Outline

1. SRTP -- Definition & Introduction
2. Measures and Standards
3. Current Practice in SRTP & Critique
Public Transport Planning

A. **Long Range (> 3 Years)**
   Major Capital Investment: Infrastructure
   Major Institutional Changes

B. **Medium Range (1 - 3 Years)**
   Bus Network Structure
   Network Size
   Fleet Size
   Fare Policy and Technology

C. **Short Range (< 1 Year)**
   Route Structure
   Service Frequency
   Vehicle and Crew Scheduling

D. **Control (Real Time)**
   Revise Route of Specific Vehicle
   Revise Schedule of Specific Vehicle
Major Planning Elements

Data Collection
Problem/Opportunity Identification
Design Options/Strategies
Cost Estimation
Ridership/Revenue Estimation
Operational Planning Process

**INPUT**
- Constraints, Demand
- Level of Service, Demand
- Travel Times Constraints
- Operator and Union Constraints

**COMPONENT**
- Bus Route Design
- Setting Timetables
- Scheduling Vehicles
- Assignment of Drivers

**OUTPUT**
- Routes and Stops
- Departure Times
- Vehicle Schedules
- Crew Schedules
Service Planning Hierarchy

Network Design
Frequency Setting
Timetable Development
Vehicle Scheduling
Crew Scheduling

Infrequent Decisions
Service Considerations Dominate
Judgement & Manual Analysis Dominate

Frequent Decisions
Cost Considerations Dominate
Computer-Based Analysis Dominates

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Evaluation Structure

GOALS

OBJECTIVES

MEASURES

STANDARDS
Use of Formal Guidelines*

- 73% of agencies use some form of formal guidelines
- 75% of these agencies use guidelines adopted by governing board
- Otherwise typically adopted by Executive Director/General Manager

Aspects of Service Covered

Service Design

Operating Performance

• Service Quality
• Economic/Productivity
Most agencies with route design guidelines include:
- Population density
- Employment density
- Spacing between routes

Other primary concerns in route design:
- Service to unserved areas
- Direct, non-circuitous routing

Coverage Example:
MBTA: The MBTA has a policy objective to provide transit service within walking distance (defined as 1/4 mile) of all residents living in areas with population densities greater than 5,000 people per square mile.

Typical Stop Spacing (by system)

<table>
<thead>
<tr>
<th>Stops per mile</th>
<th>% of systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>6-8</td>
<td>51</td>
</tr>
<tr>
<td>10-12</td>
<td>13</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>
Most agencies have guidelines for scheduling based on:

- Maximum (policy) headways
- Maximum passenger crowding

**Policy Headway Example**

**MBTA:** Maximum headway on all local routes should be 30 minutes in the peak and 60 minutes at other times. For express service there should be at least 3 trips in each peak period.

**Maximum Passenger Crowding Example**

**MBTA:** On the Green line (light rail) the maximum passengers per car should be no more than 220% of the seats in the peak period. In the off peak the maximum passenger per car should be no more than the seated capacity except in the central subway where it should be no more than 140% of the seated capacity.
A. **PEAK LOAD**

1. Peak Half-Hour: avoid such high loads that:
   - passengers frequently cannot board the first vehicle to arrive;
   - vehicles encounter high dwell times.

   Maximum acceptable load \(\sim 70\) passengers for a standard 40’ bus.

   ![Graph showing frequency of load distribution with maximum points at 55 and 70 passengers.]

   So acceptable average observed load (at maximum load point) is 55.

2. Other times: normally expect to provide a seat for all passengers.
   Acceptable average load \(\sim 40\) for a standard 40’ bus.
## TTC Loading Standards

### Acceptable Maximum-Hour Average Vehicle Loads at Peak Flow Point (Passengers Per Vehicle)

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Peak Periods</th>
<th>Off-Peak Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Routes</td>
<td>Frequency:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ Once Every 10 Minutes</td>
</tr>
<tr>
<td>40-ft Bus</td>
<td>50-57</td>
<td>35-49</td>
</tr>
<tr>
<td>50-ft Streetcar</td>
<td>74</td>
<td>58</td>
</tr>
<tr>
<td>75-ft Articulated Streetcar</td>
<td>108</td>
<td>76</td>
</tr>
<tr>
<td>6-car Subway Train</td>
<td>1100</td>
<td>400-500</td>
</tr>
</tbody>
</table>
Most agencies have guidelines covering span of service.

**Example**: MBTA

The first trip should arrive no later than, and the last trip should depart no earlier than, the times shown below (for local bus service):

- **Weekdays**: 7 a.m. - 6 p.m.
- **For high density areas only**:
  - **Saturdays**: 8 a.m. - 6 p.m.
  - **Sundays**: 10 a.m. - 6 p.m.
Most agencies have formal procedures for monitoring service delivery focusing on on-time performance, typically defined as 0 minutes early to 5 minutes late.

About two-thirds of agencies report rush hour on-time performance of 90% or above.

Most agencies also keep route level information on:

- Passenger complaints
- Missed trips
- Accidents

**Example: MBTA**

Local low frequency bus service (headways > 10 minutes):

- 75% of trips should depart 0-5 minutes after scheduled terminal departure times and arrive 0-5 minutes after scheduled terminal arrival times.

Local high frequency bus service (headways ≤ 10 minutes):

- 85% of trips should have headways no greater than 150% of scheduled headway.
- 95% of trips should have travel times no more than 5 minutes above scheduled times.
Reliability

Example: want 95% of departures to be on-time

Frequency of Running Time

Allowed Time

Recovery Time

5% probability

Running Time

Implies a recovery time of (2x standard deviation of running time)
## Economic/Productivity Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>% of Agencies Using Measure</th>
<th>Minimum Standard (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers/veh hr</td>
<td>78%</td>
<td>11-35 pass/veh hr</td>
</tr>
<tr>
<td>Cost/Passenger</td>
<td>63%</td>
<td>3 x system average</td>
</tr>
<tr>
<td>Passengers/veh mile</td>
<td>58%</td>
<td>1-3 pass/veh mile</td>
</tr>
<tr>
<td>Passengers/trip</td>
<td>53%</td>
<td>---</td>
</tr>
</tbody>
</table>

Two most critical measures in assessing route performance:

- passengers/veh hour
- subsidy/passenger
SERVICE INPUTS
- Labor
- Capital
- Fuel

SERVICE OUTPUTS
- Vehicle Hours
- Vehicle Miles
- Capacity Miles
- Service Reliability

SERVICE CONSUMPTION
- Passengers
- Passenger Miles
- Operating Revenue
- Operating Safety

Cost-Effectiveness

Service-Effectiveness

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Alternative Benefit Measures

REVENUE
PROS: - relevance to financial concern
      - related to willingness to pay
CONS:  - discounts value of reduced fare trips
       - favors higher income users

PASSENGERS
PROS: - reflects number of people who benefit
       - values each passenger equally
CONS:  - doesn’t reflect trip length

PASSENGER MILES
PROS: - weights longer trips more
       - most reflective of some benefits
CONS:  - hardest to measure
       - favors higher income passengers
Alternative Cost Measures

NET COST (Subsidy)
PROS: - usually most directly constrained
CONS: - hardest to estimate

COST
PROS: - may also be directly constrained
CONS: - hard to estimate

VEHICLE MILES
PROS: - easy to measure
CONS: - directly reflects only 30% of bus costs
- penalizes fast services

VEHICLE HOURS
PROS: - easy to measure
- related to >50% of bus costs
CONS: - doesn’t reflect cost differences between peak and off-peak services
Issues in Setting Up a Short-Range Transit Planning Process

• Role of budget constraints in the process
  => before budget is set
  => after budget is set

• Role of standards and constraints vs investing resources to obtain best ridership results

• Consideration of new service options vs protection of existing services

• Allocation of analysis/planning effort to “problem” routes vs other routes

• What form of standards/guidelines to use

• Focus on individual routes or route as component of system
TTC Service Standards Process: Overview

- Continuous Monitoring of Ridership and Loads
- Annual Route Efficiency Review for all Routes
- Identify Service Changes
- Assess Passenger Impacts
  - Major Impact
  - Minor Impact
- Approval and Implementation
- New Service Proposals
  - Municipal Requests
  - Staff Suggestions
  - Evaluation Based on System Guidelines
  - Estimate Ridership, Costs and Benefits
    - Major Cost
    - Comparative Evaluation
    - Recommendations
      - Commission Approval and Review Process
      - Implementation
      - Formal Review After 6 Months of Operation

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TTC Service Standards Process: Ridership Monitoring and Service Adjustment

1. Regular Ridership Counts
   - Customer Communications
   - Planning Staff Observations
   - Operations Report

2. Availability of Vehicles and Budget
   - Comparison of Ridership to Load Standards

3. Staff Recommendations for Service Changes
   - Review of Recommendations by Operating Personnel
   - Staff Approval of Service Changes
   - Implementation of Approved Service Changes
TTC Service Standards Process: Route Efficiency Review Program

New Riding Count on Route

Operating Experience Review
- Complaints
- Service Regularity

Year-End Financial Performance

Route Economic Performance Review

Route Structure Review
- Branch Alignment
- Time Period Service Levels

Time Period Service Review
- Surge Loading
- First/Last Trips

Minor Route and Service Changes Recommended

Implementation

Major Route and Service Changes Recommended

Referred to Comparative Evaluation

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1. Must serve people beyond 300 meters from current TTC service

2. Must maximize interconnections with rapid transit

3. Must result in a net benefit for customers
   - net benefit is measured by change in weighted travel time with weighted travel time =
     \[ A \times \text{in-vehicle time} + B \times \text{waiting time} + C \times \text{walking time} + D \times \text{transfers} \]
     and  \[ A = 1.0, \ B = 1.5, \ C = 2.0, \ D = 10.0 \]
TTC Financial Standards and Comparisons

Single measure used to evaluate service change proposals is:

customers gained (lost) per dollar spent (saved)

Used for evaluating:
• new service proposals
• possible service reductions
• fare changes

The financial unit is the net cost (cost-revenue) associated with the change.

Currently, the threshold for new service is 0.23 new customers per dollar spent.

Services with performance of less than 0.23 customers per dollar spent are examined for possible cost reduction annually.
Service Change Process

- Major service changes evaluated twice per year resulting in a ranking against other proposals and productivity for existing services.
- Board provided with recommended service changes and ranked list of all other proposals evaluated and system average performance.
- Experimental services are designated and evaluated after six months operation.
A Critique Of Current Practice

- Focus is on poorly-performing routes.
- Data limitations -- both type and quality.
- Measures not always closely tied to objectives.
- Focus on individual route performance rather than network contribution.