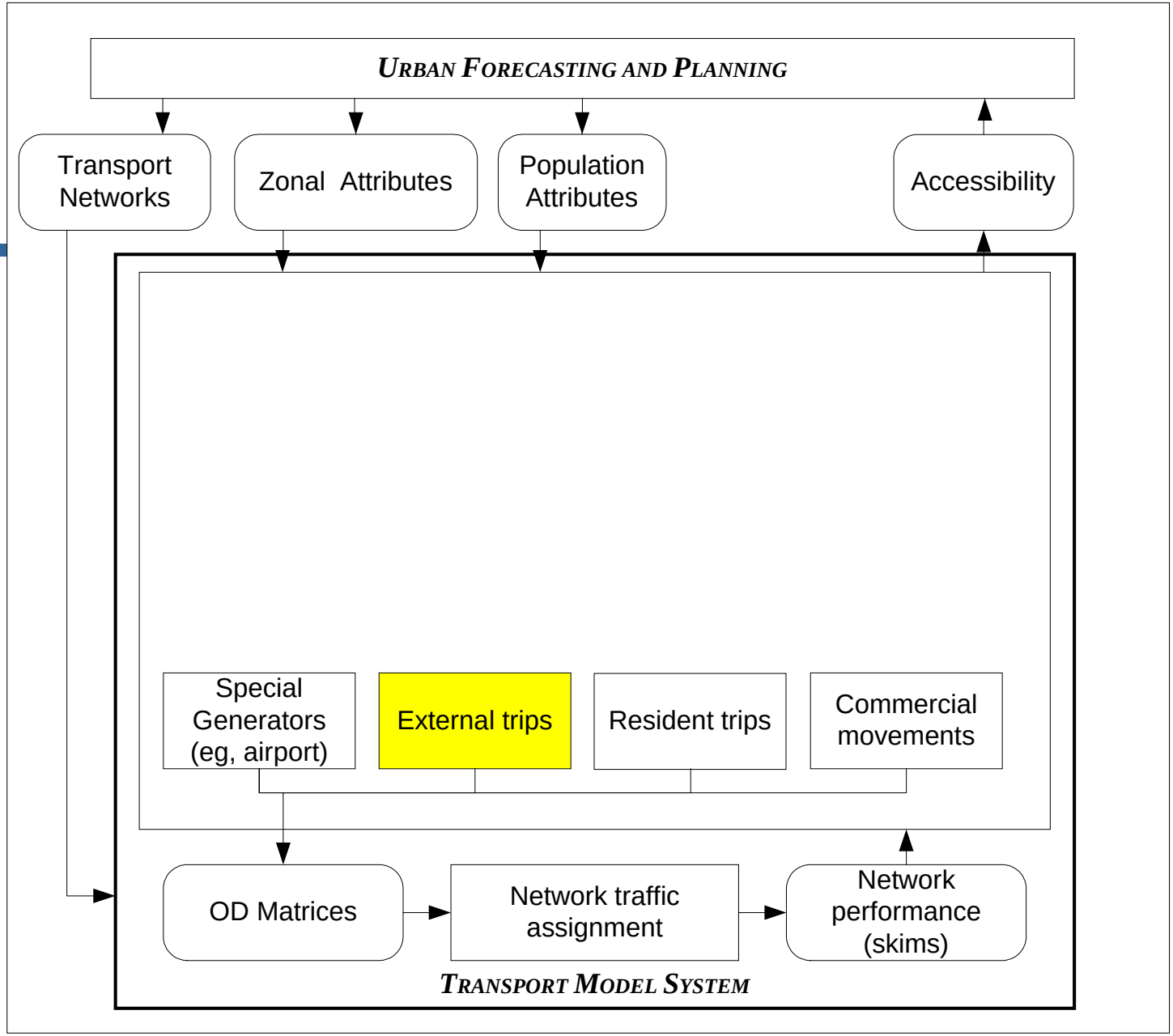
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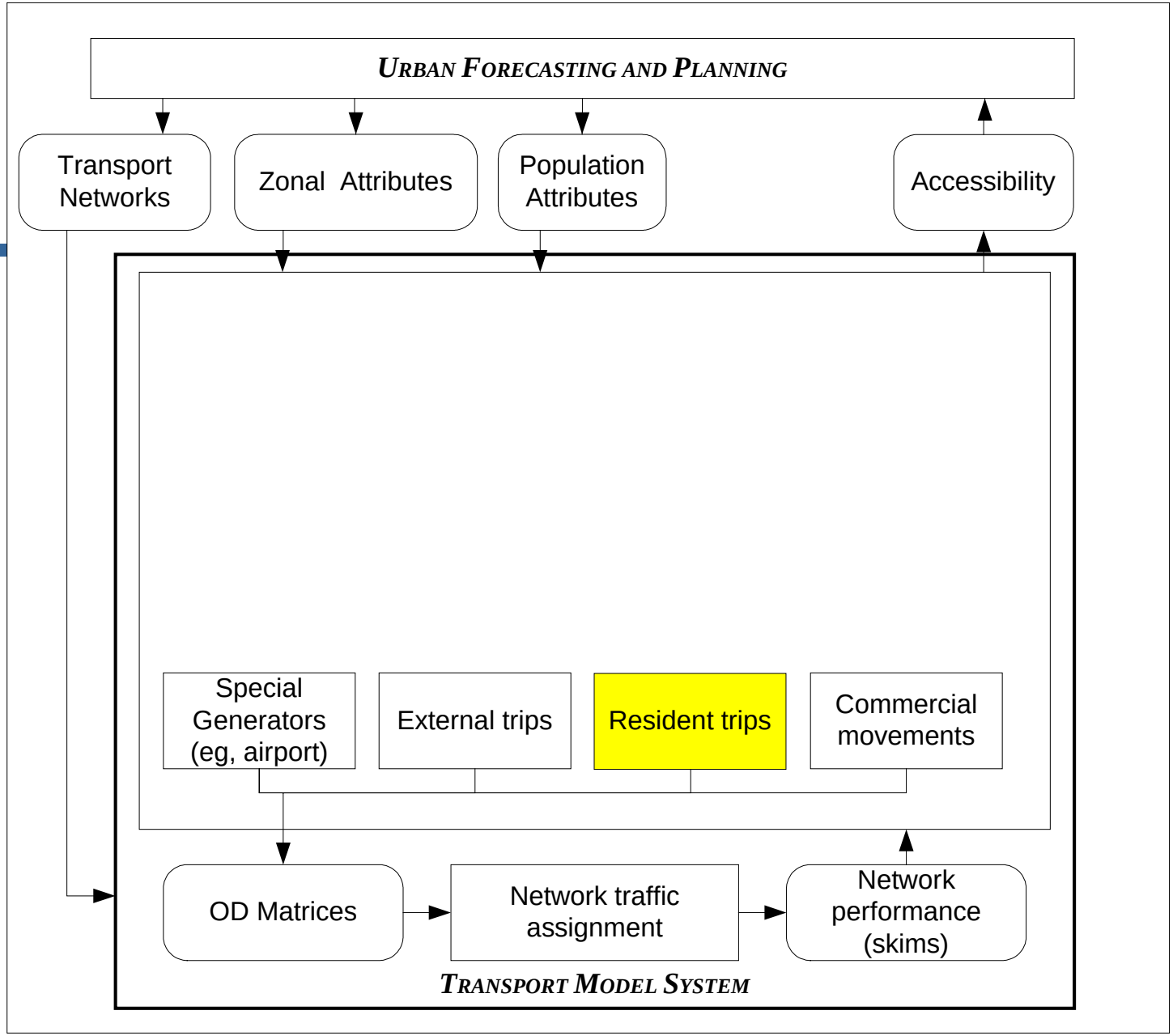
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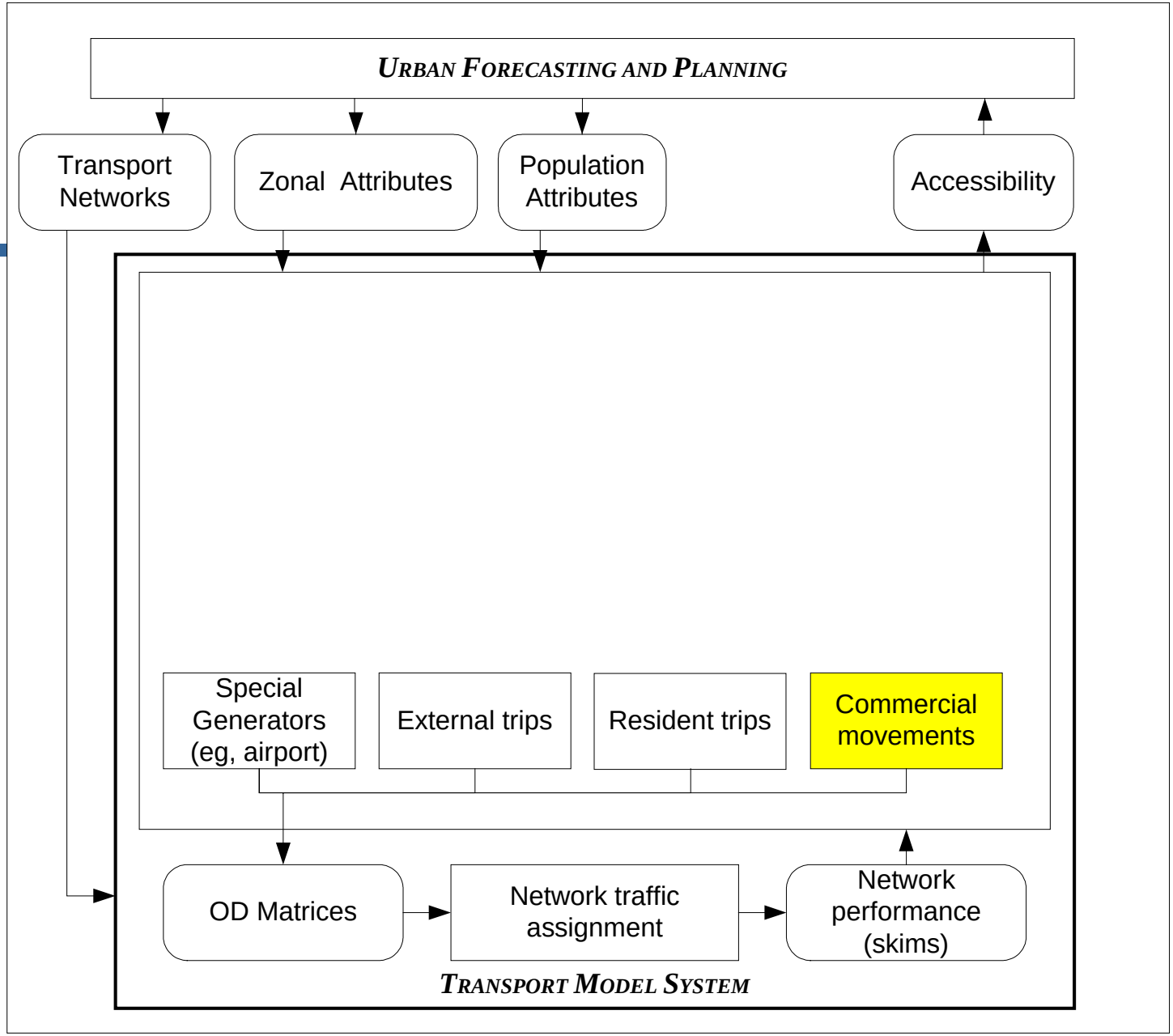
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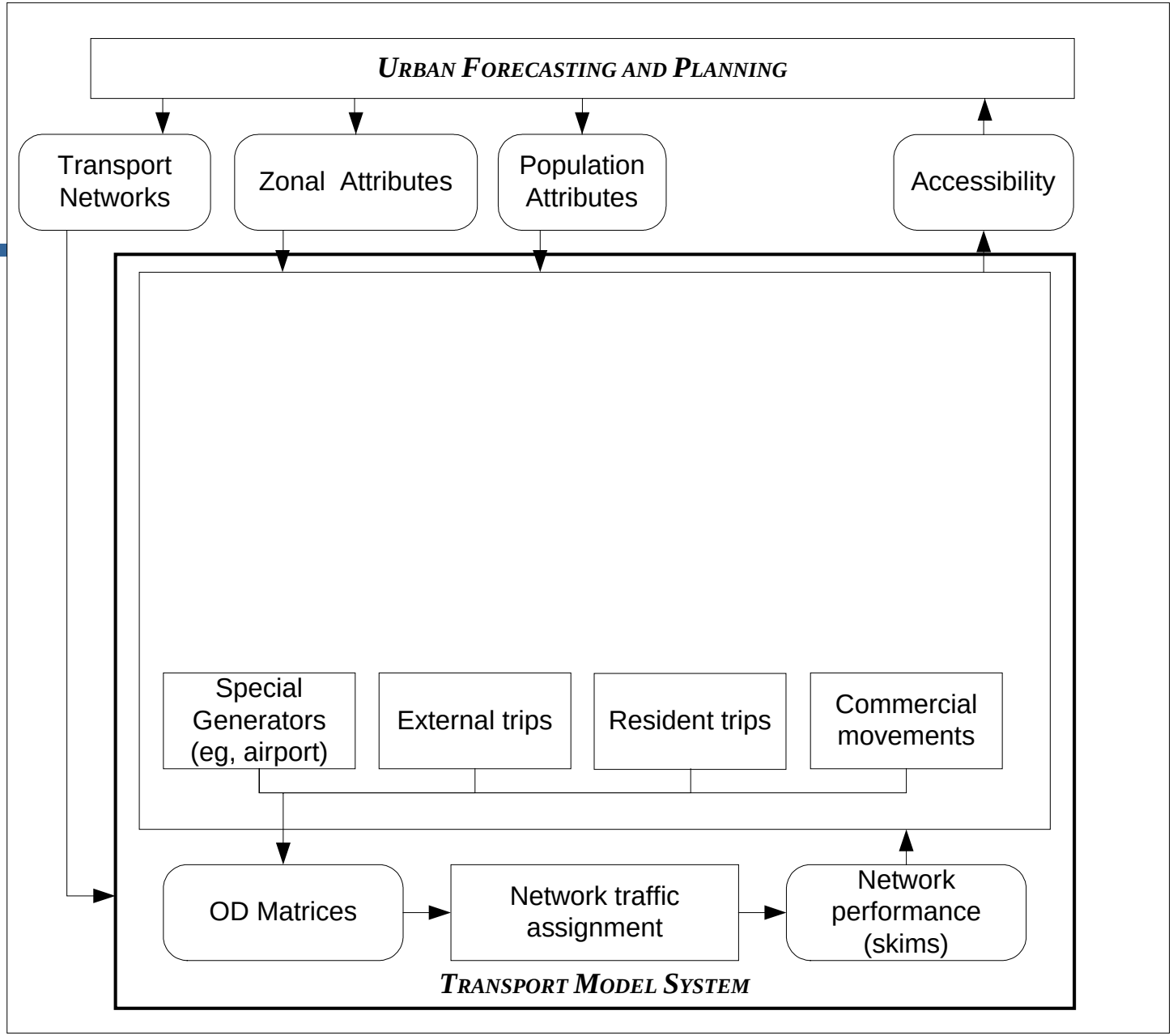
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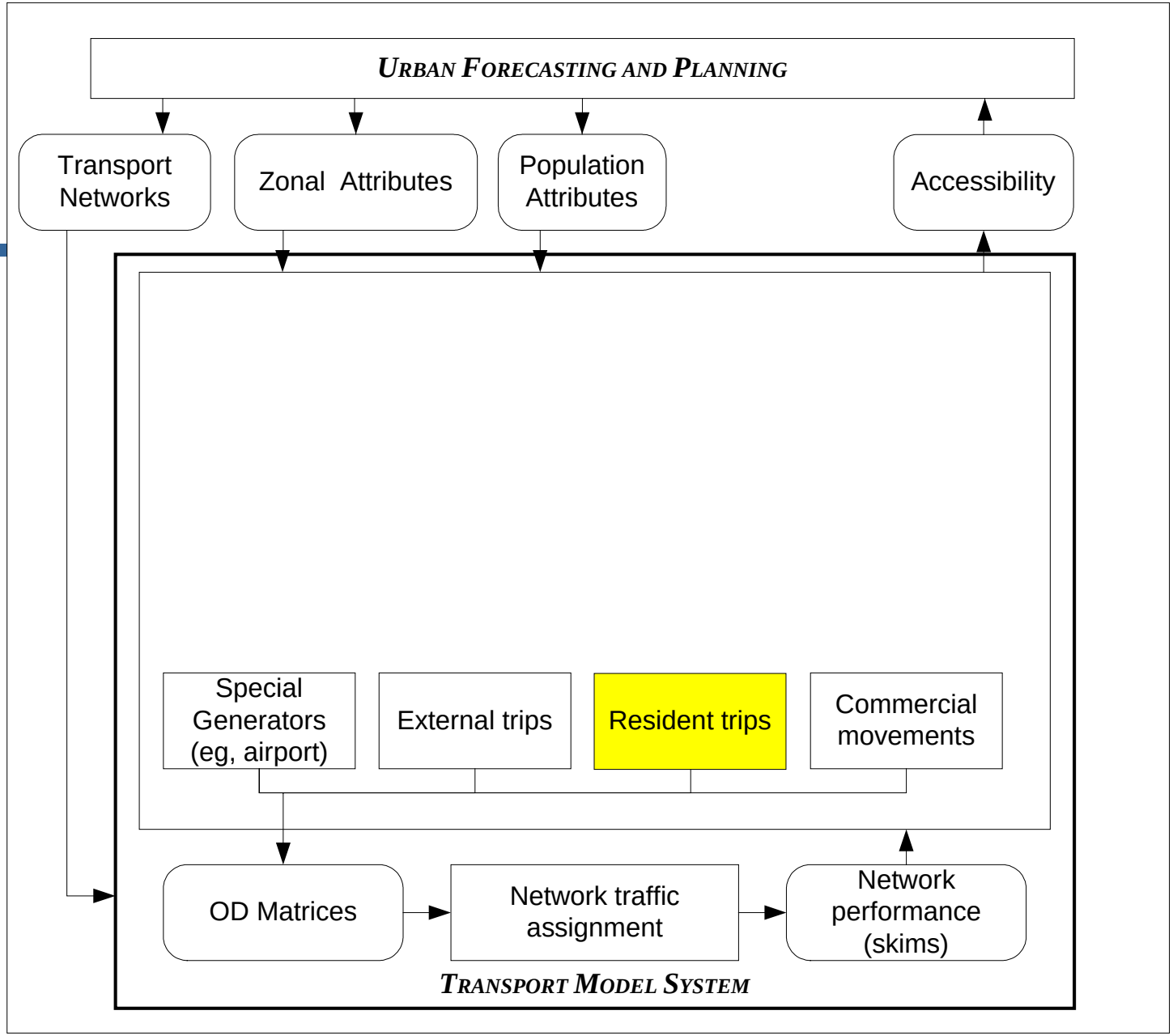
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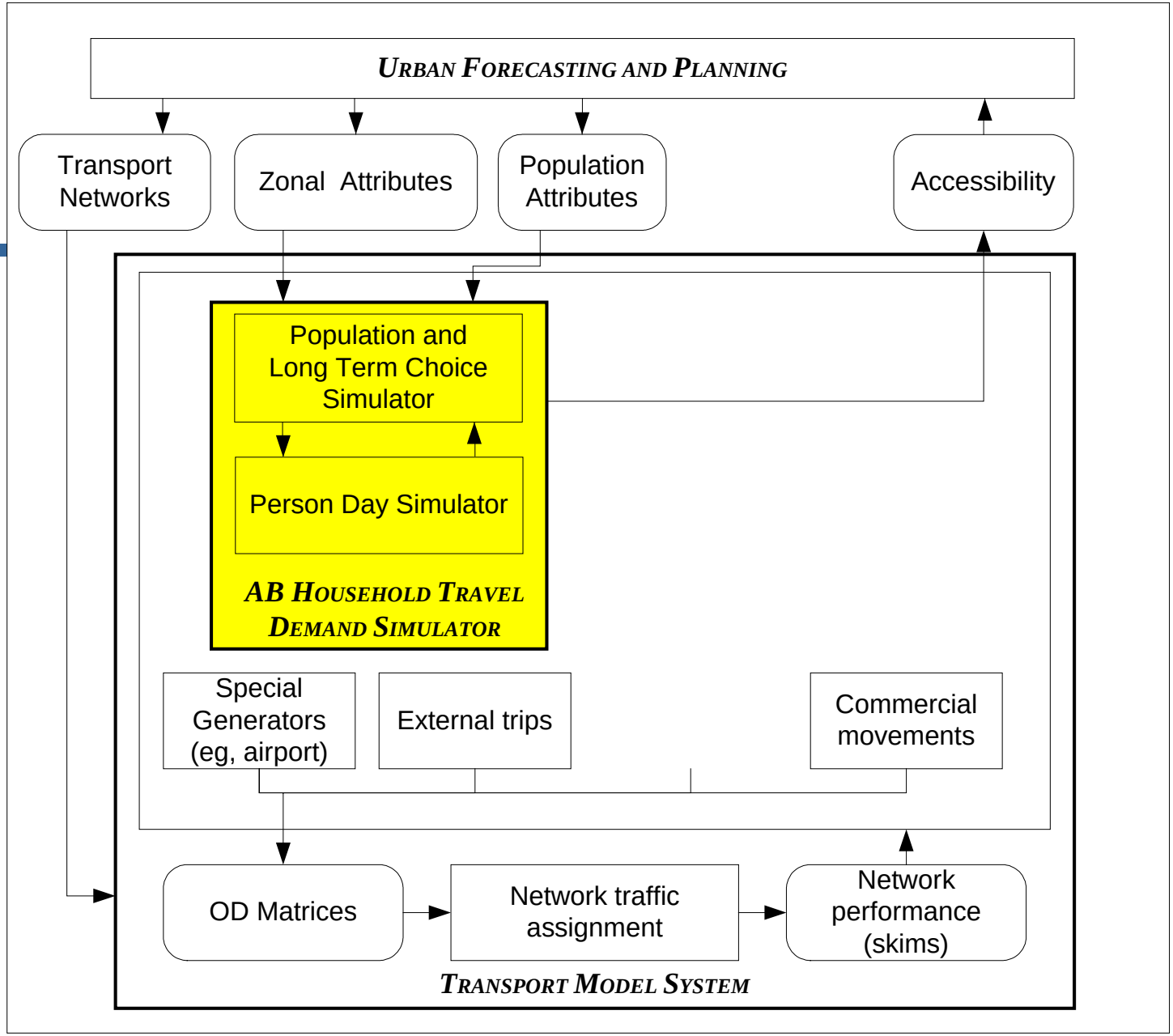
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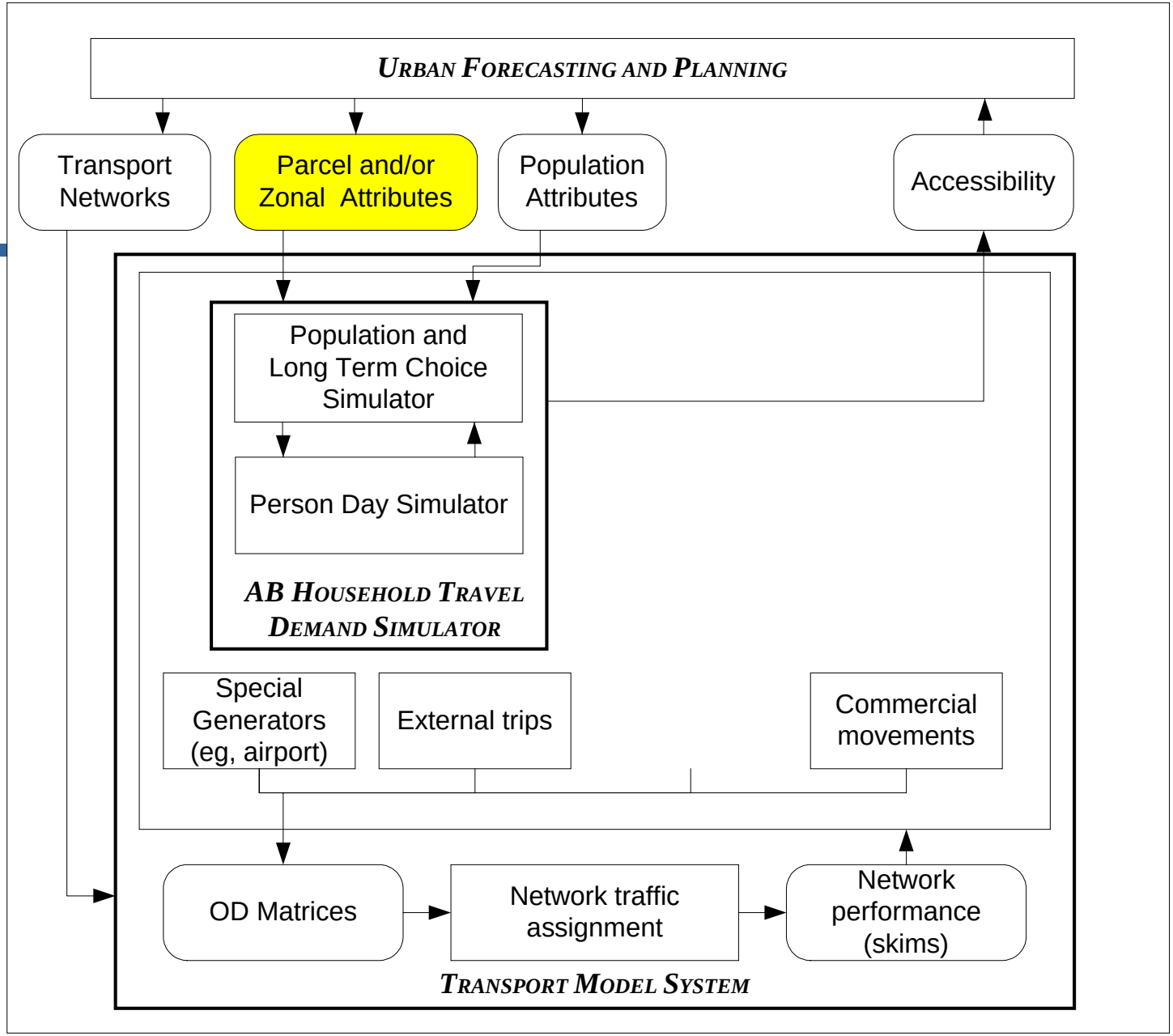
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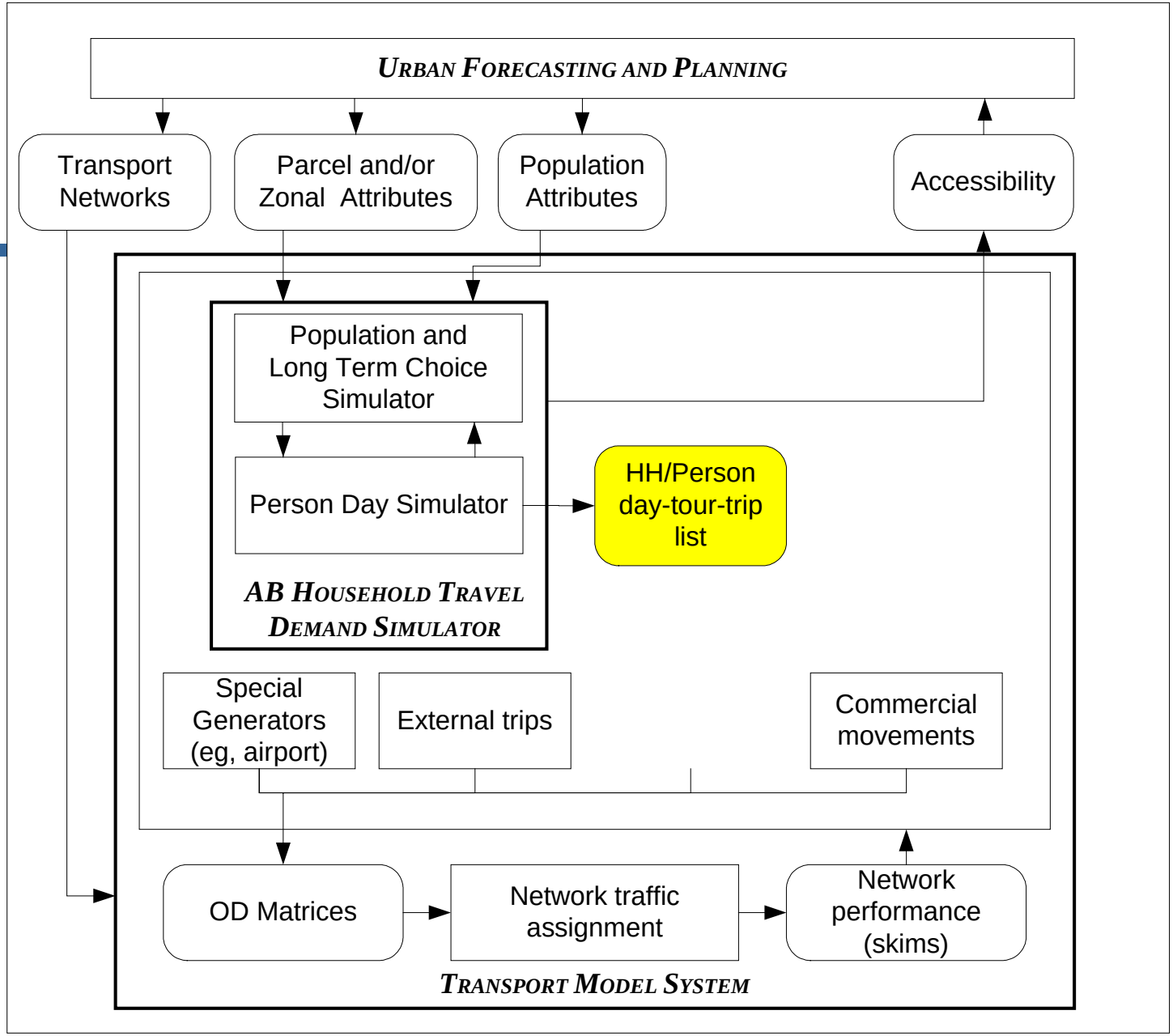
Parcel Attributes

- Within parcel itself
  - Jobs and school enrollment by type
  - Households
  - Housing stock
  - Parking by type
  - Distance to transit by type
- Surrounding the parcel
  - Same as above
  - Intersections by type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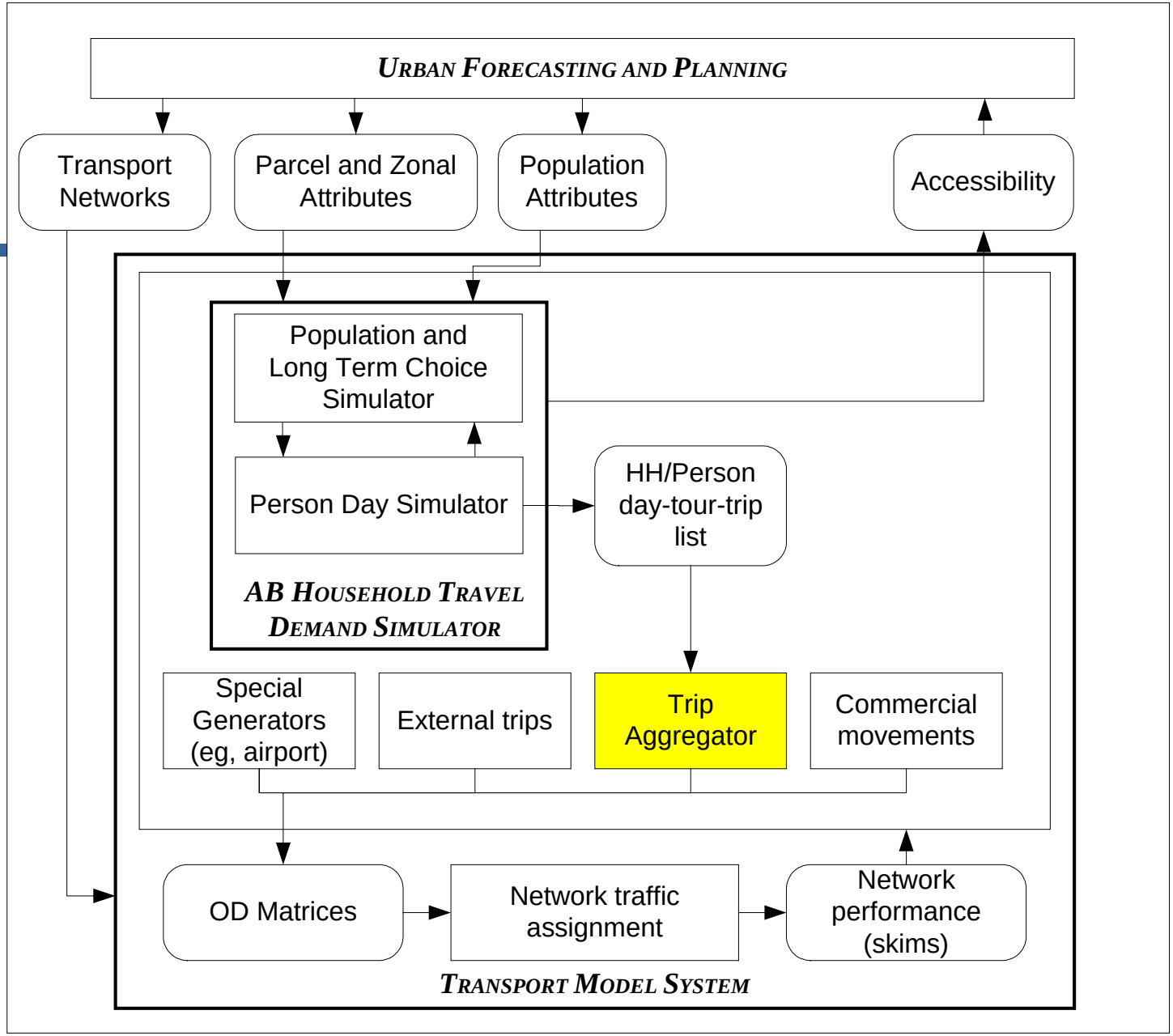
HH/Person/Day/Tour/Trip List

For each…	List includes…
Household	Location, size, vehicles, etc
Person	Age, gender, usual work & school locations, etc
Day	Number of tours and stops
Tour	Purpose, destination, timing, main mode, number of stops
Trip	Origin, destination, origin purpose, destination purpose, mode, departure time, travel time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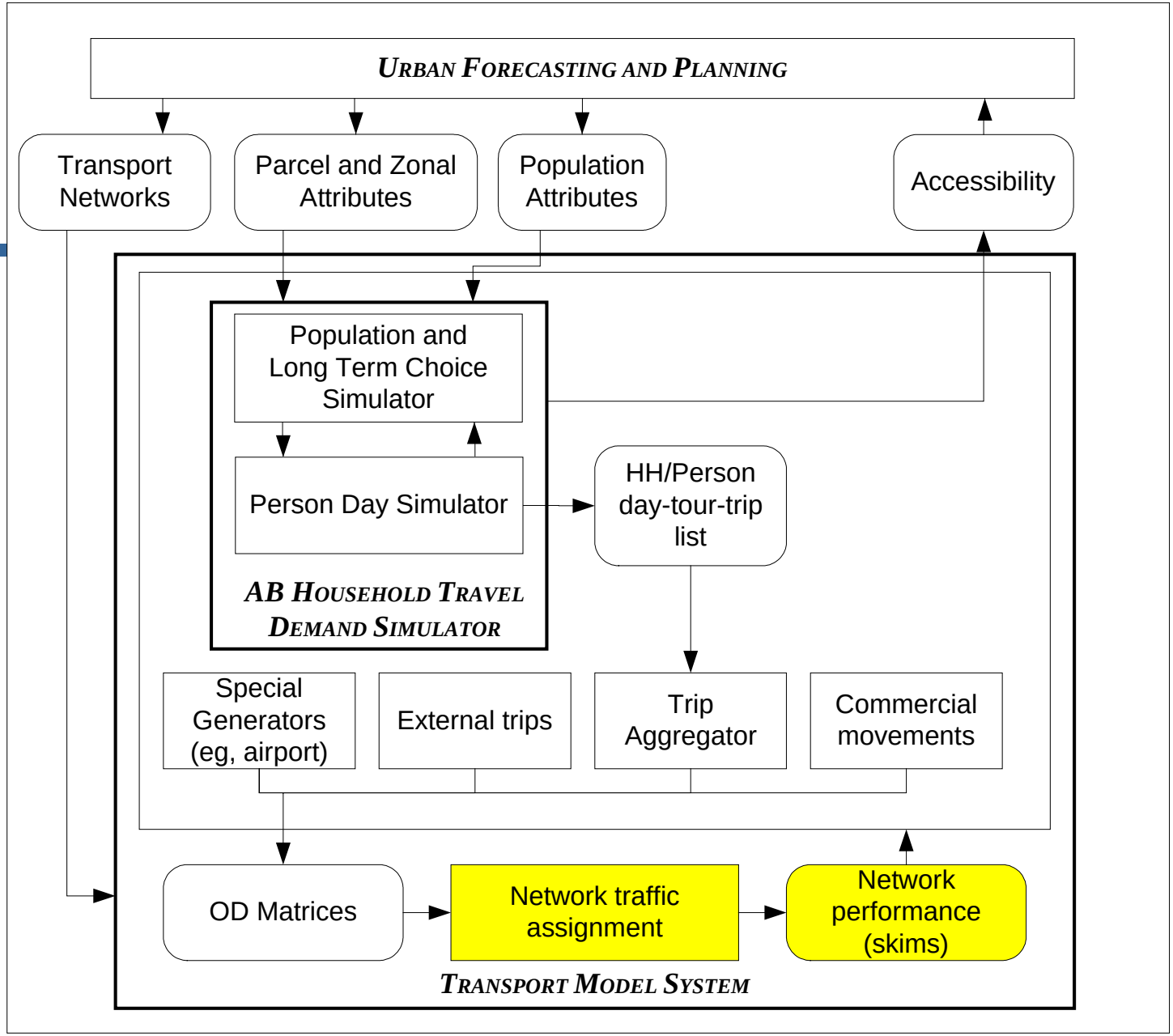
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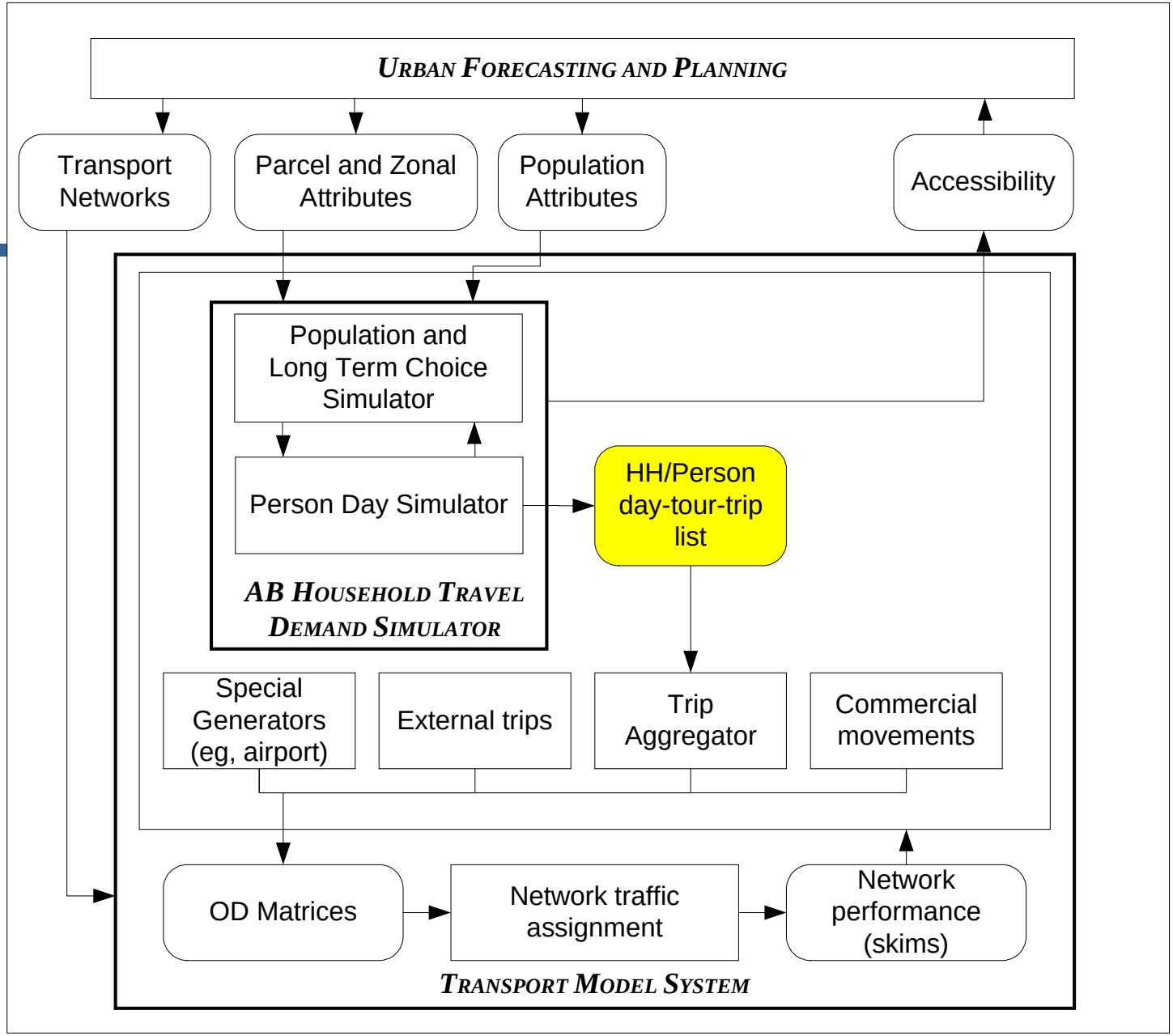
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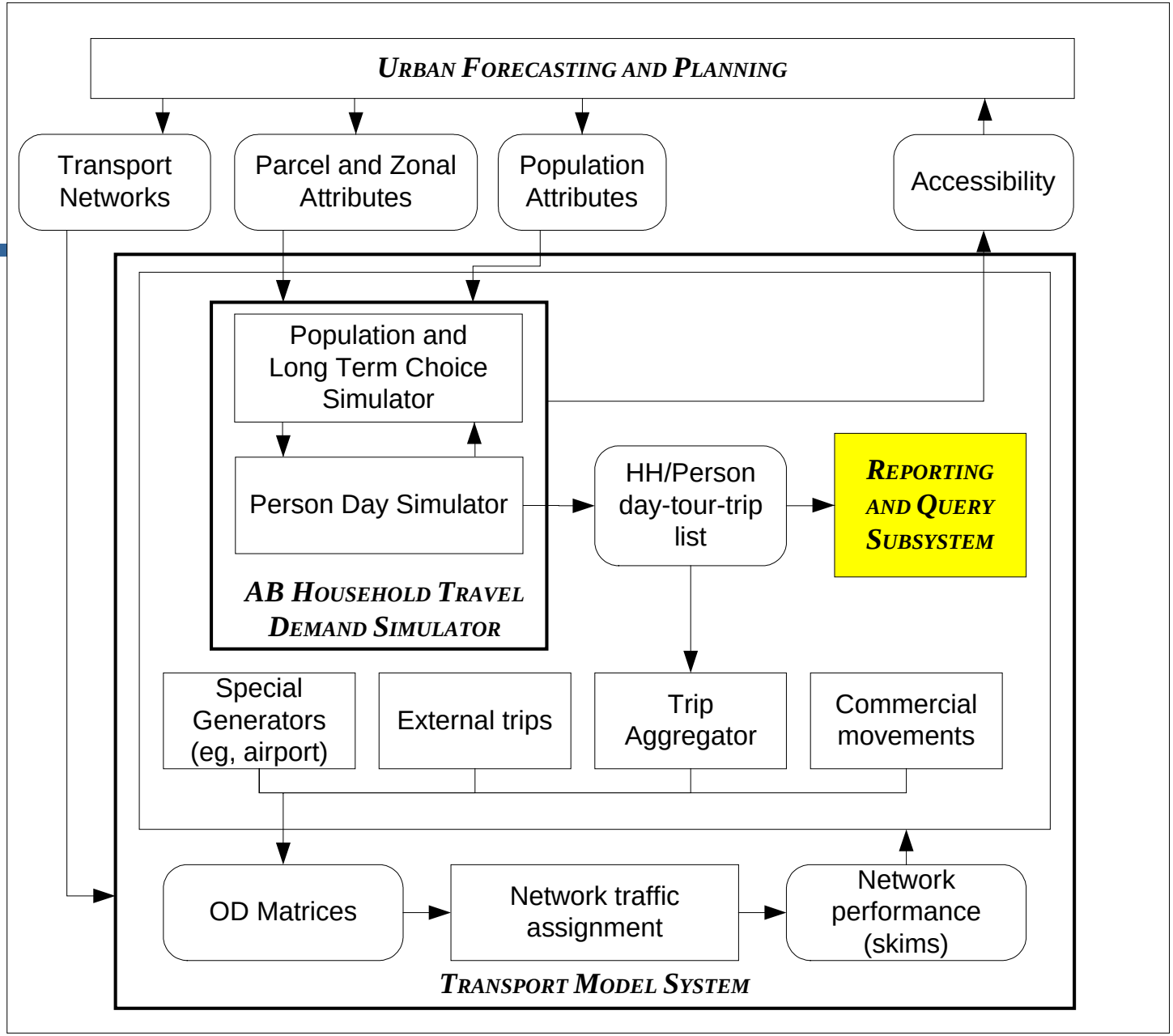
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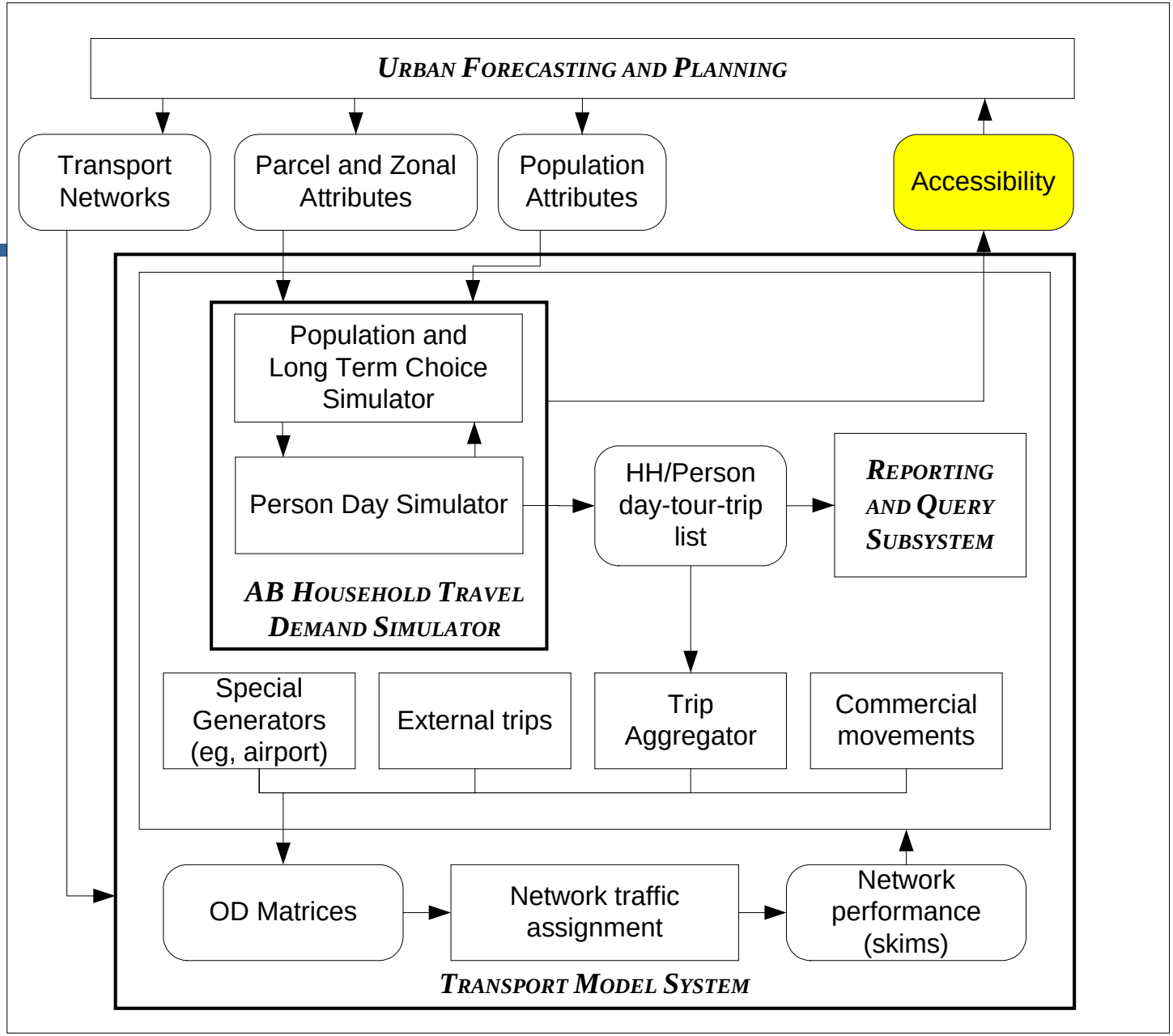
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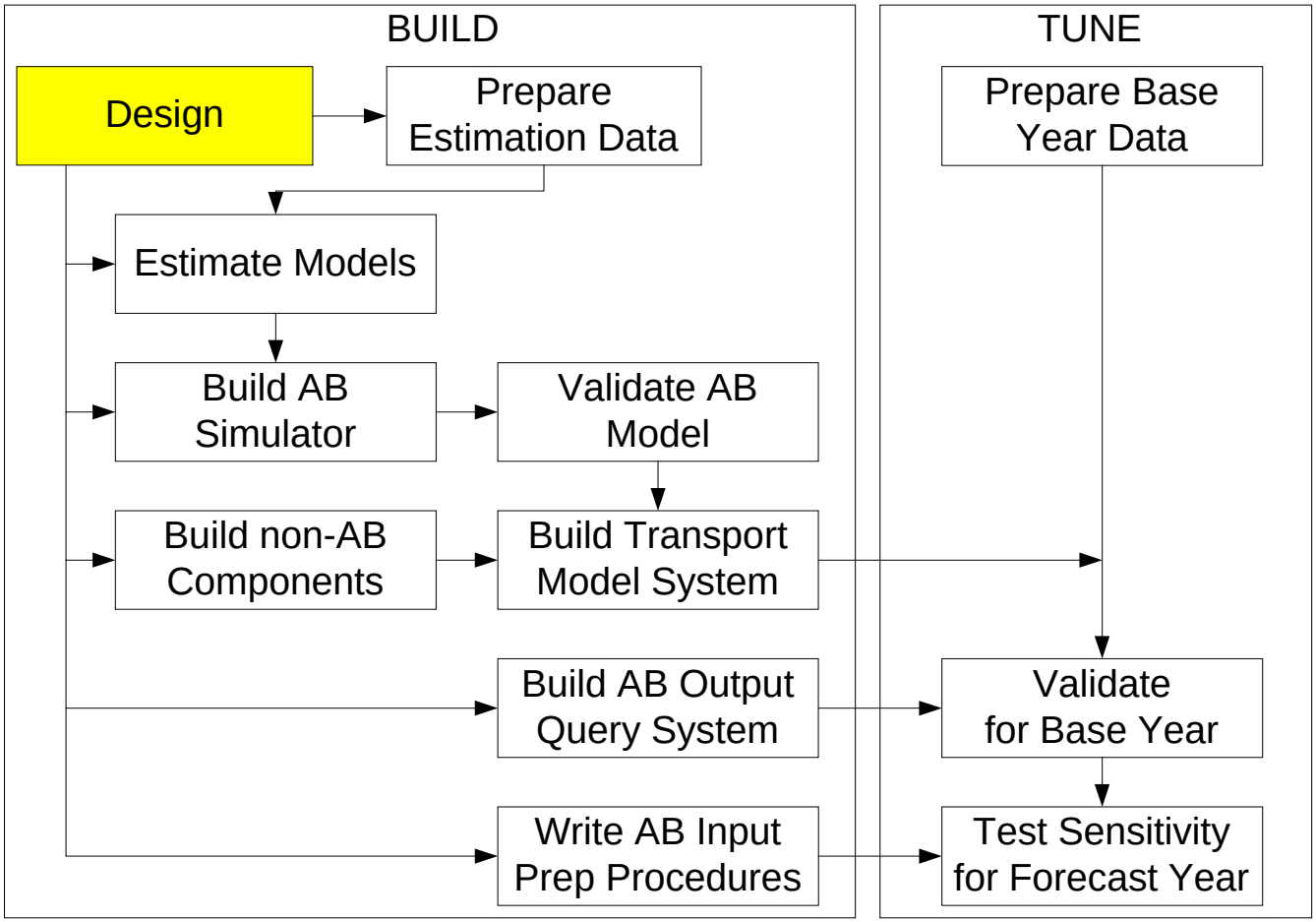
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Design

- AB Model components
- AB Model Integration
  - Downward (conditionality)
  - Upward (accessibility)
- AB Simulator (software)
- Overall transport model system

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Design
AB Model components

	Long Term models	
1.0	Population synthesizer	
1.1	Regular work location	Worker
1.2	Regular school location	Student
1.3	Regular mode to work (optional)	Worker
1.4	Transit pass (optional)	Person
1.5	Auto Availability	HH
1.6	Auto type (optional)	Vehicle

Design
AB Model components

	Day-level models	
2.1	Household day pattern (optional)	HH-day
2.2	Household joint half-tours (optional)	HH-day
2.3	Joint tours (optional)	HH-day
2.4	Person day pattern	Person-day
2.5	Exact Number of Tours	Person-day

Design
AB Model components

	Tour-level models	
3.1	Tour Destination	Tour
3.2	Work-Based Subtour Generation	Work Tour
3.3	Tour Main Mode	Tour
3.4	Tour vehicle (optional)	Tour
3.5	Tour Time of Day	Tour

Design
AB Model components

	Trip/stop-level models	
4.1	Intermediate Stop Generation	Half Tour
4.2	Intermediate Stop Location	Trip
4.3	Trip Mode Choice	Trip
4.4	Trip Departure Time	Trip
4.5	Parking location choice (optional)	Trip

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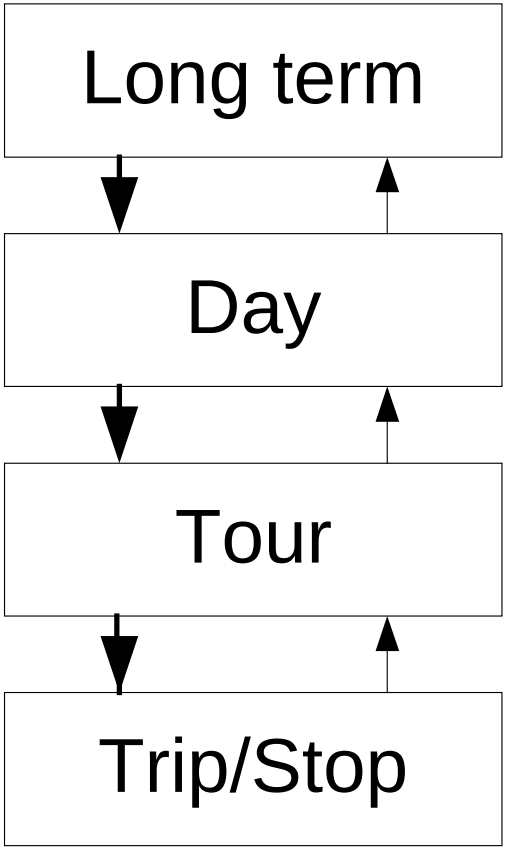
Downward Integration

Lower models take upper outcomes as given



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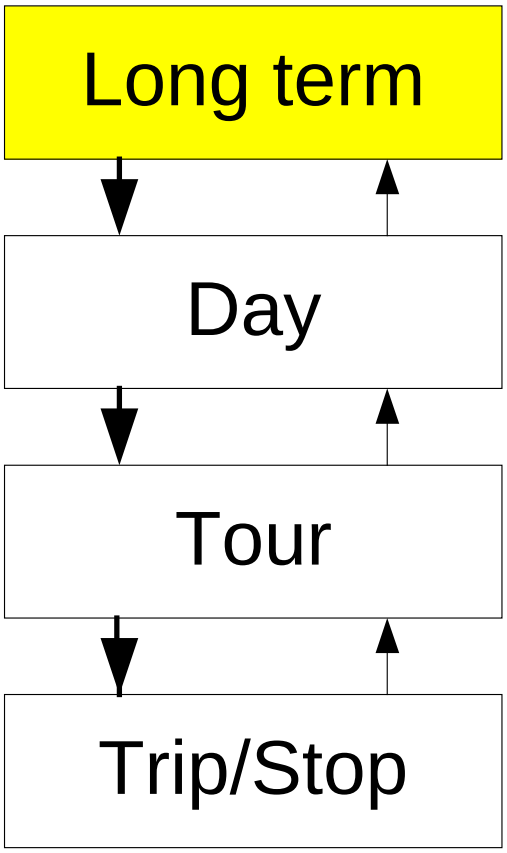

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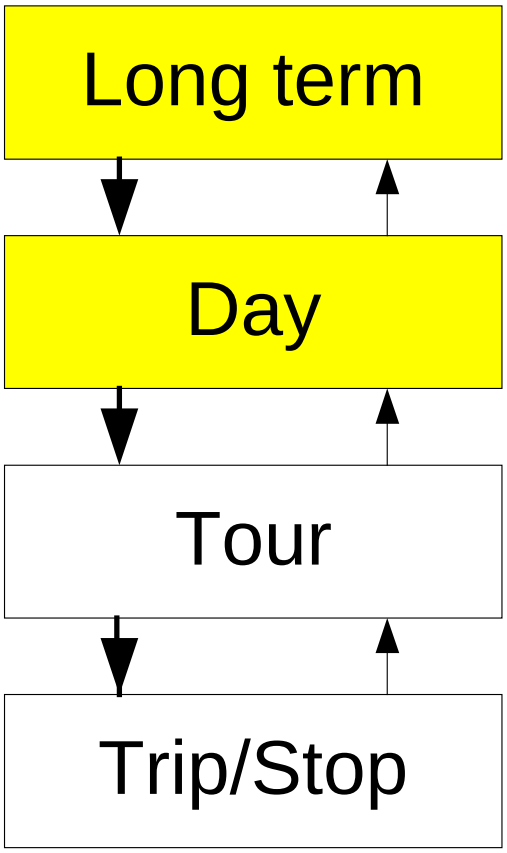

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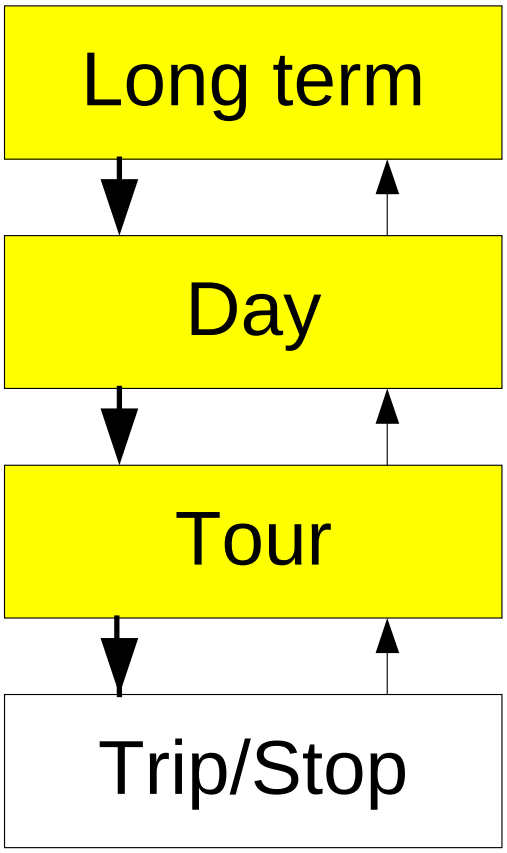

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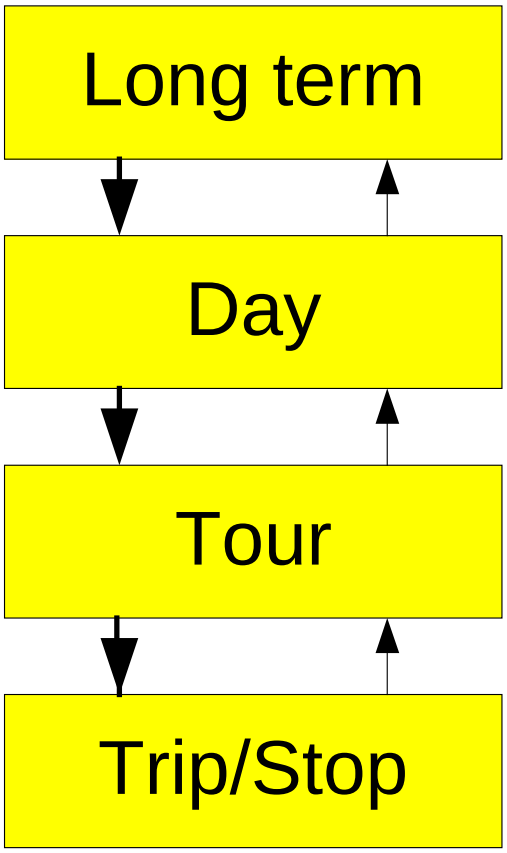
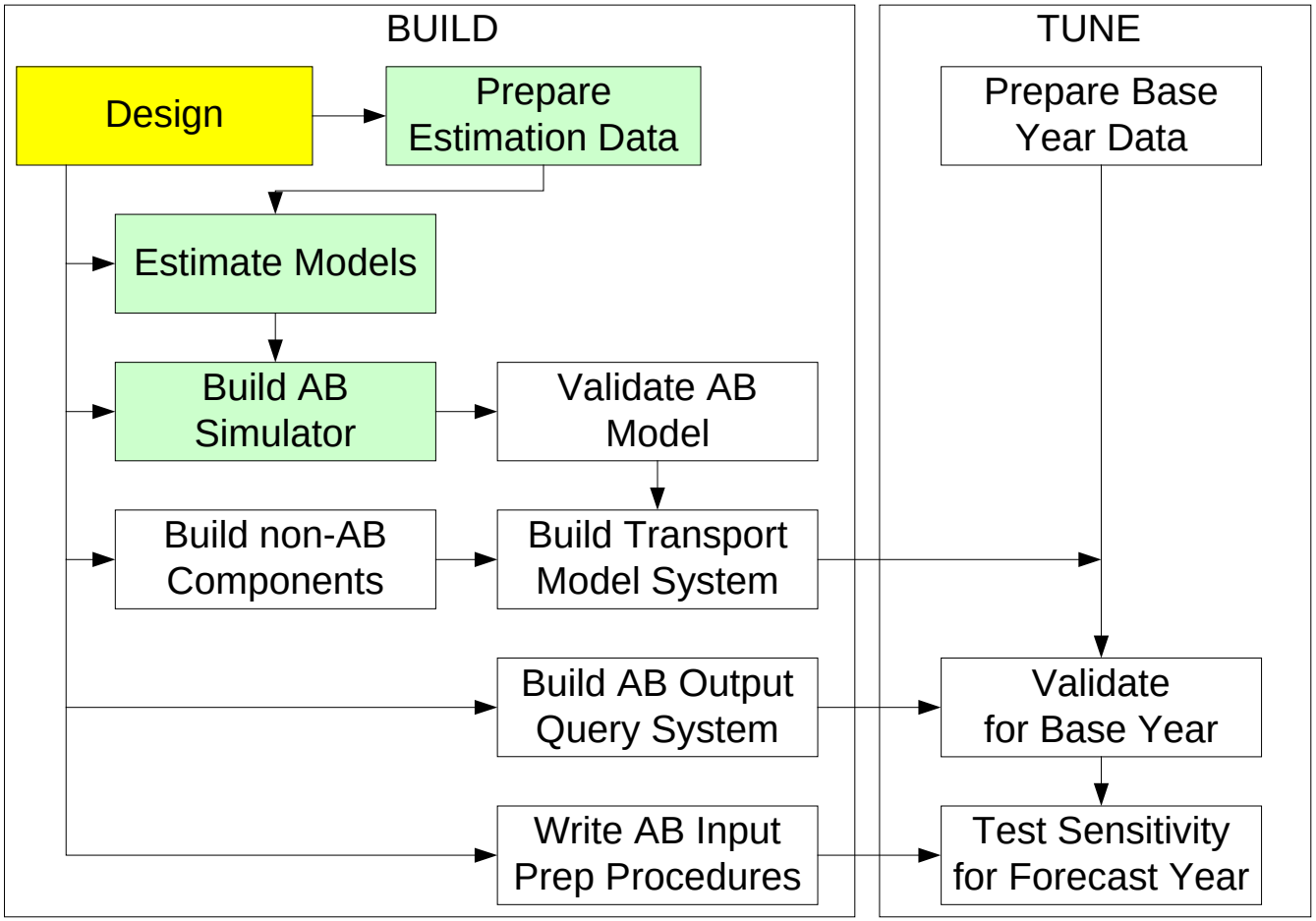
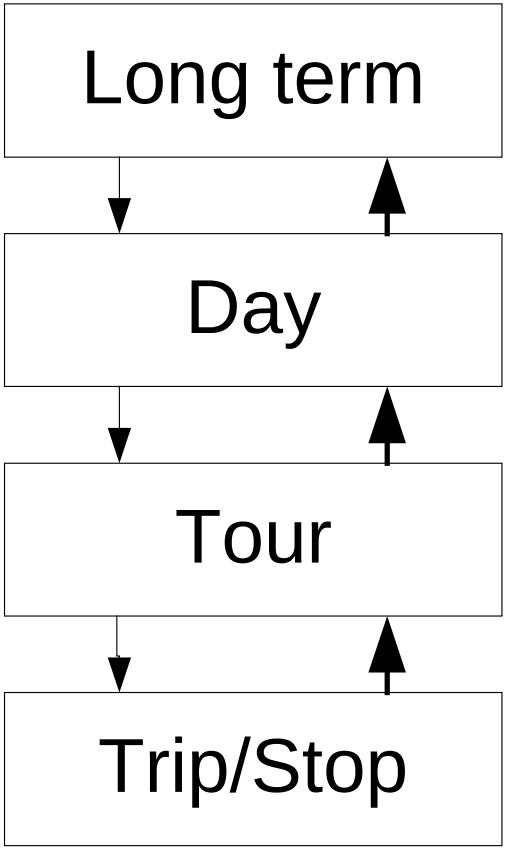


Consistent Design of Downward Integration



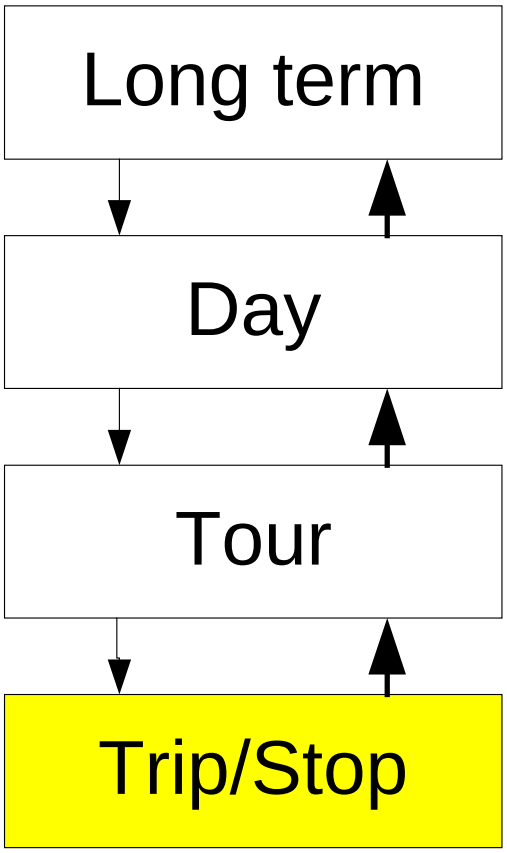
Upward Integration

Upper models should be sensitive to conditions affecting lower models



Upward Integration

Upper models should be sensitive to conditions affecting lower models



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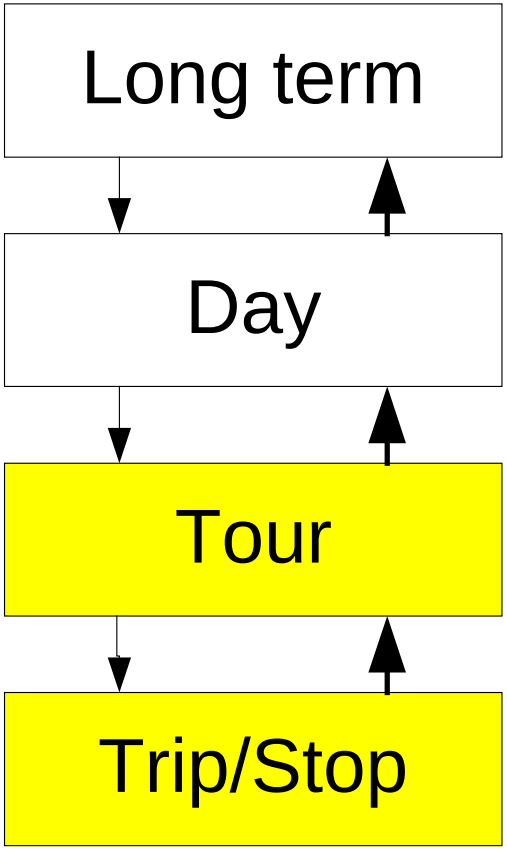

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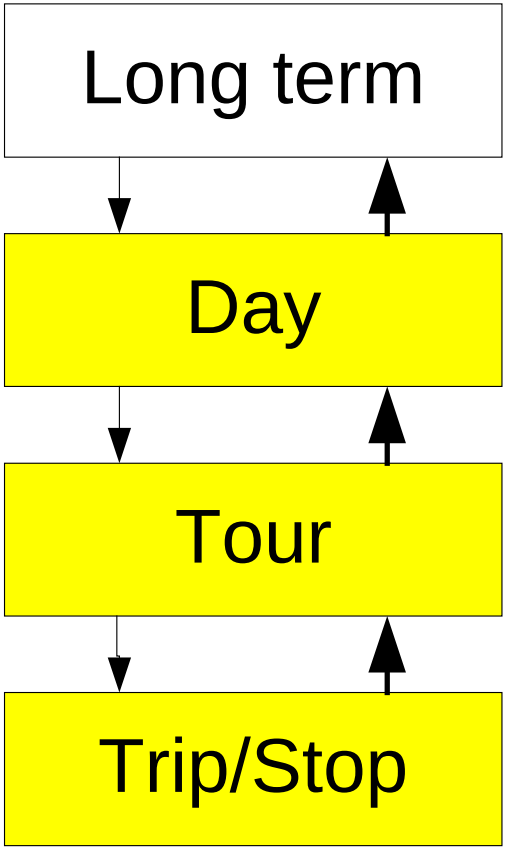

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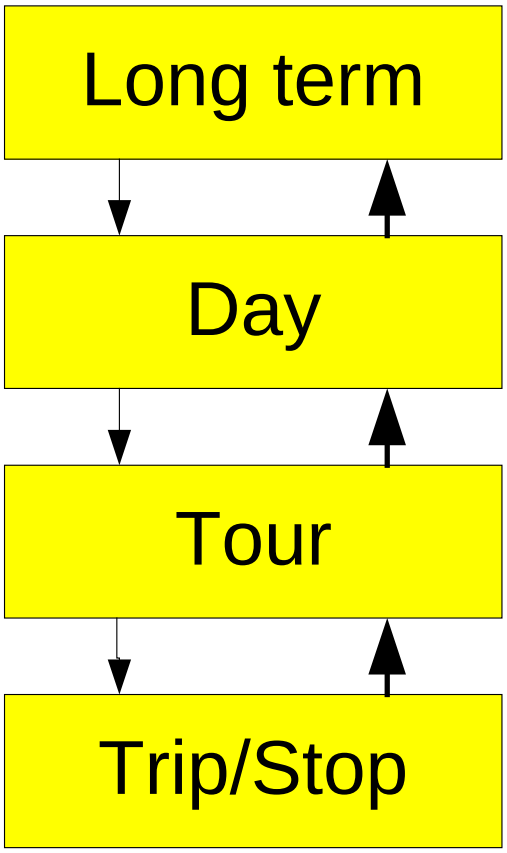
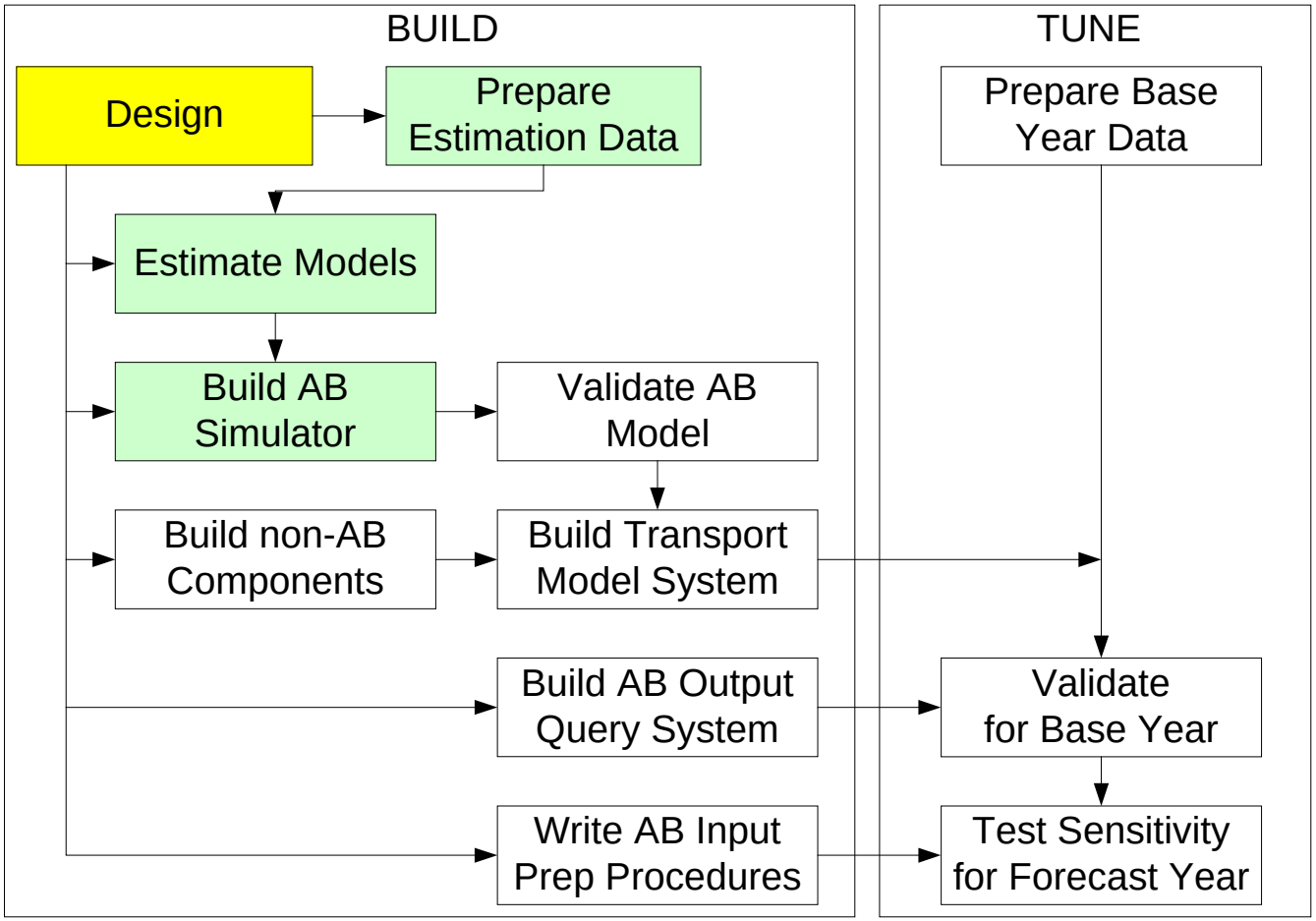


Consistent Design of Upward Integration



Design

- AB Model components
- AB Model Integration
  - Downward (conditionality)
  - Upward (accessibility)
- AB Simulator (software)
- Overall transport model system

AB Simulator

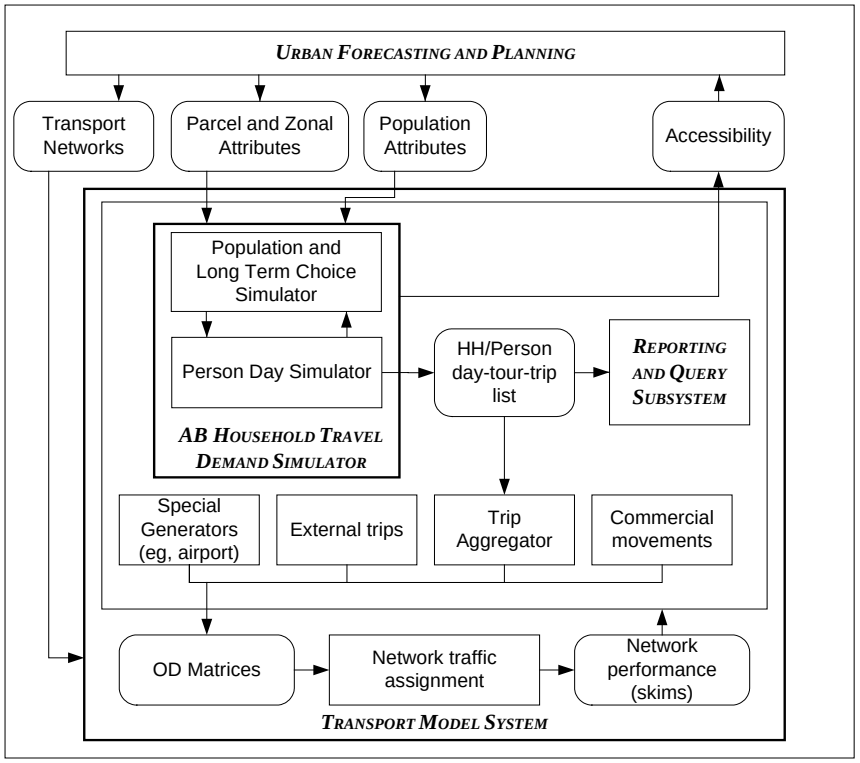
Begin
{Read run controls, model coefficients, TAZ data, LOS matrices, population controls, and Parcel data into memory}
{Draw a synthetic household sample if specified}
{Pre-calculate destination sampling probabilities}
{Pre-calculate (or read in) TAZ aggregate accessibility arrays}
{Open other input and output files}
{Main loop on households}
{Loop on persons in HH}
{Apply model **1.1 Work Location for workers**}
{Apply model **1.2 School Location for students**}
{Apply model **1.1 Work Location for students**}
{End loop on persons in HH}
{Apply model **1.3 Household Auto Availability** }
{Loop on all persons within HH}
{Apply model **2.1 Activity Pattern** (0/1+ tours and 0/1+ stops) and model **2.2 Exact Number of Tours** for 7 purposes}
{Count total home-based tours and assign purposes}
{Initialize tour and stop counters and time window for the person-day before looping on tours}
{If there are tours, loop on home-based tours within person in tour priority sequence, with tour priority determined by purpose and person type}
{Increment number of home-based tours simulated for tour purpose (including current)}
{Apply model **3.1 Tour destination**}

Design

- AB Model components
- AB Model Integration
  - Downward (conditionality)
  - Upward (accessibility)
- AB Simulator (software)
- Overall transport model system

Design of overall transport model system

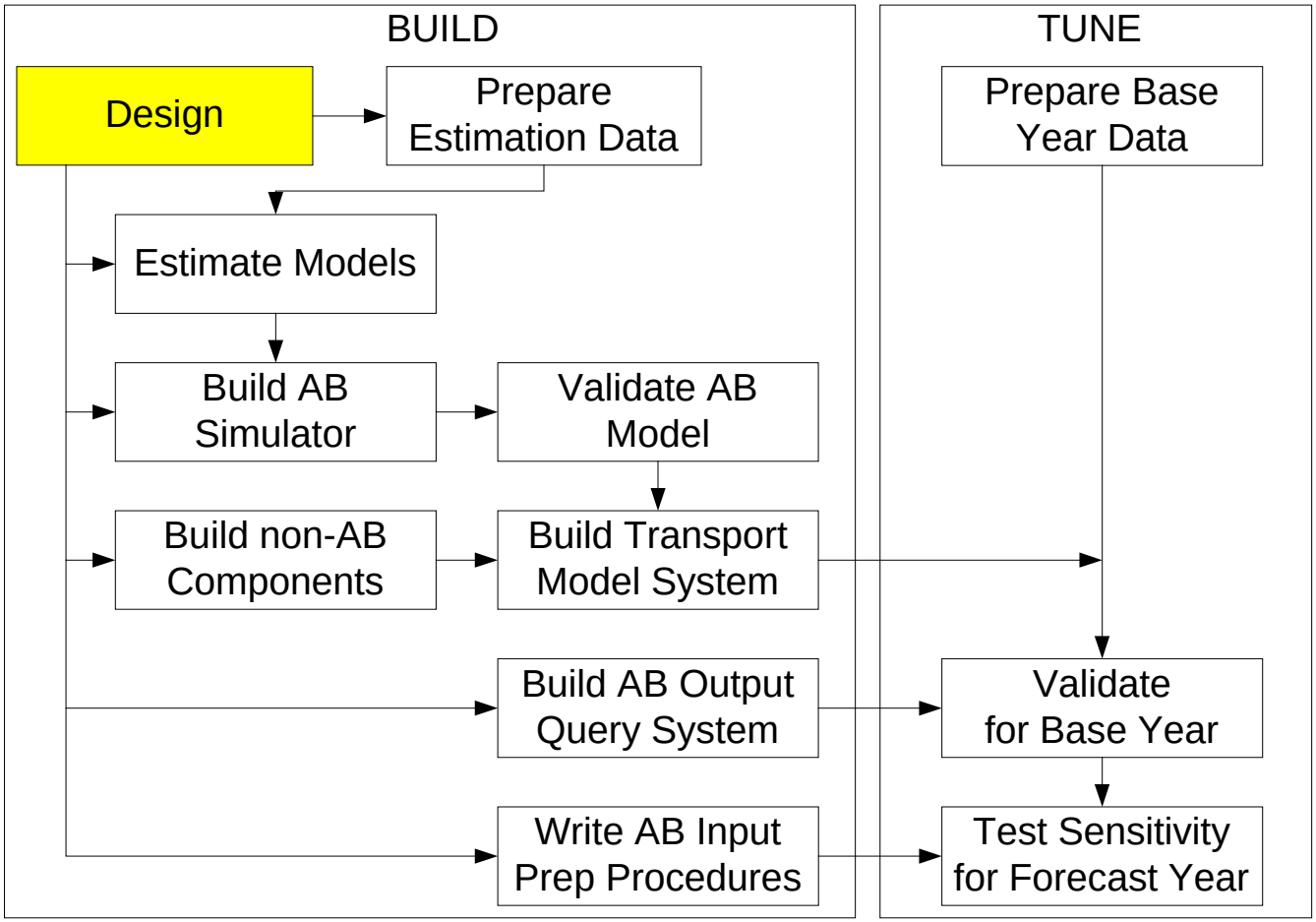
- Equilibration
- Performance



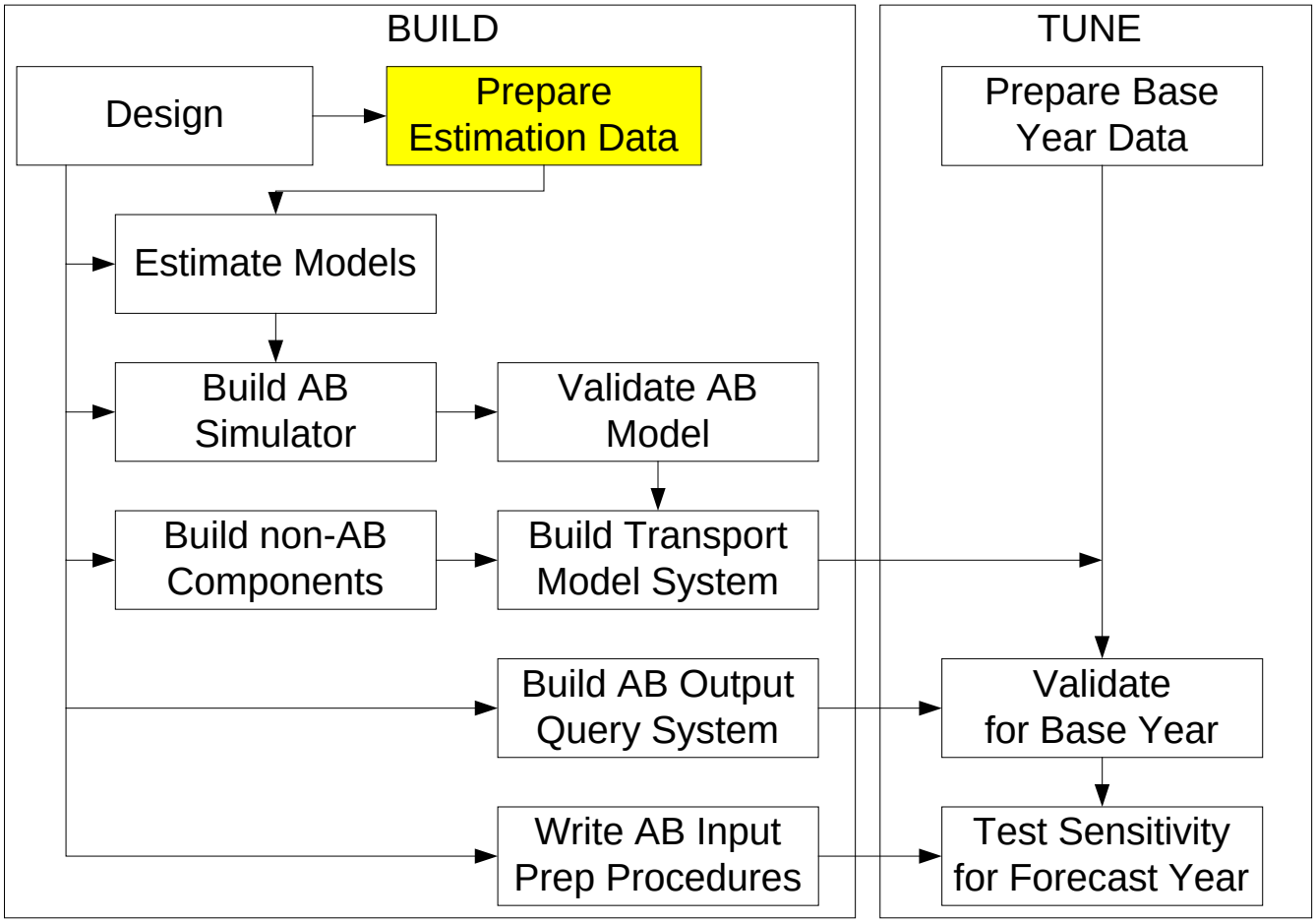
AB Model Design Issues

- Differences among existing models
  - Parcel data
  - Intra-household interactions
- Innovative features
  - Parking
  - Vehicles
  - Pricing
  - Transit
  - Other?

Design


BUILD
TUNE
Design
Prepare Estimation Data
Prepare Base Year Data
Estimate Models
Build AB Simulator
Validate AB Model
Build non-AB Components
Build Transport Model System
Build AB Output Query System
Validate for Base Year
Write AB Input Prep Procedures
Test Sensitivity for Forecast Year

Prepare Estimation Data



Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data

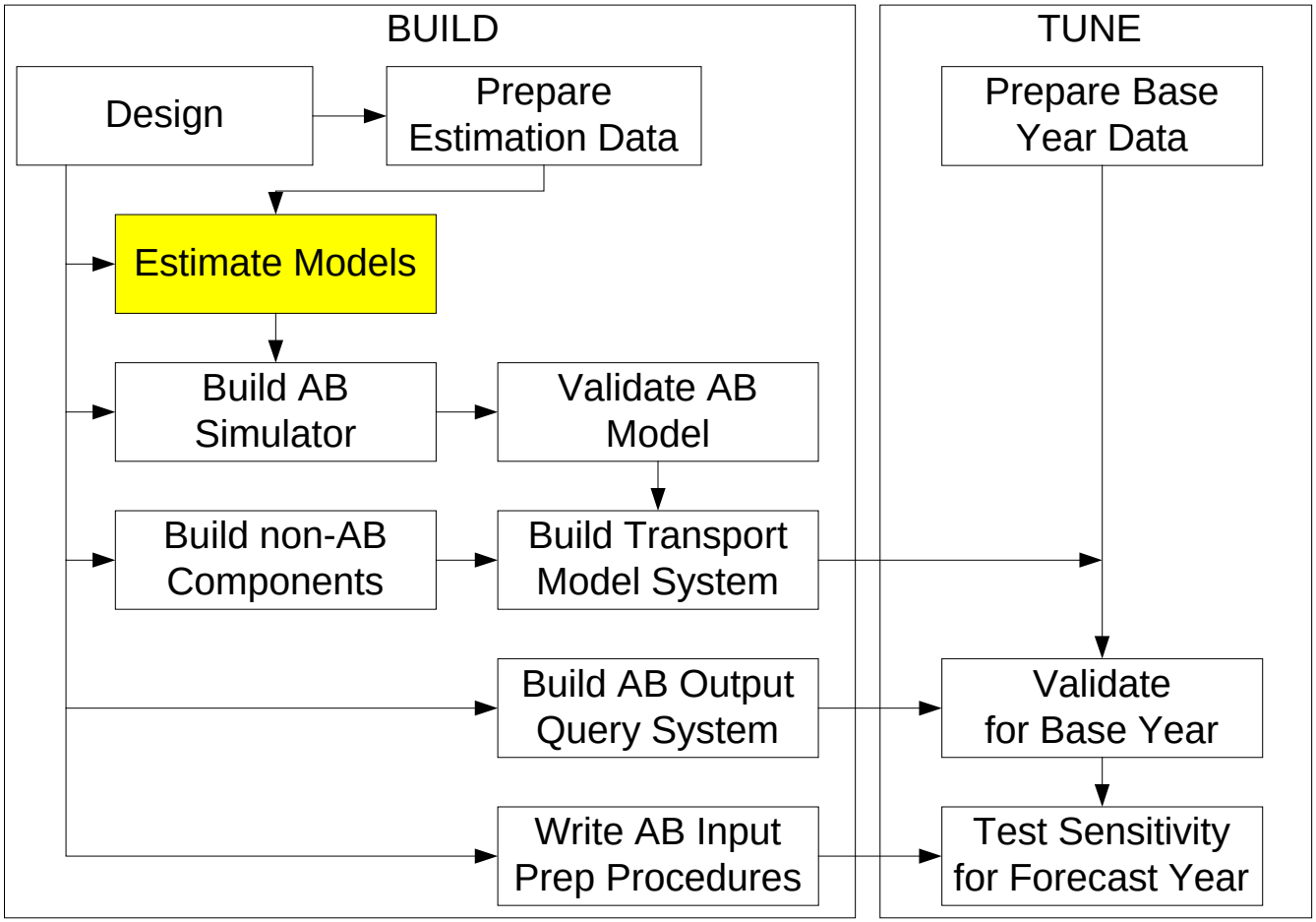
Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data

Prepare Estimation Data

- Household survey data
- LOS data (skims)
- Zonal/parcel data
  - Employment
  - School enrollment
  - Housing units
  - Network attributes

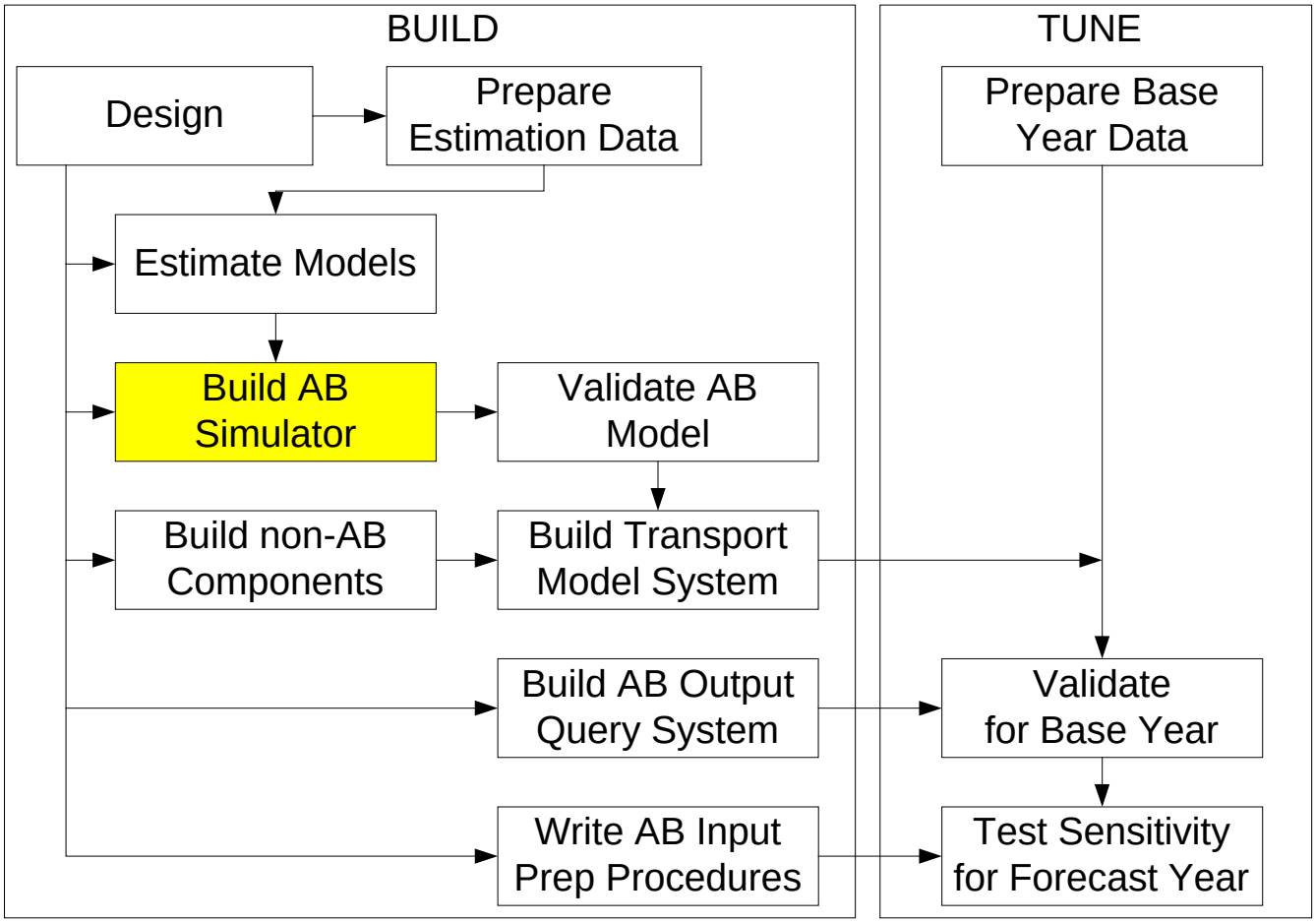
Estimate Models

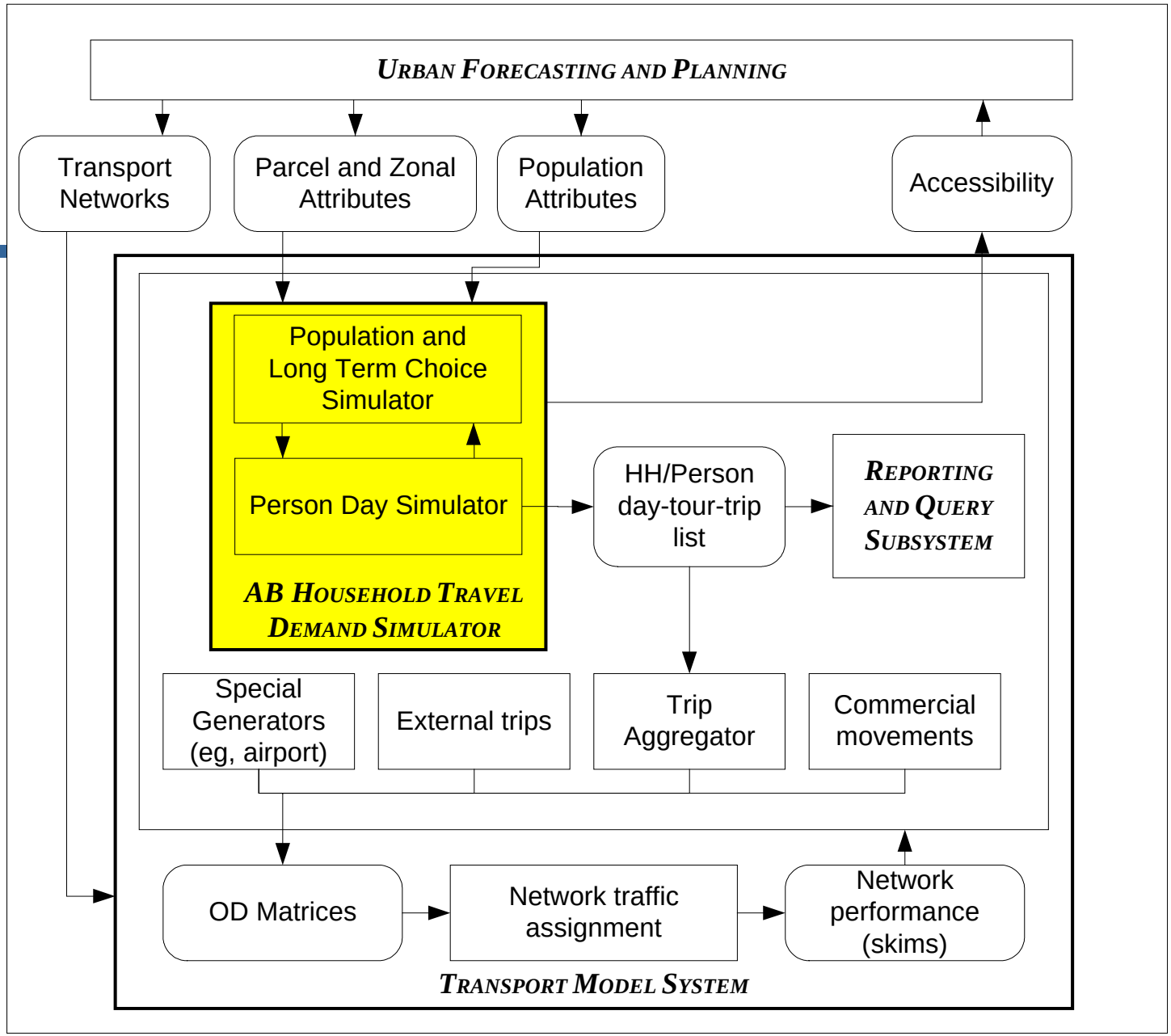


Estimate Models

- Specify
- Estimate
- Test

Build AB Simulator

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HH/Person day-tour-trip list
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Trip Aggregator
Commercial movements
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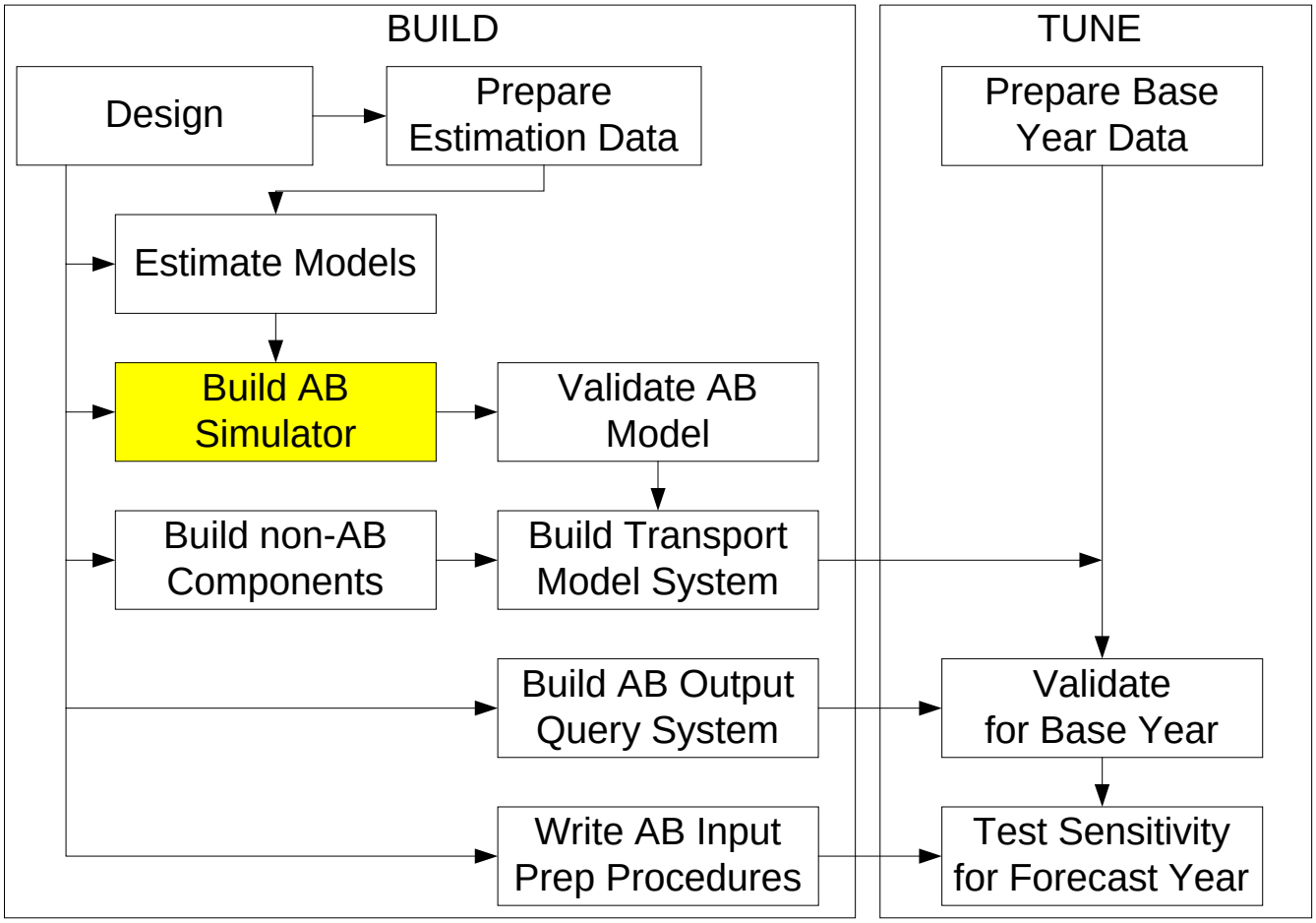
Network performance (skims)
TRANSPORT MODEL SYSTEM

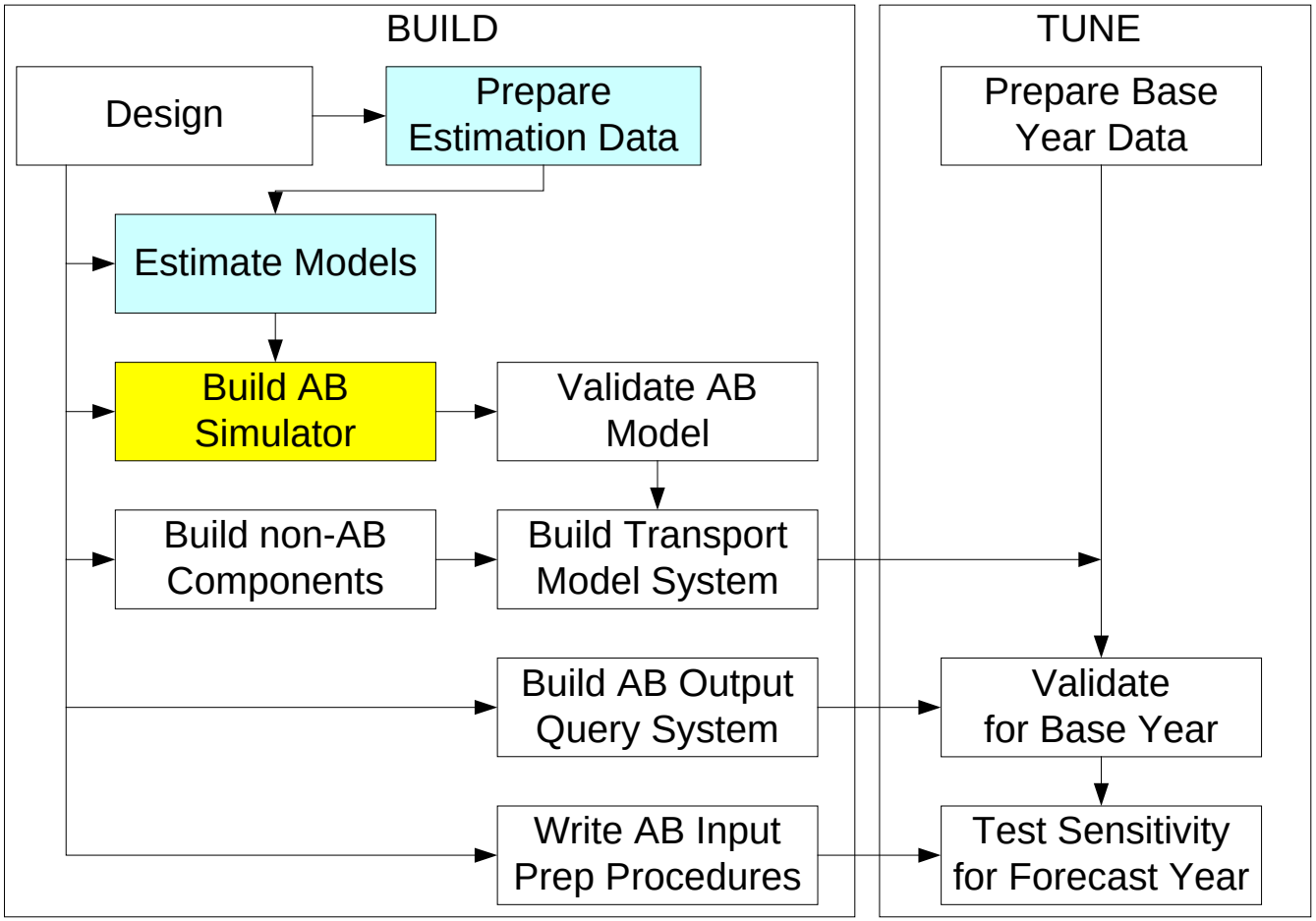
Build AB Simulator

- Creates synthetic population
- Applies all models
- Constructs detailed one-day itinerary for each person

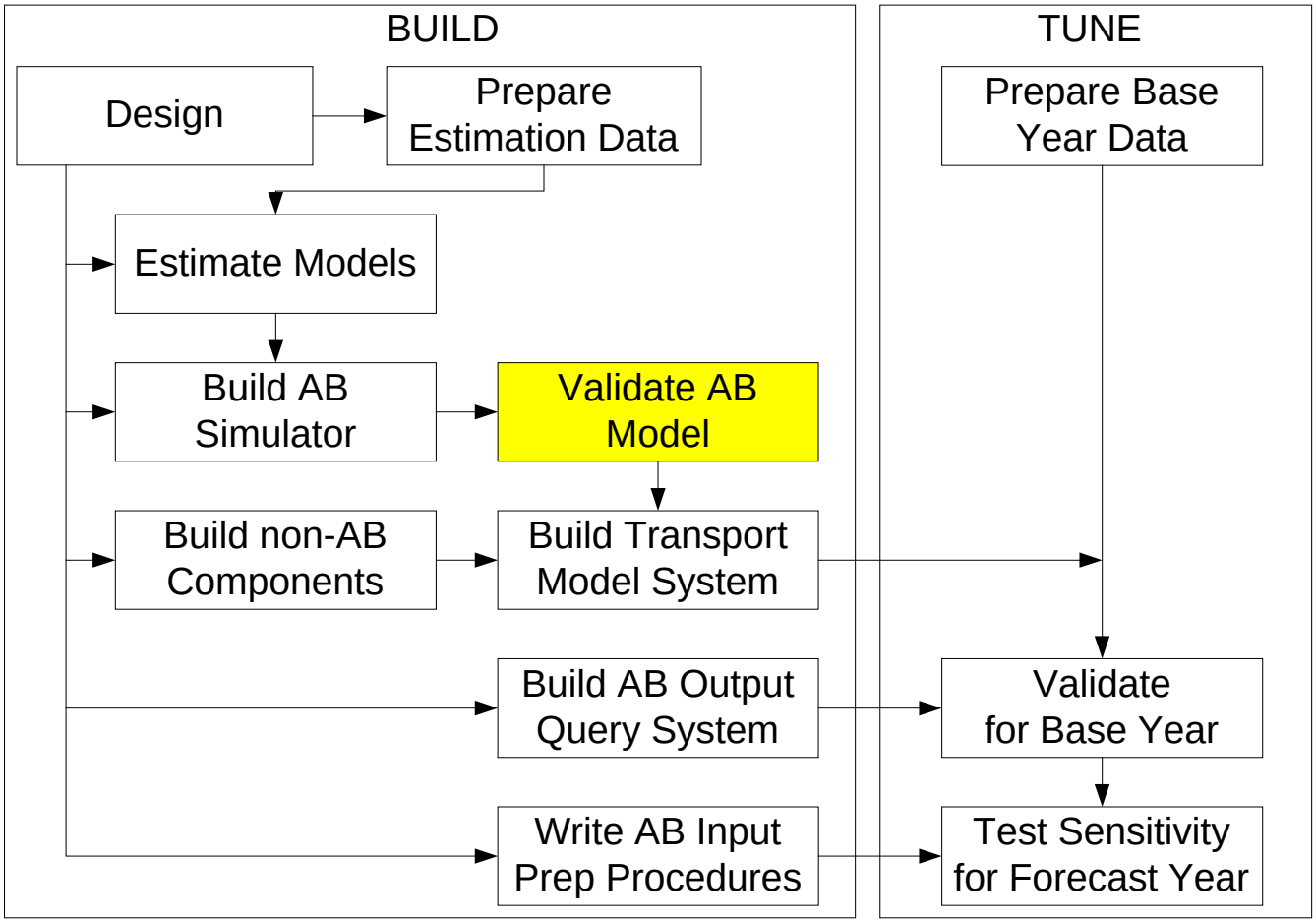
Build AB Simulator



Build AB Simulator



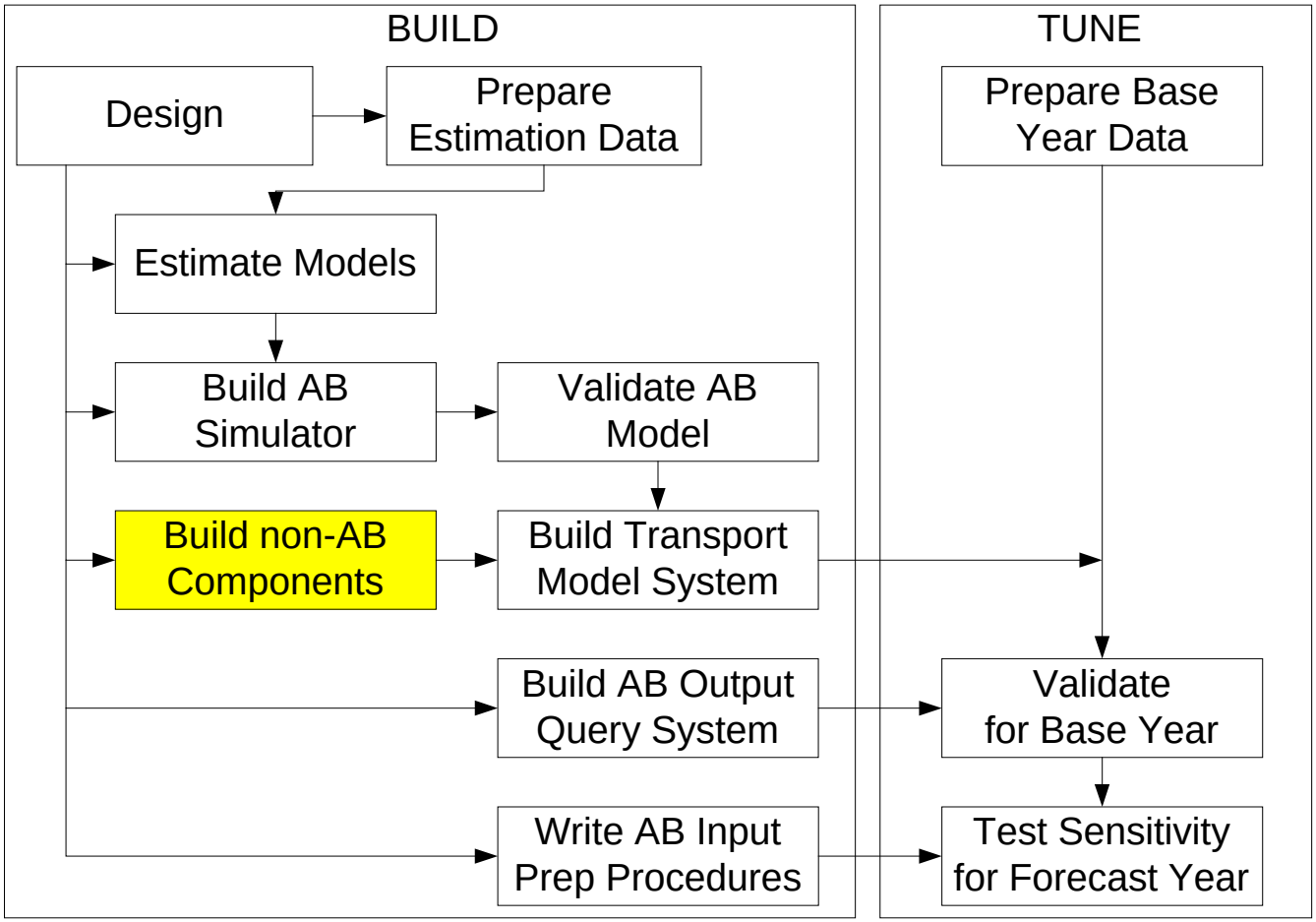
Validate AB Model

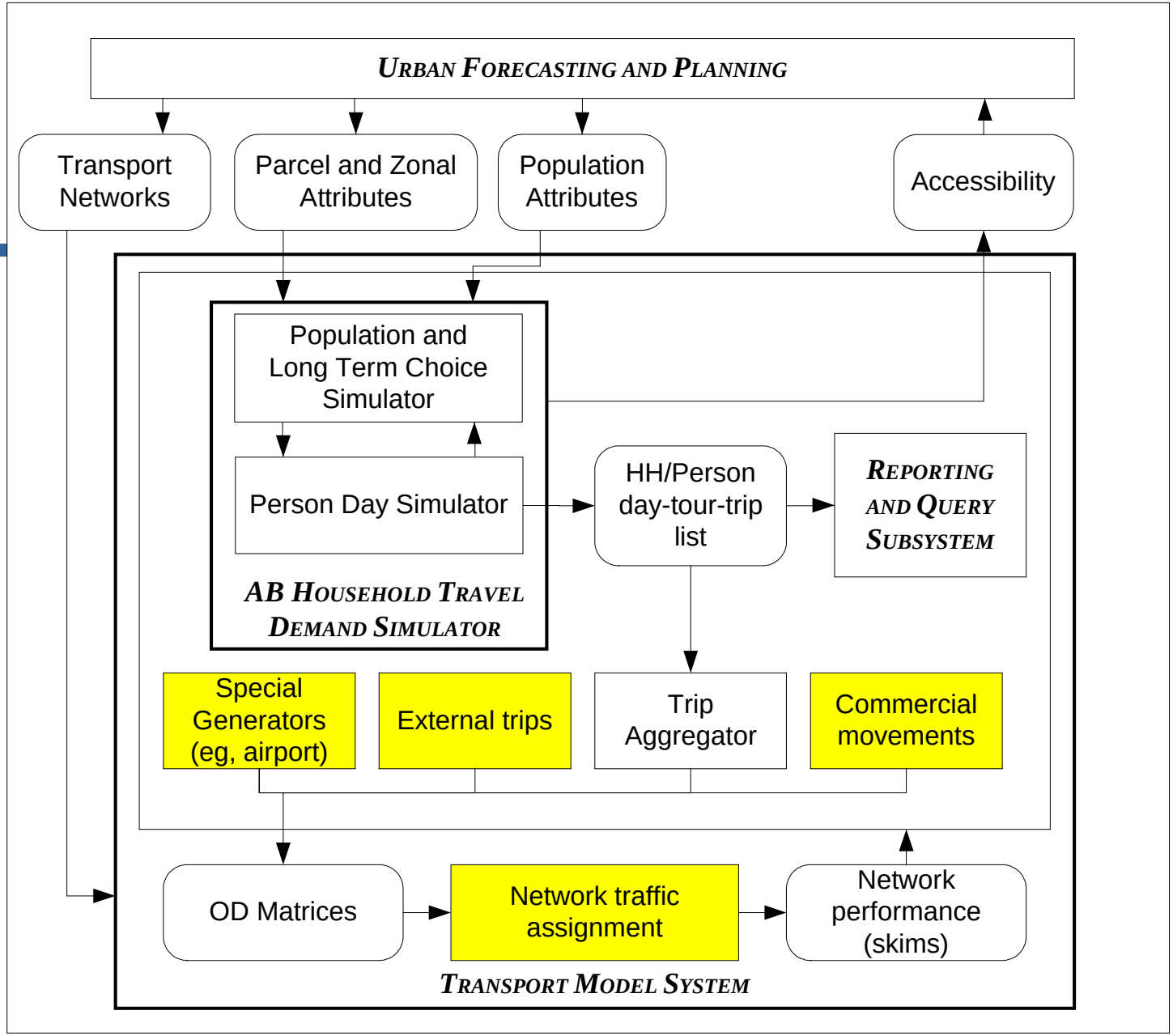


Validate AB Model

- Compare results to expanded HH survey
- Calibrate constants
- Re-estimate if needed
- Debug AB simulator

Build Non-AB Components

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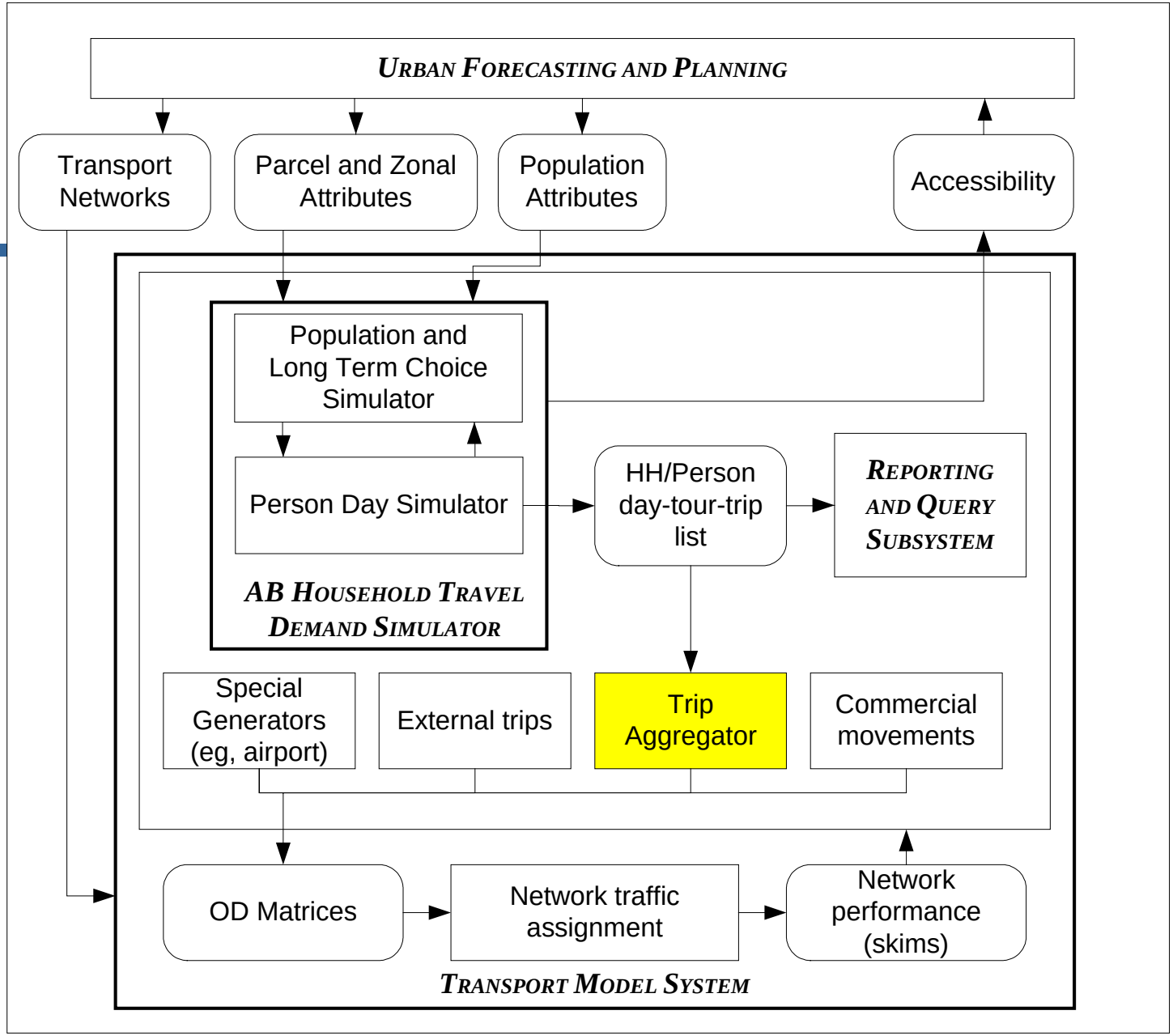
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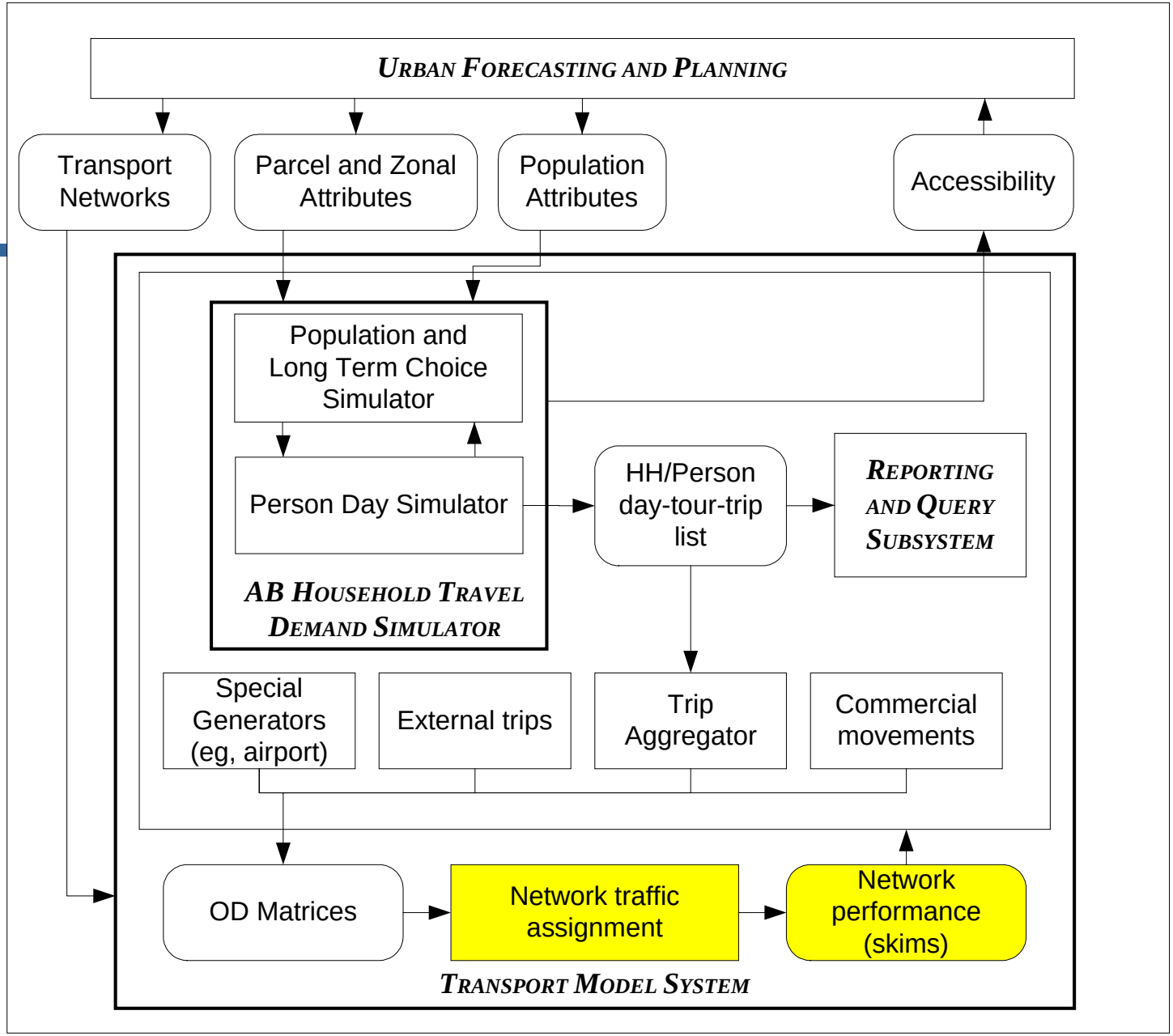
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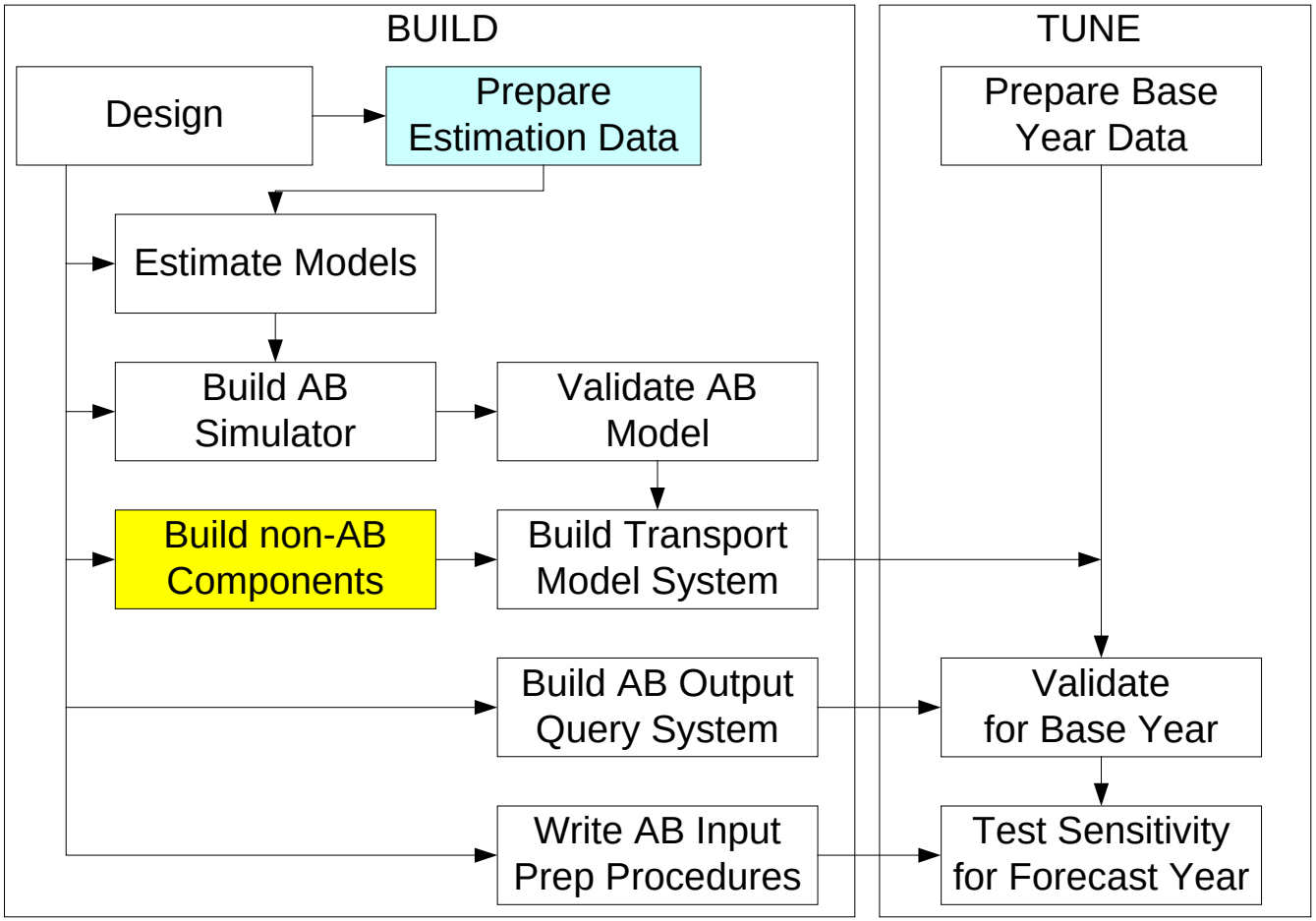
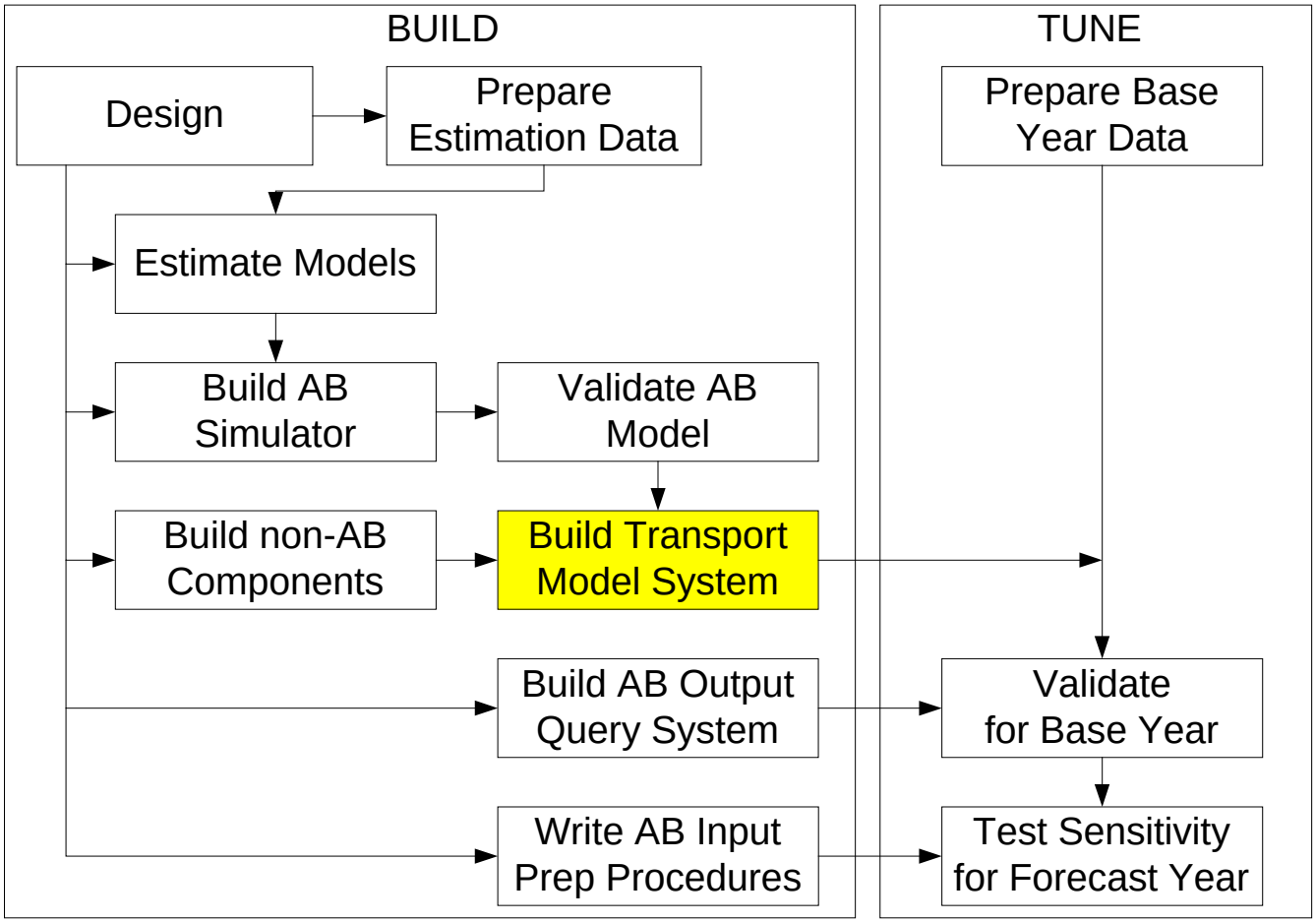
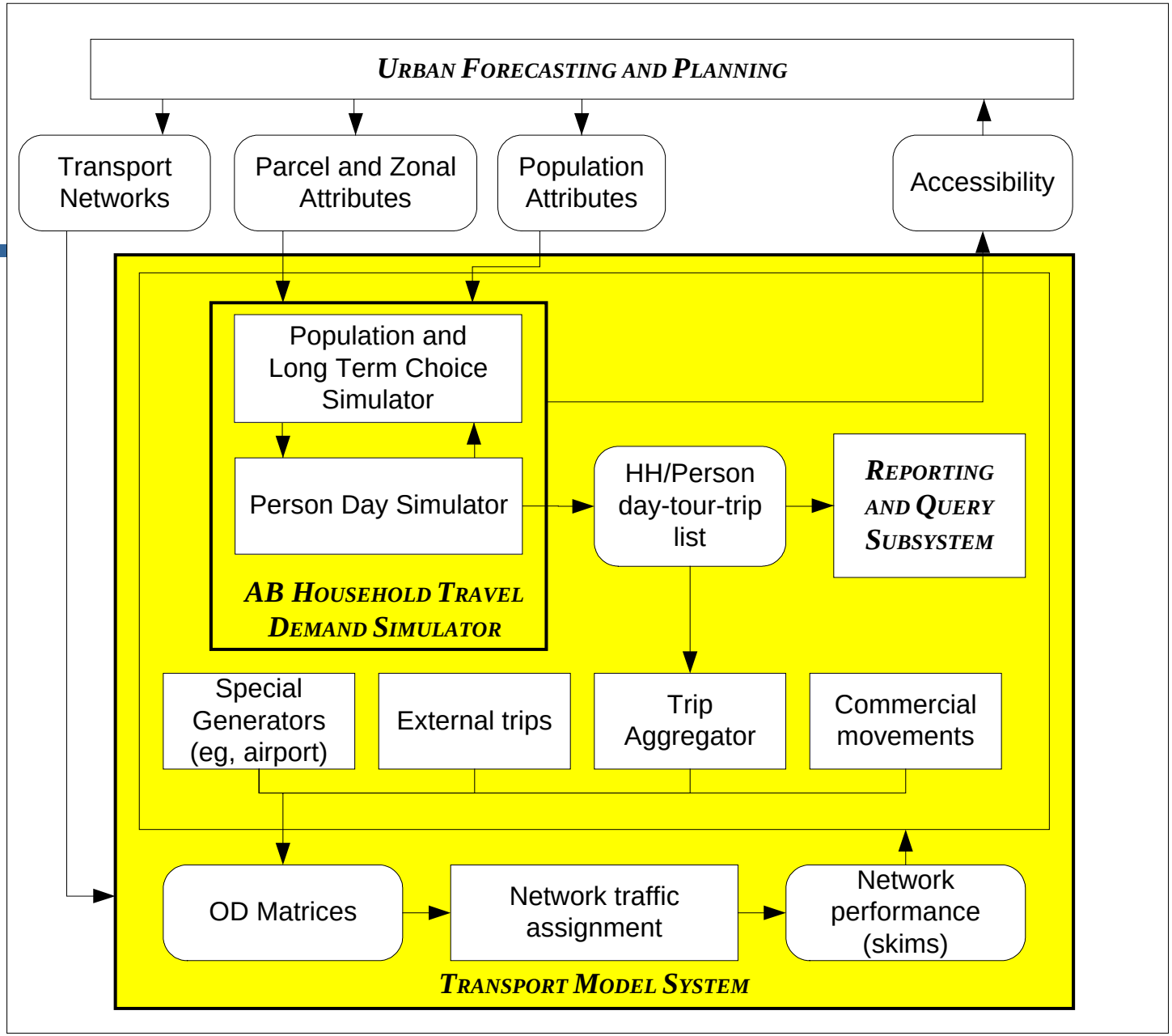


Build Transport Model System

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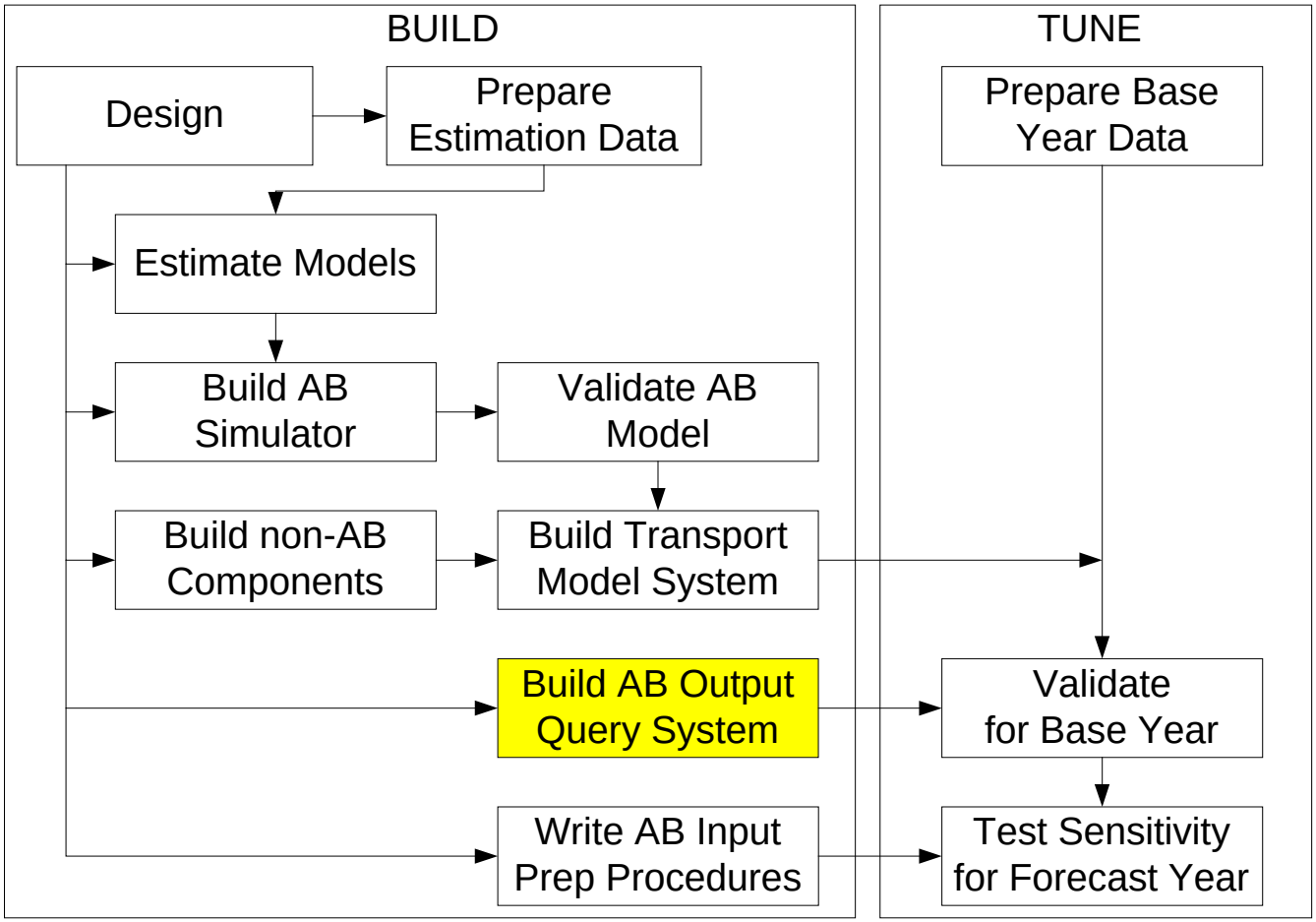
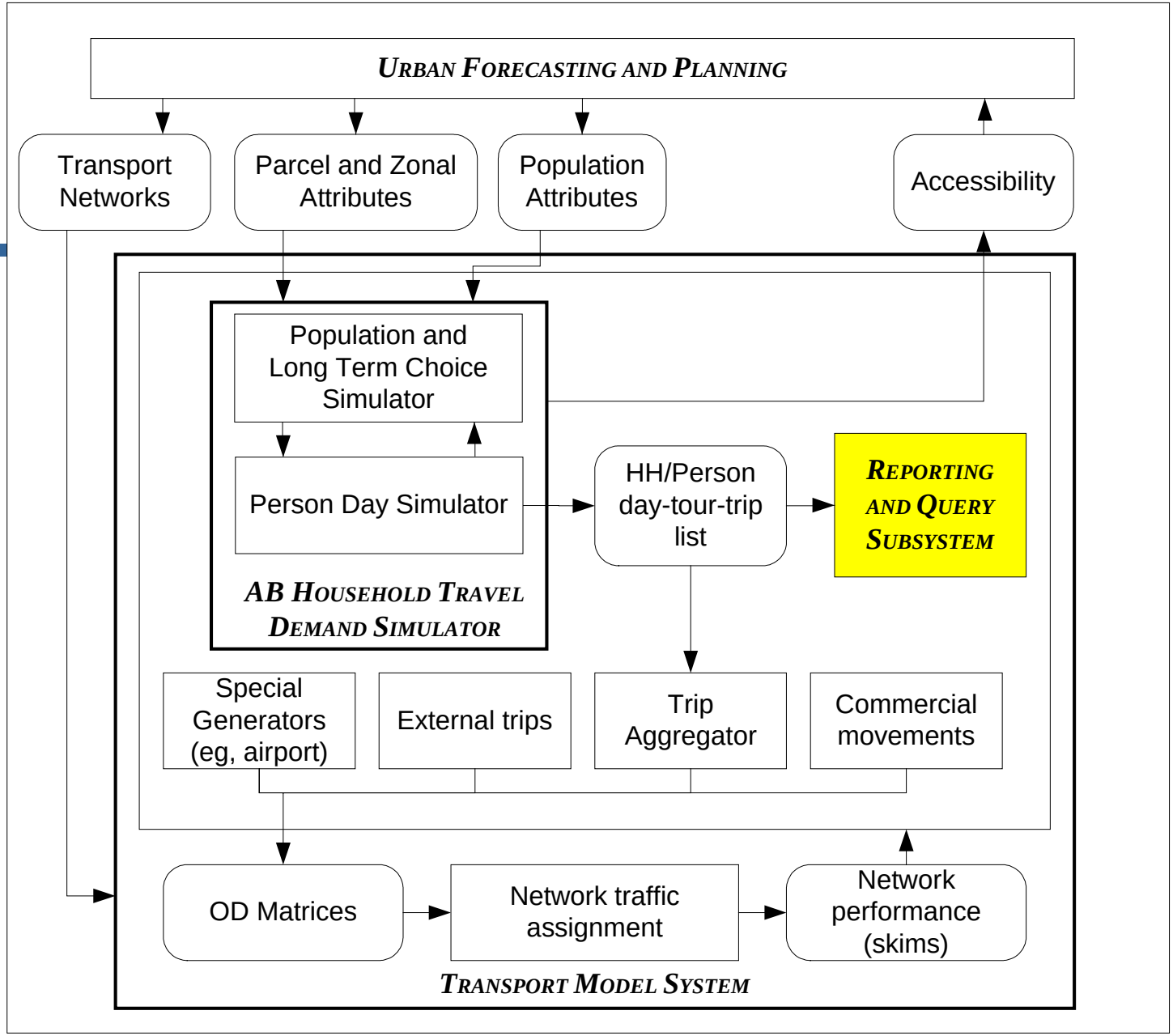
TRANSPORT MODEL SYSTEM

Build Transport Model System

- Install hardware if needed
- Assemble scripts
  - Non-AB components
  - AB simulator
  - Iteration scheme
- Test and tune
  - Convergence
  - Performance

Build
AB Output Query System

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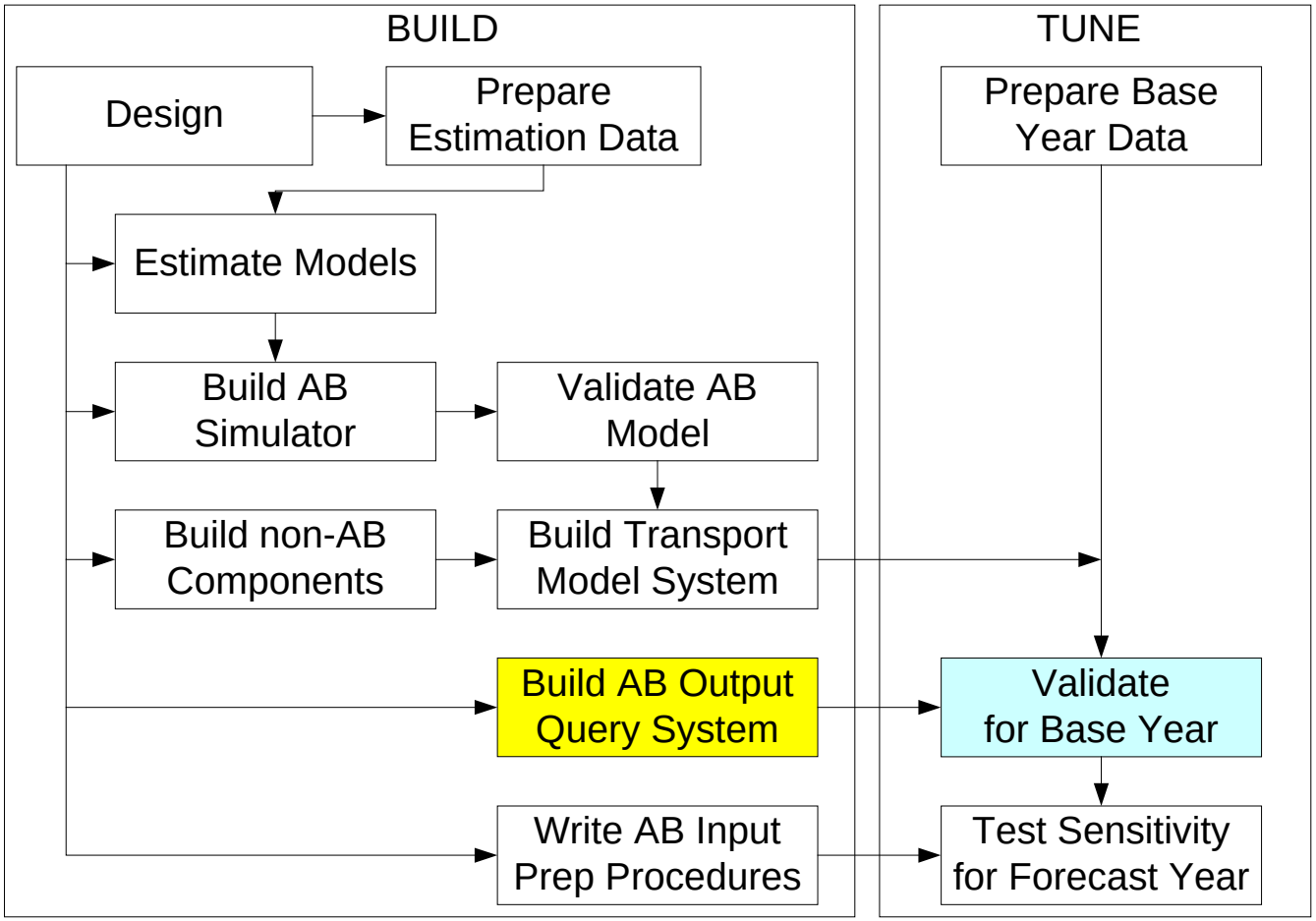

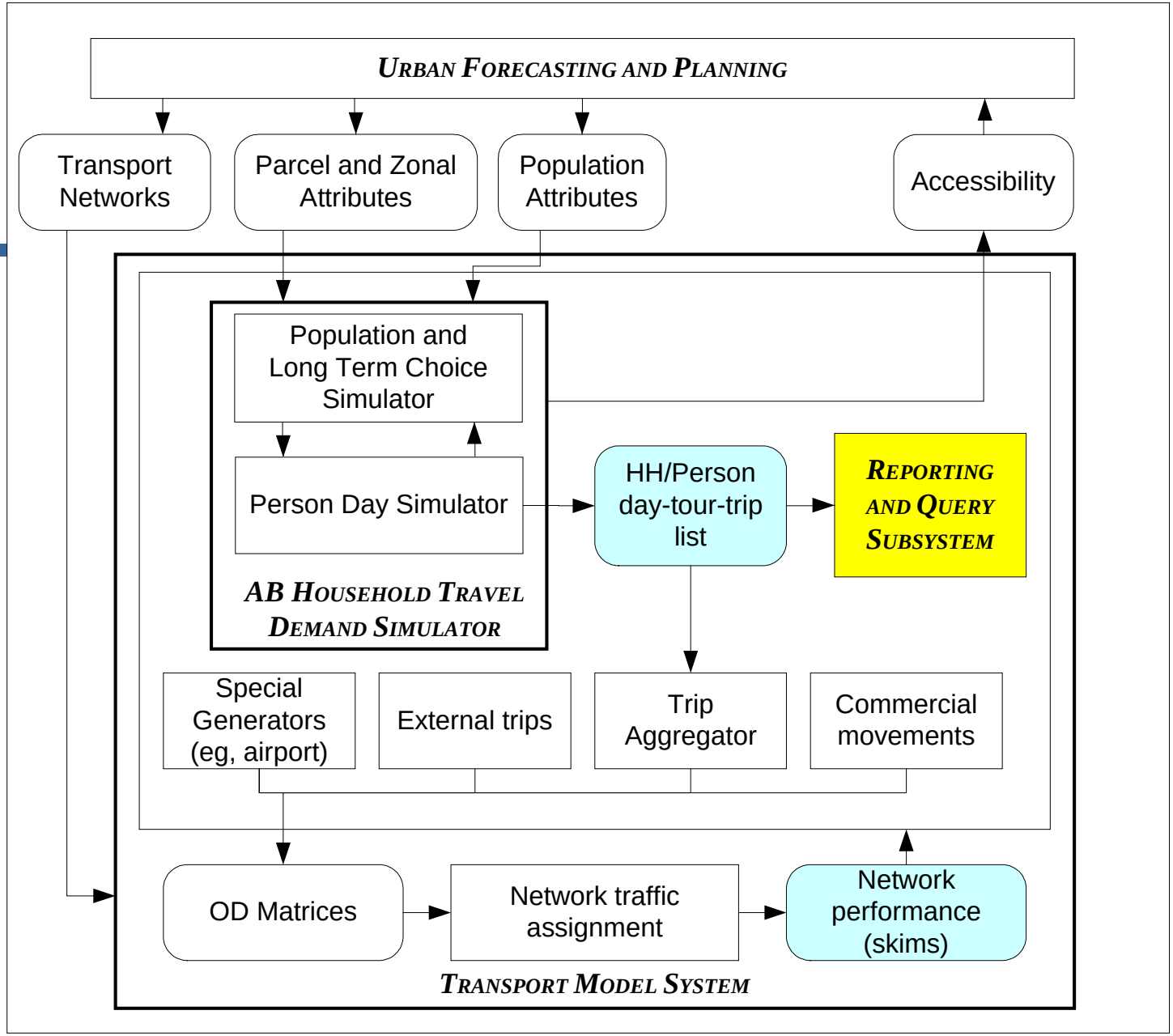
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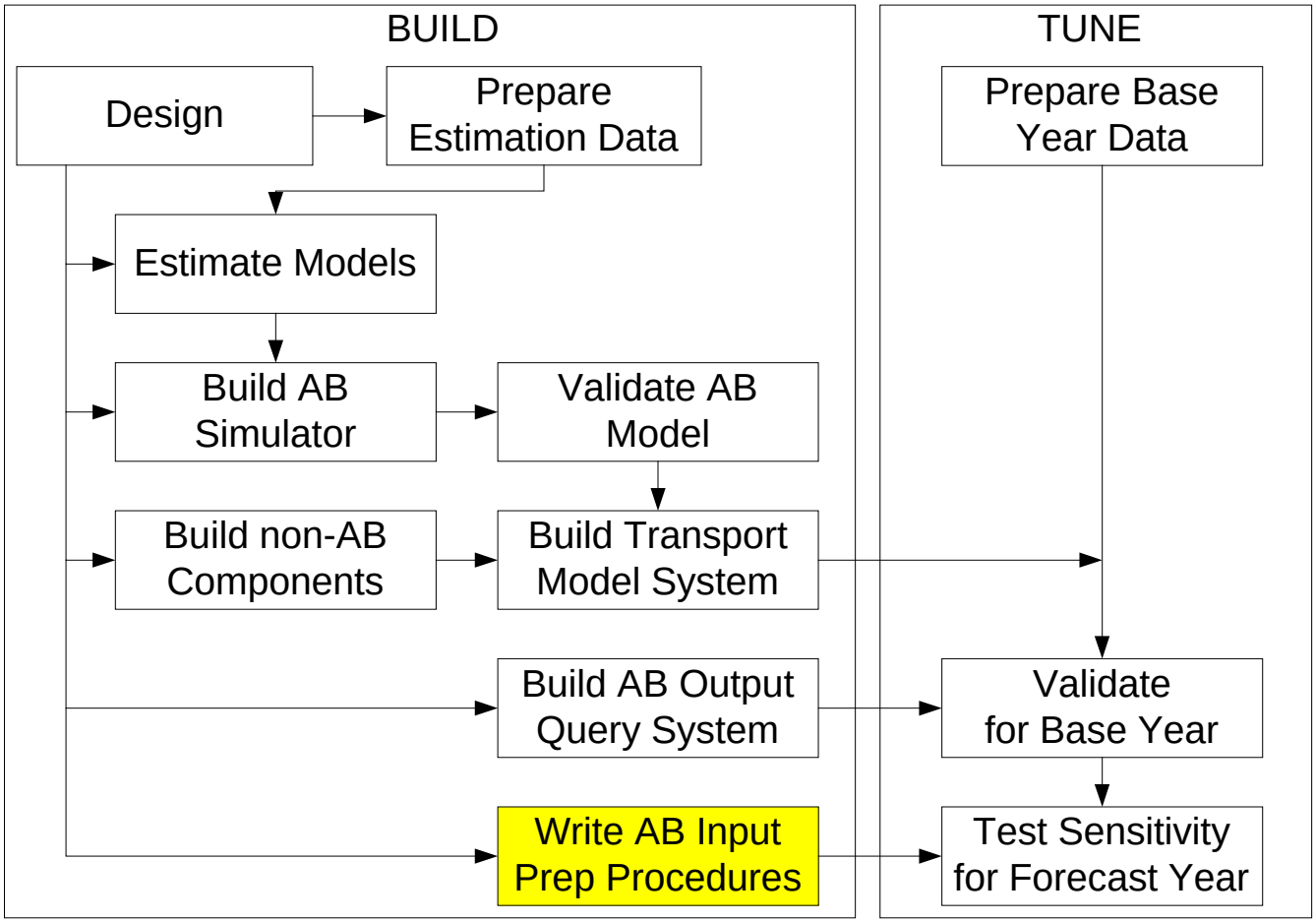
Build
AB Output Query System

- Aggregate the AB trip lists as needed
  - Customary reports
  - Queries by chosen population segments
  - Merge with GIS for visual outputs

Write AB Input Prep Procedures



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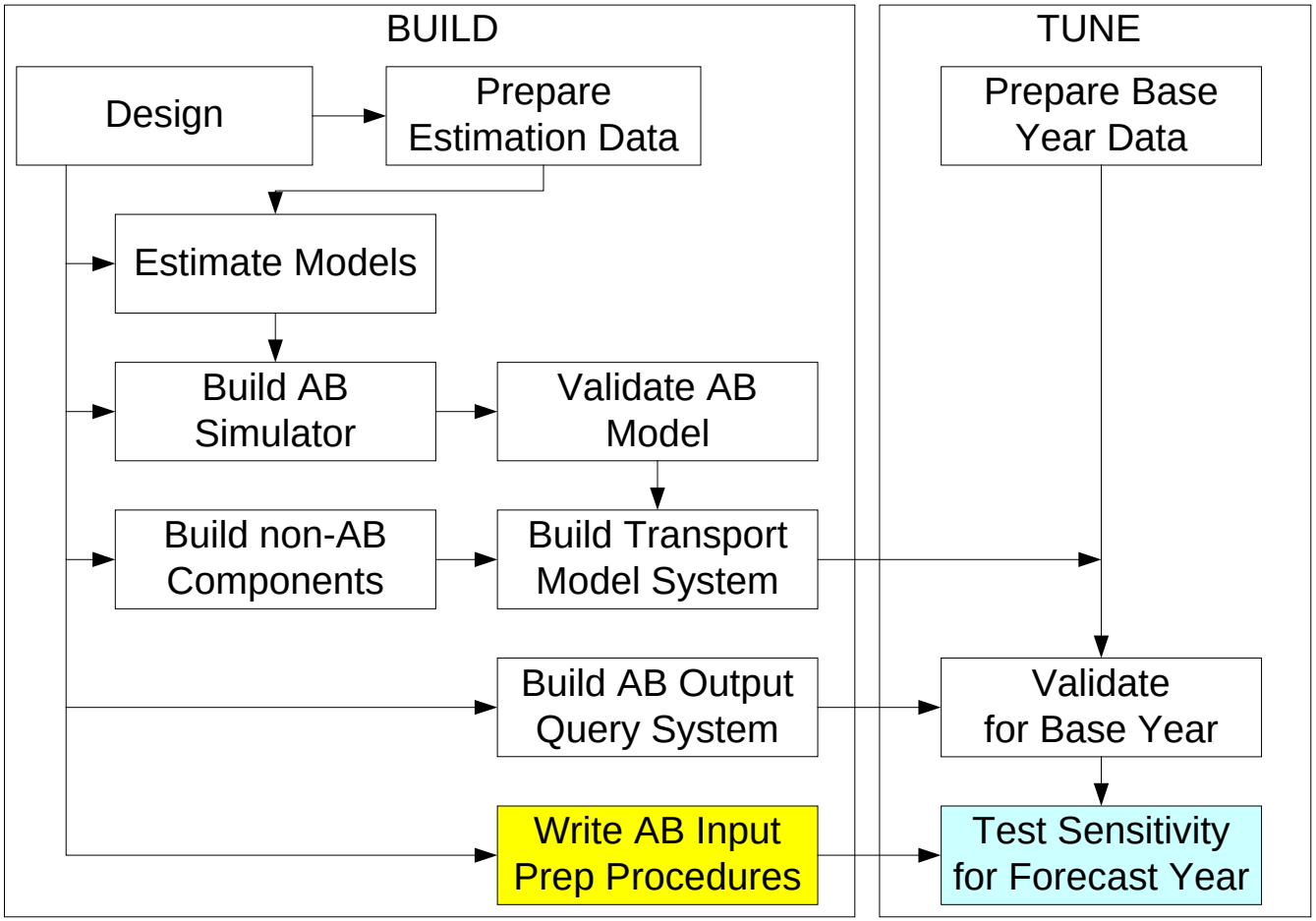

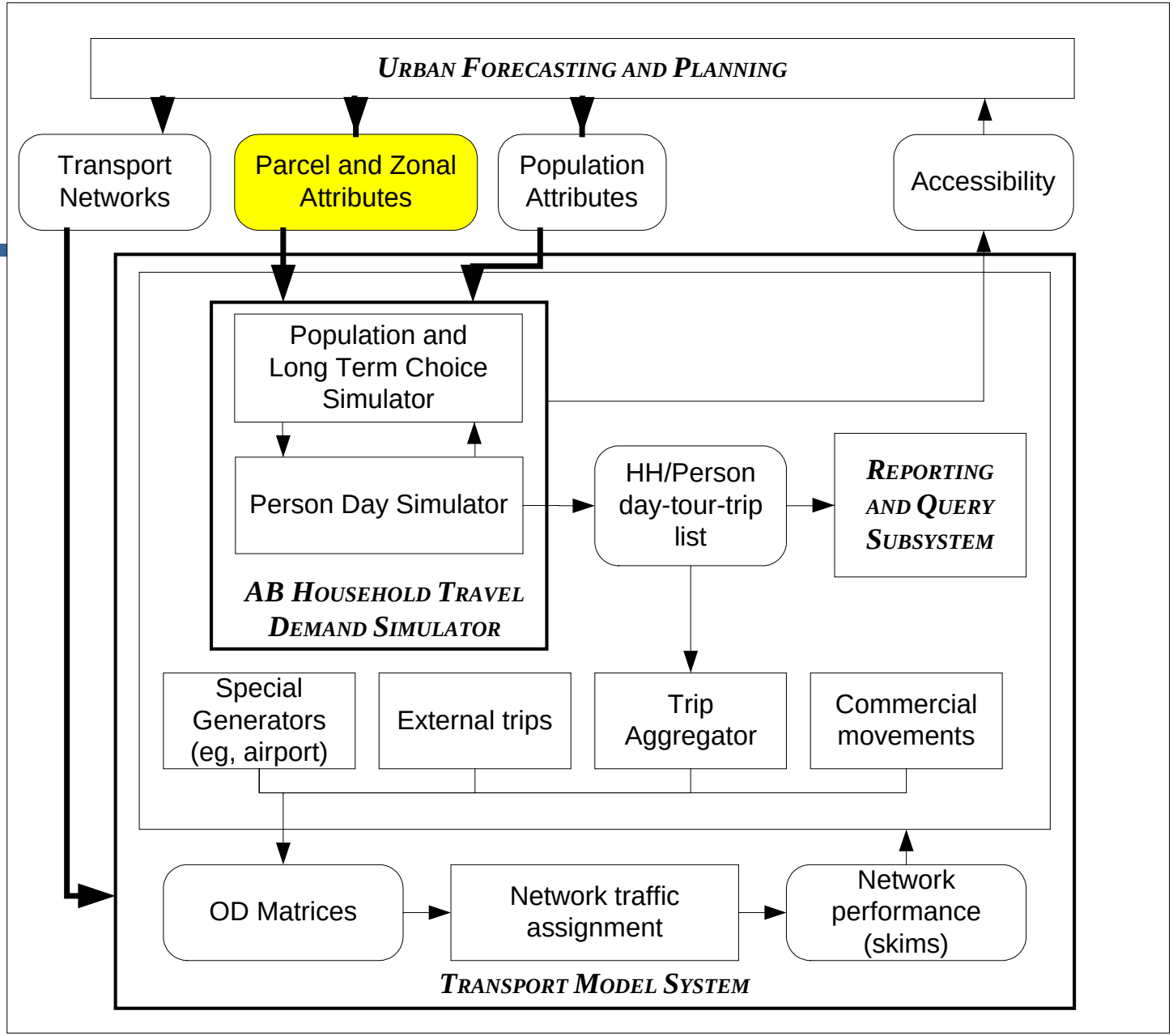
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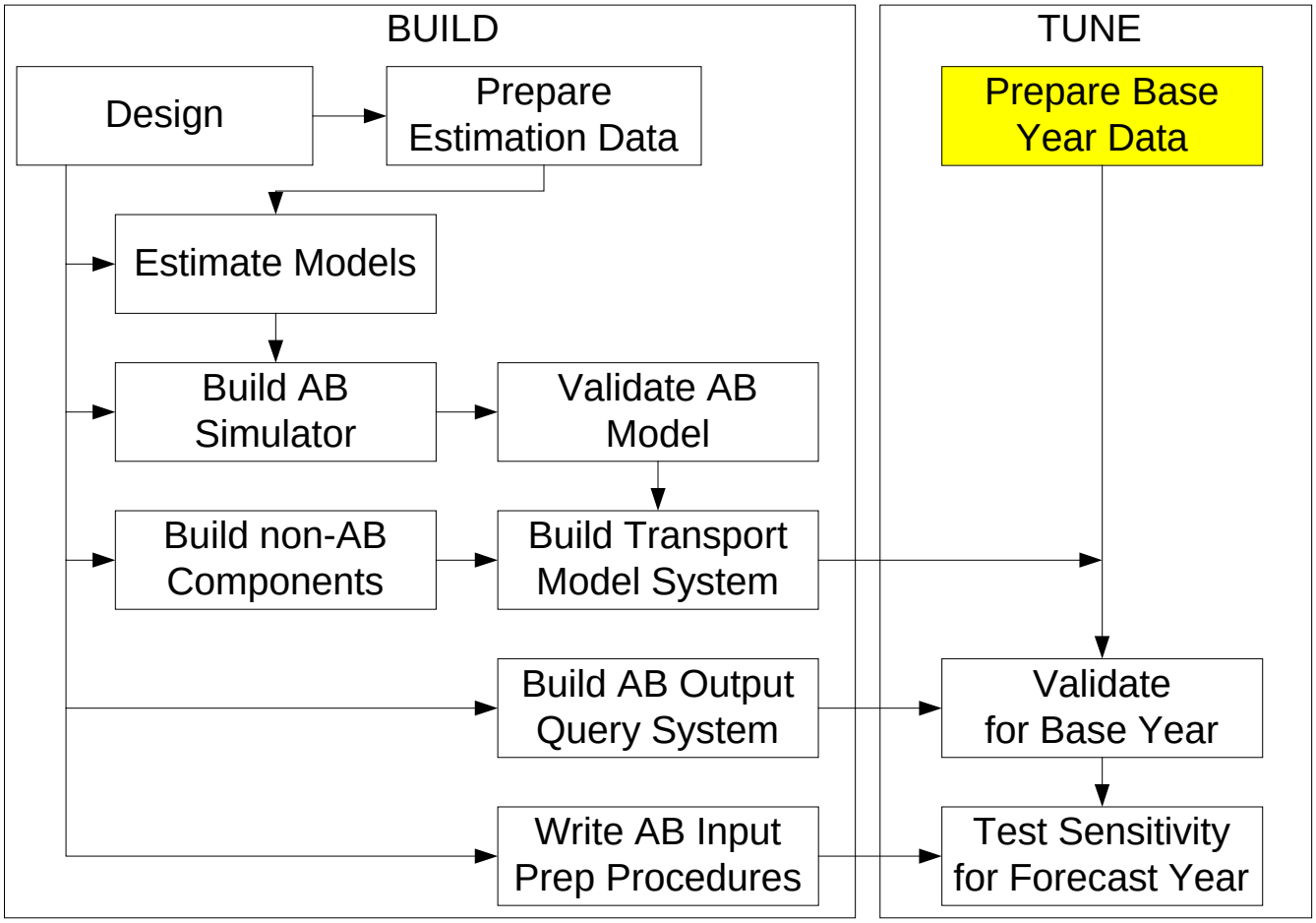
Prepare Base Year Data



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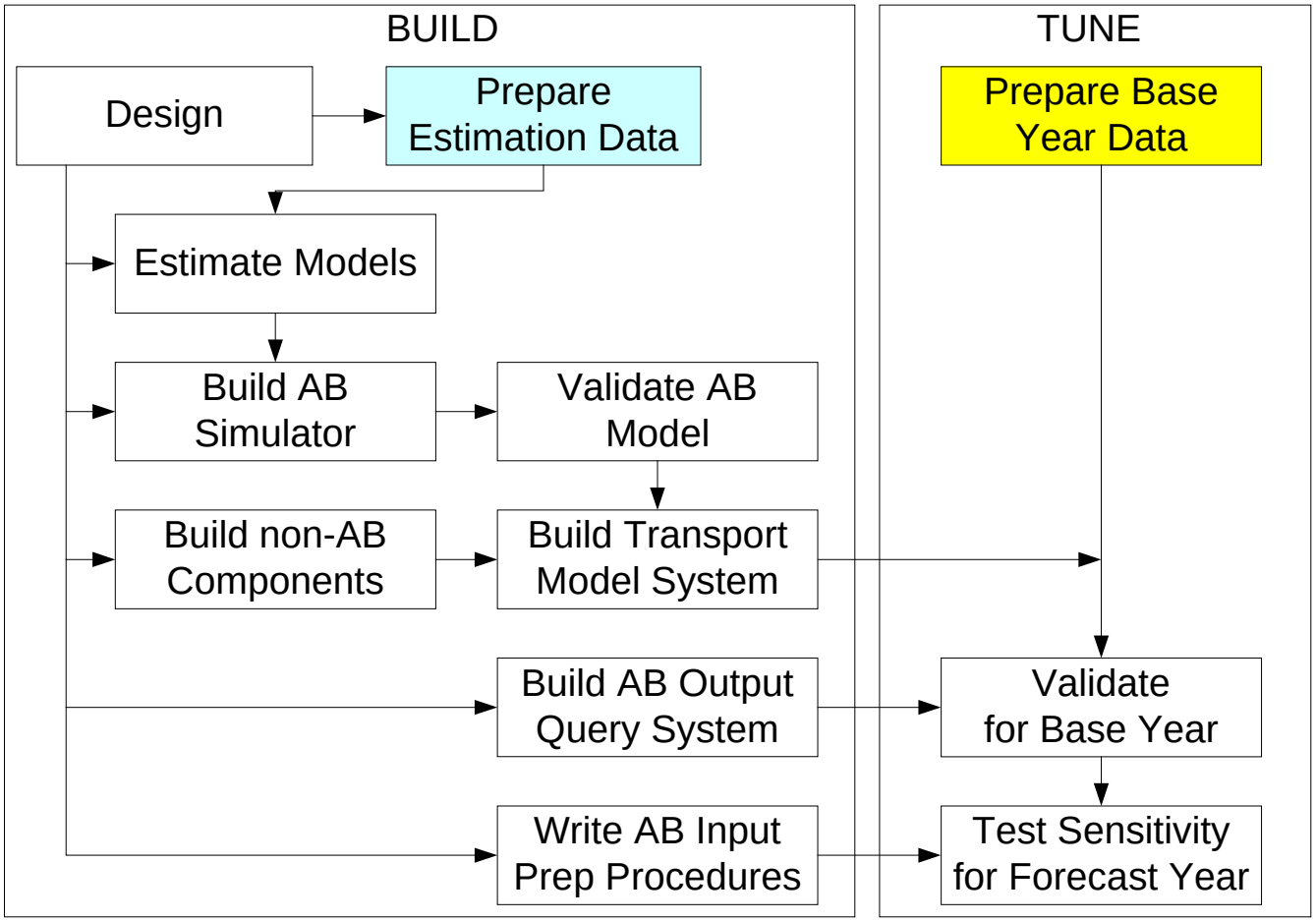

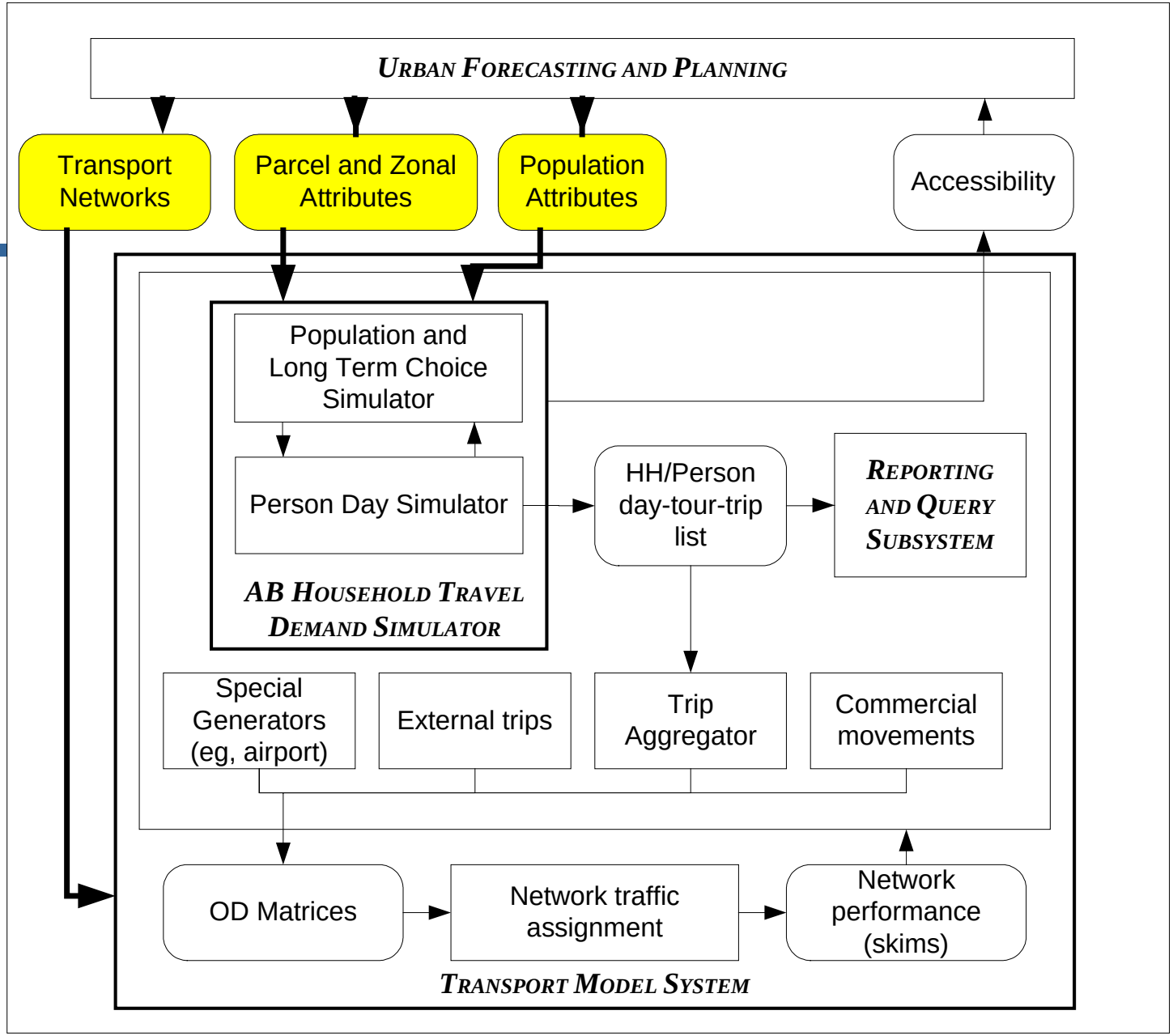
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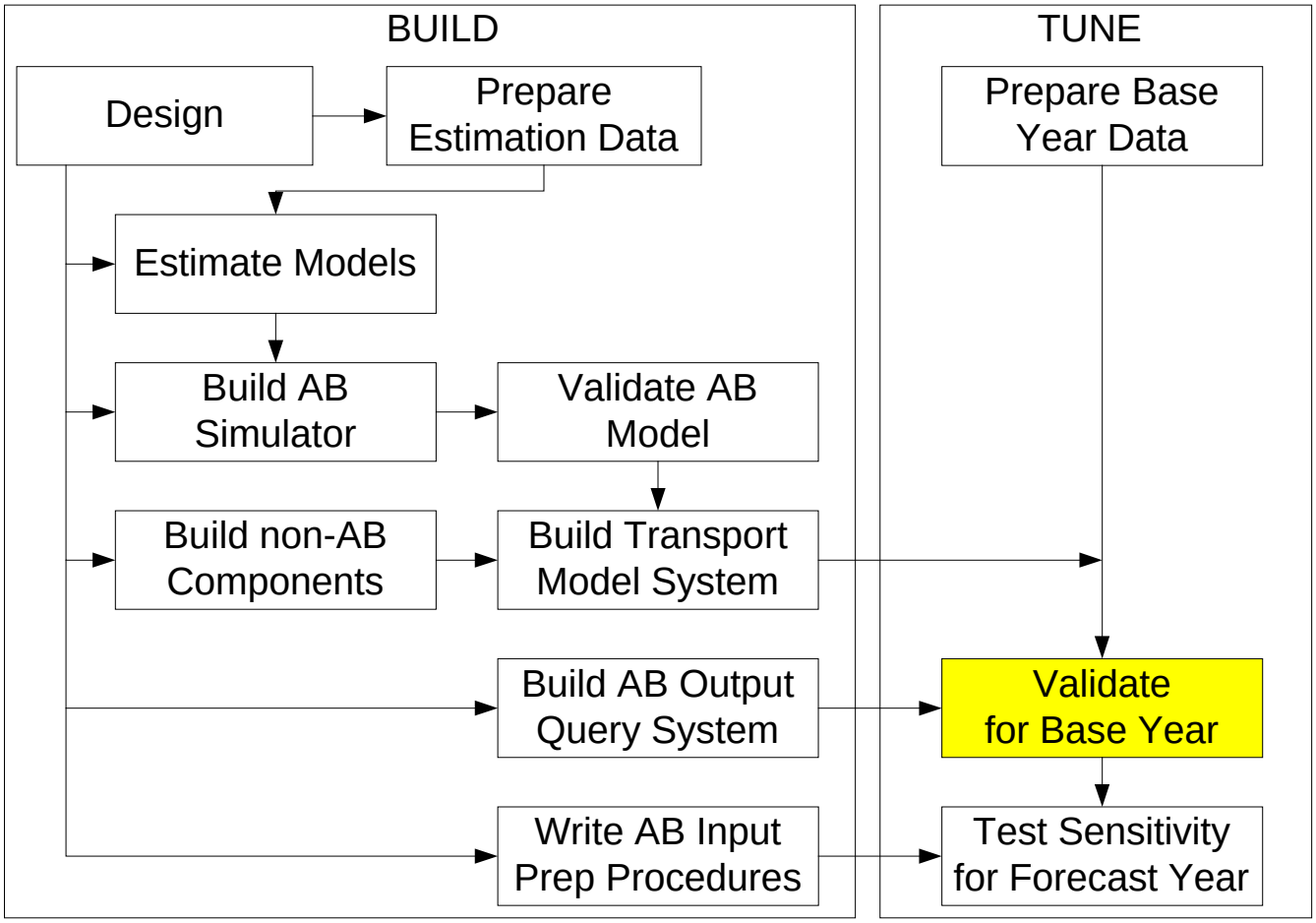
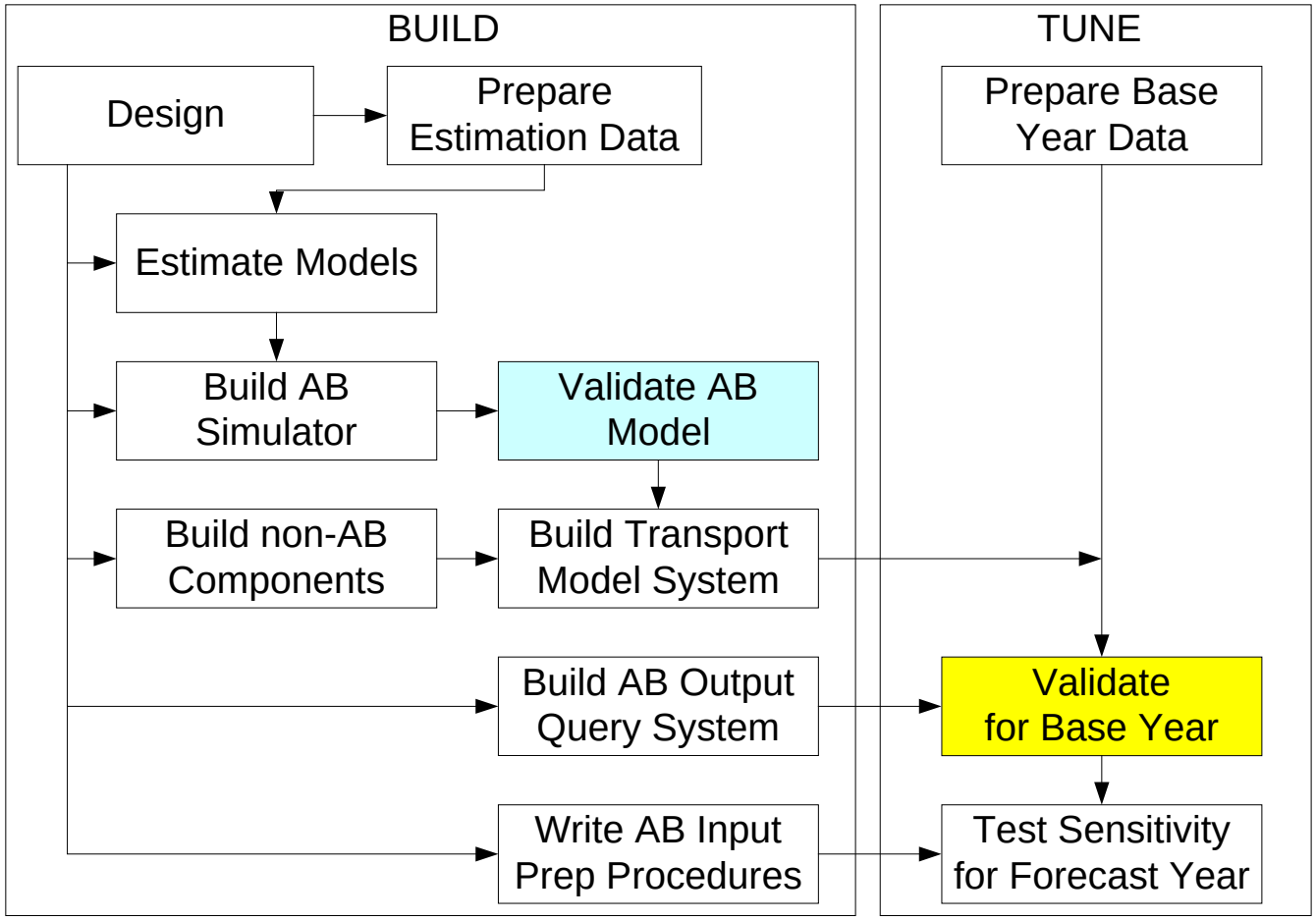
Prepare Base Year Data

- AB Input data
- Validation data (by time of day)
  - employment and school enrollment
  - work and school trip lengths
  - vehicle availability
  - transit counts
  - screenline counts

Validate for Base Year



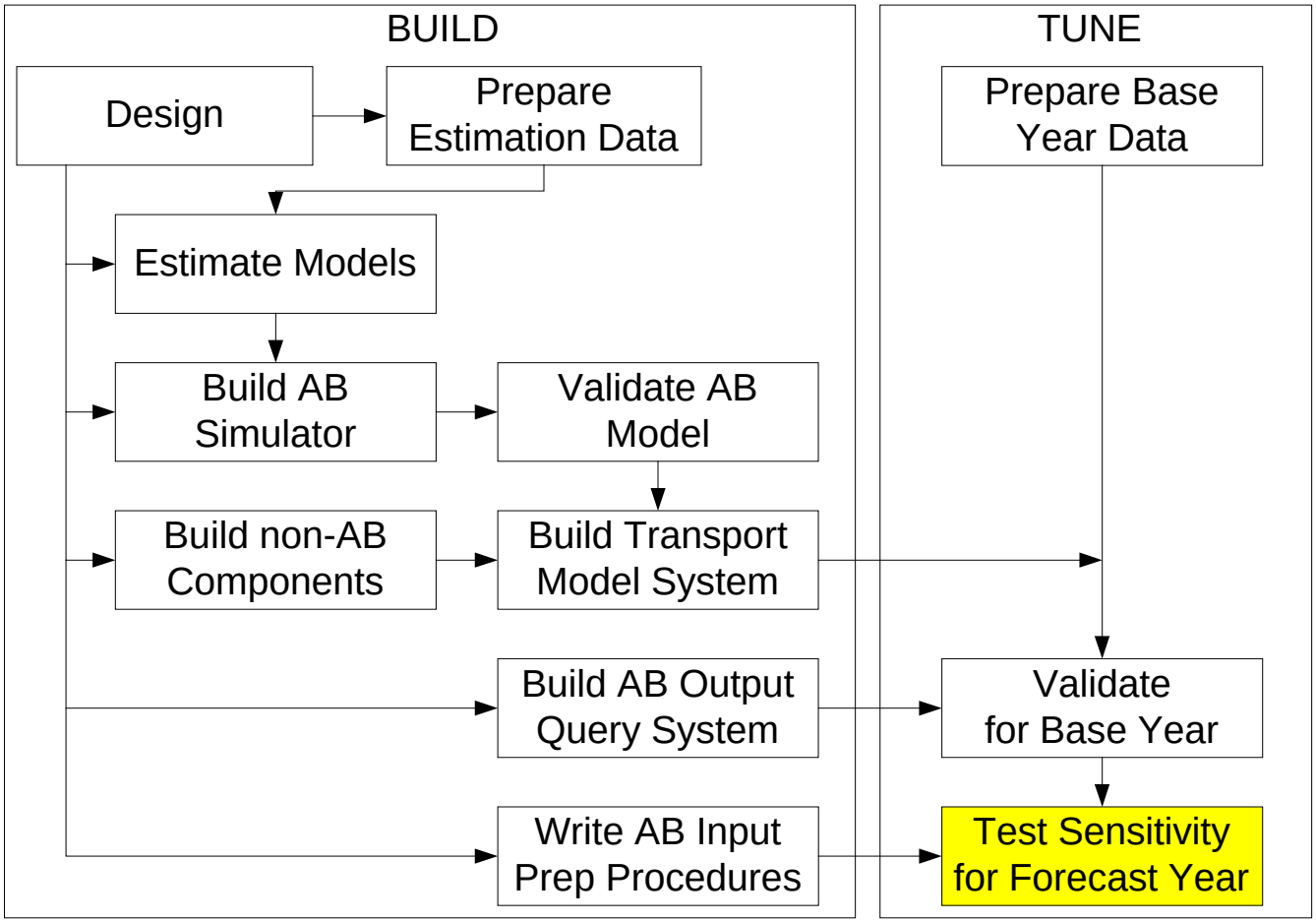
Validate for Base Year



Validate for Base Year

- Much like trip-based model validation
  - Run model system on base year
  - Compare to validation data
- By time of day
- May require
  - calibration constants
  - Adjustment of models

Test Sensitivity for Forecast Year



Test Sensitivity for Forecast Year

- Test on scenarios of interest
  - Generate validation statistics
  - Check elasticities
- May require enhancement of models
- Train users
- Familiarize clients

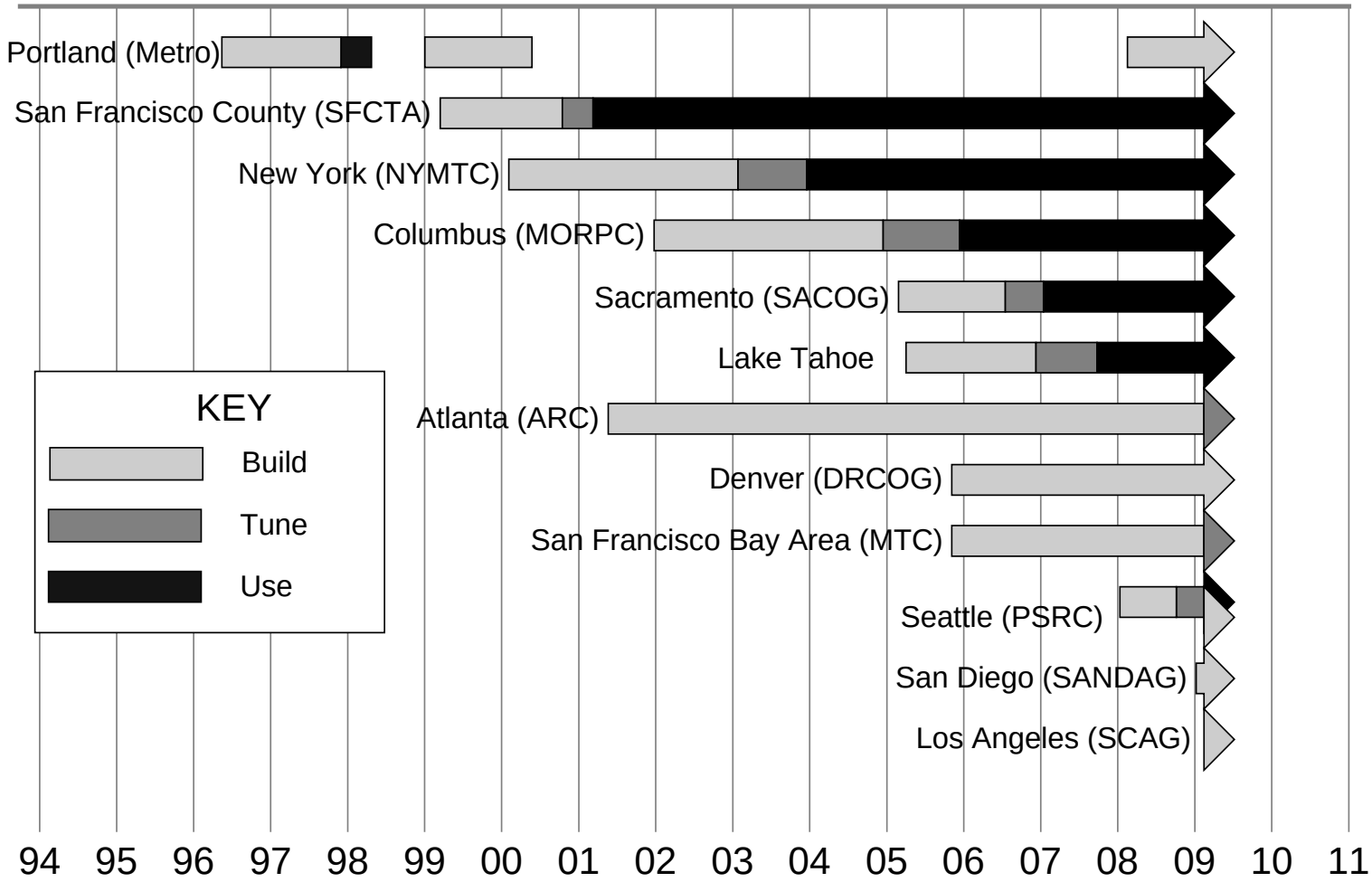
Outline

- Activity-Based (AB) Model System
- Development Tasks
- Basic Build Approaches
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions

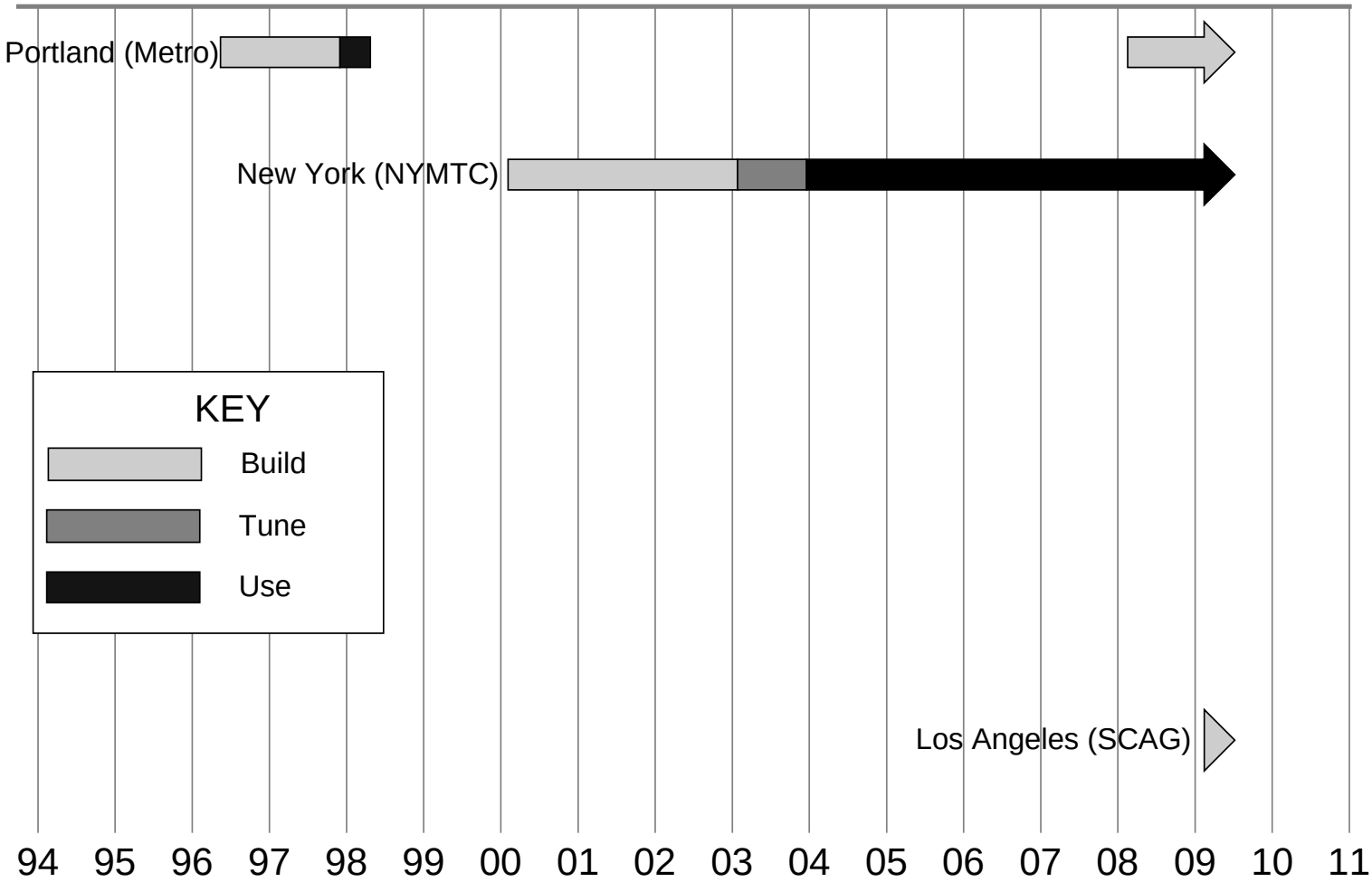
Basic Build Approaches

- Invent
- Adapt
- Adopt

U.S. Projects


Portland (Metro)
San Francisco County (SFCTA)
New York (NYMTC)
Columbus (MORPC)
Sacramento (SACOG)
Lake Tahoe
Atlanta (ARC)
Denver (DRCOG)
San Francisco Bay Area (MTC)
Seattle (PSRC)
San Diego (SANDAG)
Los Angeles (SCAG)
KEY
Build
Tune
Use
94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11

Invent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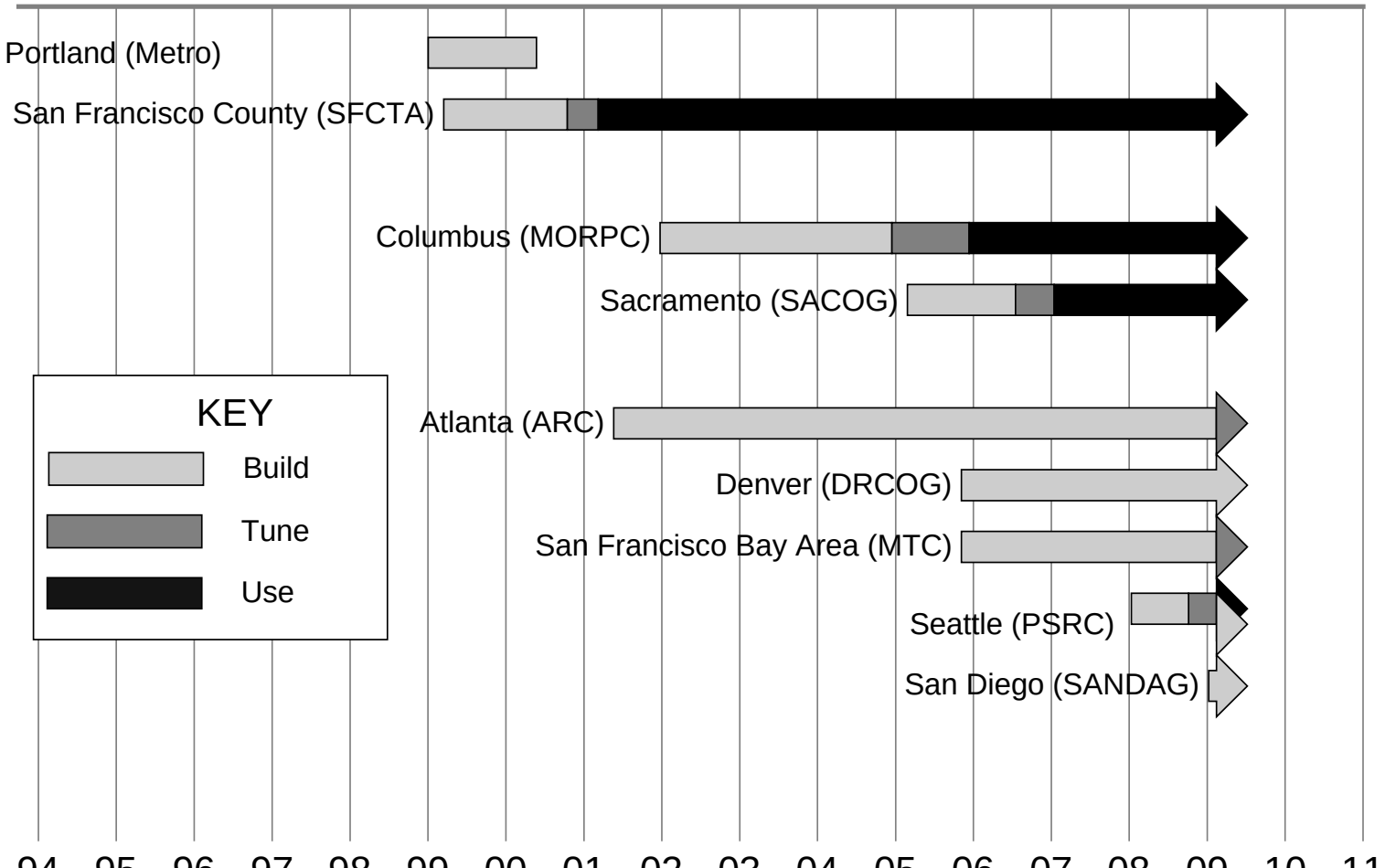
Adapt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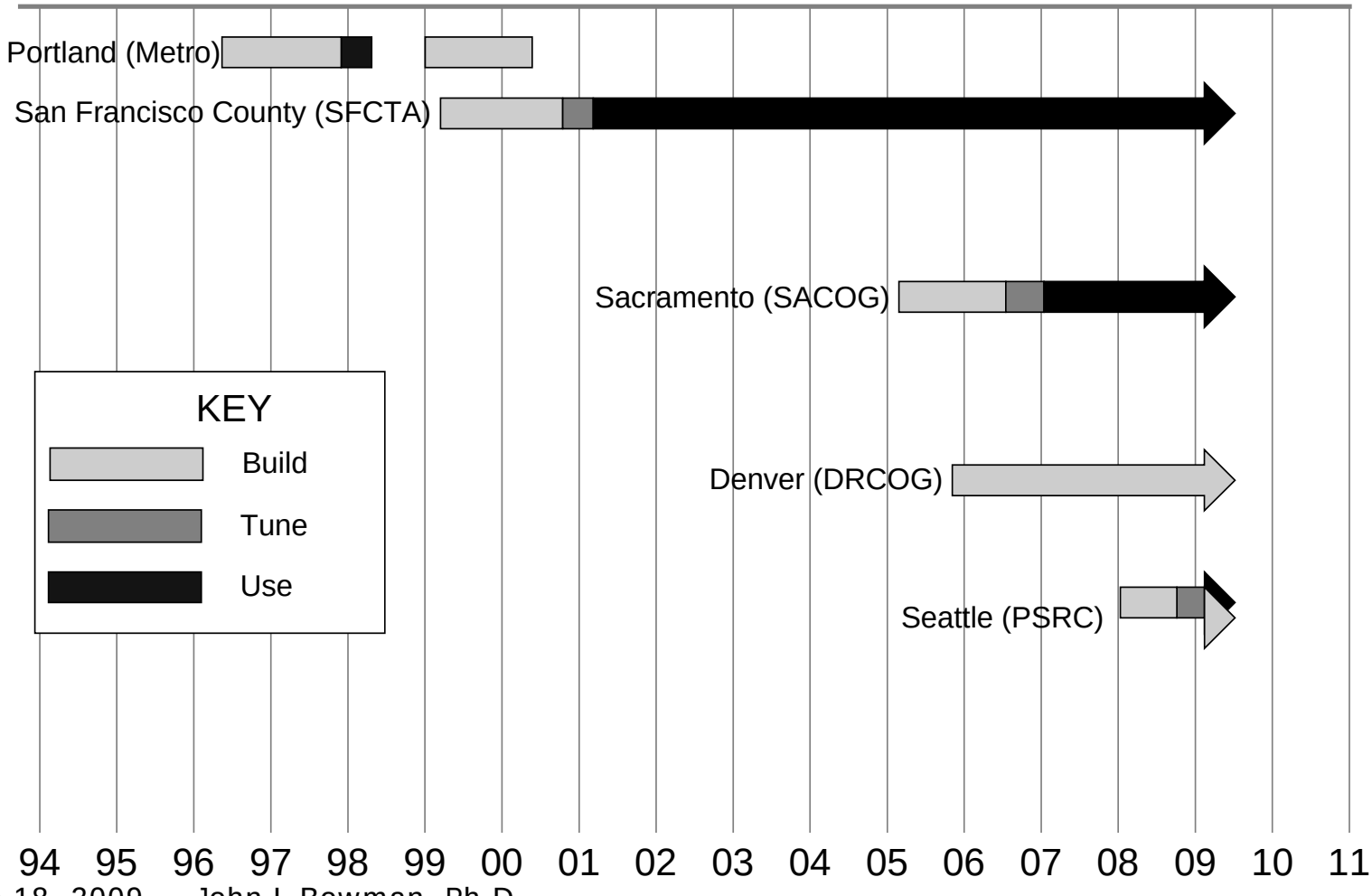
Adapt Metro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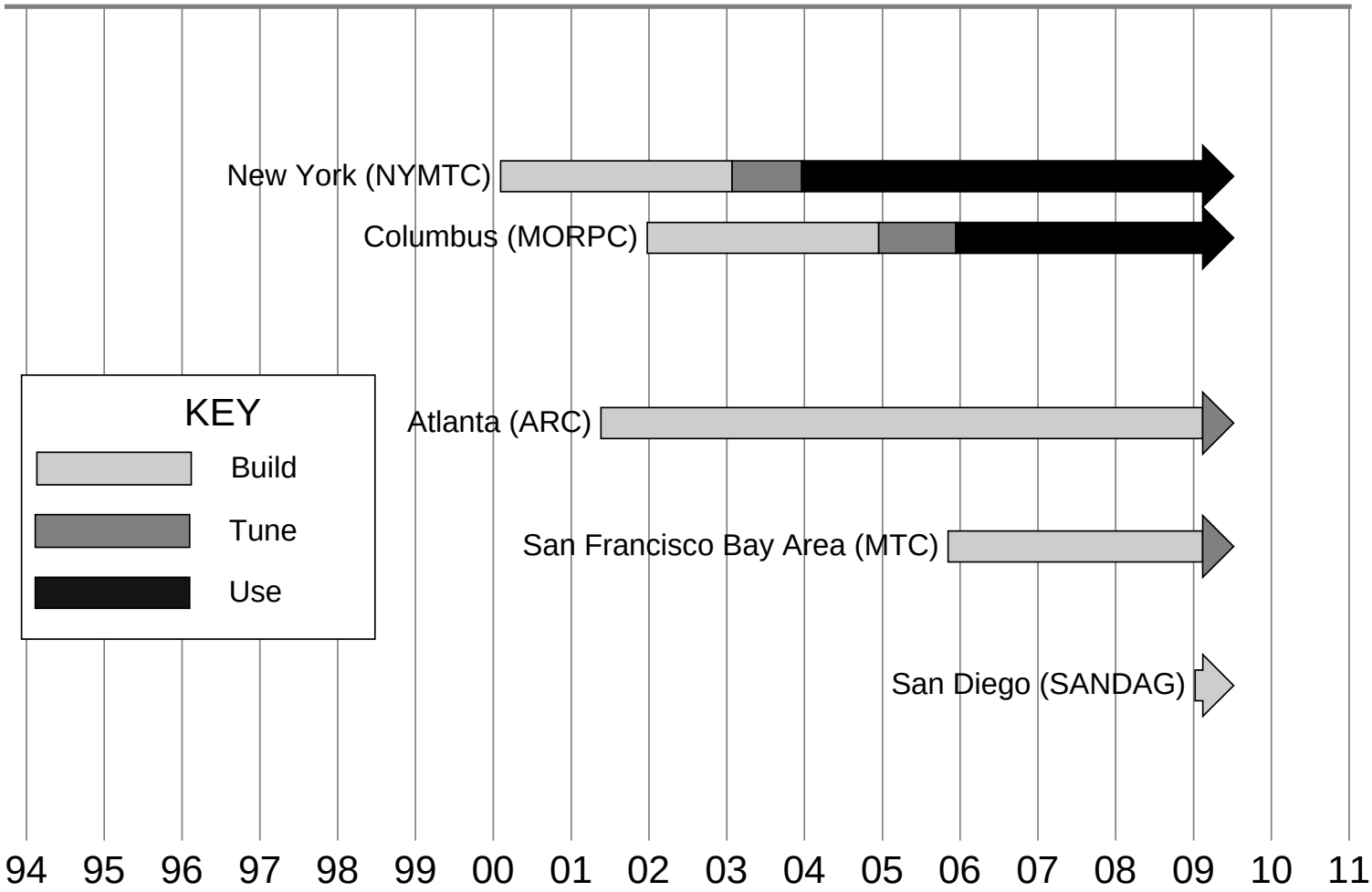
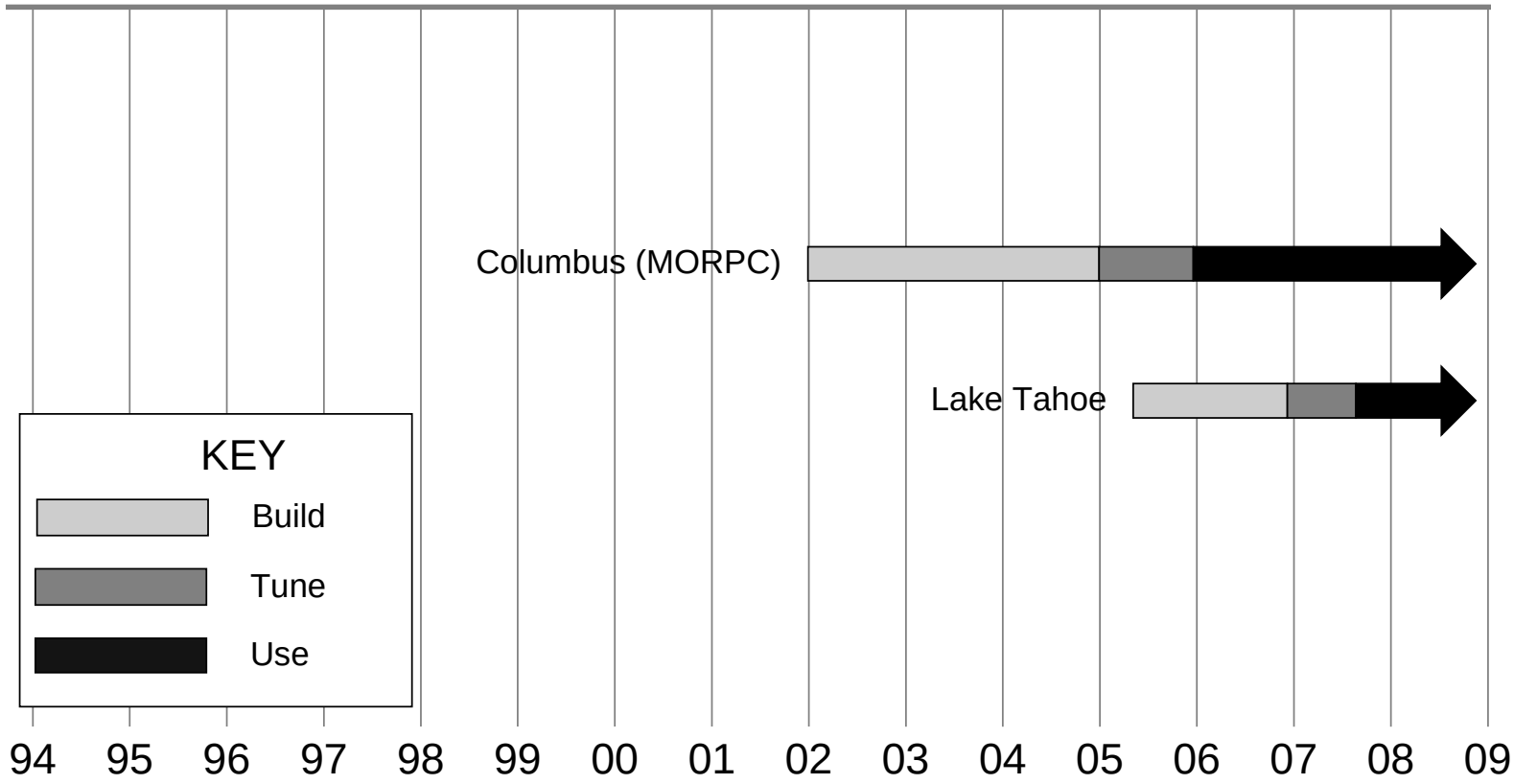
Adapt NYMTC


New York (NYMTC)
Columbus (MORPC)
Atlanta (ARC)
San Francisco Bay Area (MTC)
San Diego (SANDAG)
KEY
Build
Tune
Use
94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11

Adopt MORPC


Columbus (MORPC)
Lake Tahoe
KEY
Build
Tune
Use
94
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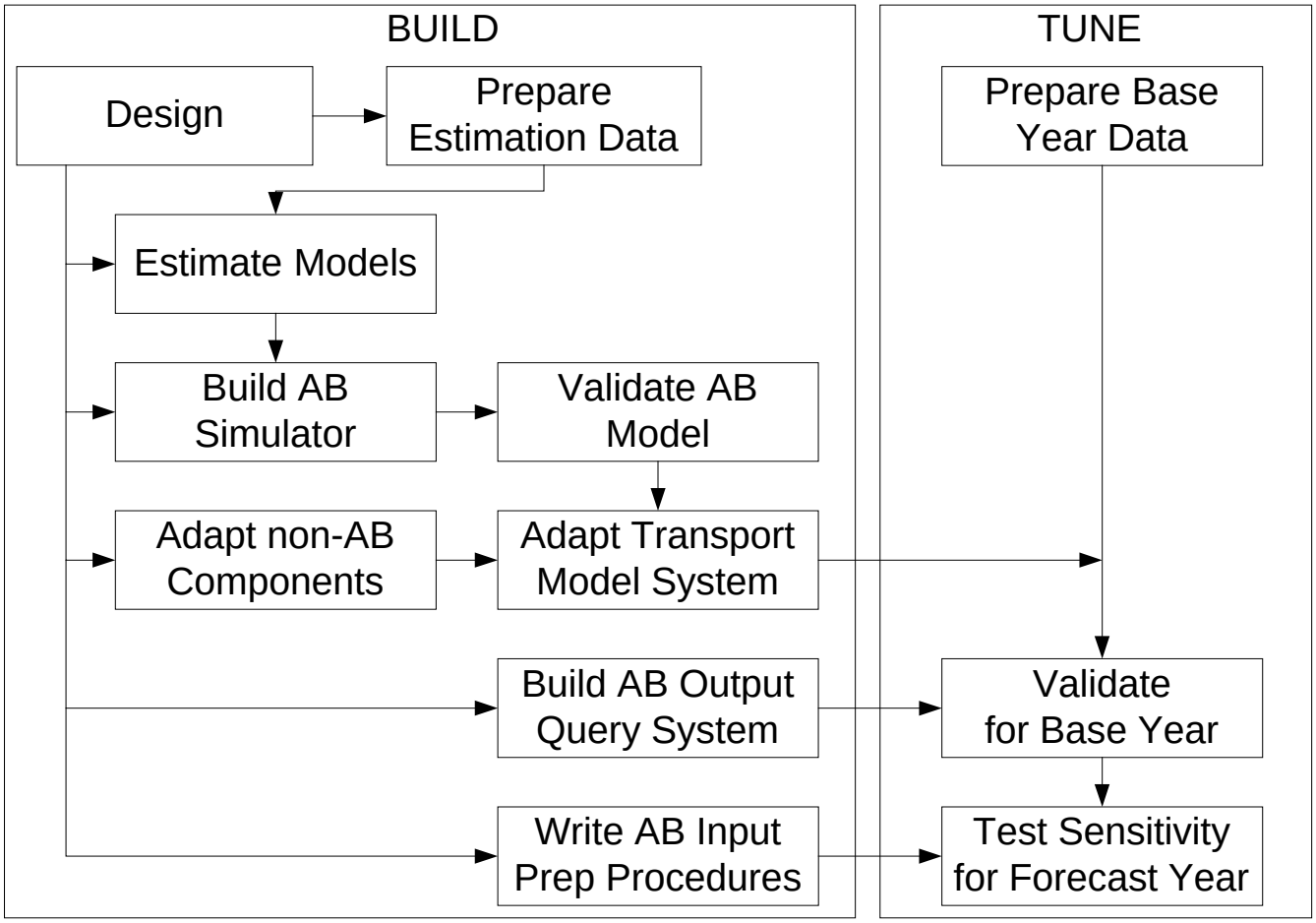
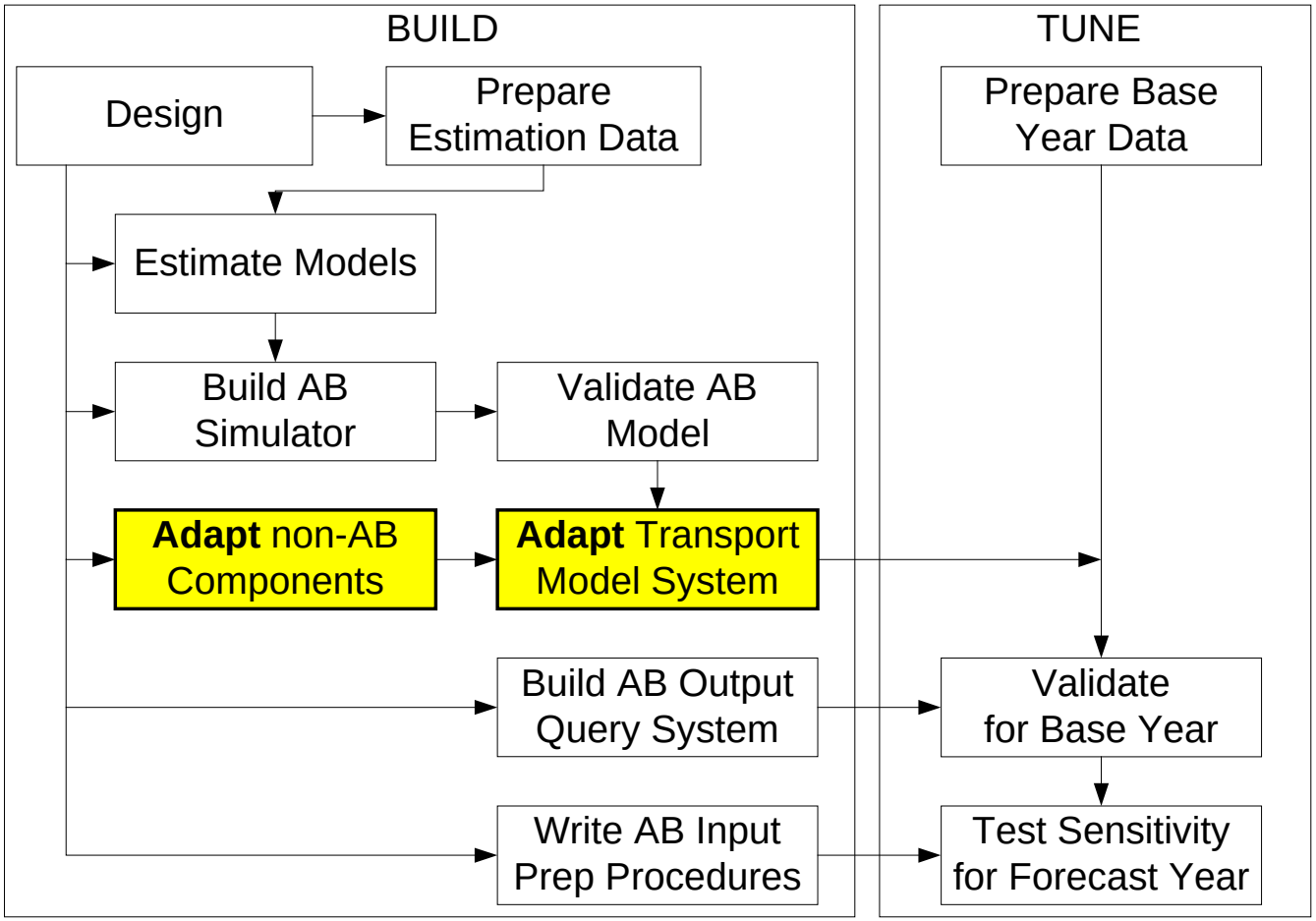
09

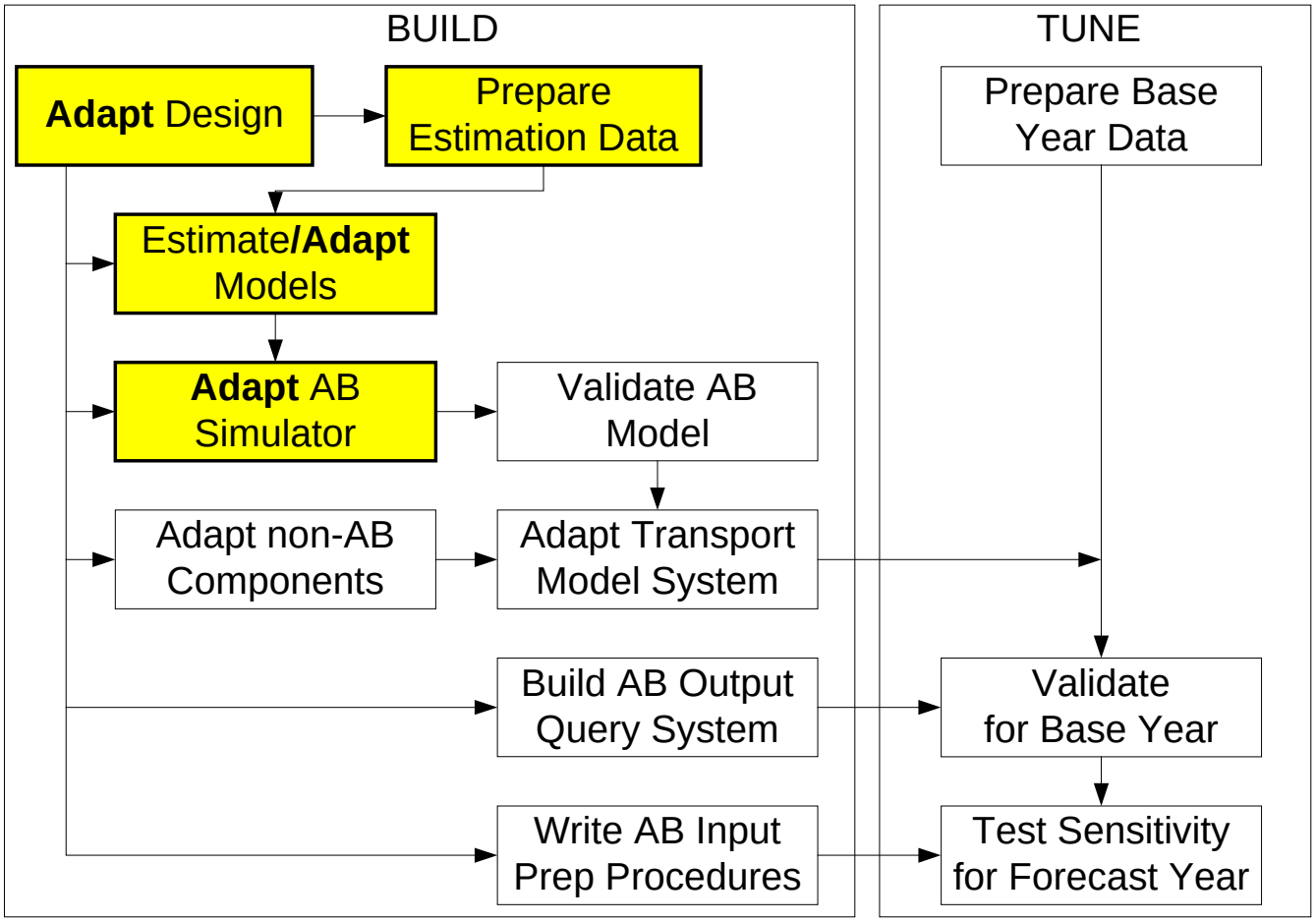
Basic Build Approaches
Invent



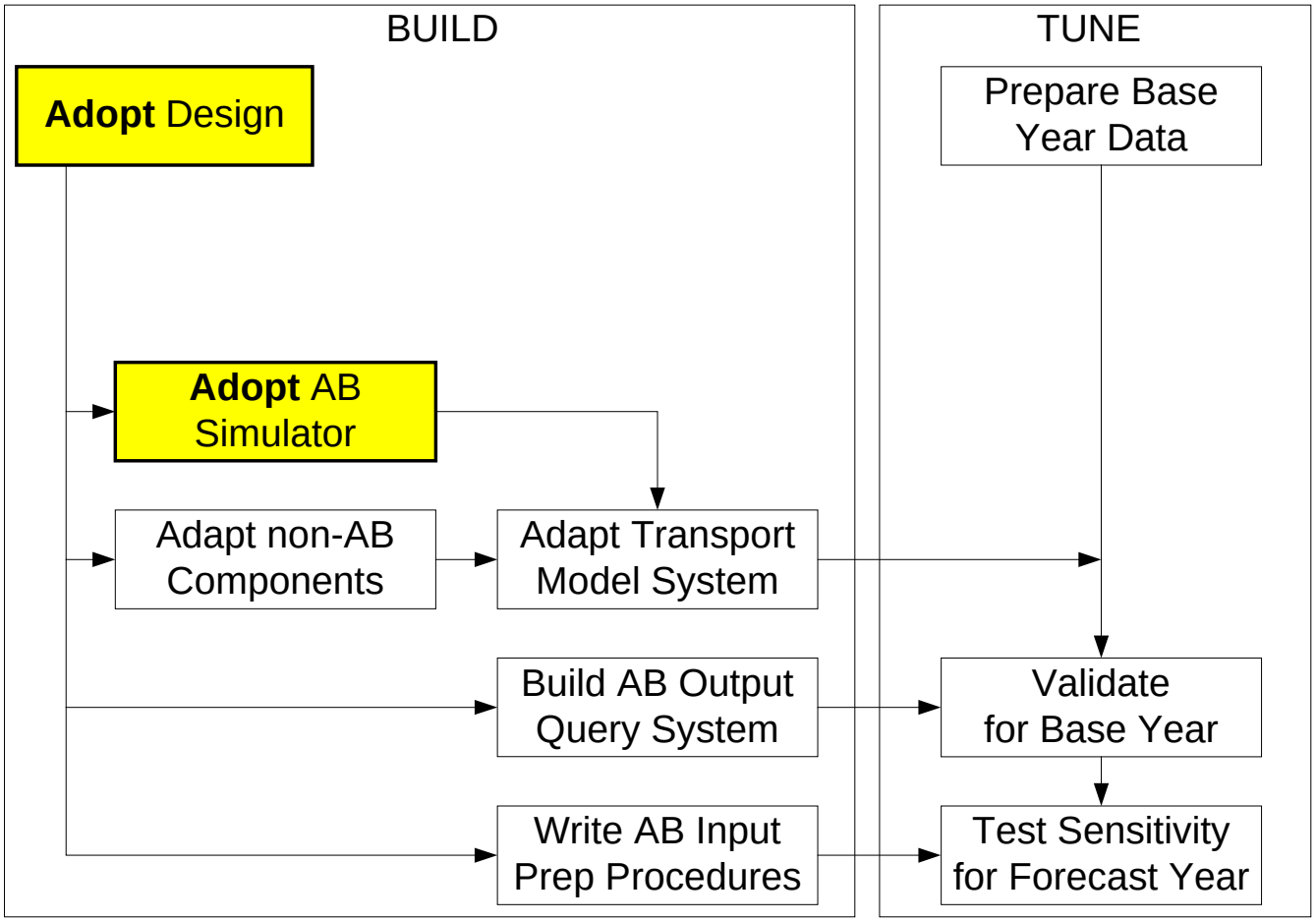
Basic Build Approaches
Invent



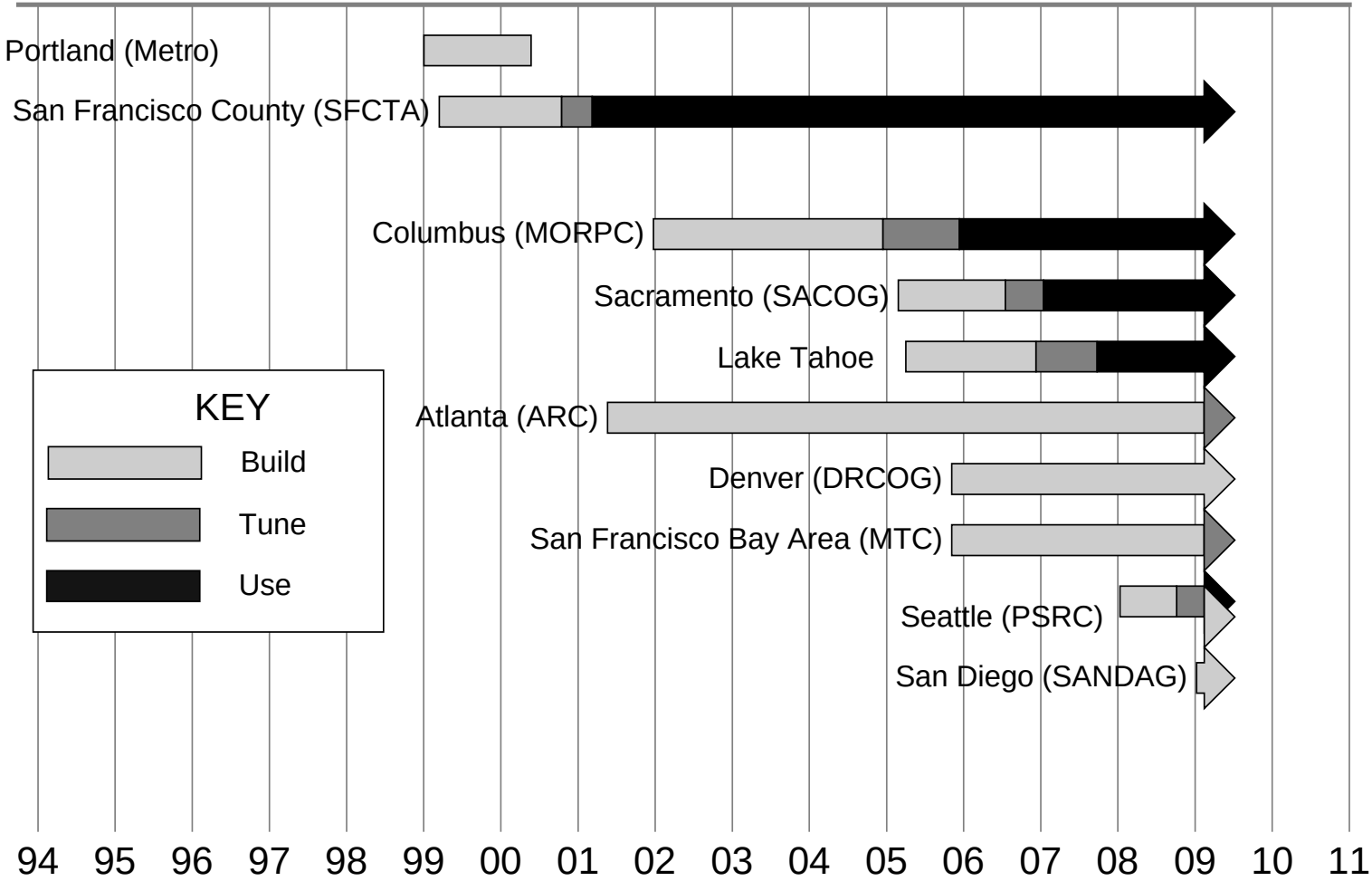
Basic Build Approaches
Adapt



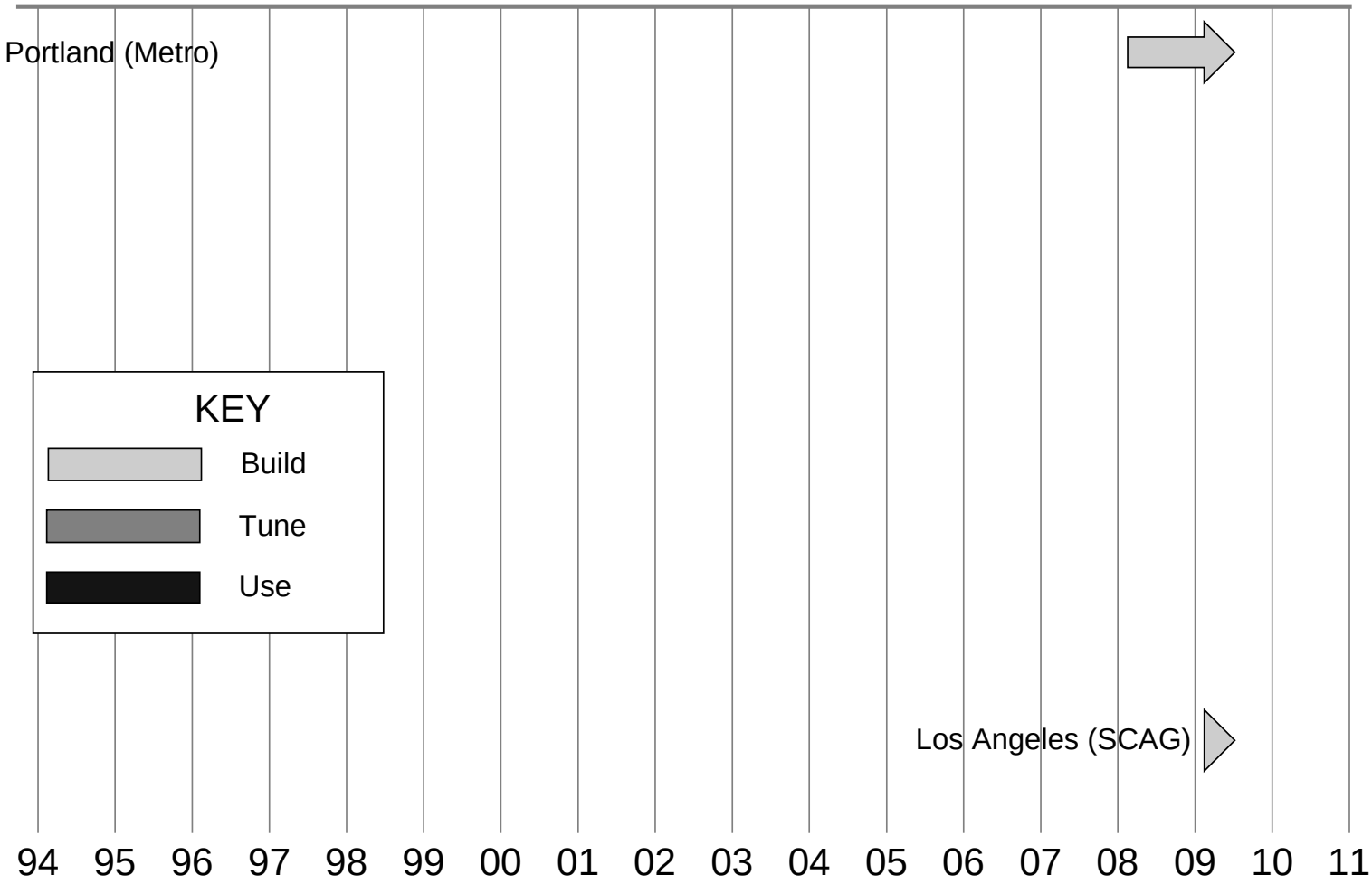
Basic Build Approaches
Adopt



Adaptations and Adoptions



Metro and SCAG: The Latest Inventions



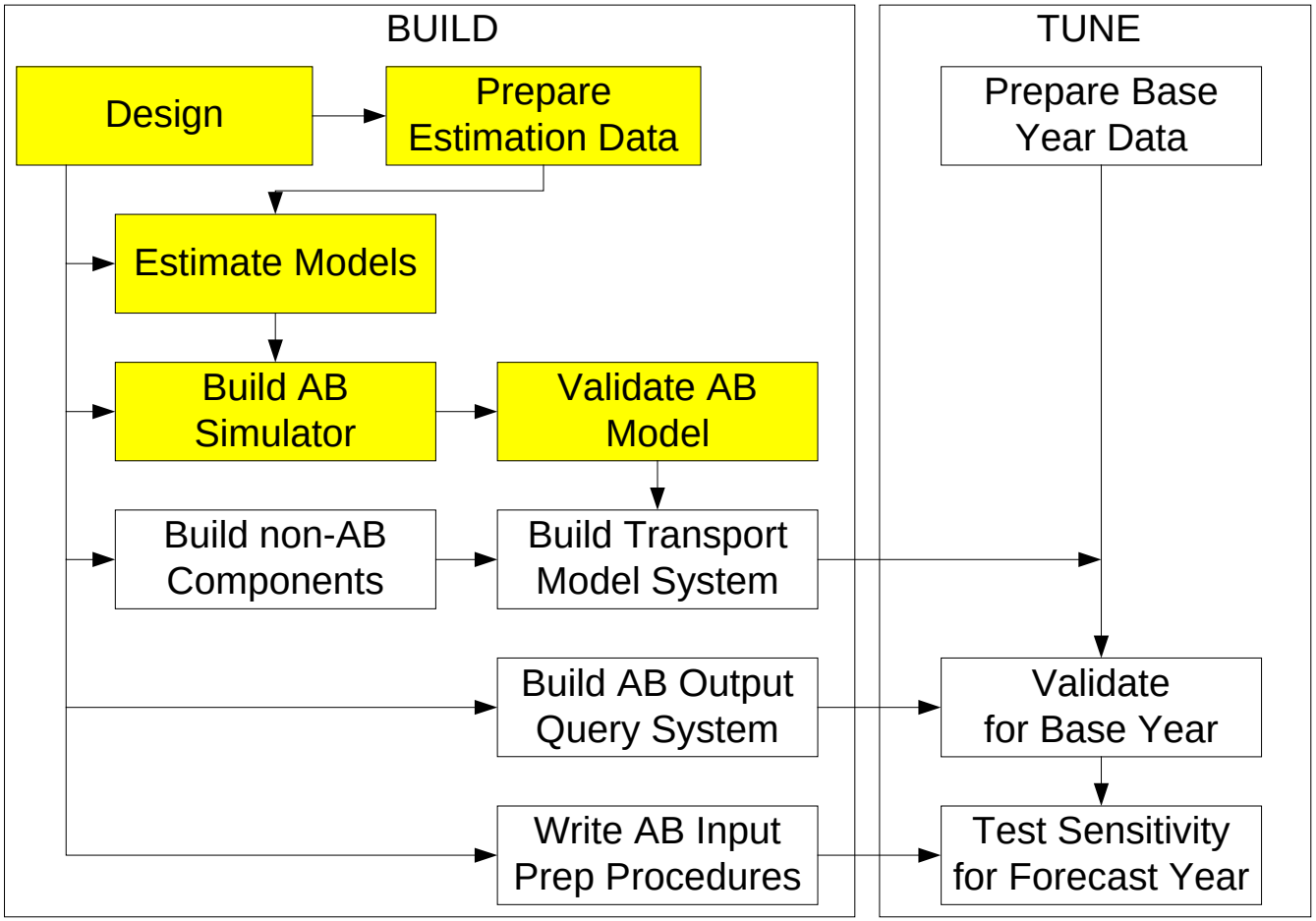
Outline

- Activity-Based (AB) Model System
- Development Tasks
- Basic Build Approaches
- Development Roles
- Management Keys to Success
- Postscript—A Few Suggestions

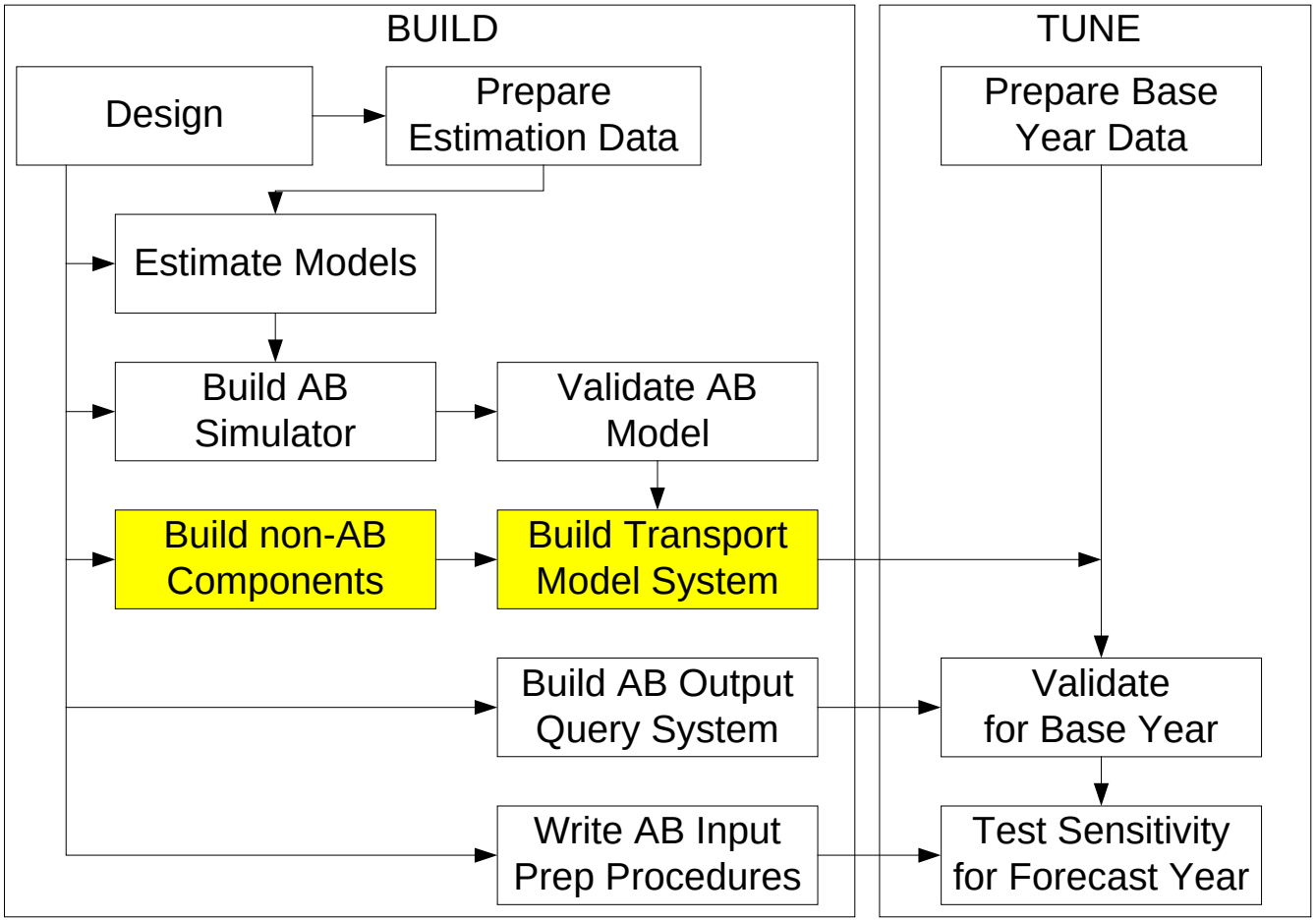
Development Roles

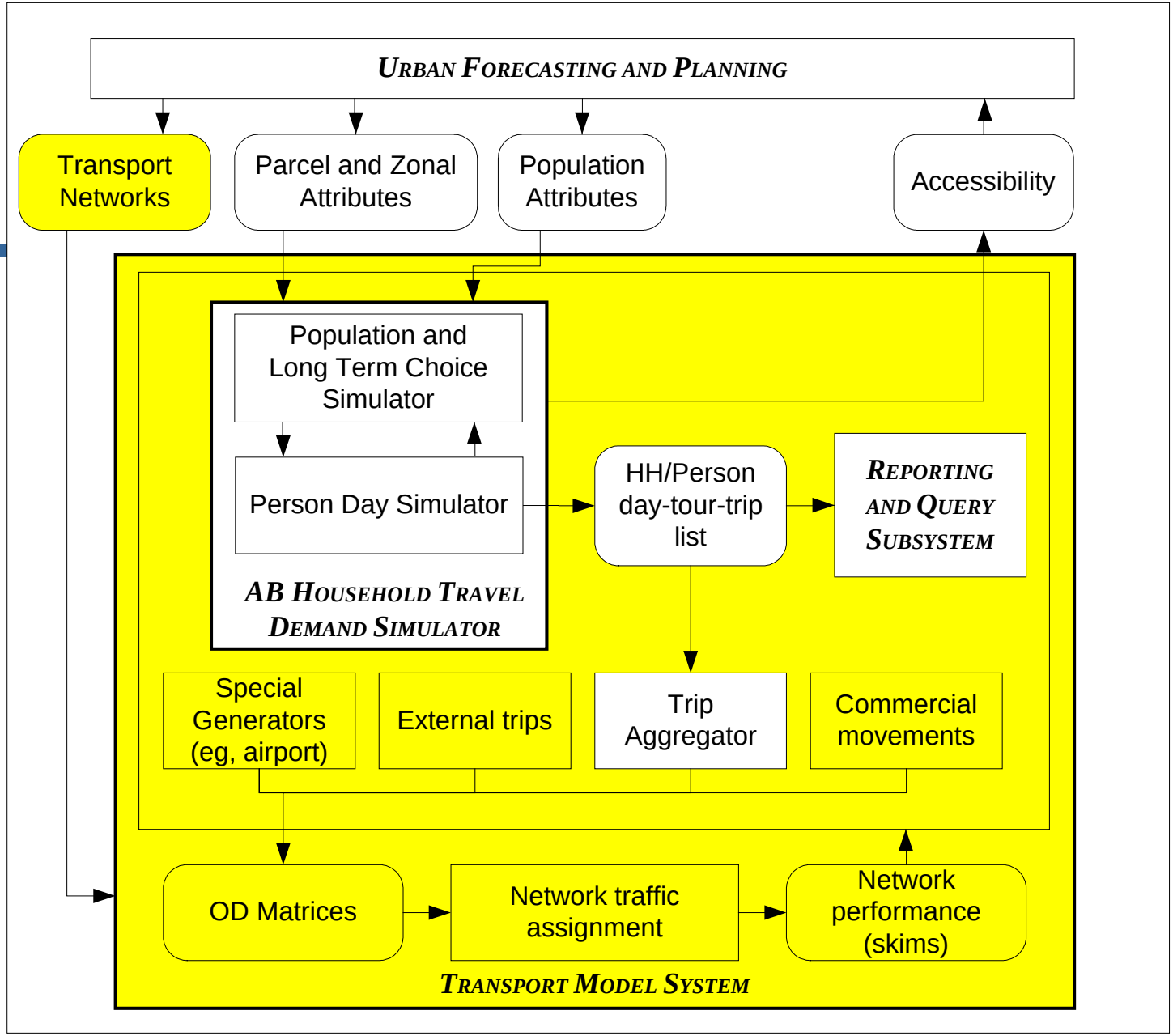
- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

Development Roles
AB Developer

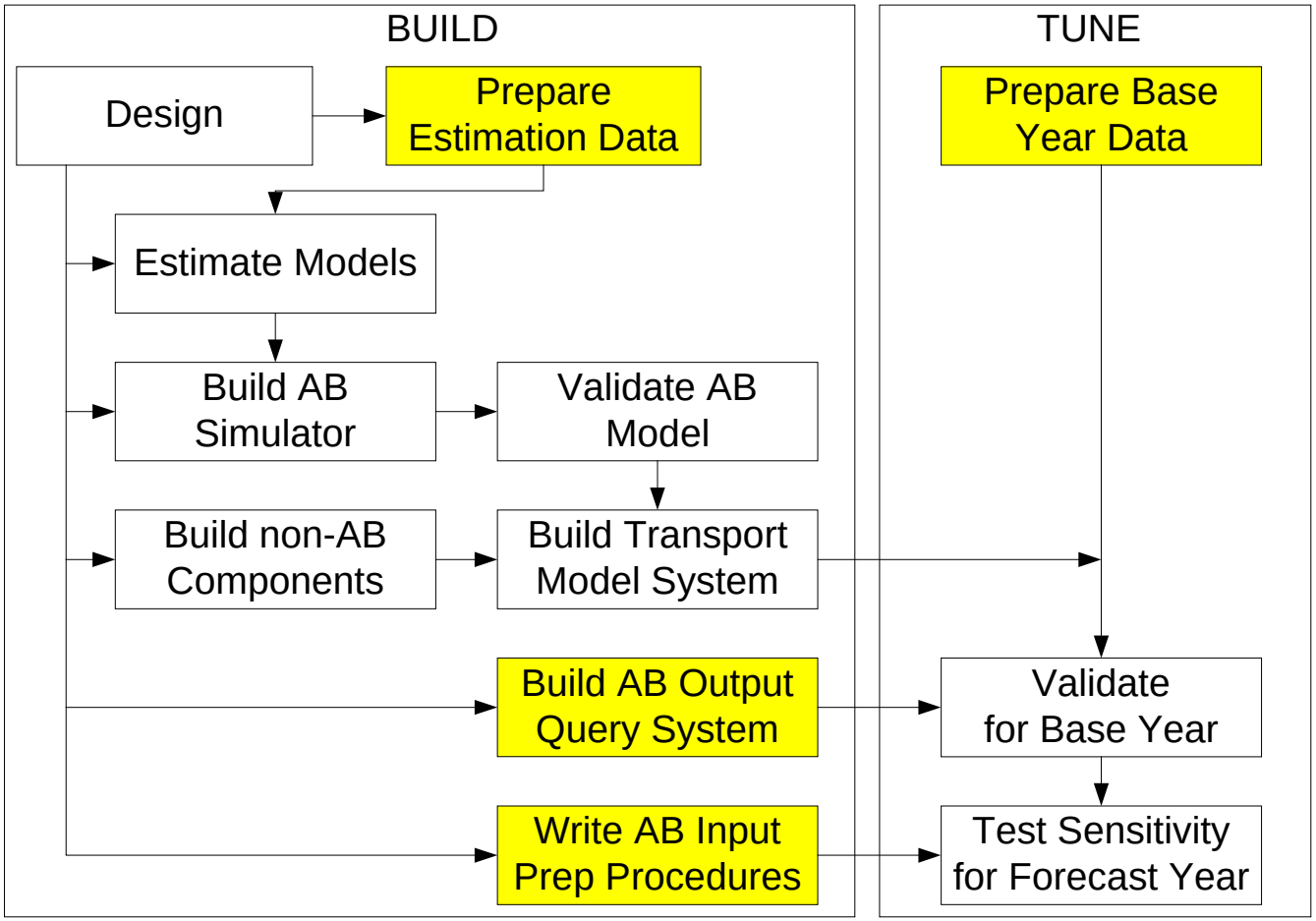


Development Roles
Trip-based Model Expert

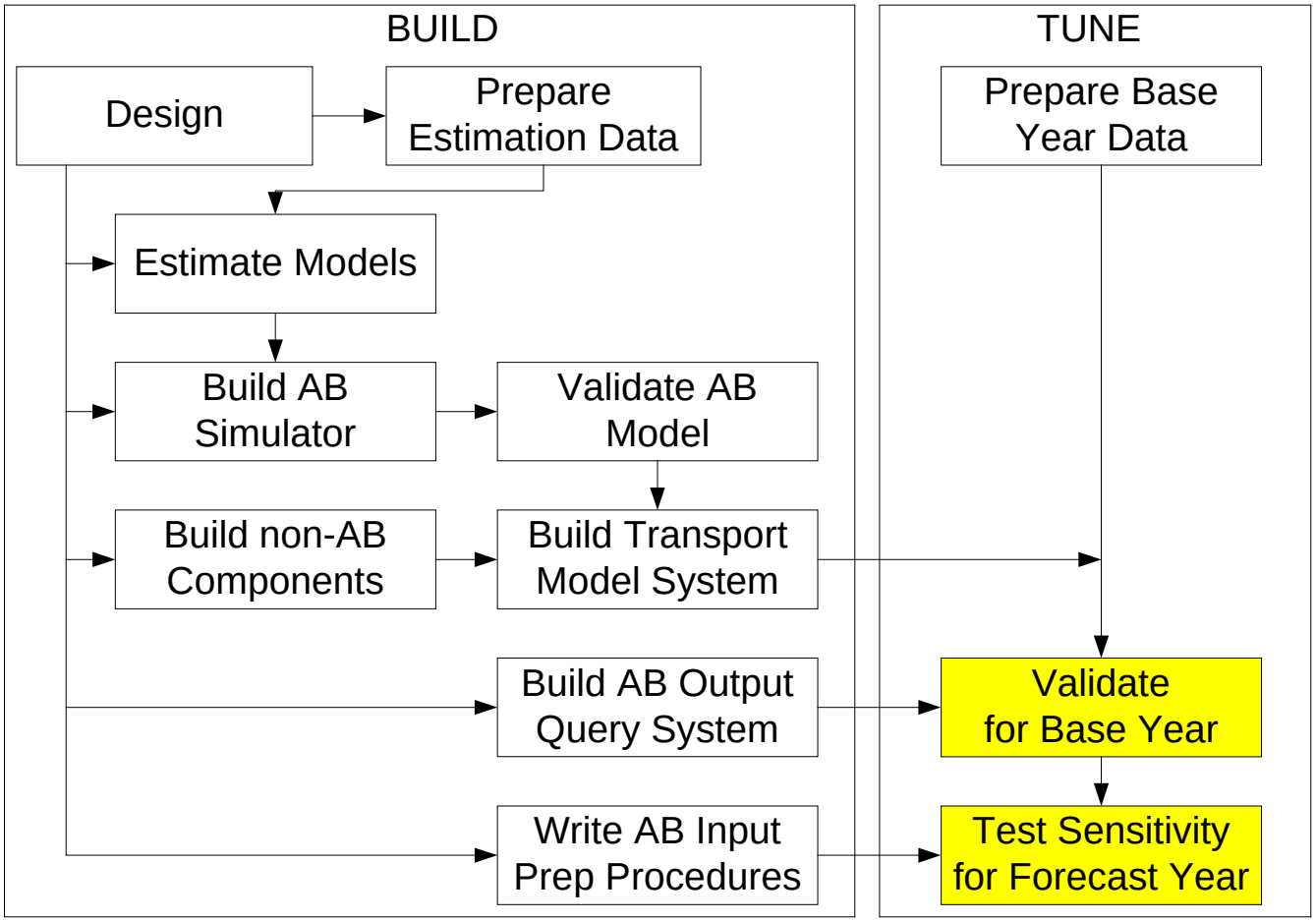



URBAN FORECASTING AND PLANNING
Transport Networks
Parcel and Zonal Attributes
Population Attributes
Accessibility
Population and Long Term Choice Simulator
Person Day Simulator
AB HOUSEHOLD TRAVEL DEMAND SIMULATOR
HH/Person day-tour-trip list
REPORTING AND QUERY SUBSYSTEM
Special Generators (eg, airport)
External trips
Trip Aggregator
Commercial movements
OD Matrices
Network traffic assignment
Network performance (skims)
TRANSPORT MODEL SYSTEM

Development Roles
GIS/DB/GUI Expert(s)



Development Roles
Application Expert



Consultant Role for All Models Now In Use

- AB developer
  - design
  - survey data prep
  - model estimation
  - AB software
- Other roles as needed
- Involvement after implementation

DRCOG: Agency is sharing AB Developer Role

- AB developer
  - design—**assist**
  - model estimation—**estimate a few**
  - survey data prep—**augment**
  - AB software—**principal developer**

Outline

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Primary Definition of Success

- Model system got fully **implemented**
- Model was implemented consistently with a **sound** design
- Model continues to be **used** for its intended purpose

Additional Aspects of Success

- Cost effective development
- Timely development
- Useful innovation
- Provides a foundation for ongoing enhancements

Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

Keys to Success
1. A Sound Design

- Workable framework
- Completed up front
- Comprehensive and Integrated
- Implemented consistently

Workable Design Framework

- Example: Metro started with successful MIT prototype
- What it gives
  - Soundness
  - Vision
  - Confidence
  - Something to build upon

Keys to Success
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Management
Keys to Success

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- Capable innovative developers
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Keys to Success
2. Capable Innovative Developers

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

Keys to Success
2. Capable Innovative Developers

- What it gives
  - Technical soundness
  - Innovation
  - Usability and usefulness
  - Follow through

Keys to Success
2. Capable Innovative Developers

- What it gives
  - Technical soundness
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Management Keys to Success

- A sound design
- Capable innovative developers
- Sustained sponsorship

Keys to Success
3. Sustained Sponsorship

- Gives: stream of funds
- Requires:
  - Sponsor motivation
  - Instigating Advocate
  - Internal Champion

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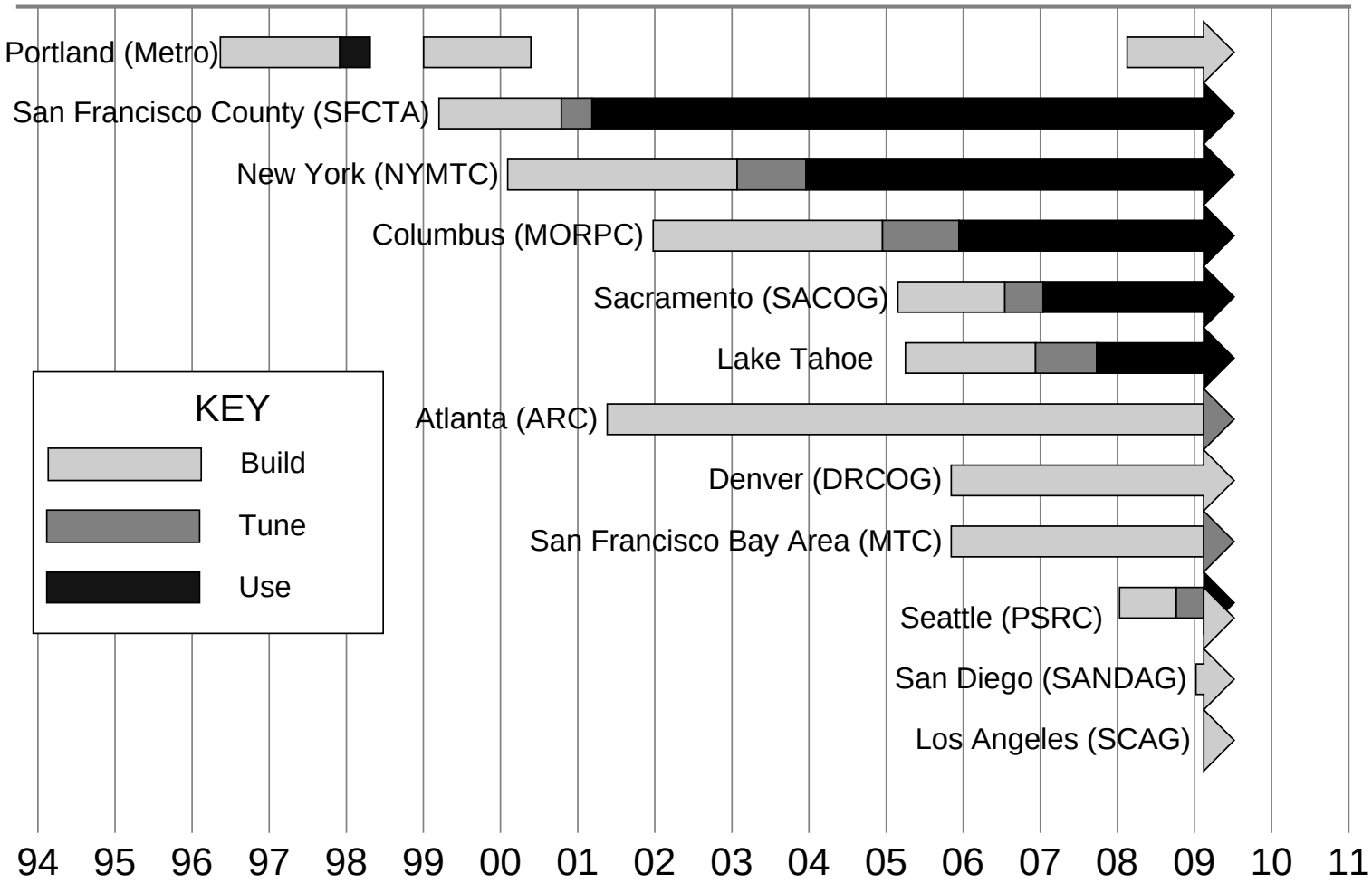
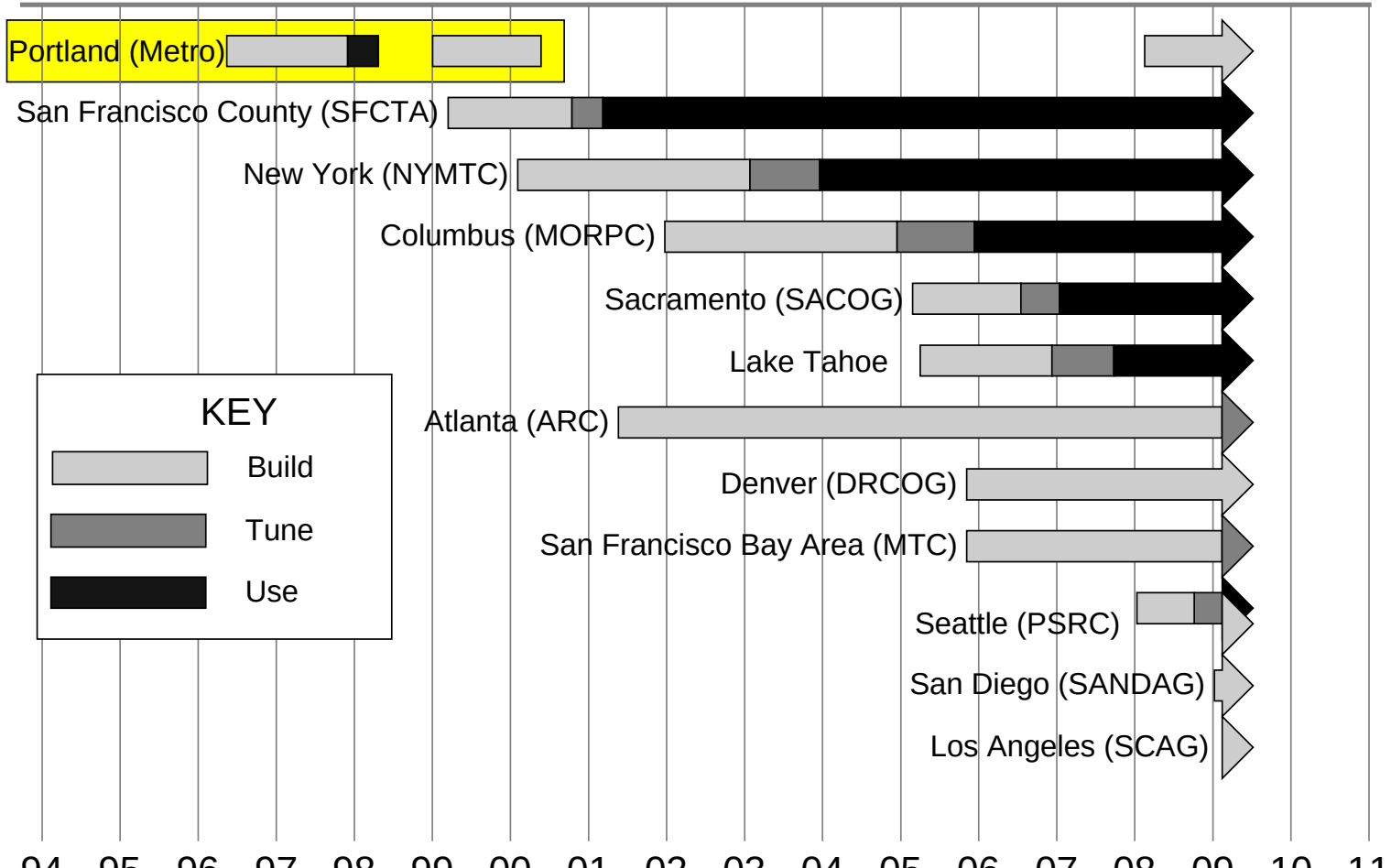
Keys to Success
3. Sustained Sponsorship

- Gives: stream of funds
- Requires:
  - Sponsor motivation
  - Instigating Advocate
  - Internal Champion

Sustained Sponsorship Counter-examples



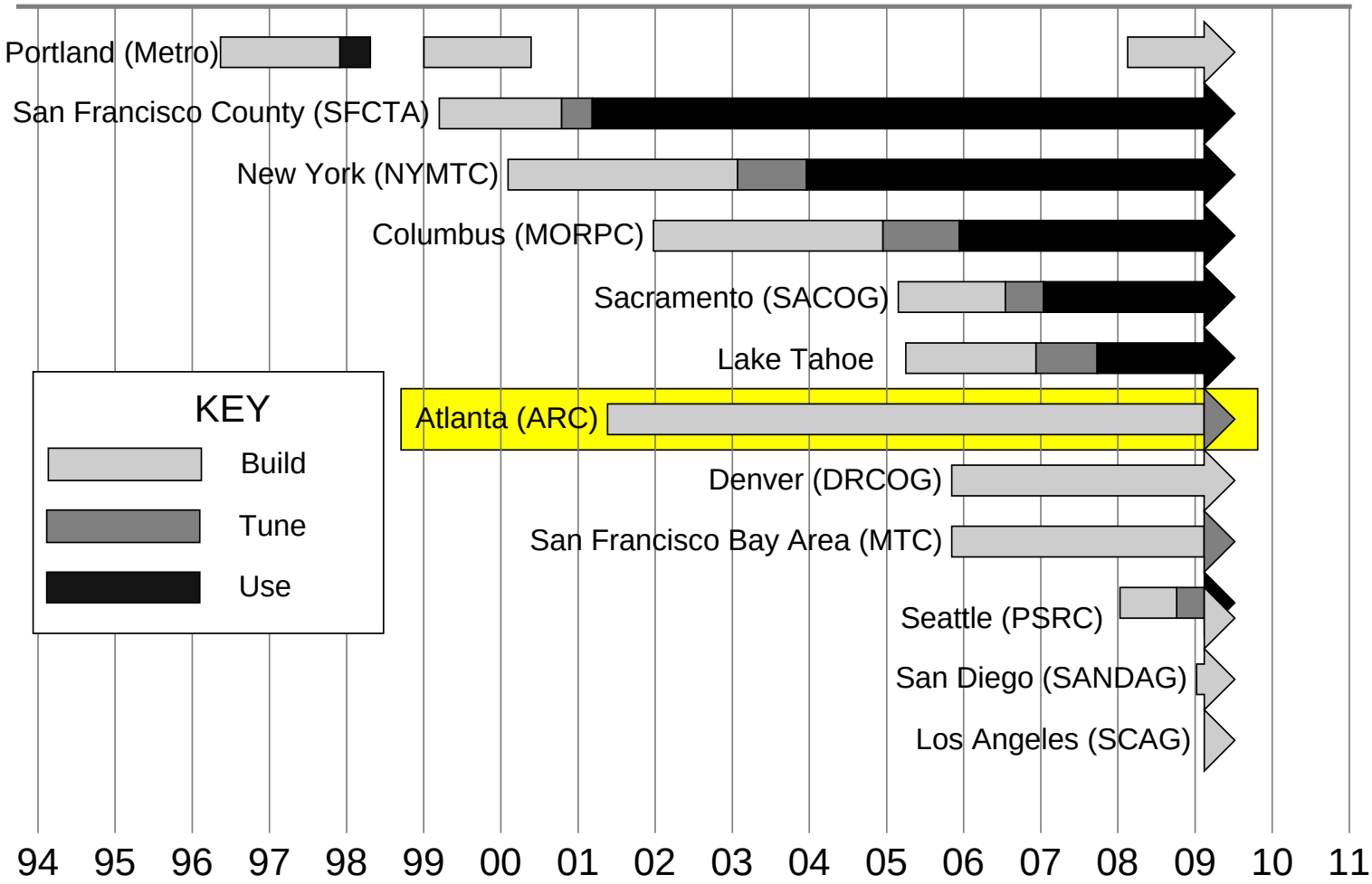
Why didn't Metro keep using their model?



Why didn't Metro keep using their model?

- Lost Sponsorship
  - MPO struggling financially
  - Federal funds for TranSIMS
  - No money for calibration & validation

Why is it taking ARC so long?



Why is it taking ARC so long?

- Sponsorship
  - ARC chose to invest at a slow rate
  - Expanded region from 13 to 20 counties
  - Commitment to implement the models didn't occur until early 2008

Management
Keys to Success

- A sound design
- Capable innovative developers
- **Sustained sponsorship**

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- Postscript—A Few Suggestions

A Few Suggestions

1. Adapt

A Few Suggestions

1. Adapt
2. Don’t wait on HH survey data

A Few Suggestions

1. Adapt
2. Don’t wait on HH survey data
3. Seriously consider parcel data

A Few Suggestions

1. Adapt
2. Don’t wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care

A Few Suggestions

1. Adapt
2. Don’t wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care
5. Implement promptly, then enhance

Outline

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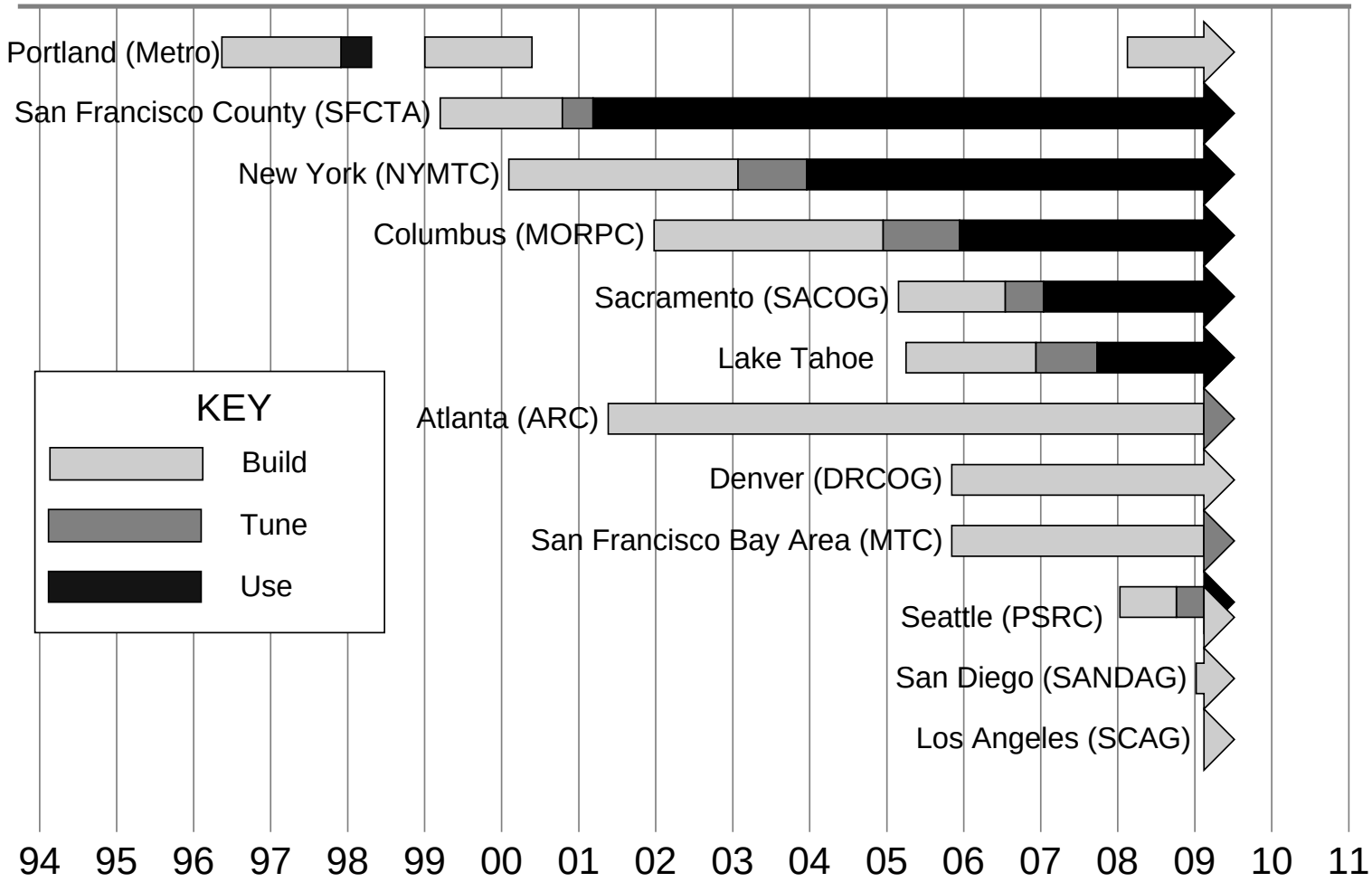
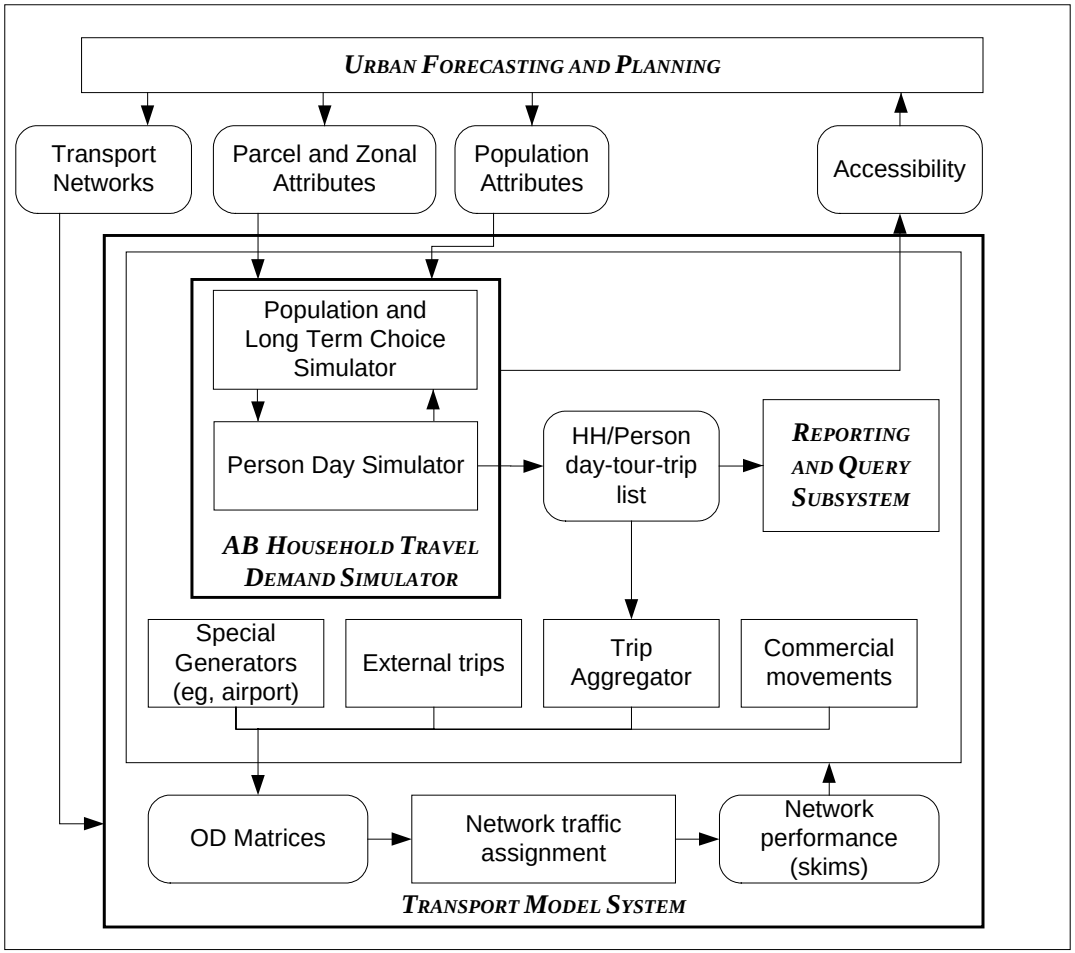
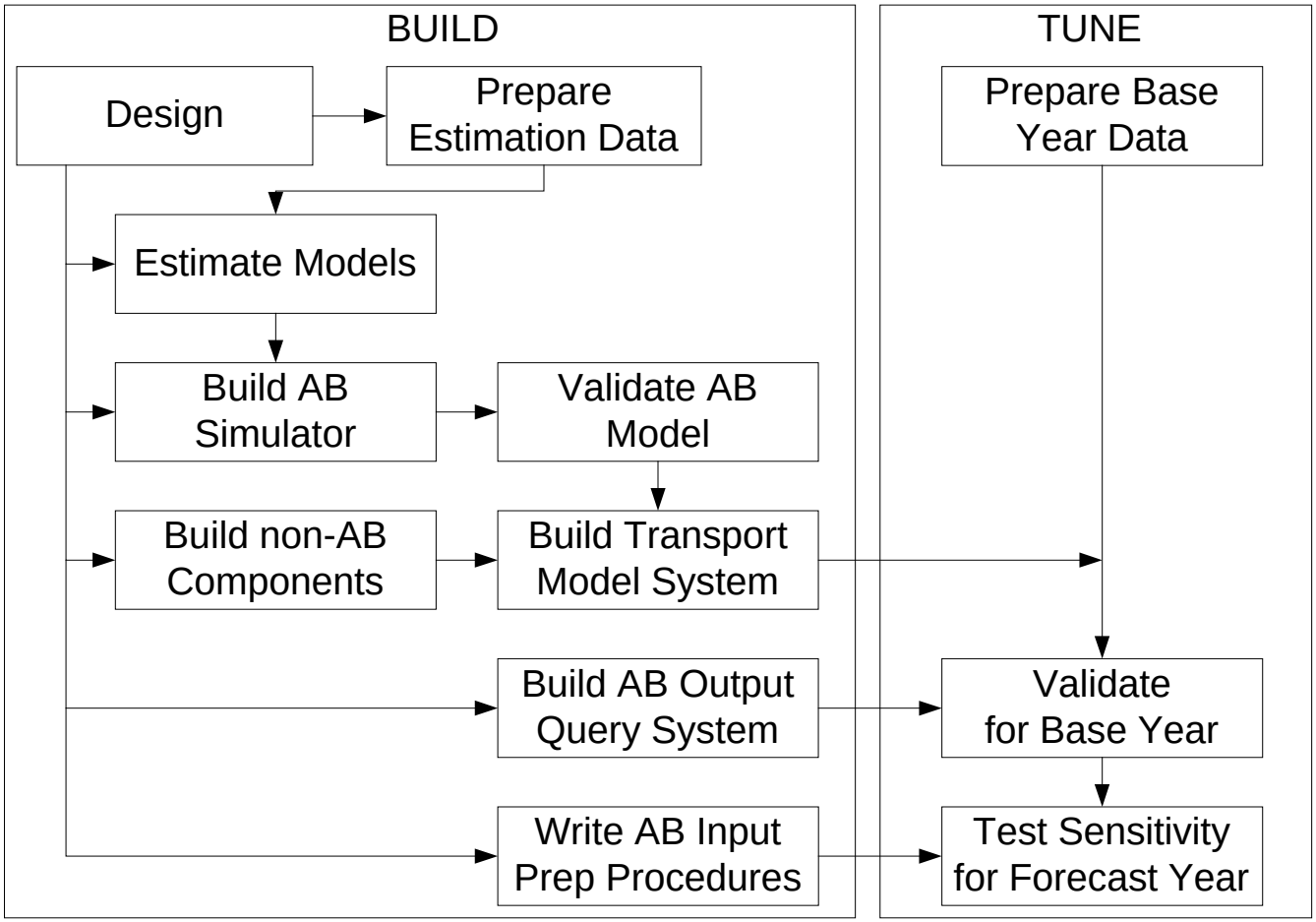
U.S. Projects


Portland (Metro)
San Francisco County (SFCTA)
New York (NYMTC)
Columbus (MORPC)
Sacramento (SACOG)
Lake Tahoe
Atlanta (ARC)
Denver (DRCOG)
San Francisco Bay Area (MTC)
Seattle (PSRC)
San Diego (SANDAG)
Los Angeles (SCAG)
KEY
Build
Tune
Use
94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11

Activity-Based Model System



The Tasks


BUILD
TUNE
Design
Prepare Estimation Data
Prepare Base Year Data
Estimate Models
Build AB Simulator
Validate AB Model
Build non-AB Components
Build Transport Model System
Build AB Output Query System
Validate for Base Year
Write AB Input Prep Procedures
Test Sensitivity for Forecast Year

Basic Build Approaches

- Invent
- Adapt
- Adopt

Development Roles

- AB Developer
- Trip-Based Model Expert
- GIS/DB/GUI Expert(s)
- Application Expert

Management
Keys to Success

- A sound design
- Capable innovative developers
- **Sustained sponsorship**

A Few Suggestions

1. Adapt
2. Don’t wait on HH survey data
3. Seriously consider parcel data
4. Innovate with care
5. Implement promptly, then enhance