Transit Model Executive Summary Workshop

FDOT District IV Auditorium

June 9th-10th, 2010

- ***Session 1: Welcome and Overview***

Workshop Agenda

- Tuesday, June 9th (1:00 PM – 5:00 PM)
  - Welcome and Overview
  - Transit Project Development and Modeling
- Wednesday, June 10th (8:30 AM – 12:00 PM)
  - Basic Transit Terminology
  - Concepts of Transit Modeling
  - Transit Modeling
  - Transit Service and Ridership Data for Modeling
  - Wrap-up

Purpose & Motivations

- Purpose
  - Become familiar with the process of transit demand forecasting and transit modeling
  - Understand the New Starts technical process
  - Offer some suggestions to improve common modeling-related issues in transit projects
  - Become familiar with non-SERPM tools
- Motivations
  - New regional emphasis on multi-modal and transit solutions
  - FRA high-speed rail award

Participants

- Show of hands…
  - FDOT
  - Transit agencies
  - Metropolitan planning organizations
  - Local governments
  - Consultants
  - Other
- Show of hands…
  - Lots transit planning experience
  - Some transit planning experience
  - Almost no transit planning experience
  - What is transit?

- ***Session 2: Transit Project Development***
  - ***FTA's Section 5309 program***
  - ***Transit project development process overview***
  - ***Modeling within FTA's Section 5309 program***
  - ***Lessons learned***
  - ***Example projects***

49 USC § 5309 Capital Investment Grants Program ("New Starts")

- The federal government's primary vehicle for funding major capital fixed-guideway transit projects (effectively began in 1976)
- Policy adjustments made during surface transportation reauthorization bills
- Closely watched by transportation policy organizations/advocates
- Administered by the Federal Transit Administration
- **Discretionary, not programmatic**
- **Projects continuously evaluated**

49 USC § 5309 Capital Investment Grants Program ("New Starts")

- Demand (as of September 2009):
  - 18 Full Funding Grant Agreements
  - 19 New Starts projects in PE and Final Design
  - 21 Small Starts projects in PD
  - Total cost of pipeline: >$24.7 billion, $10.5 billion in New Starts funding
  - FTA tracking >100 planning studies considering major transit capital investments
- Annual funding
  - New Starts: $1.4+ billion
  - Small Starts: $200 million

An Important Note…

- Today's discussions regarding the New Starts program reflect existing conditions and guidelines
- Some changes may in coming in the future…
  - FTA released an ANPRM regarding New Starts last week (http://edocket.access.gpo.gov/2010/pdf/2010-13423.pdf, announcement here: http://fta.dot.gov/news/news_events_11721.html)
  - Industry "listening sessions", formal FTA comments, and NPRM follow (reauthorization?)
  - It is not possible to guess what changes may occur in the process – or when they might occur (2 years?)
- …but reliable estimates of ridership and mobility benefits (key modeling outputs) are still needed

§ 5309 Project Eligibility

- "New Starts"
  - New fixed-guideway capital project or extension
  - Capital cost $250+ million or $75+ million federal share
  - Fixed-guideway rail, separate ROW for public transportation or high-occupancy vehicles, or overhead power supply
  - Rail, automated guideway transit, people moves, exclusive facilities for bus/BRT
- "Small Starts"
  - Capital cost <$250 million with <$75 million Small Starts share
  - Fixed-guideway for 50+% of project length in peak period, or
  - Non-fixed-guideway project in a corridor with 10 pk/15 op headways & operating 14 hours/weekday and including at least 3 of the following elements:
    - Significant transit stations
    - Traffic signal priority/pre-emption (if signals along corridor)
    - Low-floor vehicles or level boarding
    - Premium service branding

§ 5309 Project Eligibility

- "Very Small Starts" – Subcategory under Small Starts
  - Small Starts cost and scope criteria plus:
    - Capital cost <$50 million
    - Capital cost <$3 million/mile, excluding rolling stock
    - 3,000 existing riders/weekday that will benefit from the project
- "Exempt"
  - Asking for <$25 million federal share
  - Exempt from project evaluation and rating process
  - Exists "only until a new rule is published"

FTA Analyses & Evaluation
Key Attributes

- Mode-neutral
- Ensures a "level-playing field" across all projects from around the country
- Information must usefully represent the project costs/benefits

- Projects accepted into PE/PD are worthy of funding
- FTA recommends funding for investment-worthy projects

Project Information to be Submitted for Project Rating – *Varies by Project Cost*

- Project description template
- Make the Case document
- Certification of technical methods & planning assumptions
- Documentation of existing, benefiting transit riders in corridor (VSS only)
- Project site map
- Vicinity map
- Capital costs by standard cost categories
- Annualized cost worksheets
- Summary of O&M cost production
- User benefit information
  - Forecasts
  - Thematic maps and legend
  - Summary of travel forecasts
- Mobility improvements and cost-effectiveness template
- Annualization factor justification
- Quantitative land use information template and supporting narrative, data and maps
- Evidence of economic development, congestion pricing and other project benefits
- Financial plan summary
- Financial submittal checklist
- 20-year capital operating plan (including 20-year cash flow)
- Evidence of agency financial condition
- Supporting financial documentation

Note: Smaller projects require a subset of this information

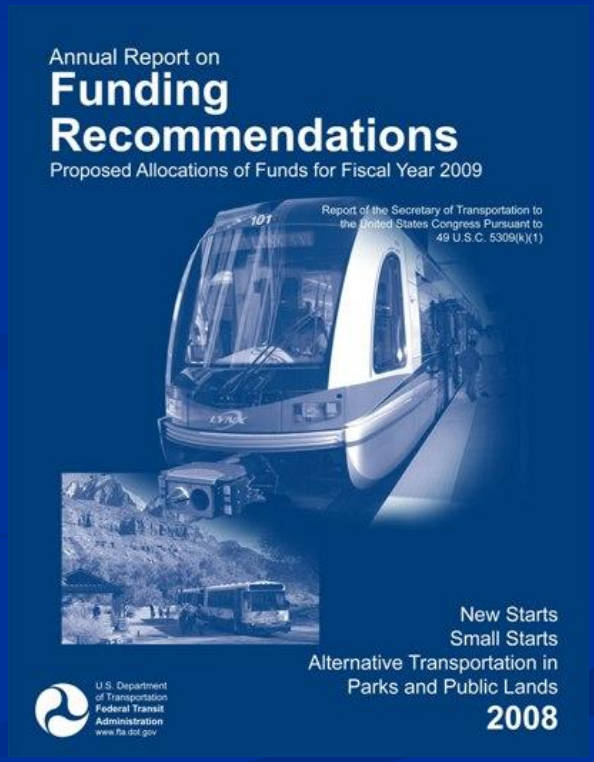
The New Starts "Pipeline"

- Any project seeking New Starts funds in AA or later phase
- A typical yearly process (continual):

Item	Year	Season
New Starts Reporting guidance from FTA	1	Spring
Sponsor completes/submits updated information to FTA	1	Summer-Fall
FTA review information submitted by sponsor	1-2	Fall-Winter
FTA delivers Annual Report (with funding recommendations) to Congress for FY 3 budget	2	February
Congress approves FY 3 budget	2	October

Project Evaluation & Rating

- Congress requires FTA to rate projects for project advancement decisions and funding recommendations
  - Projects evaluated by FTA throughout project
  - Sponsors submit project information to FTA, which uses it to rate the project
  - Ratings are submitted to Congress each year
- FTA approval required to enter PE, FD and establish FFGA



FTA New Starts Project Ratings

- **Are among the most rigorous ratings in government, and important to Congress and local communities**

- Three major ratings: overall, project justification and local financial commitment
  - Each can be High, Medium-High, Medium, Medium-Low or Low
  - Overall project rating is the average of the project justification and local financial commitment ratings
  - Medium overall rating requires at least:
    - Medium project justification rating, and
    - Medium local financial commitment rating
  - If project justification or local financial commitment are Low, the overall rating will be Low

Project Evaluation & Ratings

- Project justification criteria
  - Cost-effectiveness
  - Mobility improvements
  - Operating efficiencies
  - Economic development effects
  - Public transit supportive land use policies and future patterns
  - Environmental benefits
- Local financial commitment criteria
  - The strength of the proposed capital funding plan
  - The strength of the proposed operating funding plan
  - The proposed share of total project costs from sources other than 5309 funding

These criteria use direct model results

These also use model results

- ***All criteria are rated!***

Criteria Weights

	New Starts	Small Starts	VSS	Exempt
Project Justification				
Cost-effectiveness	20%	33%	Medium	Exempt
Mobility improvements	20%			
Operating efficiencies	10%			
Economic development	20%	33%		
Land use	20%	33%		
Environmental benefits	10%			
Financial Commitment				
Capital funding plan	50%	Medium (subject to conditions)	Medium (subject to conditions)	Exempt
Operating funding plan	30%			
Federal share	20%			

Cost-Effectiveness

- Incremental cost per hour of user benefits
- Defined as (A+B) / C, where
  - A = Δ Annualized capital costs (in base year $)
  - B = Δ Annual operating & maintenance costs (in base year $)
  - C = Annual project user benefits (Baseline vs. Build) *[Baseline is an upcoming topic]*
- Δ costs = Build – Baseline costs

Cost-Effectiveness Example

	Baseline	Build	Delta
Capital Costs (in mill$)	100	750	
Annualized Capital Costs (in mill$)	8	60	52
Operating & Maintenance Costs (in mill$)	4	7	3
Average weekday user benefits (hours)			6,000
Annualization factor			285.0
Annual user benefits (hours)			1,710,000
Cost-Effectiveness			$ 32.16

User Benefits

- Reflect the estimated mobility impacts of build project in terms of weighted travel time and costs
  - Current guidance essentially restricts user benefits to travel time savings in some situations
- Data generated by modeling process and FTA software
  - Baseline model run → Summit data file #1
  - Build mode run → Summit data file #2
  - Summit data file #1 + #2 → FTA Summit software → detailed project user benefits
  - Δ costs & project user benefits → cost-effectiveness → FTA rating
- User benefits are a major reason for the model properties required by FTA (upcoming topic)
  - User benefit reports make it easier to identify fundamental problems with models
  - Past 7 years' experience has highlighted many issues with traditional model development and testing

Cost-Effectiveness

FY 2011 Cost-Effectiveness Breakpoints

Rating	Value
High	Less than or equal to $12.49
Medium-High	Between $12.50 and $15.99
Medium	Between $16.00 and $24.99
Medium-Low	Between $25.00 and $30.99
Low	Greater than or equal to $31.00

Breakpoints between Low and Medium-Low based on:

- USDOT guidance on value of an hour of travel time (~$10/hour)
- 20% allowance for highway-congestion-relief benefits
- 100% allowance for indirect benefits

Mobility Improvements & Operating Efficiency

- Mobility Improvements (5 measures)
  - Number of transit trips using the project
  - User benefits per passenger mile on the project
  - Number of trips by transit dependents using the project
  - Transit dependent user benefits per passenger mile
  - Share of user benefits received by transit dependents compared to the share of transit dependents in the region
  - All 5 measures are generated by travel model
- Operating Efficiency
  - Change in system-wide operating cost per passenger-mile
  - Passenger-miles generated by travel model

Land Use, Economic Development & Environmental Benefits

- Land Use:
  - Transit supporting land use
- Economic Development
  - "FTA seeks well-reasoned, strongly-justified, and verifiable qualitative and quantitative explanations of the expected economic development benefits and outcomes of the…project"
  - Project benefits, not factors and conditions leading to favorable economic development
  - Revised/expanded measures under development
- Environmental Benefits
  - EPA air-quality designation
  - Revised/expanded measures under development

- Questions?

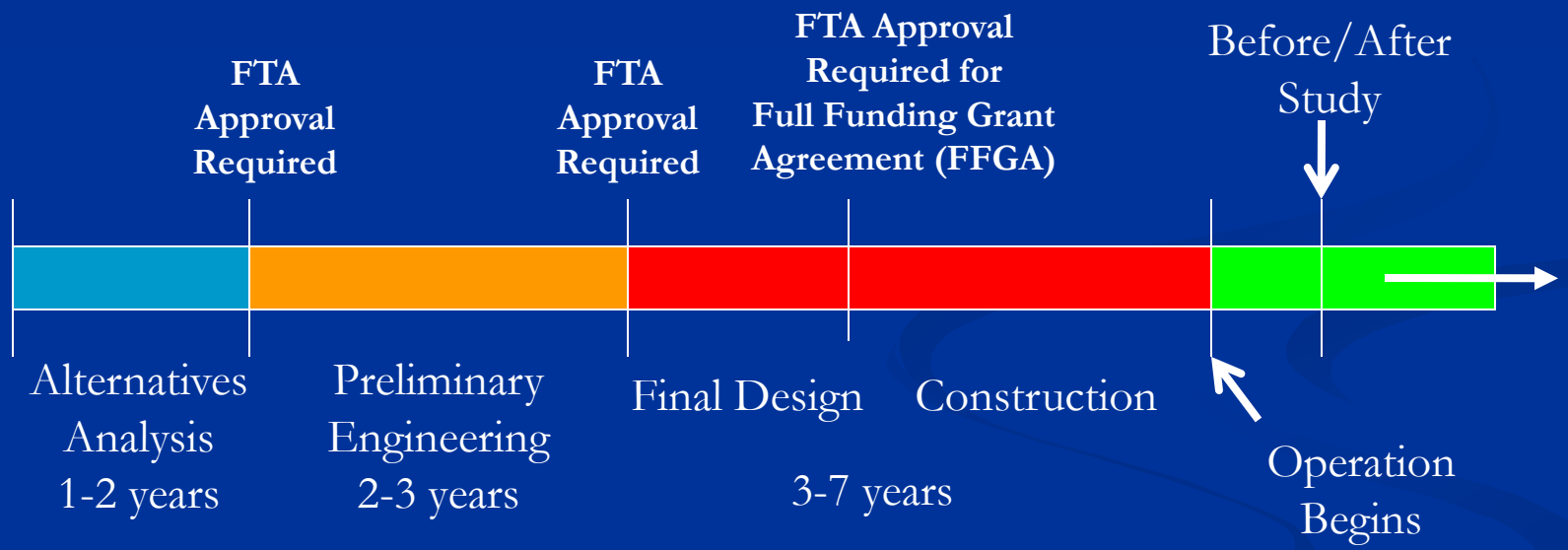
- ***Session 2: Transit Project Development***
  - ***FTA's Section 5309 program***
  - ***Transit project development process***
  - ***Modeling within FTA's Section 5309 program***
  - ***Lessons learned***
  - ***Example projects***

Project Development Process

- Definition: The planning, environmental and engineering steps taken to develop projects from ideas/visions to construction

- Efforts depend on funding source, but generally follow the Section 5309 process…

New Starts Project Development



Transit Project Development Process
Section 5309 Funding

Phase	Purpose(s)
Systems Planning	Determine needs, policies and prioritize corridors
Alternatives Analysis *	Determine corridor mode, general alignment and financial plan
Environmental Review (NEPA)	Document environmental impacts of project and allow for public comment
Preliminary Engineering *	Refinements to LPA, refine scope and cost, complete environmental analysis, initiate financial commitments
Final Design *	Finalize scope and cost
Full-Funding Grant Agreement **	Establish terms and conditions for federal funding
Construction	Build project and test operations
Before/After Analysis **	Review predicted/actual scope, costs, service levels and opening year

* - involves direct FTA coordination (AA at local discretion)

** - involves direct FTA coordination and would only occur with Section 5309 funds

Transit Project Development Process
Potential Timeframes

Phase	Length
Systems Planning	Performed on a continual basis by MPOs
Alternatives Analysis	1 – 2 years
Environmental Review (NEPA)	2 – 5 years
Preliminary Engineering	2 – 3 years
Final Design	1 – 2 years
Full-Funding Grant Agreement	<1 year
Construction	2 – 5 years
Before/After Analysis	~ 1 year (preservation begins with entry to PE; analysis not initiated until two years after project opening)

Timeframes shown here are "averages" based on experience and not definitive. Actual timeframes heavily depend on project scope and environmental challenges.

Transit Project Development Process

Costs from "Average" Corridors

Phase	Costs from "Average" Corridors
Systems Planning	Performed on a continual basis by MPOs
Alternatives Analysis	$1-3 million (and higher)
Environmental Review (NEPA)	$2-6 million
Preliminary Engineering	$2-7 million (and higher)
Final Design	Varies widely
Full-Funding Grant Agreement	Minimal beyond local financial commitment
Construction (Capital costs)	Vary widely ($3 million/mile through $100+ million/mile)
Before/After Analysis	<$1 million

Costs shown here are "averages" based on experience and not definitive. Actual costs heavily depend on project scope and environmental challenges.

Alternatives Analysis (AA)

- A focused look at alternatives at the corridor-level resulting in a decision on mode and alignment
- For New/Small Starts:
  - Identify problems, goal, objectives and purpose & need
  - Identify alternatives
  - Forecast costs, benefits and other impacts
  - Evaluate alternatives
- For Very Small Starts:
  - Develop basic information
  - Provide implementation plan

Alternatives

- Motivations
  - Comparisons lead to insights and answer questions
  - Options for decision-makers
  - New Starts requirements
  - NEPA requirements

- Four Types of Alternatives
  - No Build(s), TSM(s), Baseline, Build Options

No-Build Alternative

- Purposes
  - To meet a NEPA requirement
  - To help define the problem
  - To identify the consequences of doing nothing
  - To establish a starting point for evaluating the benefits and costs of other alternatives

- **Not a do-nothing alternative!** (see next slide)

No-Build Alternative

- Potential definitions
  - Inside the corridor…
    - Maintenance of existing facilities and services, or
    - Completion and maintenance of committed projects, or
    - Continuation of existing policies
  - Outside the corridor…
    - Committed improvements only; or
    - Improvements in the MPO's fiscally constrained plan (difficult for 1st line of a system)

Transportation Systems Management (TSM)

- An alternative that reflects the best that can be done without a guideway investment (can be costly)

- Purposes
  - A fallback alternative(s) in case resources for major investment are not found
  - A first phase of market-development program leading to major investment
  - Providing a baseline for isolating the added benefits and costs of a major investment

Transportation Systems Management
Characteristics

- Cost-effective alternative:
  - TSM/No-build cost-effectiveness better than Build/TSM cost-effectiveness
- Reflects settled service policies for the corridor
- Is not constrained by arbitrary funding limits
- Responds to corridor problems and needs

Transportation Systems Management
Typical Elements

- More frequent service
- Skip stop and express service
- Park and ride lots
- Traffic signal priority
- Queue jumper lanes
- Timed transfers
- Traffic operations (signal timing, bottleneck relief)
- Passenger facilities
- Rider information
- FTA expectation: TSM is a Very Small Starts project where appropriate

Baseline Alternative

- Baseline for New Starts evaluation and rating
  - Usually the TSM alternative
  - Infrequently the No Build alternative, where:
    - No Build is a solid TSM alternative, or
    - TSM is technically infeasible
  - TSM + major highway project(s) that are part of a multimodal preferred alterative
- Essential function of the baseline is to show the benefits of the major transit capital investment

Baseline Alternative "Rules"

- The New/Small Starts project and the New Starts Baseline should be consistent with each other, and each should be optimized to represent its transit technology in the most favorable way
- Underlying assumptions should be identical for both the Build and Baseline:
  - Land use and development
  - Parking availability and cost
  - Fare levels
  - Vehicle loading standings
  - Highway networks
  - Other elements
- FTA needs to approve baseline in AA phase

Baseline Alternative "Rules"
Implication

- Baseline and Build both defined to solve the same transportation problems
  - Project benefits are much smaller Build-Baseline than Build-No Build → can be challenging to reach "medium" cost-effectiveness

Preliminary Engineering (PE)

- The process of refining the definition of the LPA's scope, schedule, and budget sufficient to complete the Federal environmental review process required by the *National Environmental Policy Act of 1969* (NEPA)
- Begins with approved FTA request into PE
  - First data point for Before/After Study → ideally no future changes in ridership forecasts beyond project scope
- Ends with approved FTA request into FD

Final Design (FD)

- The process of preparing for construction
  - Executing various project management and delivery strategies to ensure successful completion of project construction
  - Finalizing project definition, property acquisition, third party agreement negotiations, procurement of construction services and equipment, and securing all non-New Starts funding commitments
  - Negotiating a full funding grant agreement.
- Begins with approved FTA request into FD
- Ends with signed Full Funding Grant Agreement

Full Funding/Project Construction Grant Agreement

- A multi-year contractual agreement that formally establishes the maximum level of Federal financial assistance and outlines the terms and conditions of Federal participation.
- New Starts: FFGA, Small Starts: PCGA

- Defines:
  - Project, including cost, scope, and schedule;
  - The maximum level of New Starts or Small Starts financial assistance (subject to appropriation);
  - The terms and conditions of Federal financial participation; and
  - The period of time for completion of the project

Before/After Study

- Requirements specified in FFGA/PCGA
- Purposes:
  - To expand insights into the costs and impacts of major transit investments; and
  - To improve the technical methods and procedures used in the planning and development of those investments
- Motivation:
  - Identify and transfer the lessons learned in planning, implementing, and operating transit fixed guideway investments to agencies planning similar projects
  - Basis for contractor ratings

Before/After Study

- Examine five key opening year project characteristics:
  - Physical scope;
  - Service levels;
  - Capital costs;
  - Operation and maintenance (O&M) costs; and
  - ridership and revenues.
- These characteristics – at PE, FD, and FFGA entry timepoints – must be preserved during construction and are compared to those eventually experienced in actual system

New Starts Observations & Experiences

- This is a long, involved process!
- Organizational conflicts exist at times between HQ offices and between HQ and regions
- Some FTA common comments
  - Florida's New Starts track record (more later)
  - Not bringing one corridor forward at a time into PE
  - Not including FTA criteria in AA phase and/or presenting it to the public
  - Not looking at the viability of local bus as a potential solution

- Questions?

- ***Session 2: Transit Project Development***
  - ***FTA's Section 5309 program***
  - ***Transit project development process***
  - ***Modeling within FTA's Section 5309 program***
  - ***Lessons learned***
  - ***Example projects***

Modeling & the New Starts Process

- FTA focuses on the forecasts from models and modeling approaches
  - They approve forecasts, not models!
  - But some models have properties that will produce unreliable New Starts forecasts
  - Therefore FTA scrutinizes the technical tools used to generate ridership and user benefits very carefully
- FTA looks for insights from these forecasts
  - Nature of the problem and reasonable alternatives
  - Alternatives' impacts on transit service and ridership
  - Transportation benefits and their consequences

Certification of Technical Methods & Planning Assumptions

Regardless of Selected Modeling Approach

As Chief Executive Officer of _____, I understand that FTA's Reporting Instructions for Section 5309 New Starts Criteria, dated July 2009, establish common conventions for the development of information on proposed New Starts projects that are crucial to the fair and evenhanded evaluation of projects. These conventions include:

•1. The horizon year used for the travel forecasts is 2030.

•2. The ridership forecasts are based on a single set of projections and policies consistent with the regional transportation plan and are held constant for the preparation of travel forecasts for the New Starts Baseline and New Starts Build alternatives, including:

•land use, demographics, socio-economic characteristics, and travel patterns;

•the highway network, except as modified for changes inherent to the Build alternative (such as the conversion of traffic lanes to transit-only rights-of-way);

•transit service policies regarding geographic coverage, span of service, and headways, modified where necessary to integrate transit guideways into the bus system;

•pricing policies (fares, highway tolls, and parking costs); and

•transit capacity provided given projected transit volumes, productivity standards, and loading standards.

•3. The travel models used to prepare the forecasts have been developed and tested with the best available data on current conditions in the urban area, including:

•Highway speed data collected in the year ____;

•Transit travel-time data collected in ____;

•Home-interview/travel-diary data collected in ____; and

•Transit on-board survey data collected in ____.

•4. Except for the impacts of physical changes introduced by the alternatives themselves, the performance of the highway and transit systems is held constant between the New Starts Baseline and New Starts Build alternatives, including:

•highway congestion levels;

•transit operating speeds in mixed traffic; and

•maximum access and egress distances to/from transit services, as well as representations of walking, waiting, and transfer times.

•5. Transit-mode-specific constants describing the unmeasurable attributes of individual modes are either the same across all transit line-haul modes or are derived from ridership experience on existing transit modes in the metropolitan area, and have magnitudes that are within acceptable ranges as reviewed and approved by FTA.

•6. Service levels in both the New Starts Baseline and New Starts Build alternatives have been adjusted to meet projected ridership levels using consistent vehicle-loading standards.

•7. The forecasts of ridership and transportation benefits have been subjected to quality-assurance reviews designed to identify and correct large errors that would threaten the usefulness of the information in project evaluation.

•8. The forecast of ridership using park/ride access to an individual transit stop/station does not exceed the capacity of the associated park/ride lot as reported in the current planning and/or environmental documents for the alternatives.

•11. Opening-year forecasts for the New Starts Build alternative are based on the same methodology as the out-year forecasts and are presented without adjustment.

•12. The definitions of the New Starts Baseline and New Starts Build alternatives are up-to-date, include all items known to be part of the proposed scopes, and specifically identify any remaining sources of uncertainty in the scope of the project.

•13. The capital cost estimates for the New Starts Baseline and New Starts Build alternatives are up-to-date, are based on unit costs that apply to expected conditions during construction, and specifically identify remaining uncertainties in those unit costs.

•14. Estimates of operating and maintenance costs for the New Starts Baseline and New Starts Build alternatives are based on current local experience, are adjusted for differences in vehicle and service characteristics, and for any transit modes new to the system, are consistent with experience in similar settings elsewhere. All cost components are variable, not fixed. Costs vary with changes in service levels.

•15. Annualization factors used to convert daily ridership and operating/maintenance costs into yearly totals are consistent with local experience and are the same for the New Starts Baseline and New Starts Build alternatives.

•16. The capital cost estimates are presented in 2009 base year dollars as well as YOE$.

•17. The financial plan has been updated with information from the most recent budget cycle.

•18. Any financing costs incurred because of the project have been included in the total project cost as required by FTA, regardless of whether the project sponsor is seeking reimbursement of the costs from New Starts funds.

•19. The full cost of preliminary engineering and final design has been included in the total project cost as required by FTA.

Therefore, I hereby certify that _____ (agency) has followed FTA's *Reporting Instructions for Section 5309 New Starts Criteria* (July 2009) in general, and the above-listed conventions in particular, in the preparation of this submission except for item(s) _____ that _____ (agency) has discussed with FTA and that FTA has approved.

_____

_____ _____

_____

Chief Executive Officer Date

FTA New Starts Model Requirements

1. Grasp the current transit situation
   - Quality data required for this (transit onboard surveys and other data collection methods)
   - Calibrated, validated and tested in a New Starts sense
2. Provide plausible forecasts for alternatives
   - Differences between baseline/build explained by project attributes
3. Adequately support "making the case"
   - Provide the primary causes of changes and benefits and the main effects on principal markets
4. Quantify New Starts evaluation measures

Other FTA Model Attributes

- Consistent with good practice
- Well-tested and documented
  - Grasps key markets; not simply calibrated to aggregate numbers
- Mindful of new behaviors
  - Reacts properly to changes between existing and future conditions, or between baseline and build services

Potential Technical Tools

- Traditional urban models (standard or complex)
  - SERPM 6.0/6.5/6.6A
- Simplified approaches
  - Incremental versions of model sets
  - Simplified models
  - Calculations of travel time savings

Not SERPM!

Example of Simplified Approach:
Fitchburg Commuter Rail

AM PEAK

B A C E D E

Station	Inbound Run Time, Existing (min)	Inbound Run Time, Build (min)	Travel Time Savings (min)	Existing AM Riders	Opening Year AM Riders	Person Hours Saved	New AM Riders (.6 elasticity)	New Riders Hours Saved	User Benefits New & Existing Riders
Fitchburg	88.8	79.2	9.6	308	314	50.19	20	1.63	51.82
North Leominster	81.6	72	9.6	285	290	46.47	21	1.64	48.11
Shirley	73.8	64.2	9.6	124	127	20.26	10	0.79	21.05
Ayer	66.6	58.2	8.4	259	264	37.02	20	1.40	38.42
Littleton	57.6	51	6.6	135	138	15.15	9	0.52	15.67
South Acton	49.8	45.6	4.2	625	637	44.62	32	1.13	45.74
West Concord	46.2	42.6	3.6	331	338	20.27	16	0.47	20.75
Concord	42	39	3	310	316	15.79	14	0.34	16.13
Lincoln	36.6	33.6	3	241	246	12.29	12	0.30	12.59
Silver Hill	34.2	33	1.2	30	31	0.61	1	0.01	0.62
Hastings	32.4	30.6	1.8	54	55	1.64	2	0.03	1.67
Kendall Green	30.6	28.8	1.8	153	156	4.69	6	0.08	4.77
Brandeis/Roberts	25.8	24.6	1.2	299	305	6.11	9	0.09	6.19
Waltham	22.8	21	1.8	374	382	11.46	18	0.27	11.73
Waverly	17.4	16.8	0.6	76	77	0.77	2	0.01	0.78
Belmont	14.4	14.4	0	104	106	0.00	0	0.00	0.00
Porter Square	9	8.4	0.6	23	24	0.24	1	0.00	0.24
North Station	0	0	0	0	0	0.00	0	0.00	0.00
				3,730	**3,805**	287.56	**191**	8.71	**296.27**

Conditions that Favor Certain Modeling Approaches

- Simplified approaches
  - Existing and mature transit market
  - Relative minor service upgrades (in scope and/or cost)
  - Cost-effectiveness easily proven with existing riders
- Traditional urban models
  - New transit mode or type of service
  - Major investment or service upgrade
  - New markets needed to justify project
    - Long-term population and/or employment growth
    - New transit markets

- ***Common modeling-related problems that arise during the New Starts process…***

Some New Starts/Transit Problems Related to Modeling …

- Not reviewing travel model to see if it adequately reflects transportation system and travel markets (or reviewing for the first time during planning process)
- Assuming travel model validated for LRTP purposes can be used "out of the box" for AA process
- Not considering alternative approaches to regional travel model
- Lack of data to properly evaluate/inform model
- Little/no coordination with FTA regarding baseline alternative and technical tools
- Constrictive or rigid schedules that for little/no review of model forecasts and outputs

Implications of Modeling Problems

- If modeling problems not identified during planning process & project is constructed:
  - Inadequate market insights →
    Inadequate models → Unreliable forecasts →
    Uninformed decisions → Poor track record
- If modeling problems identified & addressed late in planning process:
  - Project delays in addressing model issues → New forecasts →
    Change in recommended decision →
    Unhappy decision makers and public
- If modeling problems identified & addressed early or before planning process:
  - No/minimal delays in addressing model issues →
    One set of reliable forecasts →
    Informed decision

- ***Potential solutions to avoid these modeling problems…***

Potential Solution #1

- Decide on technical tools to use before AA RFP
  - Key drivers: existing markets, project scope & funding source
  - Not always regional travel model!
    - Smaller capital cost → simplified methods?
    - Mature existing market → simplified methods?
  - Coordinate with FTA with recommended decision

Potential Solution #2

- Assess model readiness and data availability for the project before AA RFP
  - The model must adequately reflects the transportation system and how people use it and grasp the key travel markets/characteristics related to the project
  - Travel models prepared for LRTP analyses are not ready "off the shelf" as they require additional time to fully test and be reviewed by FTA
  - Simplified methods usually require new data collection
- Develop a plan to construct/enhance model and collect relevant data
- Meet with FTA to review model assessment and technical plan

Potential Solution #3

- Coordinate with FTA throughout AA process…
  - To help FTA understand problem, alternatives, LPA
  - To locate and fix potential problems
  - To avoid re-work and unexpectedly delays not addressed before request for entry into PE
- Some opportunity points:
  - Scope of AA work
  - AA initiation package (required)
  - Technical framework/approach
  - TSM definition
  - Technical results (preliminary and final)
  - Final report (required)

Potential Solution #4

- Within the project schedule, allow for extensive review of insights from model outputs
  - Nature of the problem(s) for specific travel markets
  - Ability of the alternatives to improve transit service
  - Ridership response for specific travel markets
  - Benefits accruing to those markets and others

One Suggested Process to Manage Modeling…

- Assess likely funding source/type to determine best modeling approach
- Develop/review model approach to see if it adequately reflects key markets and characteristics
- If needed, develop plan to construct/enhance model
- Coordinate with FTA early and often throughout AA…
  - To review model assessment and construction/enhancement plan
  - To review finished model & review TSM
  - To review preliminary forecasts (prior to LPA)
  - Throughout project to address project, model changes as needed

Lessons Learned

- An understanding of project problems and benefits →
  Requires an understand existing travel markets →
  Requires good model → Extensive model testing →
  Requires good data → Time!
- Data collection takes time
  - Procurement , fieldwork , initial processing, model-related processing, incorporation to model and model testing
- Provide for direct communication between data collection and modeling staff/consultants
- Be aware of tension between project sponsors and FTA
  - Local vs. New Starts values, priorities and decision-making
- Some model inputs are outside immediate control
  - Population/employment forecasts → MPO
  - Survey/data collection quality → Data collection companies

- ***Model and data assessments for example projects…***

Example Corridor Projects

1. Arterial bus improvement along heavily-used local bus route


3105
909

Project #1 Pre-Project Assessment (1 of 3)

Project Characteristic	Best-Guess Assessment
Study area	8-miles along major east-west arterial Termini: major shopping malls Major attractions: community college, office complex
Transportation services	Major east-west arterial connects with two north-south freeways One heavily-used bus route with connections to other routes at the shopping malls
Transportation problem(s)	Auto congestion and long bus dwells making auto and bus travel unreliable
Travel market(s)	

Project #1 Pre-Project Assessment (2 of 3)

Project Characteristic	Best-Guess Assessment
Likely alternatives	
Likely funding needs, sources	
Model investigation	
Data investigation	

Project #1 Pre-Project Assessment (3 of 3)

Project Characteristic	Best-Guess Assessment
Model assessment	
Data assessment	
Initial action plan	

Example Corridor Projects

1. Arterial BRT improvement along heavily-used local bus route

2. Suburban circulator system


HOTELS

Project #2 Pre-Project Assessment (1 of 3)

Project Characteristic	Best-Guess Assessment
Study area	Suburban employment complex and immediate area
Existing transportation services	Confluence of two freeways and major arterial Modest express bus service from outlying suburban area
Transportation problem(s)	Need to provide intra-area circulation: Constraints on future parking availability Transit riders have long walk to many employers Daytime intra-area trips very inconvenient due to pedestrian/car conflicts Need to spur economic development
Travel market(s)	n

Project #2 Pre-Project Assessment (2 of 3)

Project Characteristic	Best-Guess Assessment
Likely alternatives	
Likely funding needs, sources	
Model investigation	
Data investigation	

Project #2 Pre-Project Assessment (3 of 3)

Project Characteristic	Best-Guess Assessment
Model assessment	
Data assessment	
Initial action plan	

Example Corridor Projects

1. Arterial BRT improvement along heavily-used local bus route

2. Suburban circulator system

3. Major capital corridor investment

Project #3 Pre-Project Assessment (1 of 3)

Project Characteristic	Best-Guess Assessment
Study area	20-mile freeway corridor adjacent to parallel railroad and major arterial Termini: another freeway and SR 999 (major arterial) Major attractions: downtown Springville, warehousing area
Transportation services	Major arterials about every 2-4 miles intersect with freeway Two express bus routes modestly used
Transportation problem(s)	Some freeway congestion today, major congestion expected in next 20-30 years Limited express bus services do not offer much alternative
Travel market(s)	

Project #3 Pre-Project Assessment (2 of 3)

Project Characteristic	Best-Guess Assessment
Likely alternatives	
Likely funding needs, sources	
Model investigation	
Data investigation	

Project #3 Pre-Project Assessment (3 of 3)

Project Characteristic	Best-Guess Assessment
Model assessment	
Data assessment	
Initial action plan	

- Questions?

Transit Model Executive Summary Workshop

Day 2

FDOT District IV Auditorium

June 9th-10th, 2010

- ***Session 4: Transit 101***
  - ***Definitions***
  - ***Service Characteristics and Terminology***

What is Transit?

- Transportation by a conveyance that provides regular and continuing general or special transportation to the public
- Different than auto modes…
  - Supply varies throughout the day in terms of direction and frequency
  - Multiplicative cost per trip
  - Discretionary federal funding source for major investment
    - Required comparison with lower cost options (may be a different mode)
    - Relatively high modeling and data requirements

Transit Service

- Line-haul
  - Relatively long movement between two areas
  - Examples: home→work, home→school
- Circulation
  - Movement within an area
  - Example: intra-downtown
- Inter-city
  - Movement between two regions
  - Example: Ft. Lauderdale-Orlando

Mode Inventory
Common Line-Haul Modes

- Local bus – fixed-route service that provides frequent stop locations
  - Local bus service comprises a majority of transit service in SE Florida
- Express bus – fixed-route service that provides limited-stop service between two areas, usually along a freeway or major arterial (e.g., 95 express)
  - Few express bus services in SE Florida
- Bus rapid transit (BRT) – provides the quality of rail transit and the flexibility of buses; usually limited-stop service with off-board fare collection
  - No definitive BRT service in SE Florida, best example is Miami Busway

Mode Inventory
Common Line-Haul Modes

- Light rail transit (LRT) – "lighter" rail vehicle capable of traversing rail track and streets in mixed-flow traffic
  - No light rail service currently in SE Florida
- Heavy rail – heavier rail vehicles capable of larger passenger capacities; must run on rail track (e.g., Metrorail)
- Commuter rail – similar to heavy rail but serves a regional area (e.g., Tri-Rail
- Trolley/Streetcar – bus or rail vehicles that typically provide circulation service

Different Modes of Transit Service

Bus

Streetcar

Commuter Rail

Heavy Rail

Public Timetable of Fixed-Route

Citrus Connection

10 Shuttle

For More Information CALL
Para más información llame al
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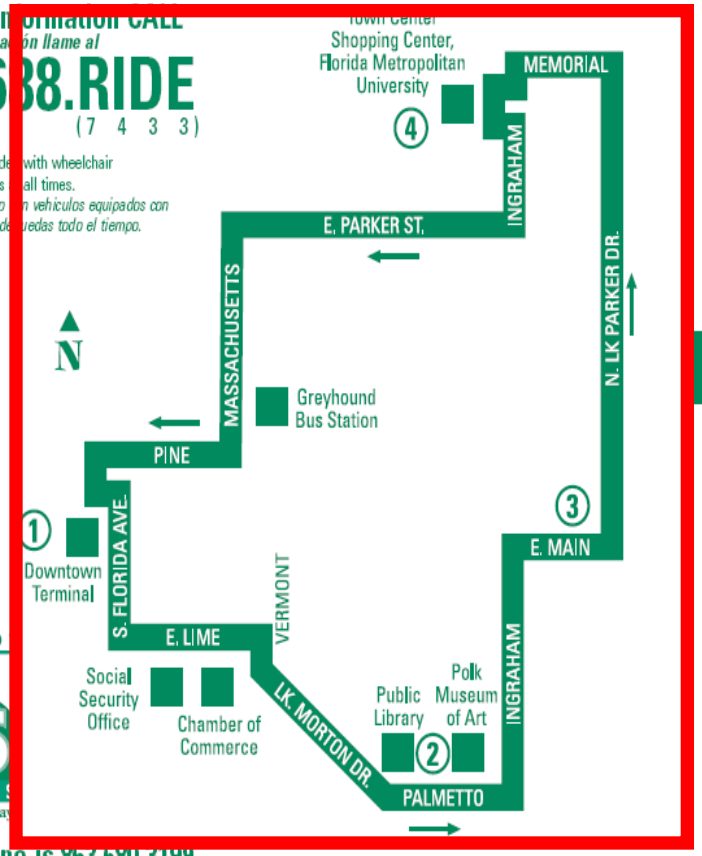
(7433)

Service will be provided with wheelchair lift-equipped vehicles at all times.
Servicio será provisto con vehículos equipados con cargador para sillas de ruedas todo el tiempo.



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Our TDD line is 863.680.3199

① Depart Terminal	② Public Library Polk Museum of Art	③ East Main St. Lake Parker Dr.	④ Town Center Shopping Center	① Arrive Downtown Terminal
Monday - Friday Schedule				
7:15	7:22	7:26	7:31	7:40
8:15	8:22	8:26	8:31	8:40
9:15	9:22	9:26	9:31	9:40
10:15	10:22	10:26	10:31	10:40
11:15	11:22	11:26	11:31	11:40
12:15	12:22	12:26	12:31	12:40
1:15	1:22	1:26	1:31	1:40
2:15	2:22	2:26	2:31	2:40
3:15	3:22	3:26	3:31	3:40
4:15	4:22	4:26	4:31	4:40
5:15	5:22	5:26	5:31	5:40
Saturday Schedule				
6:15	6:22	6:26	6:31	6:40

Transfer Guide
Guia de Transferencia

TRANSFERS CAN BE MADE AT THE LAKELAND TERMINAL WITH THE FOLLOWING ROUTES:
Las transferencias pueden ser hechas en la Terminal de Lakeland con las siguientes rutas:

11 East Main/Combee Road, 12 Winter Haven via Auburndale, 20 Grove Park/Crystal Lake, 21 Edgewood, 22XL Bartow Express, 30 Cleveland Heights, 31 South Florida Ave., 40 Ariana/Beacon, 41 Central Ave., 42 West Memorial, 50 Kathleen/Providence, 51 North 98/Duff Road, 52 North Florida Ave, 53 Lakeside Village, 56 Kathleen/Mall Hill Road, 57 Kidron/Flightline.

See individual route schedules to determine arrival and departures times.
Ver horarios de ruta individual para determinar los tiempos de llegada y salidas.

Please Note: Limited transfers after 6:15 p.m. weekdays and 5:15 p.m. Saturdays. Please check for your trip.
Por favor Note: No hay transferencias después de las 6:15 p.m. en semana y las 5:15 p.m. los sábados. Por favor chequee para su viaje.

- Transfers between route 10 Shuttle and route 11 East Main/Combee can only be made at the Town Center Shopping Center.
  Tranferencias entre la ruta 10 Shuttle y la ruta 11 East Main/Combee, pueden solo ser hechas en el Centro de Compras "Town Center."
- Transfers can be made to route 52 North Florida Avenue in back of the Town Center Shopping Center at the corner of Lakeshore Drive and East Memorial Blvd.
  Transferencias pueden ser hechas hacia la ruta 52 North Florida Avenue, detrás del Centro de Compras "Town Center"en la esquina de Lakeshore Drive e East Memorial Blvd.
- See individual route schedules for transfer times.
  Ver horario de ruta individual para tiempos de transferencia.

Common Access/Egress Modes

- Walk/Bicycle
  - Dominant access mode for local bus riders
- Park-ride
  - Driving to a parking location and boarding the transit vehicle there
  - Dominant access mode for express bus and commuter rail riders
- Kiss-ride/Drop-off
  - Being dropped off (via car) at a transit stop/station and boarding the transit vehicle
  - Can be a major access mode for local bus and rail riders

Other Transit Terminology

- Headway/Frequency
  - The time between two transit services at a fixed-point
  - Local buses typically operate on 15-30 minute headways

- Fares
  - Boarding fare – paid at initial boarding
  - Transfer fare – assessed when transferred between transit vehicles (lower than the boarding fare; can be free)
  - Fare zones – rider pays one fare within a specified area (zone), and pays additional fares if traveling into a different area; used by Tri-Rail

Boarding Fares
District IV Area

Agency	Service	Boarding Fares
Palm Tran	Local bus	$1.50 $4.00 (daily unlimited)
	Commuter Express	$5.00 (daily unlimited)
Broward County Transit	Local bus	$1.50 $3.50 (daily unlimited)
	95 Express	$2.35
Miami-Dade Transit	Local bus	$2.00
	Express bus	$2.35
	Metrorail	$2.00
South Florida Regional Transit Authority	Tri-Rail	$2.50 first zone $1.25 2nd, 3rd zones ~$0.60 other zones

Transit Metrics (Partial List)

- A linked transit trip is the movement from the origin zone to the destination zone, and is represented by the values in the mode choice trip table
- An unlinked transit trip is the movement from one transit service to another, and is represented by boardings generated during transit assignment
- Examples:
  - 45 linked trips on a "one-seat" ride path → 45 unlinked trips
  - 45 linked trips on a two-transfer path → 135 unlinked trips

Transit Metrics (Partial List)

- Ridership
  - Generally, the number of transit vehicle boardings (i.e., unlinked trips)

Average Weekday Ridership
District IV Area

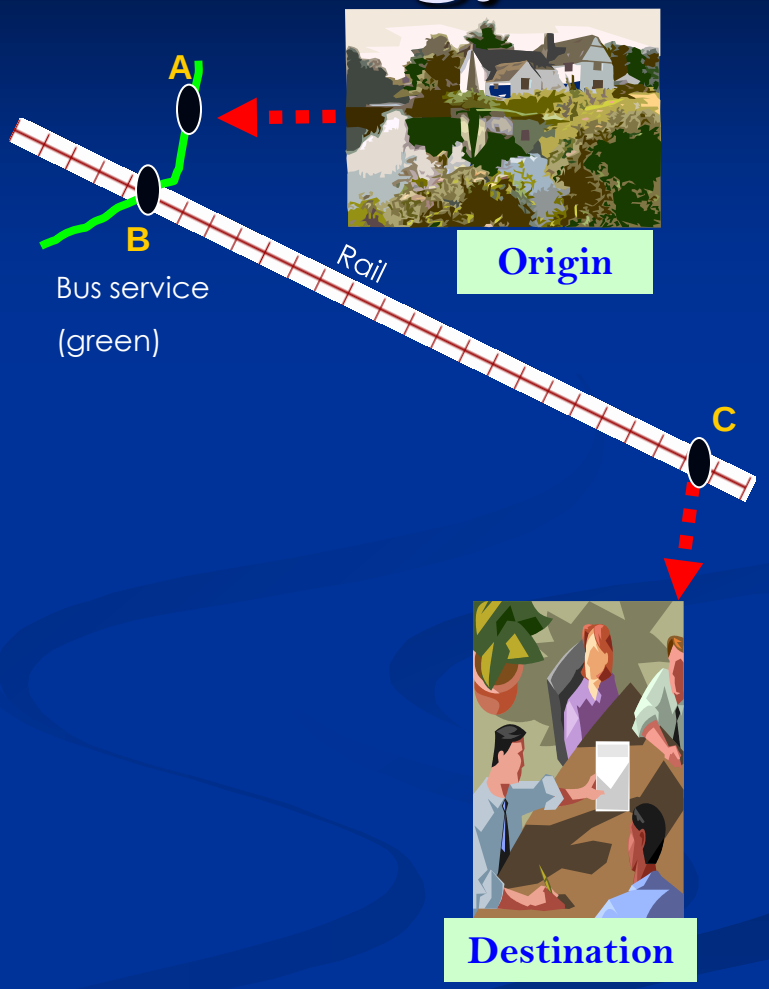
Agency	Approximate Average Weekday Ridership
Palm Tran	37,000
Broward County Transit	128,000
Miami-Dade Transit	364,000
South Florida Regional Transit Authority	15,000

Transit Metrics (Partial List)

- Ridership
  - Generally, the number of transit vehicle boardings
- Route Miles
  - The number of revenue miles for a particular route
  - Two 15-mile routes → 30 route-miles
- Vehicle Miles of Travel / Vehicle Hours of Travel
  - The number of revenue miles (hours) traveled by transit vehicles
  - Two 15-mile routes served each by 4 buses/day → 240 veh-miles
- Passenger Miles of Travel / Passenger Hours of Travel
  - The number of miles traveled (or hours spent traveling) by passengers on the system
  - One passenger travels 6 miles on rail → 6 pax-miles
  - Two passengers travel for 45 minutes on bus → 1.5 pax-hours

Transit Path Terminology

Attribute	Definition	Movement
Access time	Time needed between origin and transit stop/station	Origin → Bus stop A
Initial wait time	Time spent in waiting for the first transit boarding	At bus stop A
In-vehicle time	Time spent traveling in a transit vehicle	A – B and B – C
Transfer walk time	Time taken to transfer from one transit to the another	At station B
Transfer wait time	Time spent in waiting for the transfer transit to arrive	At station B
Egress time	Time taken to walk from egress stop to the destination	Station C → Destination



- Questions?

- ***Session 5: Concept of Transit Modeling***
  - ***Purpose***
  - ***Challenges***
  - ***Approaches***

Modeling Definition & Purpose

Modeling is a simplified representation of the "real world" in mathematical and statistical terms intended to (a) promote understanding of the real system and/or (b) provide analytical solutions to systemic problems

Data is the foundation of models, and must be based on comprehensive (not individual) observations

Transit Modeling Challenges

- Focus on travel behavior rather than traffic flow/volume
  - Modal "decision" evaluates dozens of variables, all of which have to be reasonably reflected (e.g., parking costs, fares, frequencies, travel times, access, alternate modal choices, etc.)
  - Responses to travel services not always readily predictable (e.g., toll plaza vs. open road tolling) → forecast uncertainty
  - New modes and services → no local experience → forecast uncertainty

Transit Modeling Challenges

- Transit service variations require more detailed network representation
  - Direction, frequency, time of day
- FTA New Starts requirements
- Challenging data collection (detailed travel information, personal characteristics)

Technical Approaches

- Sketch-Planning Methods
  - Simplified mathematical tools that can estimate future travel demand and behavior using current conditions or a collection of previous experiences
- Data-Driven Methods
  - Straightforward calculations/representation of relatively simple and predictable project situations
- Travel Demand Models
  - Mathematical models that forecast future travel demand and behavior based on current conditions and future projections of household and employment centers
- Simulation Models
  - Mathematical models based on traffic flow, speed and density of the traffic stream on an individual vehicle- or roadway section-basis[3]

Only these can account for mode choice and multi-modal travel demand and behavior

Technical Approaches
Relative Comparison

Attribute	Sketch-Planning	Data-Driven	Travel Demand	Simulation Models
Typical level of geography	Corridor-level	Corridor-level	Regional	Sub-corridor or corridor-level
Typical time fidelity	Daily or peak/off-peak periods	Daily or peak/off-peak periods	Peak/off-peak periods	Sub-second for peak hour
Data requirements	Low	Low	High	Medium
Key Travel Characteristic being modeled	Varies, but limited to 1-2 variables	Straightforward computation of travel time savings/benefits	Modal and sub-modal decisions; corridor movements; new mode behaviors	Traffic flow
Useable for New Starts?	No, usually missing key attribute	Maybe, depends on project	Yes, but must meet FTA criteria	No, insensitive to changes in transit LOS

Technical Approaches
Examples

- Sketch-planning methods
  - TBEST
  - ARRF

TBEST (1 of 2)

- Transit Boardings Estimation and Simulation Tool
- Transit boarding estimation tool for fixed-route bus routes at the stop-level
- Owned and developed by FDOT Public Transit Office (PTO)
- Commonly used for TDPs and short-term service planning
- Direct-demand model – demand directly determined from supply characteristics

TBEST (2 of 2)

- Key variables
  - Stop location, route, direction, frequency, fares, hours/operation and other supply variables
  - Poverty, Black, Hispanic populations near stops and others
- Insensitive to…
  - Gas prices or auto travel cost
  - Any change in auto travel or other mode
  - Changes in travel patterns
- Project attributes best suited for using TBEST
  - Small-scale, low-cost transit service impacts
  - Site- or bus-stop-specific impacts
  - Local bus service
  - Transportation development plan

ARRF (1 of 2)

- Aggregate Rail Ridership Forecasting model
- Estimates boardings of rail projects
- Developed by Federal Transit Administration to supplement conventional forecasting models
  - Insights into reasonableness of forecasts
  - Understanding of potential markets
  - Targets for travel model calibration in starter-lines
  - Basis for QC comparison in system-expansion lines

ARRF (2 of 2)

- Key variables
  - CTPP 2000 journey-to-work trip flows
  - Fixed-guideway routes, level of service, stations (PNR/no PNR designations)
- Insensitive to…
  - Gas prices or auto travel cost
  - Any change in auto travel or other mode
- Project attributes best suited for using ARRF
  - Rail systems planning or feasibility study
  - New Starts project

Technical Approaches
Examples

- Sketch-planning methods
  - TBEST
  - ARRF
- Data-driven methods

Data-Driven Model Example #1

- Corridor: major east-west arterial
- Transit services:
  - 1 east-west route (heavily-used)
  - 2 other routes that partially traverse arterial
- Problem: heavy use and auto congestion are causing unreliable bus travel times
- Data:
  - On-to-off counts for routes along major arterial, resulting in table of daily stop-to-stop movements…

Data-Driven Model Example #1

Stop-to-Stop Movements

		Destination Stops								
		High St.	**Main St.**	**Front St.**	**3rd St.**	**4th St.**	**5th St.**	**Long St.**	**Spring St.**	**Broad St.**
Origin Stops	**High St.**	-	18	230	84	263	385	331	419	386
	Main St.	12	-	268	76	410	379	99	368	359
	Front St.	60	199	-	315	430	231	245	402	146
	3rd St.	291	350	72	-	399	160	362	245	213
	4th St.	274	295	357	157	-	170	142	185	139
	5th St.	155	344	295	102	117	-	339	331	320
	Long St.	103	383	75	68	299	412	-	355	322
	Spring St.	154	290	140	172	376	60	141	-	354
	Broad St.	273	334	420	423	210	269	366	386	-

Observed total trips on all 3 routes:
18,314

Data-Driven Model Example #1

- Recommended alternative: install transit signal priority system to reduce delays at intersections
  - Estimated travel time savings: 30 seconds per signal

Data-Driven Model Example #1

Travel Time Benefits by Stop-to-Stop Movement

		Destination Stops								
		High St.	**Main St.**	**Front St.**	**3rd St.**	**4th St.**	**5th St.**	**Long St.**	**Spring St.**	**Broad St.**
Origin Stops	**High St.**	-	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
	Main St.	0.5	-	0.5	1.0	1.5	2.0	2.5	3.0	3.5
	Front St.	0.5	1.0	-	0.5	1.0	1.5	2.0	2.5	3.0
	3rd St.	1.5	1.0	0.5	-	0.5	1.0	1.5	2.0	2.5
	4th St.	2.0	1.5	1.0	0.5	-	0.5	1.0	1.5	2.0
	5th St.	2.5	2.0	1.5	1.0	0.5	-	0.5	1.0	1.5
	Long St.	3.0	2.5	2.0	1.5	1.0	0.5	-	0.5	1.0
	Spring St.	3.5	3.0	2.5	2.0	1.5	1.0	0.5	-	0.5
	Broad St.	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5	-

Multiplying these benefits by observed stop-to-stop movements produces a table of daily user benefits…

Data-Driven Model Example #1

Total Benefits by Stop-to-Stop Movement

		Destination Stops								
		High St.	**Main St.**	**Front St.**	**3rd St.**	**4th St.**	**5th St.**	**Long St.**	**Spring St.**	**Broad St.**
Origin Stops	**High St.**	-	9	230	126	526	963	993	1,467	1,544
	Main St.	6	-	134	76	615	758	248	1,104	1,257
	Front St.	30	199	-	158	430	347	490	1,005	438
	3rd St.	437	350	36	-	200	160	543	490	533
	4th St.	548	443	357	79	-	85	142	278	278
	5th St.	388	688	443	102	59	-	170	331	480
	Long St.	309	958	150	102	299	206	-	178	322
	Spring St.	539	870	350	344	564	60	71	-	177
	Broad St.	1,092	1,169	1,260	1,058	420	404	366	193	-

Total daily user benefits: 32,224 minutes (537 hours)

Data-Driven Model Example #2

Fitchburg Commuter Rail

Location

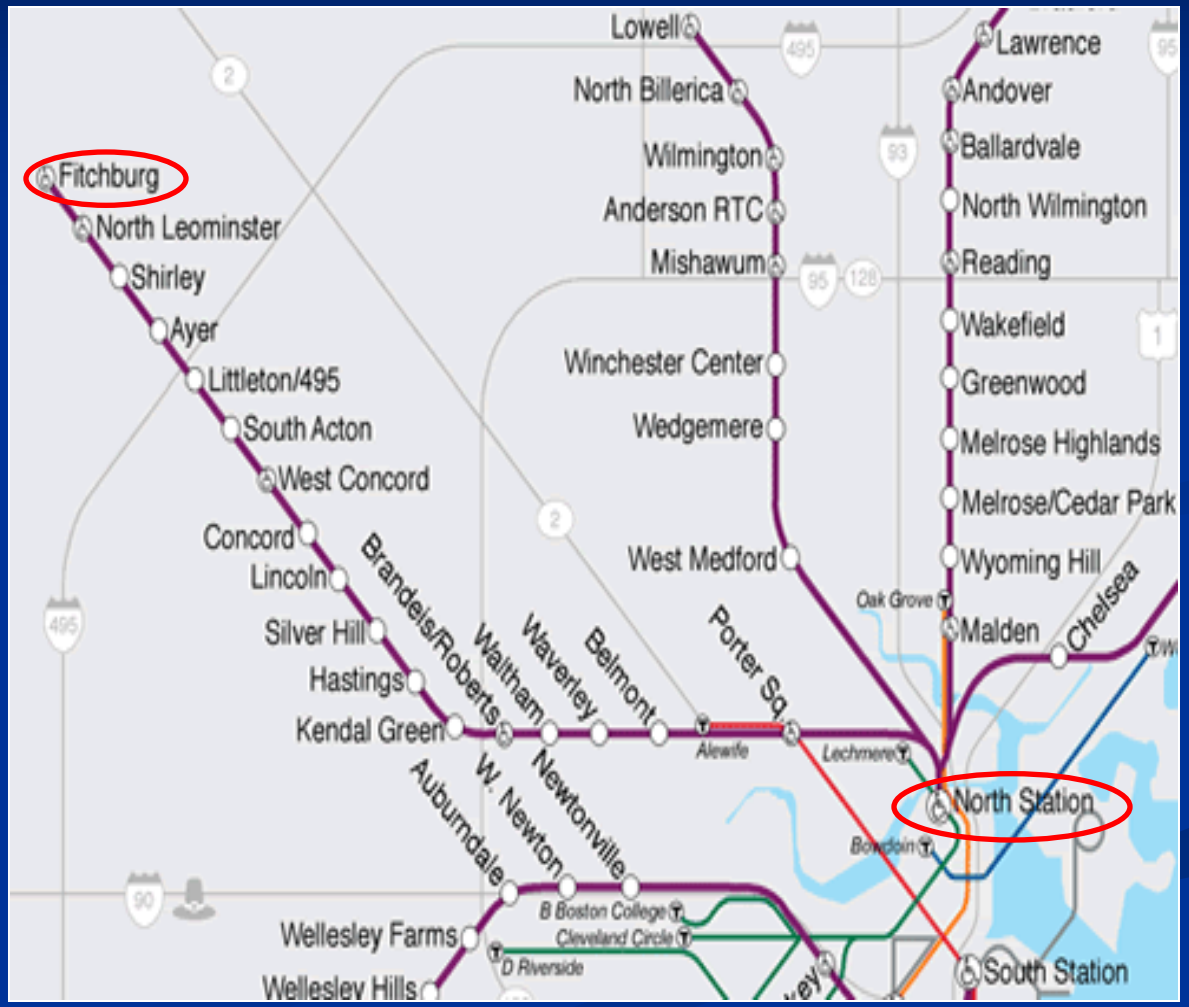
- Northwest suburban corridor of the Boston metro area

Existing line

- 49.5 miles
- 18 stations
- 89 minutes travel time
- 60 mph maximum speed
- 10,600 trips/day, nearly all to/from downtown Boston

Problem

- ~20% of trains >5 min late
- Heavy freight corridor; single tracked over 15%; delays
- Poor drainage
- Antiquated signalization
- Delays at grade crossings



Data-Driven Model Example #2
Fitchburg Commuter Rail

- Proposed project
  - Track improvements; top speed → 80mph
  - In-cab signal system
  - Installation of 10 miles double track
  - Improvements to four grade crossings
  - Construction of three high level platforms
  - Improvements to the drainage system
  - O&M cost savings → 2 added midday round trips
- Capital cost: $149.8M

Data-Driven Model Example #2
Fitchburg Commuter Rail

- Framework for the analysis
  - Spreadsheet calculations
  - On-off counts, by direction
- Computations
  - A – station on/off counts
  - B – train-time improvements from simulations
  - C – opening year estimates from aggregate factor
  - D – new riders from B and a run-time elasticity
  - E – person-hours saved; new and existing riders

Data-Driven Model Example #2

Fitchburg Commuter Rail

AM PEAK

B A C E D E

Station	Inbound Run Time, Existing (min)	Inbound Run Time, Build (min)	Travel Time Savings (min)	Existing AM Riders	Opening Year AM Riders	Person Hours Saved	New AM Riders (.6 elasticity)	New Riders Hours Saved	User Benefits New & Existing Riders
Fitchburg	88.8	79.2	9.6	308	314	50.19	20	1.63	51.82
North Leominster	81.6	72	9.6	285	290	46.47	21	1.64	48.11
Shirley	73.8	64.2	9.6	124	127	20.26	10	0.79	21.05
Ayer	66.6	58.2	8.4	259	264	37.02	20	1.40	38.42
Littleton	57.6	51	6.6	135	138	15.15	9	0.52	15.67
South Acton	49.8	45.6	4.2	625	637	44.62	32	1.13	45.74
West Concord	46.2	42.6	3.6	331	338	20.27	16	0.47	20.75
Concord	42	39	3	310	316	15.79	14	0.34	16.13
Lincoln	36.6	33.6	3	241	246	12.29	12	0.30	12.59
Silver Hill	34.2	33	1.2	30	31	0.61	1	0.01	0.62
Hastings	32.4	30.6	1.8	54	55	1.64	2	0.03	1.67
Kendall Green	30.6	28.8	1.8	153	156	4.69	6	0.08	4.77
Brandeis/Roberts	25.8	24.6	1.2	299	305	6.11	9	0.09	6.19
Waltham	22.8	21	1.8	374	382	11.46	18	0.27	11.73
Waverly	17.4	16.8	0.6	76	77	0.77	2	0.01	0.78
Belmont	14.4	14.4	0	104	106	0.00	0	0.00	0.00
Porter Square	9	8.4	0.6	23	24	0.24	1	0.00	0.24
North Station	0	0	0	0	0	0.00	0	0.00	0.00
				3,730	**3,805**	287.56	**191**	8.71	**296.27**

Data-Driven Model Example #2
Fitchburg Commuter Rail

- Forecast
  - Trips/day: 10,600 today → 11,300 opening year
  - Time savings: 987 hours/day in opening year
  - Benefits in scale with costs
- Uncertainty analysis on new-trip elasticity

ELASTICITY	NEW TRIPS	HOURS SAVED	CE
-0.4	453	975	24.03
-0.6	679	987	$23.75/hr
-0.8	905	999	23.47

  - Conclusion: little risk to the conclusion on CE
    - Medium CE = $16.00 – $24.49

2 WEEKS!

Technical Approaches
Examples

- Sketch-planning methods
  - TBEST
  - ARRF
- Data-driven methods

- Travel demand models
  - Urban
  - Sub-area
  - Inter-city

Urban Travel Demand Models
Maintained by District IV

- Southeast Florida Regional Planning Model (SERPM)
  - Palm Beach, Broward, Miami-Dade Counties
  - Time of day modeling for auto and transit
  - Best prepared for New Starts analysis

- Greater Treasure Coast Regional Planning Model (GTCRPM)
  - Palm Beach, Martin, St. Lucie and Indian River Counties
  - Partially Brevard and Broward Counties
  - No time of day or transit modeling

Other Travel Demand Models

- Sub-area
  - Geographic scope covers project area only
  - Networks and necessary components taken from urban model and adjusted accordingly for project-specific analysis
  - Networks are generally refined to capture more detailed movements
  - New model components may be supplemented as needed

- Inter-city
  - Geographic scope covers large project area (usually 2+ urban areas)
  - New networks are assembled from urban models
  - New model components are developed for this specialized travel market
  - Data collection on air and interstate travelers generally required

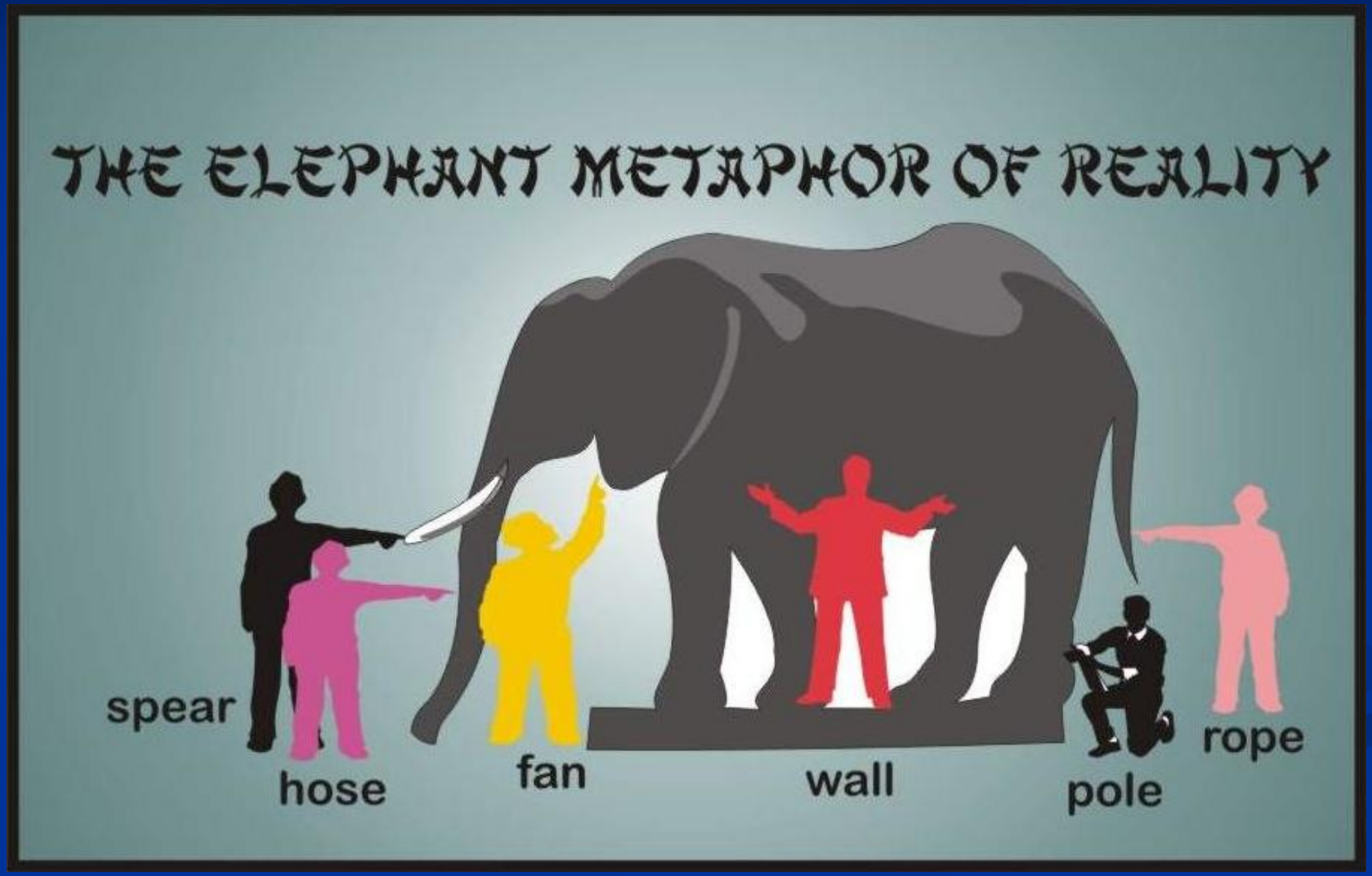
- Questions?

- ***Session 6: Transit Service and Ridership Data for Modeling***
  - ***Purpose***
  - ***Data types and sources***
  - ***Data acquisition and issues***
  - ***Lessons learned***

“You can observe a lot by watching”

- Yogi Berra

The Importance of Comprehensive Observations



Purpose

- Provide insights on travel and transit markets and conditions…
  - What are the major travel and transit markets?
  - How well does the model grasp those markets?
  - How well does the model grasp the transportation conditions?
- …that provide a foundation for effective models

Key Model Data

- Travel patterns
- Performance of the transportation system
- Volumes on facilities/services
- Others

Travel Patterns

- Need data to compare observed and estimated person trips stratified by:
  - Trip purpose
  - Socio-economic characteristics
  - Time of day
  - Mode and sub-mode
  - Access/egress mode
  - Geography

Travel Patterns

Example

Estimated Demand/Travel Patterns

	CBD	Urban	Suburbs	Tech Center	Rural	Total
CBD	1,000	1,000	-	-	-	**2,000**
Urban	40,000	1,000	-	1,000	-	**42,000**
Suburbs	7,000	1,000	10,000	35,000	2,000	**55,000**
Tech Center	1,000	3,000	3,000	1,000	-	**8,000**
Rural	1,000	19,000	7,000	3,000	-	**30,000**
Total	**50,000**	**25,000**	**20,000**	**40,000**	**2,000**	**137,000**

Observed Demand/Travel Patterns

	CBD	Urban	Suburbs	Tech Center	Rural	Total
CBD	1,000	-	-	1,000	-	**2,000**
Urban	7,000	10,000	21,000	3,000	1,000	**42,000**
Suburbs	35,000	1,000	5,000	12,000	2,000	**55,000**
Tech Center	2,000	-	1,000	4,000	1,000	**8,000**
Rural	5,000	-	-	20,000	5,000	**30,000**
Total	**50,000**	**11,000**	**27,000**	**40,000**	**9,000**	**137,000**

Travel Patterns
Data Sources

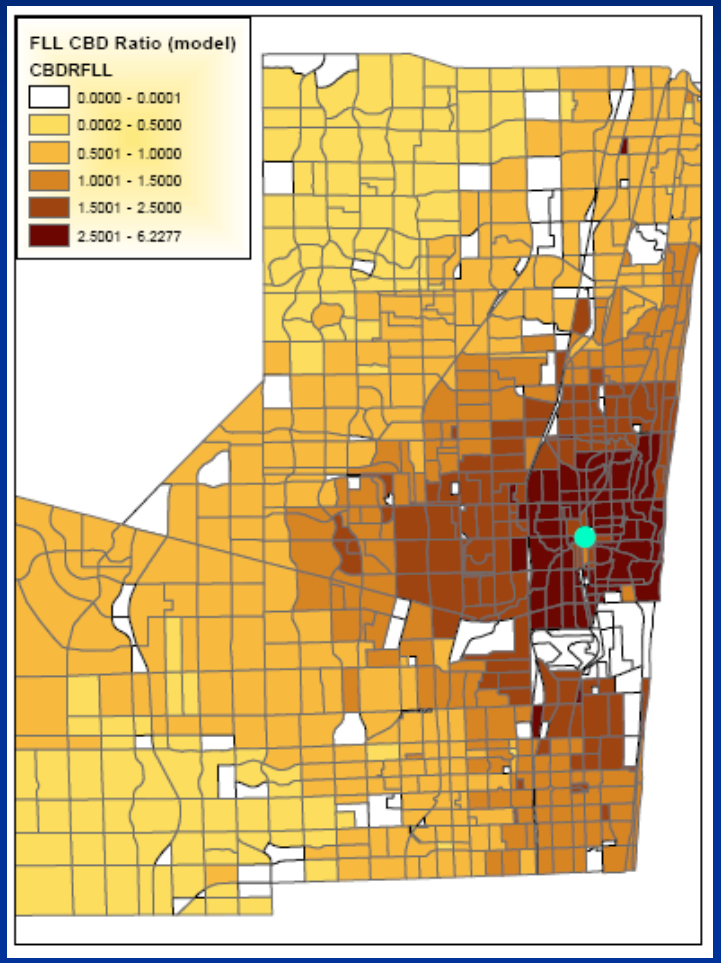
- CTPP 2000, ACS, NHTS?, workplace surveys
- Transit onboard surveys
- On-to-off counts
- Passive data collection methods
  - Smart cards, toll tags, Bluetooth, etc.

Work Travel Patterns

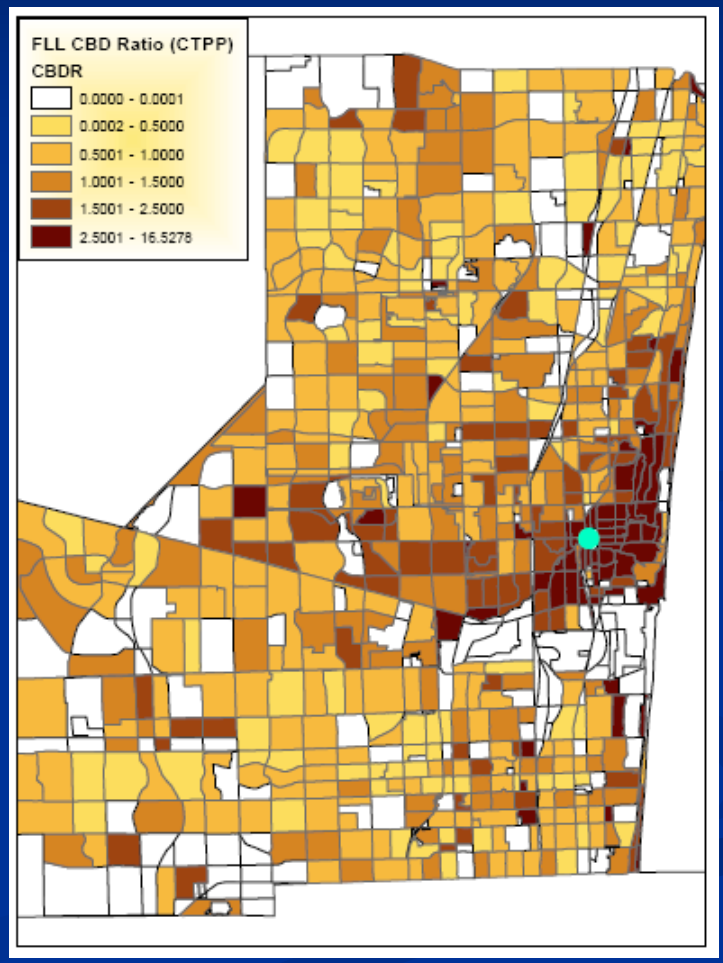
- Census Transportation Planning Package
  - Derived from the 2000 Census "long form" (1 in 6 sample)
  - Journeys (Home→Work) by TAZ, tract, block group
- American Community Survey
  - Successor to CTPP
  - Smaller sample (1 in 40) and broader geography
  - Detailed information won't be available for 1-2 years
- Workplace surveys
  - Employee home locations for major employers

Work Flows to Ft. Lauderdale CBD

Based on CTPP 2000 Data



Estimated



Observed

Transit Onboard Surveys

- Detailed origin/destination instrument distributed onboard transit vehicles
- FTA New Starts requirements
  - Test models against current data (<5 years)
  - Include required data items
    - Trip origin: location, purpose, transit access mode, park-ride location
    - Transit path: full set of transit lines used, boarding & alighting stops/stations
    - Trip destination: location, purpose, transit egress mode, park-ride location
    - Person: driver's license (age, worker/student, gender optional)
    - Household: vehicles, persons/adults/drivers/workers (income optional)

Transit Onboard Surveys

- "Average" cost
  - $35 per completed form (onboard survey only)
  - $50+ per completed form (survey + auxiliary counts + analysis)
- "Average" time
  - 1 year from RFP to cleaned survey data
  - Additional survey processing needed

Note: Costs shown here are "averages" based on experience and not definitive. Actual costs and times heavily depend on survey methodology and local conditions.

Transit Onboard Surveys

- Typical problems
  - Inattention to key travel markets
  - Inattention to non-response bias (see next slide)
  - Pilot survey little more than operational "dry run"
  - Differing perspectives of survey firm and modeling staff
  - Limited insight on travel patterns
- Some solutions
  - Review key travel markets and potential non-response biases before survey RFP
  - Develop survey plan
  - Use pilot survey to test different data collection methods
  - Address survey firm and modeling staff responsibilities up front
  - Collect auxiliary data to better capture travel patterns

The Real Impact of Non-Response Bias

Survey Results

Daily boardings	600
Completed surveys	15

Uniform Expansion

Daily boardings	600
Completed surveys	15
Survey weight	40.0

Walk-access trips	80
Drive-access trips	520

Park-ride lot count = 15 cars

Revised Expansion

Walk-Access Expansion	
Daily boardings	570
Completed surveys	2
Survey weight	285.0

Drive-Access Expansion	
Daily boardings	30
Completed surveys	13
Survey weight	2.31

On-to-Off Counts

- Relatively new approach to transit data collection
- Gather boarding and alighting stop/station for all riders
  - Short interviews, questionnaires, "smart card" data
- Strengths
  - High response rate!
  - Travel flows!
  - Can correct for some non-response biases
- Weaknesses
  - Little information besides travel flows

Passive Data Collection

- Smart cards, toll tags, Bluetooth, others…
  - Can track traveler's movements along the system
  - Need permission of controlling authority
  - Rich sample size (huge help!)
  - Limited data besides flows

Transportation System Performance

- Roadway supply
  - Capacity, time of day restrictions/movements, signalization, turning movement restrictions, free-flow speeds, number of lanes
  - Time of day congested speeds, travel times and volumes
- Transit supply
  - Schedules, speeds, fares, park-ride locations, connectivity between lines
  - Time of day travel times and volumes

Transportation System Performance
Travel Time Data Sources

- Roadway speeds
  - Freeway speed/travel time monitoring systems
  - Large sample speed/travel time survey (focused on both point-to-point and link-specific times)
  - Inrix, Google, Traffic.com and similar companies
  - Bluetooth monitors
  - Automated traffic counters
- Transit speeds
  - Public time tables for transit
  - Automatic vehicle locators (AVLs)

Facility/Service Volumes
Data Sources

- Reconciled time of day roadway counts by different collection times and sources

- Transit volumes
  - Farebox, smart card records
  - Automated passenger counters (APCs)
  - Manual ridechecks

Lessons Learned (1 of 3)

- Collect data to test model outputs (!!)
- Take advantage of passively-collected data, innovative techniques and data collected by other agencies
- Begin an expanded data collection program to ensure that reliable, relevant data is ready for use
- Don't underestimate the resources needed to collect and process data

Lessons Learned (2 of 3)

- Those who didn't answer your survey can impact the survey results as much (or more) as those who did answer your survey
- The survey questionnaire is a key component, but not the key component
  - Key components: knowing travel markets before developing survey plan, developing good questionnaire, testing survey execution (in the field), checking the raw data extensively, verifying survey expansion
- It's not good enough to expand the survey, the survey expansion must be verified also

Lessons Learned (3 of 3)

- Surveys almost always provide a learning opportunity that needs to be addressed in the next data collection opportunity
  - Tri-Rail: auto egress trips, overnight airport parkers
  - Well-planned movements by transit riders

- Thank you!

References

Slide	Reference
7	TCRP Legal Research Digest 30
8	FTA Workshop on Alternatives Analysis (September 2009)
9	Communications with FTA staff
10-11	Materials from FTA New Starts website (http://www.fta.dot.gov/planning/planning_environment_5221.html)
12	FTA Workshop on Alternatives Analysis (September 2009)
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15	FTA Workshop on Alternatives Analysis (September 2009) Picture from http://www.fta.dot.gov/publications/reports/reports_to_congress/publications_7753.html
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17-19	Materials from FTA New Starts website
21	FTA New Starts Workshop (July 2003)

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32-40	FTA Workshop on Alternatives Analysis (September 2009)
42-44	FTA Major Capital Transit Investment Fact Sheets
45-46	Materials from FTA New Starts website and FTA New Starts Workshop (March 2009)
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51	Materials from FTA New Starts website
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64	Sub-bullets from FTA Workshop on Alternatives Analysis (September 2009)
65	4th bullet from FTA Workshop on Alternatives Analysis (September 2009)
66	4th bullet from FTA Workshop on Alternatives Analysis (September 2009)
69	http://www.fta.dot.gov/about/about_FTA_3353.html
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90-91, 95	FDOT Transit Modeling Workshop (2007-2008)
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95	The transit agencies' websites accessed week of June 1st 2010
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108-109	Materials from http://www.tbest.org/
110-111	Some material from FTA New Starts Workshop (March 2009)
118-122	FTA New Starts Workshop (March 2009)
129	Picture from http://christopherramey.files.wordpress.com/2010/04/blindmenelephant.jpg
130-135	TMIP's *Shining a Light Inside the Black Box* Webinar (Spring 2008)
137	FTA New Starts Workshop (March 2009)
140	FDOT Transit Modeling Workshop (2007-2008)
143-145	TMIP's *Shining a Light Inside the Black Box* Webinar (Spring 2008)
146	All but 1st bullet from TMIP's *Shining a Light Inside the Black Box* Webinar (Spring 2008)

Acronym List (1 of 2)

AA – alternatives analysis
ACS – American Community Survey
ANPRM – Advance Notice of Proposed Rule-Making
APC – automated passenger counter
ARRF – Aggregate Rail Rideship Forecasting Model
ASE – Automated Skyway Express (Jacksonville)
AVL – automatic vehicle locator
BRT – bus rapid transit
CBD – Central Business District
CTPP – Census Transportation Planning Package
EPA – Environmental Protection Agency
FD – final design
FDOT – Florida Department of Transportation
FFGA – full-funding grant agreement
FTA – Federal Transit Administration
FY – fiscal year
GTCRPM – Greater Treasure Coast Regional Planning Model
HQ – headquarters
LOS – level of service
LPA – locally preferred alternative
LRT – light-rail transit
LRTP – long range transportation plan

Acronym List (2 of 2)

MPO – Metropolitan Planning Organization
NEPA – National Environmental Policy Act\
NPRM –Notice of Proposed Rule-Making
O&M – operating and maintenance
PCGA – project construction grant agreement
PD – project development
PE – preliminary engineering
PNR – park-and-ride (access mode or lot)
PTO – Public Transit Office (FDOT)
QC – quality control
RFP – request for proposal
ROW – right-of-way
SERPM – Southeast Florida Regional Planning Model
TBEST – Transit Boardings Estimation and Simulation Tool
TAZ – Traffic analysis zone
TDPs – Transit Development Plans
TSM – transportation systems management
USC – United States Code
USDOT – United States Department of Transportation