Alternatives Analysis and Characteristics of Urban Transport Modes
Why Alternatives Analysis (AA)?

- At the conclusion of metropolitan long range strategic planning:
  - A corridor has been identified as a top priority for rapid transit
  - However, accurate information (e.g., costs, environmental impacts) is not available to select a precise mode and design concept
- AA provides the better information needed to make a supportable decision
  - Detailed look at fewer reasonable alternatives
  - Focused geographically
  - Shorter (e.g., fifteen year) time horizon
What is an Alternatives Analysis?

A process for finding the most desirable alternative for geographic area that:

- Solves transport and related problems
- Is cost-effective
- Is affordable
Alternatives Analysis Analogy
Meeting a Family’s Transport Needs

1. What are our transport needs?
2. How much money do we have to spend?
3. What are our options?
   - Continue to use public transport
   - Buy a vehicle
4. How do the private vehicle options compare in terms of our needs and tastes?
   - Size?
   - Features?
   - Comfort?
   - Repair record?
   - Costs?
   - Aesthetics?
5. Opinion of spouse, spouse’s brother?
6. Decision
What Alternatives Analysis is Not!

A feasibility study where:

- A single, pre-determined solution is assessed
  - Physical and operational ability to implement
  - Absolute economic return

- Other, potentially more cost-effective and desirable options are ignored
Feasibility Study Analogy
Meeting a Family’s Transport Needs

1. I want (need?) a car
2. Is it feasible for me to buy a Mercedes Benz?
   Do I have the money or can I borrow it?
   ▪ Yes: Go buy it
   ▪ No: Don’t buy anything, continue to take public transport
Establish Goals and Objectives; Transportation, Quality of Life

Evaluate Current Problems, Future Challenges

Identify Investment Alternatives

Evaluate Alternatives

Decision on Mode and General Alignment

Go!
Alternatives Analysis Guidelines

1. Make sure that everyone understands process from start
2. Understand the problems needing solution
3. Establish goals, objectives and evaluation criteria
4. Identify and collect the information needed for proper analysis and decision-making
5. Consider the right alternatives
6. Develop complete, objective and reliable information
7. “Make the case” for the selected alternative
Make Sure That Everyone Understands Process From Start

- Alternatives Analysis, not feasibility study
- Clarify “big decision” to be made at conclusion of Alternatives Analysis
  - Type of transport investment
    - e.g., metro, Bus Rapid Transit, Light Rail Transit, roadway
  - General alignment
  - Related management and operations strategies
2 Understand the Problems Needing Solution

- Analyze current and expected future “no project” conditions
  - Key information needs
- Identify underlying causes, not just symptoms
  - e.g., congestion and air pollution are symptoms, not causes
- Make sure everyone, decision makers and the public understand the issues
Symptom: Traffic Congestion
Land Use
Possible Cause of Congestion

- Poor land use, site planning
  - Widely scattered, single-purpose developments
  - Site planning not pedestrian or public transport “friendly”
  - Site planning forces auto dependency
View on the Ground: Pune, India
Demand Side Changes
Possible Cause of Congestion

- Explosive population, income and motorization growth

- Changing demographics
  - Declining household sizes (grown children moving to own residences)
  - Younger/older population

- Changing origin-to-destination patterns
  - Less core-focused
Changing Public Transport Demand Patterns Accra, Ghana

Links with Bus and Tro-tro volumes >250 vph in 2013 AM Peak
Supply Side Changes
Possible Cause of Congestion

- Public transport system
  - On-street, poorly regulated competition
  - Route structure not consistent with travel needs
  - Insufficient capacity in major corridors
- Non-Motorized Transport
  - Declining space dedicated
  - Right-of-Way (ROW) encroachment
- Roads
  - Poor condition / Lack of connectivity
  - Ineffective parking / traffic management
  - Poor enforcement of traffic rules
Inefficient Traffic, Public Transport Operations
Incomplete Arterial Grid

Manila
Poor/No Secondary Street Network
Right-of-Way (ROW) Encroachment
Inefficient, Ineffective General Traffic Management
Local Emissions
Poor Pedestrian Environment
Pedestrian and Bicycle Safety
Motor Vehicle Safety
Public Transport Safety
Sustaining the Existing System
Establish Goals, Objectives and Evaluation Criteria

- Cost-effectiveness
- Affordability
- Related non-transport issues
Cost-Effectiveness Criteria

- Combines
  - Total equivalent annual costs (capital, operating, maintenance)
  - Effectiveness measure or measures
    - e.g., travel time savings, public transport trips, person km of travel

- Calculated as changes from “no project” or base case
Typical Cost-Effectiveness Criteria

- Cost per person Km of travel
- Cost per Public Transport Trip
- Benefit/Cost ratio
- Net present value
- Implicit cost of travel time savings (used by U.S. Department of Transportation for major Public Transport projects)
Affordability as a Criterion

- Should not be limited to initial capital cost of alternatives
- Should also include
  - Ongoing operation/maintenance
  - Costs associated with rest of transport system
    - Especially “background” local bus system needed for alternative to produce benefits
- Recapitalization
Non-Transport Criteria

- Environmental, local and global
- Social
- Land and economic development effects
- Health, safety
Simplicity is a Virtue!

- Decision makers and citizens must understand the criteria.

- Criteria must be “scalable,” capable of being related to something from everyday life.
  
  e.g.,
  - cost/Public Transport trip compared to cost of a car or taxi trip,
  - cost per hour of travel time savings compared to wage rates.
Identify and Collect Needed Information

- Current and future conditions
- Analytical forecasting tools
Current and Future Conditions

- Data describing current situation
  - Population
  - Land use
  - Demand
  - System supply & performance
    - e.g., travel times, capacity utilization
  - Finance
    - e.g., profitability, available funding

- Forecast data on future growth
  - Population
  - Land use
Data to Support Tool Development and Application

- Forecasts needed for evaluation criteria
- Analytical tools needed to show differences among the alternatives in key criteria such as:
  - Travel demand
  - Network performance analysis
    - e.g., capacity utilization, travel times, transfers
  - Environmental impact assessment
    - e.g., local/global air, noise emissions
  - Costs
    - e.g., implementation, operating, maintenance, recapitalization
  - Financial resources
Consider the Right Alternatives

- Recognize that there is more than:
  - One rapid transit mode
    - Not just metros/Light Rail Transit
  - One type of road capacity addition
    - Not just expressways, freeways, flyovers
- Keep in mind that system integration is critical
  - Rapid transit/local bus
  - Expressway/arterial street
- Consider integrated public transport priority/traffic management as an alternative
  - Comprehensive package of “low-cost” improvements
Packaged Roadway / Public Transport Investments

Mexico City Metro, Expressway

Barcelona LRT, Arterial

Beijing BRT, Expressway
Guidelines for Developing Good Alternatives

- Make each alternative competitive
  - Develop each alternative based on an analysis of the current market for travel
  - Refine each alternative so it is operationally “feasible” and reasonable, physically, financially

- Establish constant policy setting, but identify policy options (e.g., tolls, traffic management, fares) to be tested
Is More Highway Capacity Needed?

Beijing
Is Metro Enough?

Bangkok

Manila
Rapid Transit Alternatives

- Bus Rapid Transit (BRT)
- Light Rail Transit (LRT)
- Metro
Common Rapid Transit Features

- Objective: High Capacity, performance, and quality

- Physical Characteristics
  - Dedicated running ways, best fully grade-separated
  - Distinct stations with shelter, security, amenities
  - High capacity, easy boarding/alighting vehicles with good internal circulation
  - Supportive Intelligent Transportation Systems (ITS) applications
  - Unique branding
Common Rapid Transit Features

- Service, Operational Characteristics
  - All day, high frequency service
  - Medium stop spacing minimum (0.5-2 km)
  - Simple route structure
  - Off-board fare collection
  - Tight dispatching, supervision
LRT Elements
Light Rail Transit (LRT)

- Vehicles
  - Steel wheeled, high capacity vehicles up to 40 meters long
    - Norm is electric but can be Internal Combustion (IC) propulsion
    - Can be trained up to limits dictated by block lengths in at-grade sections

- Stations
  - Platforms can be low or high, depending on passenger volumes and design constraints
LRT Characteristics

- **Revenue speeds**
  - Key Factors: Station spacing and operating environment
  - Range: 20-50 km/h

- **Maximum capacity**
  - Key Factors: Level of grade separation/dedication and operating environment
  - Range
    - 11,000 Passengers/hour Tramways
    - 30,000 Passengers/hour Fully grade separated

- **Total implementation costs for a line**
  - Key Factors: Design and local cost environment
  - Range: US$15M – $60M/km
Metro

- Highest capacity, highest performance rapid transit system
- Key is *fully grade-separated, dedicated running way and stations, no grade crossings*
  - Can be elevated, in subway, or surface
- Can be automated or manually driven, with “fail-safe” signal system
Metro

- **Vehicles**
  - Up to 23 meters long
  - Electric propulsion system, “third rail” or overhead contact system

- **Stations**
  - Spacing longest of Rail Transport modes >0.75 km
  - Usually high platform stations

- **Service**
  - Frequencies up to 40 trains per hour
  - Service plans with more than one service on a running way or stopping at a station rare in modern systems
Metro Characteristics

- Revenue speeds
  - Key Factor: Station spacing
  - Range: 30-60 km/hour

- Maximum capacity
  - Key Factors: Passing at stations and operating environment
  - Range: Up to 75,000 Passengers / hour

- Total implementation costs for a line
  - Key Factors: Design and local cost environment
  - US$40M – US$200M/km
Transit System Mode Comparison

Source: Montassar DRAIEF - SYSTRA
Operating Costs including Depreciation (US$/seat-km)

Source: Montassar DRAIEF - SYSTRA
Develop Complete, Objective and Reliable Information

- Be transparent
  - Fully disclose an **honest, objective** assessment of benefits, costs, impacts and **risks**

- Address risks
  - Sensitivity analyses (what happens if everything goes wrong)
  - Independent “reasonability” assessment of costs and benefits can build credibility
Forecasting Cautions

- Ridership forecasts
  - Avoid compound optimism
    e.g., Population, employment forecasts, walking distances, transfer penalties, speeds, capacities, fares and other user fees

- All cost forecasts
  - Apply different contingency factors to costs by project component, type of construction, and level of engineering
    - Conceptual planning factors higher than preliminary engineering ones
    - Tunneling factors much higher than for surface construction
Tell a clear, coherent and concise story:

- Problem(s) addressed
- Relative effectiveness and costs of each alternative in addressing the problem(s)
- Why the selected alternative is best
Metropolitan Strategy, Priority Corridors, Alternatives

Number of Alternatives versus Level of Detail

Alternatives Analysis (Project identification)

Feasibility Study/ Preliminary Design

Level of Engineering Definition, Analysis Detail

20% Design
Summary

- Alternatives Analysis is not a feasibility study
- Outlined the Alternatives Analysis process
- Discussed guidelines for effective Alternatives Analysis
- Described key characteristics of rapid transit modes