12 – Early Quality-of-Service Analysis of the Alternatives

- Design of service plans
- Early understanding of the alternatives
- Better communications with FTA

Motivations

- Experience over the past four years
  - Limited insights from review of service plans for the alternatives
  - Real insights from analytical reporting of forecasts – thematic maps, D-D tables
  - So, FTA does not “approve” alternatives – especially the TSM alternative – based on early definitions

Motivations

- Early discussion still important
  - Sponsors want reassurance
  - FTA wants to avoid late disagreements
- Early analysis of service plans is highly desirable
  - Enough to understand service implications
  - And to permit agreement on the strategic service plan for each alternative

Principles for Alternatives Design

- Address purpose and need
- Include baseline options
- Include all reasonable modes and alignments
- Encompass an appropriate range of options without major gaps in costs
- Include:
  - Alternatives addressing different goals
  - Alternatives have a reasonable chance of becoming the locally preferred alternative (LPA)

Principles for Alternatives Design

Since all alternatives should address the same purpose and need:

All alternatives should strive to provide enhanced quality of service to the same markets

Alternatives Definition

- Three stages
  - Conceptual
  - Detailed
  - Final
- Each describes with increasing detail
  - Technology
  - Alignment
  - Operating Plan

Conceptual Alternatives

- Operating plans are strategic; for example:
  - LRT with park-ride
  - Express buses on separate guideway with stations
  - Express bus on freeway; park-ride but no stations
  - Limited stop service on arterial + signal preemption
  - High frequency local service
- FTA wants to talk about the concepts and the strategic service plans

Detailed Alternatives

- Operating plans sufficient to support network coding and O&M cost analysis

Final Alternatives

- Reflects analysis and refinement of detailed alternatives to demonstrate:
  - Responsiveness to purpose and need
  - Consistency with markets served by the build alternative
  - Cost-effective relative to the no-build
- Baseline
  - Approved by FTA only after project sponsor completes detailed analysis

Quality of Service Analysis

- Systematic approach to understanding how each alternative serves the intended markets
- Review of route maps and tables of frequencies for consistency is important, but not sufficient
- Need to understand the interaction between the travel model and the service plan

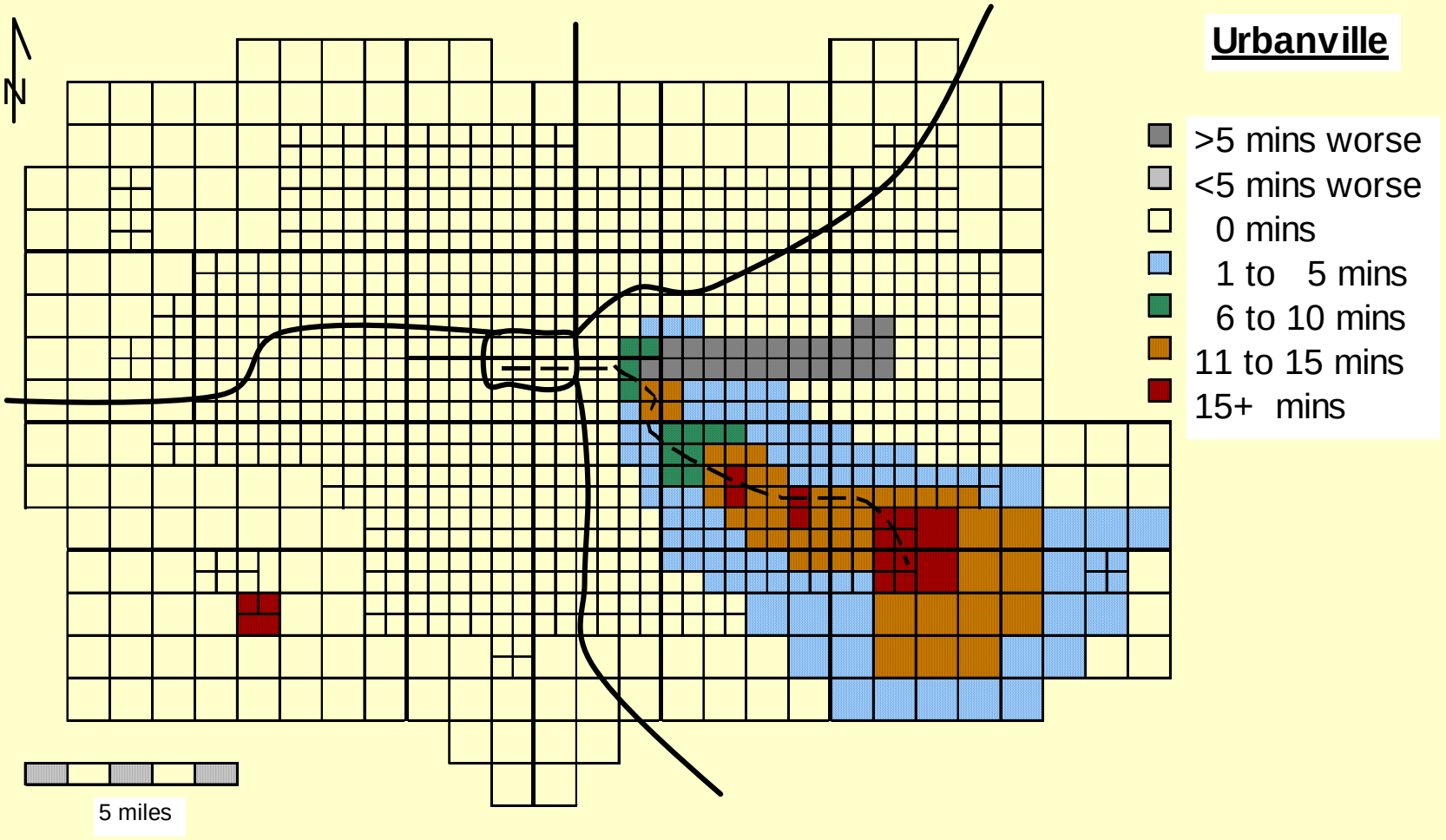
Some Basic Issues

- Route structure
- Span of service (days and hours)
- Fare structure
- Park-ride locations, capacities and access

An Approach to QOS Analysis

- Develop networks early in the analysis
  - For both Build and possible Baseline alternatives
- Use your travel models
  - Networks and pathbuilder, at least
  - And mode choice?
  - And user-benefits calculations?

Early QOS Analysis



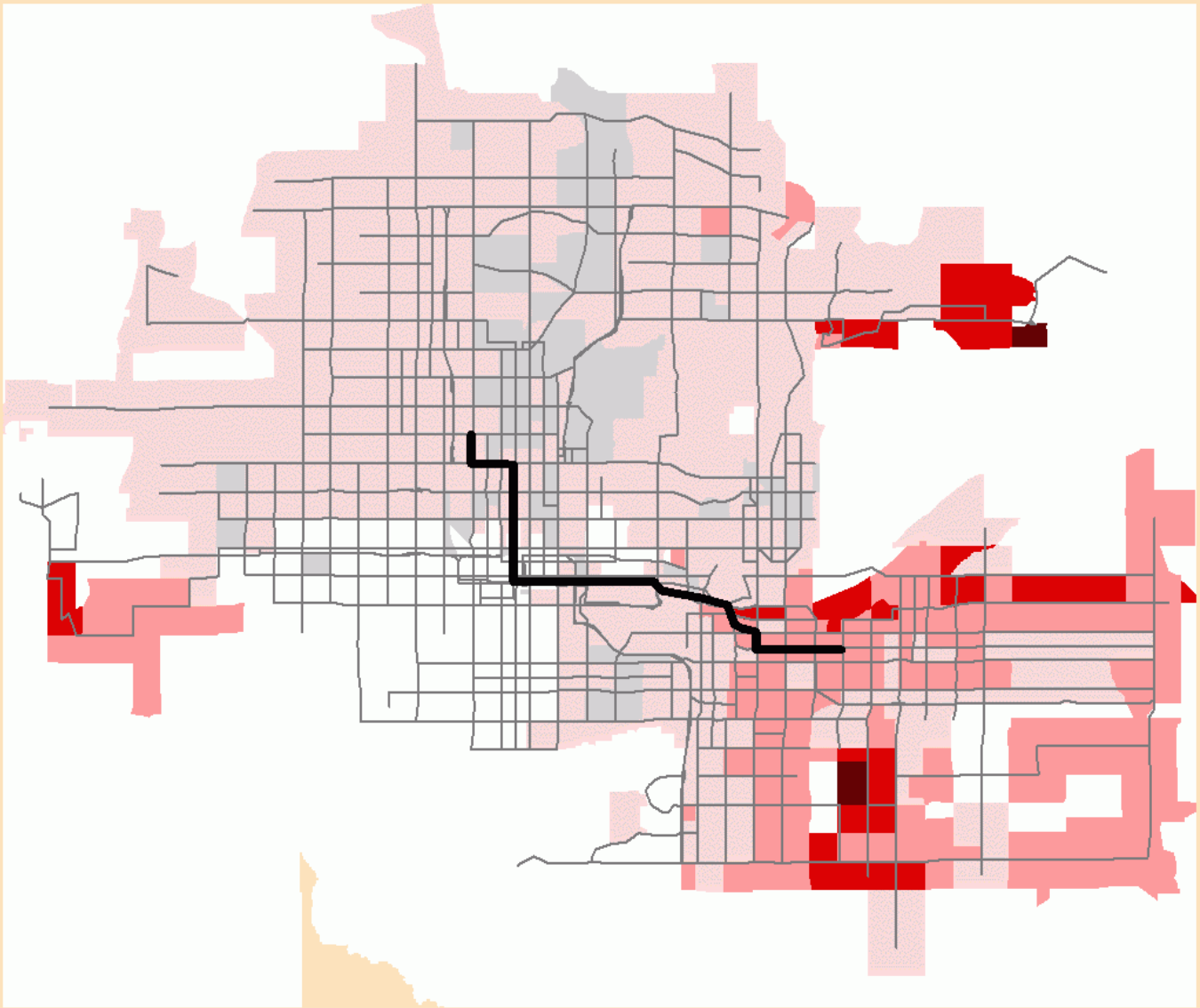
Central Phoenix/East Valley PE/DEIS

MARICOPA ASSOCIATION of GOVERNMENTS

ZONE 842 WEIGHTED TRAVEL TIME DIFFERENCE 2020

[BUILD WALK TO RAIL - NOBUILD WALK TO LOCAL BUS]

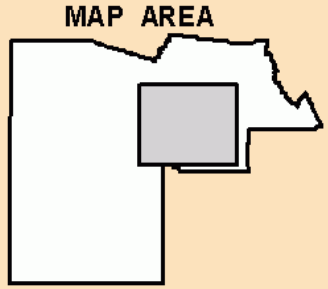
Maricopa County, Arizona
(Transit Service Area)



Travel Time Difference

- Out of Range
- More than 60 minutes decrease
- 40 - 60 minutes decrease
- 20 - 40 minutes decrease
- 0 - 20 minutes decrease
- 0 - 20 minutes increase
- 20 - 40 minutes increase
- 40 - 60 minutes increase
- More than 60 minutes increase
- Light Rail
- 2020 Transit Network

MAP AREA



Source: MAG Transportation Model, 2000
RPTA Transit Networks

An Approach to QOS Analysis (continued)

- Develop some type of forecast year transit trip table
  - From previous analysis
  - From model application for one network
  - Use person trip table if nothing else available
- Use the tools you have to examine
  - Trip table differences
  - Skim table differences
  - Summit can assist but is not required at this stage
- Use GIS to assist in analysis

An Approach to QOS Analysis (continued)

- Examine differences in:
  - Coverage
  - Fares
  - Travel time (weighted and unweighted)
  - Park-ride service areas
  - Number of transfers

An Approach to QOS Analysis (continued)

- Look for:
  - Areas where service is reduced in a proposed TSM alternative compared to the No-Build
  - Areas where service is reduced in the Build alternative compared to a TSM alternative
  - Significant changes in the QOS for markets not directly served by the proposed project

Barriers?

- How much of this is being done early?
- If not much, what prevents it?
  - Working on models?
  - Operating plans not really defined?
  - Holding information closely?
- How about early application of full models to get previews?
- Anything that FTA should do?

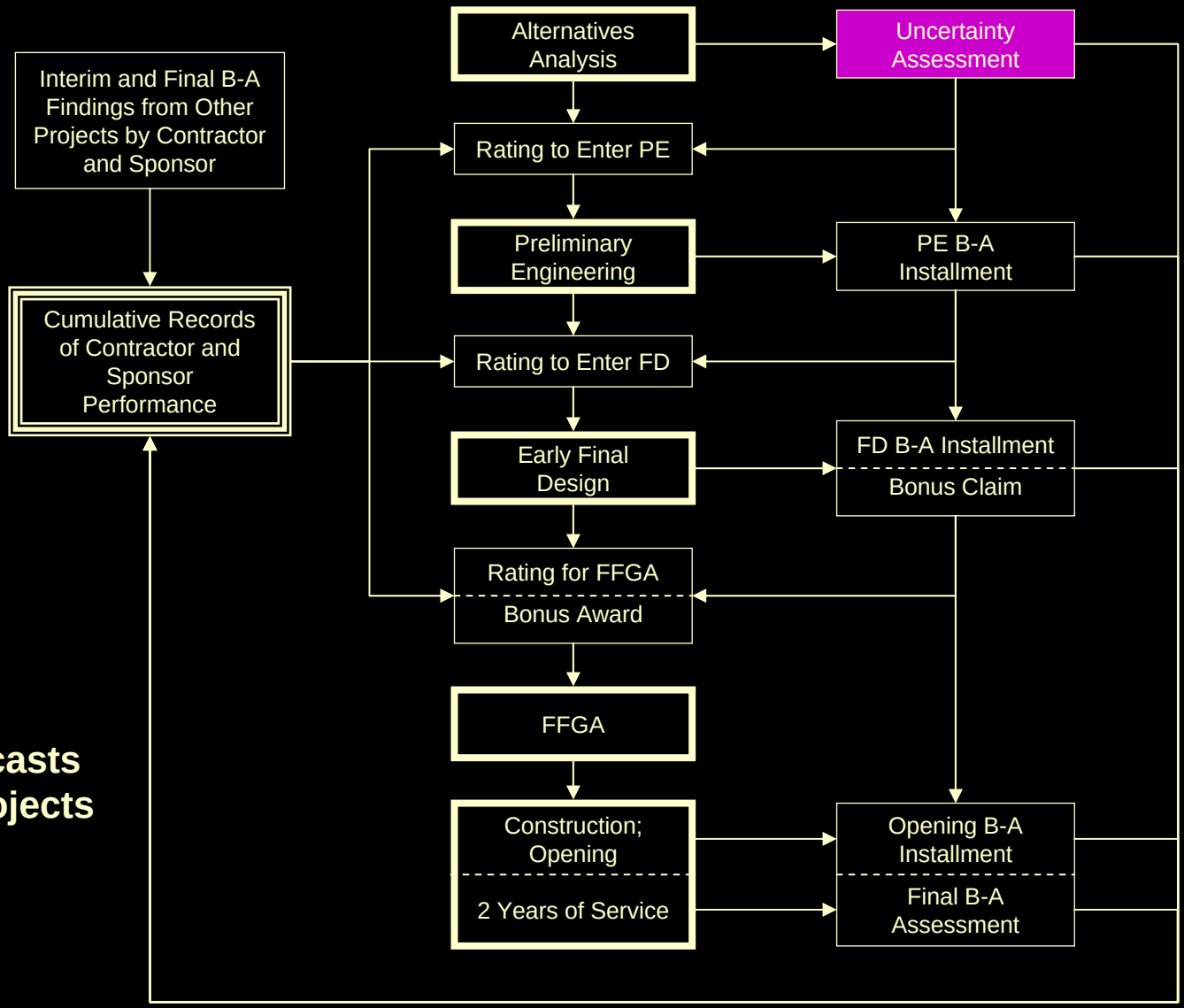
13 – Dealing with Uncertainties in New Starts Forecasts

- Related New Starts requirements
- A framework
- Framing uncertainties in forecasts

Related Requirements

- FTA ratings: to consider reliability of numbers
- Analysis of uncertainty: to support ratings
- Before-After studies: to improve understanding and tools
- FFGA Bonus Awards: to provide incentives
- Performance Tracking: to promote good practice

A Framework for Dealing with Uncertainty and Accuracy in Forecasts for New Starts Projects



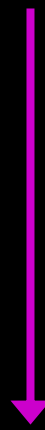
Uncertainty Analysis

- Potentially a central role
- Lessons from colleagues?
  - Weather forecasters
  - Travel forecasters

Uncertainty Analysis

- An approach?
  - "Forecast" of current conditions and travel patterns

What things must happen to get us from here to there?



Performance of project
Growth
Highway congestion
Parking prices
Fares
Etc., etc., etc.

  - Forecast of future conditions, travel patterns, and performance of a New Starts project

Framing Uncertainties

- Stepwise build-up of forecasts
  - Today
  - Plus the future transit network
  - Plus future trip tables
  - Plus future highway congestion
  - Plus future parking costs
- Isolation of contributions to full forecast

Framing Uncertainties

- Assignment of probabilities to increments
  - Upper and lower bound?
  - Probability distribution?
  - Specific discussion of individual sources of uncertainty
- Range of possible outcomes
  - Separate forecasts (upper, lower, best-guess)?
  - Monte-Carlo → frequency distribution?

Questions

- How desirable is a redefined meaning to the term “forecast?”
- How possible is it to achieve, at least for the locally preferred alternative?
- What are the barriers?

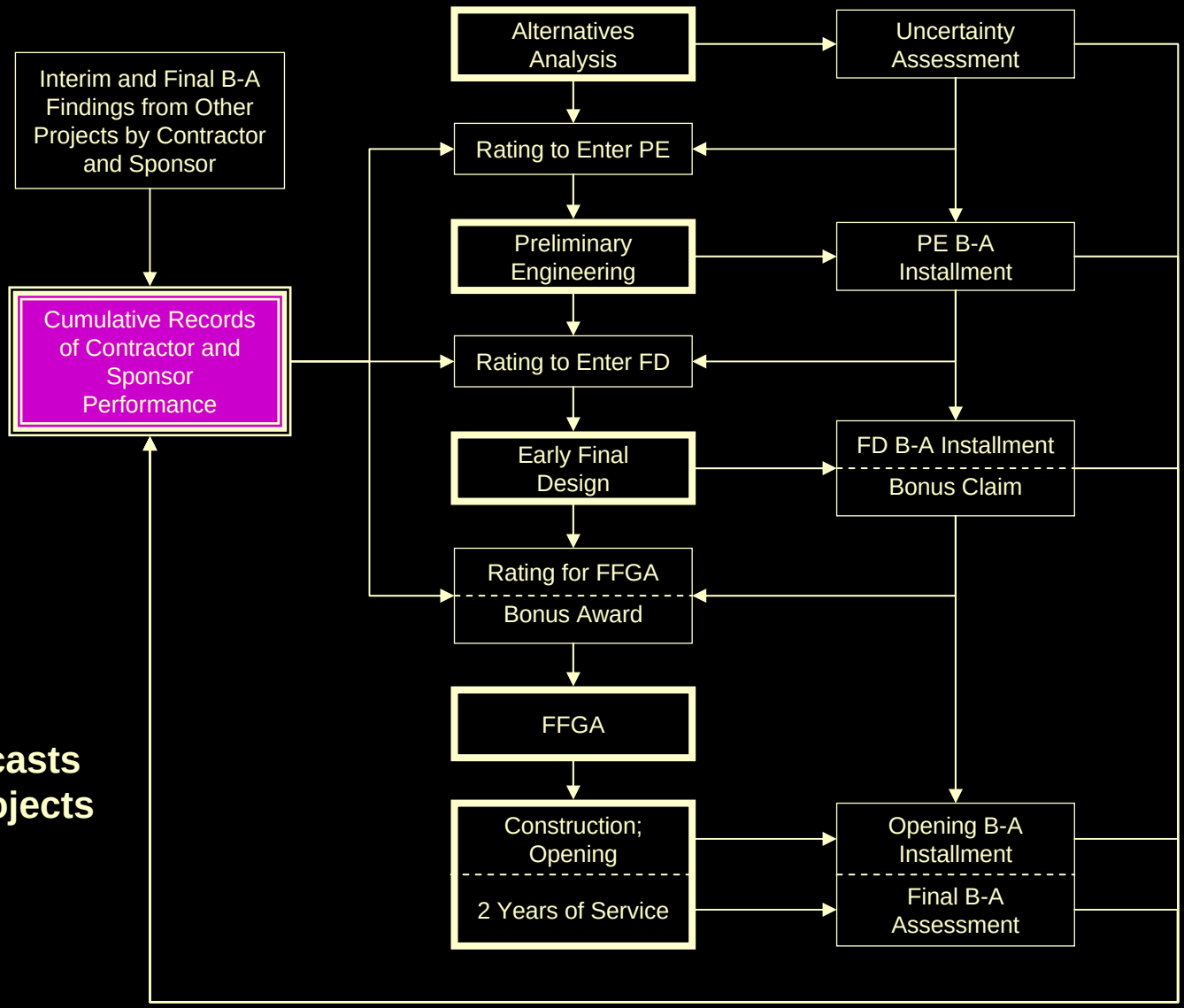
14 – Tracking the Accuracy of Transit Forecasts

- The requirement
- Principles
- Implementation

Requirement

- SAFETEA-LU
  - Track performance of contractors in making reliable forecasts of costs and ridership
  - Account for the various sources of errors in the forecasts

A Framework for Dealing with Uncertainty and Accuracy in Forecasts for New Starts Projects



Principles

- Accountability appropriate generally
  - Contractors producing travel forecasts
  - Others producing travel forecasts
  - Project sponsors managing technical work
  - Project sponsors defining context
  - MPOs maintaining forecasting capabilities
  - MPOs making demographic forecasts
- So, track all participants

Principles

- Incentives for good practice
  - Current project ratings affected by:
    - Performance on previous projects
    - Current efforts (data collection, model upgrades, peer reviews, etc.)
  - Performance evaluation based on broadened definition of a “forecast”

Principles

- Performance
  - High score: Actual ridership ~ predicted ridership
    - For the right reasons?
    - Impact of offsetting errors?
  - Good score: Actual ridership < predicted ridership
    - Cause(s) documented in uncertainty analysis
    - Magnitude of impact ~ documented range
  - Bad score: Actual ridership < predicted ridership
    - Uncertainty analysis silent on cause(s)
    - Or characterized causes as very unlikely

Questions

- General approach useful?
- Appropriate implementation?

15 – Properties of Travel Models for New Starts Forecasting

- General requirements
- Specific issues

Topics

- General requirements
  - Calibration and validation (next session)
  - Ability to support coherent case for project
- Specific issues

Problematic Characteristics of Transit Forecasting Methods

- Unusual coefficients in mode choice models
- Non-logit decision rules
- Bizarre alternative-specific constants
- Alt-specific constants for “new New Starts”
- Path / mode-choice inconsistencies
- Accuracy of bus running times
- Stability of highway-assignment results

Unusual Coefficients

- IVT coefficients for HBW trips
  - Most models: -0.030 < Civt < -0.020
  - Variations: -0.045 < Civt < -0.007
  - Concern: Is this a reflection of behavior?
  - FTA caution: some further analysis appropriate if Civt < -0.03 or Civt > -0.02
- IVTT coefficients for non-work trips
  - Civt for HNB trips ~ Civt for HBW trips
  - Civt for HBO trips ~ 0.1 to 0.5 x Civt HBW trips

Unusual Coefficients

- Large Covt/Civt ratios
  - Most models: 2.0 < Covt/Civt < 3.0
  - Variations: Covt/Civt as low as 0.25! as high as 16!
  - Concern: different ridership gain and user benefits per minute of OVT
  - Concern: behavior or estimation error or distortion?
  - FTA requirements: compelling evidence if 2.0 < Covt/Civt < 3.0

Unusual Coefficients

- Wide variations in LogSum coefficients
  - Problem
    - $0.7 < C_{LogSum} < 1.0 \approx$ multinomial logit
    - Many models with “asserted” (not estimated) C_{LogSum}
  - Concern: overstated impacts on new transit trips & benefits(?)

Non-Logit Decision Rules

- “Thresholds” and “cliffs”
- Rules invented to improve reasonableness of forecasts
- Have random and sometimes extremely undesirable (+ or -) impacts on ridership and user benefits

Non-Logit Decision Rules

- Example 1:
  - Rule: 3 minute IVT minimum on transit
  - Motivation: eliminate very short transit trips
  - Undesirable impact: If project reduces transit time for an important interchange from 4 minutes to 2.9 minutes in CBD:
    - Transit share may drop from 25% to 0%
    - Potentially large negative benefits

Non-Logit Decision Rules

- Example 2:
  - Rule: For drive-access trips, transit IVT must be greater than drive access time
  - Motivation: Eliminate unlikely drive access transit trips
  - Undesirable impact: If project adds attractive close-in parking lot, rule may be violated
    - Transit share may drop to 0%
    - Potentially large negative benefits

Non-Logit Decision Rules

- Example 3:
  - Inconsistent access-coding rules across transit modes – guideways vs. local buses
  - Differences between alternatives caused solely by differences in access limitations

Non-Logit Decision Rules

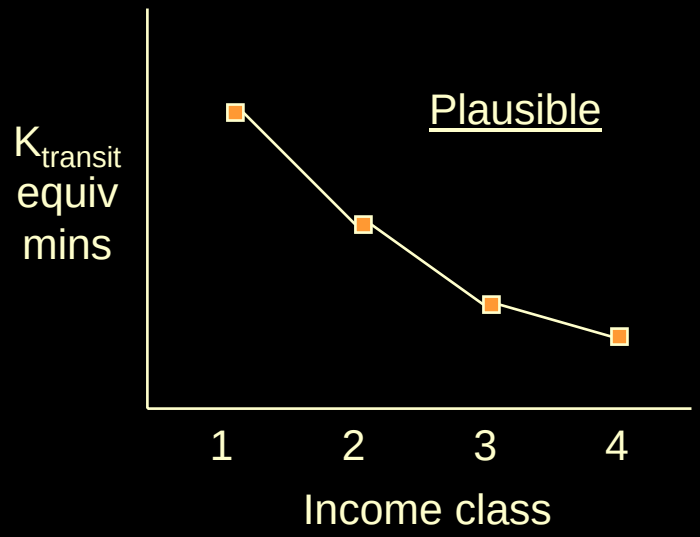
- Conclusions:
  - Use continuous functions in disutility equation rather than 0/1 tests
  - Same relationships in path builders
  - Accept some degree of model inaccuracy in lieu of over-defined model process
  - Consider how models will react in forecasting differences between alternatives

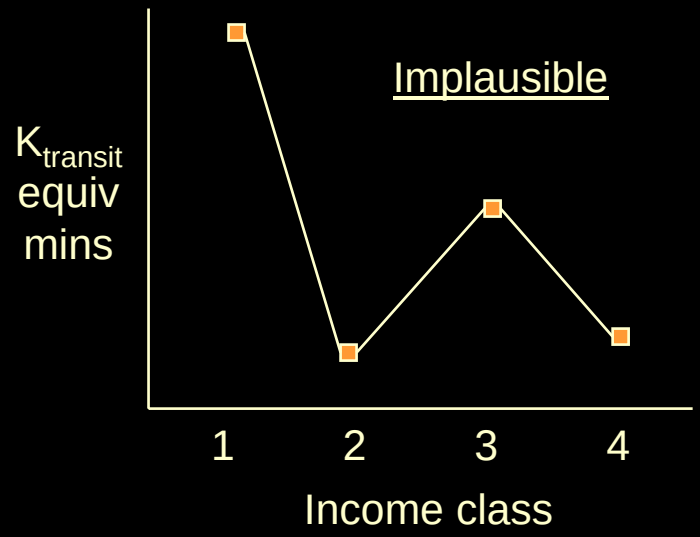
Bizarre Alternative-Specific Constants

- Problem
  - Naïve calibration → bad constants
  - Bad constants → large bogus utility changes
  - Bogus delta utilities → errors in trips & benefits

Bizarre Alternative-Specific Constants

A test for dominance of trip-table errors over behavioral content of alternative-specific constants… Is the pattern explainable?





Bizarre Alternative-Specific Constants

- Better calibration strategy: less “precision”?
  - Class-specific targets only for mode & access choices
  - Aggregate targets for transit line-haul choice
- Practical advantages
  - Line-haul target-shares do not have to be correct
  - Bizarre line-haul constants less likely
- Behavioral improvement?
  - Avoids implication that different classes value differently the unincluded attributes of line-haul choices
  - Resulting errors in line-haul-by-class highlight likely distortions in person-trip tables by class

"New" New Starts

- Transit constants for "new" New Starts
  - Some current systems inadequate to support calibration of constants representing:
    - "full" TSM (drive access)
    - "build" alternatives (guideways)
  - Difficulties with two common approaches
    - Borrowing constants from other urban models
    - Stated preference methods
  - Some insights from the AARF/CTPP model
  - Best handled as source of uncertainty?

Path / Mode-Choice Consistency

- Conformance between parameters in:
  - Transit path selection
  - Mode choice utility expressions for transit choices
- Consequences of disagreement
  - “Better” paths may look worse to mode choice
  - Build alternatives may lose some trips and benefits

Networks and Speeds

- Level-of service estimates must:
  - Replicate current conditions reasonably well
  - Predict defensible deltas: today vs. future
  - Predict defensible deltas: across alternatives
- Potential problems
  - Highway & bus link speeds → <2 mph
  - Imbalance between development and arterial capacity

Summary: Requirements

- Models are tools to provide insights
- Performance requirement
  - Provide basis for coherent statements
  - Usefulness, not perfection

16 – Calibration and Validation

- New Starts “standards”
- Meaningful calibration
- Useful validation

FTA Standards

- Reasons for travel forecasts
  - Insights into problems and alternatives
  - Information for decisionmaking
- Performance requirements for models
  - Ability to support a coherent story
  - Absences of fatal flaws
  - Usefulness, but not perfection

FTA Standards

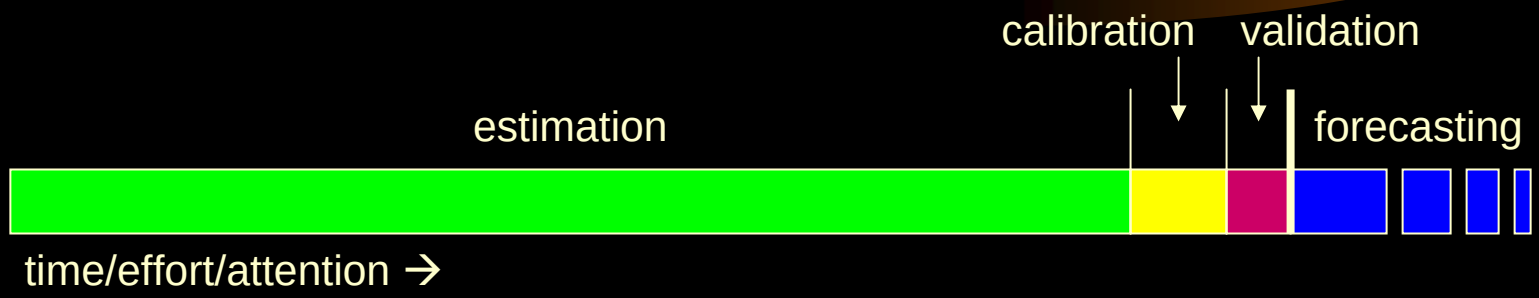
- Evidence of a useful model set
  - Previewed in its specifications
  - Revealed by its forecasts (today, future)
  - Judged by the coherence of insights, story
- Elements of the story
  - Current and future (No-Build) conditions
  - Performance of the alternatives
  - Sources of transportation benefits

FTA Standards

- Traditional model development
  - Estimation of “behavioral” model parameters
  - Calibration of model adjustments
  - Validation of model forecasts vs. “today”

Calibration and Validation

Traditional model development



Potential problems

-- too much effort on estimation; not enough on calibration, validation

-- insufficient data on important travel behaviors

-- calibration factoring and rules, rather than real corrections

-- inattention to properties of “calibrated” models

-- forecasting started too late to inform calibration

Calibration

- Data
  - Highway travel times
  - Transit travel times
  - CTPP 2000
  - Transit rider survey (controlled sample)
  - Household diary survey
- Calibration should exhaust the data sources

Calibration

- Highway speeds
- Travel-pattern models
  - Trip ends by sub-area
  - Trip tables (sub-area to sub-area, by class)
- Calibration of transit-specific models
  - Transit link speeds
  - Transit pathbuilding *(assignment of survey data!)*
  - Transit-mode choice
  - Transit volumes – lines, stations, and lots

Validation

- Coherence of travel behaviors implied by the model
- Reasonableness of predicted changes
  - Between today and the future
  - Between base and build alternatives

Documentation

- Calibration
  - Description of key current transit markets
  - Demonstration of model understanding
  - Discussion of limitations in forecasting
    - Unobserved behaviors
    - Effects embedded in constants, K-factors
- Validation
  - Coherence of model properties
  - Reasonableness of predicted changes

FTA "Standards"

- Implications for New Starts
  - Early discussion of specifications → less chance of later problems
  - Better calibration/validation → better support for unusual characteristics in forecasts
  - Weaker calibration/validation → less latitude in FTA acceptance of forecasts

17 – Methods for Transit Data Collection

- Motivations
- Scope
- Approaches

Motivations

- Understanding of current role of transit
  - Major functions, markets
  - Context, part of making the case
- Informing travel models about transit
  - Models' grasp of the major functions
  - Basis for ability to make useful forecasts
- Proposed regulatory requirement
- FTA-provided contractor assistance

Scope

- Relevant markets and transit services
- Sample size and distribution
- Sample control and expansion
- Necessary data items

Scope – Markets & Services

- Relevant markets and transit services
  - Nominally system-wide
  - Targeted corridors
    - Outlying commuter markets
    - CBD circulation markets

Scope – Sample Size

- Sample size and distribution
  - Less emphasis on line-level statistics
  - More attention to important travel markets
  - Sufficient sample to support tabulations by:
    - Geography: district-to-district flows
    - Socio-economic characterstic(s)
    - Transit line-haul modes
    - Access modes

Scope – Sample Control

- Sample control and expansion
  - Sampling plan
    - Dealing with sampling error
    - Controlling for non-response biases
  - Counts!
    - Stations
    - Access modes
    - Automated sources

Scope – Data Items

Necessary data items	Optional data items
Trip origin and destination (O&D)	First boarding (on) location
Activity purposes at the origin & destination	Last alighting (off) location
Trip access and egress modes (O&D)	Fare payment method
Park/ride location	Frequency of transit use
All transit lines used for the trip	Other household characteristics
Driver's license (or ability to drive)	Other personal characteristics
Household vehicles	Satisfaction with service
Household workers	
----- subject to revision -----	

Approaches

- Surveys of Riders
  - On-board
  - At stop
  - Park-ride lots
- Counts
  - Boardings
  - Parking lot occupancy
- Other
  - On-time performance
  - Financial
  - Fare-box data

Surveys of Riders

- Information to be gathered
  - Rider characteristics
  - Characteristics of rider's household
  - Trip characteristics
    - Purpose
    - Origin/destination
    - Modes of access/egress
    - Frequency of trip

On-board Surveys

- Must be coordinated with counts to permit expansion
- Self-administered
  - Response bias
  - Incorrect information
  - Largest sample (distributed, maybe not returned)
- Interviews
  - Smaller sample
  - Difficulty with short trips
  - More accurate information

Approaches to dealing with multiple trip problem

- Surveying travel in only one direction (e.g. inbound)
- Surveying travel only during a portion of the day (e.g. start-of-service until 2 PM) and assuming travel symmetry
- Asking riders if they were previously surveyed or if they will make a return trip.
- Asking riders to complete a survey on all trips and trip segments.

At-stop Surveys

- Consider for projects with “stations”
- Requires interviewers

Park-ride Lots

- Windshield mail-back
- Interviews

Counts

- Boardings by stop or station
- Departures by stop or station
- Persons on-board by link or segment
- Vehicles in parking lots

Other Data Types and Sources

- On-time performance
  - Of interest for certain types of projects (e.g. BRT)
  - AVL systems may be used if available
- Financial data
  - Revenues achieved
- Farebox data
  - Boardings by payment type (buses)
  - Boardings by day of week and time of day

Information to Be Gathered

- Definition of markets
  - Who is riding and for what purposes?
- Analysis of travel demand models
  - Identify independent variables in models
  - Collect these data

18 – Preservation and Analysis of New Starts Travel Forecasts

- Motivations and objectives
- Preservation
- Before-After / Predicted-Actual Studies

Motivations

- Before-After Studies
  - Required since the 2001 New Starts rule
  - Include comparison of forecasts with actuals
- Tracking of “contractor” performance
  - SAFETEA-LU
  - Includes identification of sources of error
- FTA Predicted-Actual study: few records!

Preservation

- Milestones
  - Entry into preliminary engineering
  - Entry into final design (and FFGA?)
- Forecasts for build & baseline alternatives
- Preservation of insights
  - Dangers of postponing analysis until “after”
  - So, analysis of changes at milestones

Preservation

- Possible approaches
  - Preserve the numbers only
    - Save files (zone attributes, trip tables, etc.)
    - Rely on forensics to understand changes, errors
    - Challenges in allocating causes of errors
  - Preserve ability to recreate the forecasts ✓
    - Networks, models, reporting tools
    - Much better platform for isolating causes
    - Challenges with software, hardware, zones, etc.

Preservation

- Providing continuity
  - Project sponsors responsible for B&A study
  - Consultants or MPO often prepare the forecasts
- Preservation as a wrap-up task in forecasting
- Active FTA role in preservation
  - Back-up plan for sponsor & contractor archives
  - FTA contractor: obtain, test, and archive
    - Ability to replicate forecasts
    - Analysis of changes in forecasts since previous milestone

Implementation

- Before-After Studies
  - Since 2001
- Preservation and analysis at milestones
  - 2006 “Policy Guidance”
- Applicability
  - Projects without FFGAs by guidance date
  - Projects entering PE after guidance date

Barriers?

- Challenges?
  - Software and hardware?
  - Changes in zone systems?
  - Others?
- What should FTA be doing to help?