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Methodologies


Factors Influencing
Travel Demand




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Cluster 2/Module 1 (C2/M1): Factors Influencing Travel Demand.

This presentation is one of the support materials prepared for the capacity building program *Building Leaders in Urban Transport Planning (LUTP)*.

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Objective

This presentation covers the following:

- The importance of understanding the factors that affect travel demand
- The key market factors that drive travel demand
 - Trip characteristics
 - Land use
 - Trip maker demographics
 - Highway and Public Transport system cost and performance parameter

LUTP Factors Influencing Travel Demand (C2/M1) 2

This presentation addresses the factors influencing passenger demand. First, the importance of understanding the factors that affect travel demand is discussed. Travel demand forecasts are used in a variety of public transport management and planning applications

Next the key factors that drive travel demand. These factors are organized in the following categories:

- The traditional and strategic views of the parking problem
- The importance of parking to: 1) travel behavior, 2) “livability” of cities, and 3) traffic flow on roads.
- Off-street issues and policies
- On-street issues and policies



Opening Exercise Daily Work Commute

- **Wife, husband daily commute to work together**
 - **No children, own motorcycle, earn \$2,000 US/month**
- **Travel Options**
 - **Metro**
 - Walk 0.5 km, metro 20 minutes, walk 0.5 km, fare \$.40/person
 - 3-minute peak intervals
 - **Bus**
 - Walk 0.1 km, metro 35 minutes, walk 0.2 km, fare \$.25/person
 - 5-minute peak intervals
 - **Motorcycle**
 - 30 minutes door-to-door, free parking on sidewalk
- **Which travel option makes the most sense?
What factors did you consider?**

One cannot plan, design or operate a successful public transport system without knowing how many customers will use it. In order to analyze or forecast understand public transport ridership, one must understand the factors the influence its magnitude and character. The purpose of this exercise is to get you thinking about market factors that people and their travel choices.

A family of two make a daily commute to offices in the center of Delhi, India.

Both husband and wife work and have no children. They earn about \$2,000 US per month. The family owns one motorcycle.

They have three travel options.

Option 1 is to take the Metro. This travel involves traveling on one line. The travel time on the metro vehicle is 20 minutes. The peak intervals are 3 minutes. The one-way fare is \$0.40 US per person. They must walk 0.5 km from their home to the Metro station and 0.5 km from the Metro station to their offices.

Option 2 is to take the bus. They must walk 0.1 km from their home to the bus stop and 0.2 km from the bus stop to their offices. The travel time on the bus is 35 minutes. The peak intervals are 5 minutes. The one-way fare is \$0.25 US per person.

Option 3 is to drive the motorcycle. The travel time is 30 minutes door-to-door. There is free parking on sidewalk.

Think about the characteristics of the travelers, the commuting trip, and the travel options.

Which travel option makes the most sense for the husband and wife? What factors did you consider?

Please take about 5 minutes to answer these questions.

Why is it Important to Understand Travel Market Factors?

- Basis for estimating ridership
- Uses of ridership estimates
 - Fundamental measure of benefits
 - Essential for planning and design
 - Facilitates performance analysis
 - Revenue and financial sustainability
 - Productivity



One cannot plan, design or operate a successful public transport system without knowing how many customers will use it. Whether evaluating public transport investment alternatives, assessing their feasibility, or planning service, the number of customers or ridership is the basic measure of benefit from which all others, including environmental, social, economic and financial criteria are derived. The costs of providing public transport, both for initial investment and subsequent operations and maintenance as well as operating revenue are also directly related to ridership.

In order to analyze or forecast public transport ridership, one must understand the factors that influence its magnitude and character.

Market Factors

- **Public transport use affected by many factors**
- **No two cities or even neighborhoods have same mix of factors**
- **Mix of public transport service types should match the variety of market factors**



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Public transport usage is affected by many different factors. The vast variety of combinations means that no two cities or even corridors in a single city will have precisely the same public transport travel market.

Public transport systems that do the best job of serving all their customers recognize that each market is unique. They offer an array of different services that are best suited for the different travel markets in their cities.



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Market Factors Affecting Public Transport Use

- Trip characteristics
- Land use
- Trip maker characteristics
- Public transport system factors



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Travel is often characterized by the decisions travelers make when they move from where they are to where they want to go. These decisions include how often and when to travel, where to travel to and how to travel. These decisions are shaped by four sets of factors. These are:

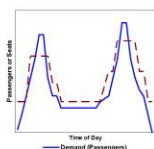
1. Trip characteristics (e.g., trip purpose and time-of-day)
2. Land use at both the travel origin and destination (e.g., suburb to suburb or urban core to urban core)
3. Trip maker characteristics (e.g., household size and income, traveler age and gender)
4. Public transport system factors (e.g., origin to destination travel times and costs by mode)

Each type of factor is discussed in the next slides. Trip characteristics is the subject of the first discussion.

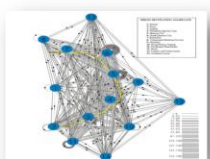
Trip Characteristics



Purpose



Time-of-Day



Trip Distance

The choice to use public transport is affected by the type of trip that will be taken. The most important trip characteristics that impact travel decisions (and, hence, the market for public transport) are travel purpose, the time of day the respective trip is made, and its origin and its destination. These are discussed in the next three slides.

Trip Purpose

- **Non-work**
 - Shopping, personal business, medical, recreational, religious
 - Occasional trips: 1 – 3 times/week
 - Discretionary trips means users can forgo them, change timing or combine them
 - People often travel as a group, e.g., family
- **Work/school trips**
 - Recurring (e.g., 5 days/week)
 - Not-discretionary, more tightly scheduled
 - Workers/students travel as individuals



Trip purpose has an important impact on the decisions of travelers. . First, some trip purposes involve group travel (e., g., social recreation) while others are made individually (e.g., work). Individuals traveling alone pay a single transit fare, while travel groups must pay multiple fares. At the same time, person costs for some modes (e.g., taxis, autos and even motorcycles) decrease the larger the traveling group.

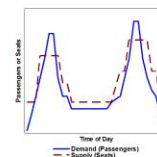
Second, travelers making some types of trips may be carrying packages (e.g., for shopping) or luggage, making public transport use difficult.

Work and school trips are recurring and frequent, while others (e.g., to a special event) are occasional. Cost is a more important factor for frequently recurring trips (e.g., every day), while obtaining basic public transport route and schedule information is an issue for trips made to fulfill unexpected needs.

Finally, some trips are combined with others in what is known as a “trip chain,” or “tour,” especially for women working outside the home. Tours can be difficult on public transport if travelers must pay multiple fares, and endure multiple long waits, especially if traveling with a child or packages.

Travel Time-of-Day

- **Peak** — morning/afternoon commuting hours
 - Concentrated in a few hours to few destinations
 - High percentage of work trips
 - More individual travel
- **Off-Peak** — midday, evening, weekend hours
 - Spread out over day to many destinations
 - More non-work travel
 - More group travel
 - Safety, security issues



The time of day and/or day in the week that travel occurs also has a large impact on travel behavior. Safety and security are important concerns at night, especially for women and other vulnerable travelers. There are fewer travel choices available for off-peak travel because of lower demand, and they are often priced differently than they might be during peak periods when congestion is also higher.

As noted above, peak travel tends to be made by people traveling as individuals for work or school, while group travel often occurs during off peak periods and/or on weekends. Peak travel also tends to be focused on work destinations, which tend to be few in number in developing cities and concentrated, while off-peak travel destinations tend to be more diffuse.

Trip Distance



Extremely short trips (2 km) mostly made by walking



Bicycles viable option up to 8 – 10 km



Conventional bus trip lengths generally 5 – 10 km in developing cities



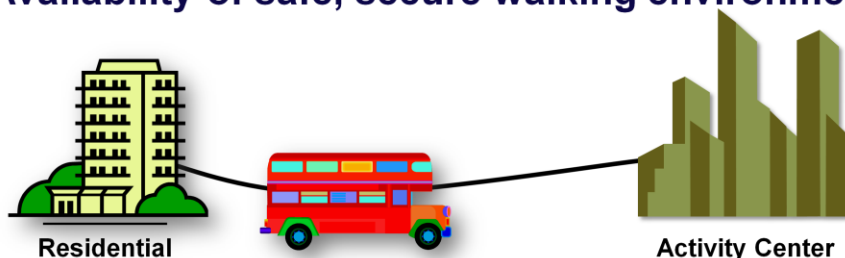
Urban rail trip length average over 8 km

The distance between origins and destinations is a big determinant of mode choice. Walking and biking are attractive for short trips because they are low cost (free) and the trip can be started immediately (no waiting for the vehicle). However, they are increasingly unattractive for longer trips.

The longer the trip, the more attractive public transport becomes relative to non-motorized modes and even private motorized vehicles (two as well as four wheeled). A negative aspect of using public transport is the time spent walking to and from the transport service and waiting for the vehicle to arrive. As these fixed times becomes a smaller and smaller proportion of the total trip time on long trips, they are less of a deterrent to the use of public transport. Longer trips in congested conditions are more onerous for private motorized vehicle drivers than for high quality public transport passengers.

Land Use

- **Intensity/density**
 - Residential (origin)
 - Activity center (destination)
- **Mix of Uses**
- **Availability of safe, secure walking environment**



Land use is the second category of market factors affecting public transport use. Land use at both trip ends, origin and destination has a very dramatic impact on public transport and other travel demand.

Dense, the pedestrian-friendly land use makes public transport more attractive to travelers in comparison to private modes. Walking through vibrant, multiple-use, safe and secure areas makes getting to and from public transport less onerous.

Relatively dense, multi-use areas also facilitate trip-chaining on foot (combining several trips together). This also makes public transport relatively more attractive.

Lower density, sprawling single purpose (e.g., residential) development results in long trip lengths. Public transport is relatively unattractive because of: 1) the difficulty of accumulating enough demand to support a high level of service and 2) long walks to and from the transport services.

Making significant land use changes that increase public transport use is a long term process. It requires commitment and enforcement of supportive policies.

Density and Walkability Affects Public Transport Use

- **Public transport works best for trips between:**
 - *High density, “walkable” residential and*
 - *High density “walkable” non-residential areas (e.g., traditional central business districts)*
 - *That are arranged linearly along major arterials*
- **Traditional public transport does not serve well trips between:**
 - *Low density residential areas and*
 - *Low density employment areas*
 - *That are arranged randomly*



All trips by any mode involve some amount of walking at both ends. However, by its very nature, public transport often will require the most walking. For public transport to be attractive:

- Development densities must be high
- Employment, residences, stores, etc. must be placed to be as close as possible to public transport
- Time spent walking to and from stops, stations and terminals must be brief, direct, safe, secure and pleasant

Though bicycle, local bus and autos can provide good access to high performance public transport (e.g., BRT, LRT, metros) in relatively low density areas, at least one trip end, preferably the non-home end, should be in the kind of transit-friendly environment described above. If both trip ends do not have these characteristics, then the probability of using any form of public transport in lieu of private motorized modes will be low.

Pedestrian-Friendly Streets Beijing Examples



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These pictures show pedestrian-friendly and bicycle-friendly streets in the old sections of Beijing. These are excellent markets for public transport.

Important Trip Maker Characteristics

- Income
- Household (family size)
- Gender
 - Proportion women working outside home
- Age
 - Percentage of young and old



Trip maker characteristics is the third category of market factors affecting public transport use. Income and, to a certain extent, family size are related to the probability that there are travel options available and how their attributes are valued. Age and gender relate to the importance of safety and security to women and the young and the old.

Let us long at each of these important characteristics.

Income is Most Important Demographic Factor

- **Low income**
 - **Affordability**
 - A problem when daily fares > 10% to 20% of daily income
 - Concessionary fares can help
 - **Alternatives are walking, bicycling**
- **Medium income**
 - **Affordability generally not an issue**
 - **More alternatives**
 - e.g., informal taxis, formal taxis, two-wheelers (motorized)
- **High income**
 - **Affordability not an issue**
 - **Autos are basic alternative**

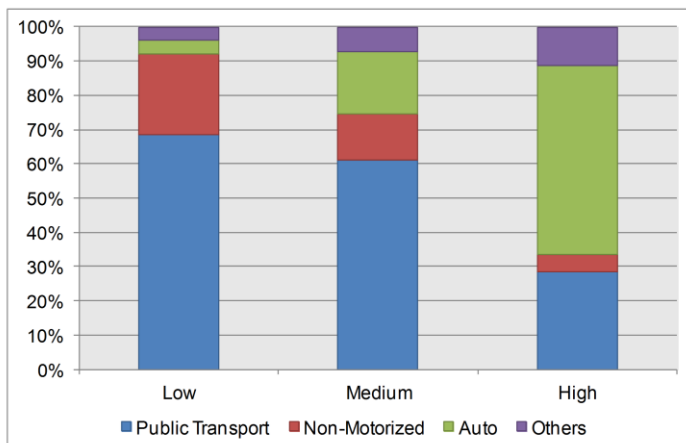


Lower income individuals and families generally have high usage rates of non-motorized vehicles and public transport. They have fewer options available since private motorized travel often is unaffordable. They also place lower values on extra travel time which means that they will accept riding slower modes.

The lowest-income travelers may not even be able to afford public transport. Instead, they may make all their trips by walking. They may use bicycles for some trips if they can afford them.

As income increases, public transport and two-wheeled, motorized private modes are affordable and are travel options. These travelers place higher values on extra travel time so they choose to use faster modes.

Bogota Travel by Income Group



This slide illustrates the rising propensity to use autos with rising income. It also illustrates the importance of non-motorized transport among lower income travelers in Bogota, a medium-income, developing city.

Household Size

- Household size impacts trips rates as well as mode choice
 - Smaller household sizes have higher total per capita trip rates
 - The impact of household size on public transport use is mixed
 - Smaller traveling groups favor public transport
 - Smaller household size may mean higher per capita income and higher per capita auto or motorcycle availability



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Household size impacts trips rates as well as mode choice. The smaller the household size (tendency everywhere as incomes rise) the higher the trip rate per capita. This occurs because fewer trips are made by a single traveler that serve the needs of others, e.g., for food shopping.

However, the smaller the household size, the more attractive public transport becomes for traveling in groups. As travel group size gets larger, other modes such as taxi become cost competitive. For example, it may be cheaper for a group of six to travel to a concert by taxi. However, for a group of two, public transport may be a cheaper option for going to the concert.


Income also affect travel choices by households. Small households with medium to high income have a higher propensity to use private motorized modes because of the higher probability that a vehicle will be available to each household member for any trip.





Gender

- **Men are a larger proportion of public transport riders in developing cities**
 - **Lower proportion of women working**
 - Higher proportion of women using public transport on weekends when non-work trips increase
 - **Combining of trips (trip chaining)**
 - **Religious rules**
- **Women's safety/security concerns**
 - **Lighting at stops**
 - **To stop/from stop**



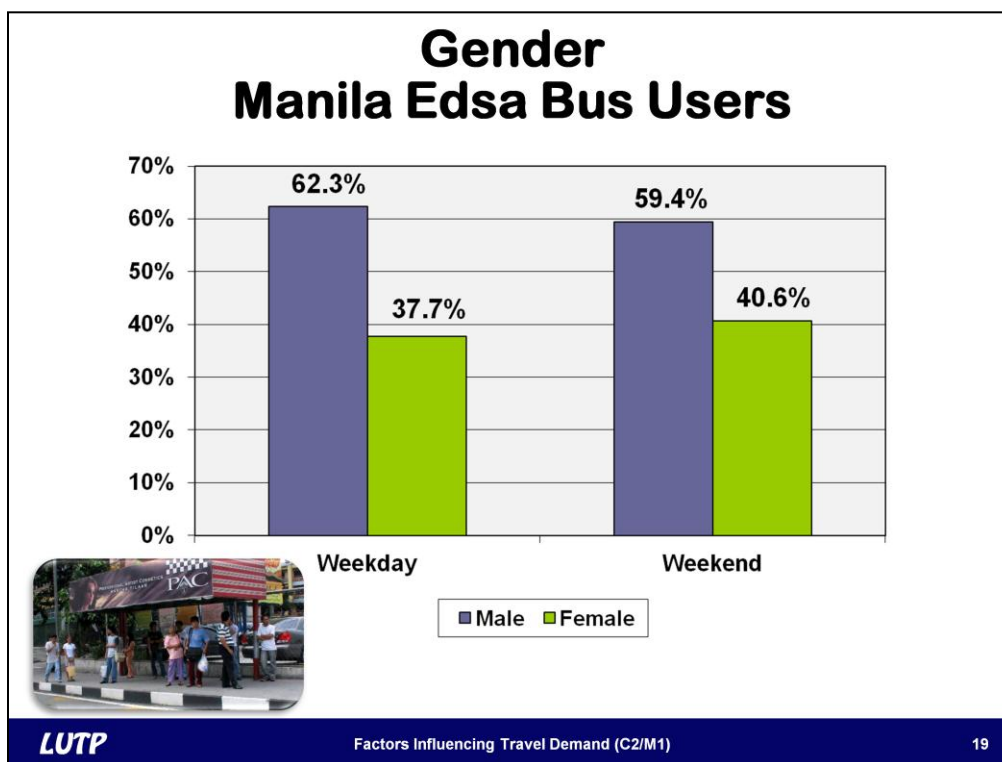
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Though often overlooked as a factor impacting travel behavior, gender's influence is extremely important. Men generally are a larger proportion of public transport riders in developing cities. There are several reasons. First, in many developing countries, a lower portion of women than men work at jobs that require commuting travel.

Second, whether working at home or outside, women are more likely to combine trips (trip chains) rather than make individual trips from home and back. This means that women may make less public transport trips than men even though they travel to the same number of destinations.

Finally, in some countries, religious practices discourage women from even traveling next to or even in the same vehicle as men who are non-family members. This makes conventional public transport use difficult if not impossible.

Women are much more concerned about safety and security than men. This is true not only at stops or in vehicles but also when walking to and from them. In some situations, women may avoid making public transport trips that men would make because of these concerns.



This chart illustrates the different use patterns of men and women by day of the week on buses using the Manila ring road, “Edsa.” In a traditional society with large families, men are much more likely to work outside the home than are women. Public transport is very crowded on workdays, especially during peak periods. This results in a much higher proportion of men on public transport on work days.

On weekends, the majority of riders are still men, but the proportion of women is slightly higher. This suggests that women are more likely to use public transport for non-work purposes, especially when it is less crowded and, therefore, more secure from pickpockets and gropers.

Age

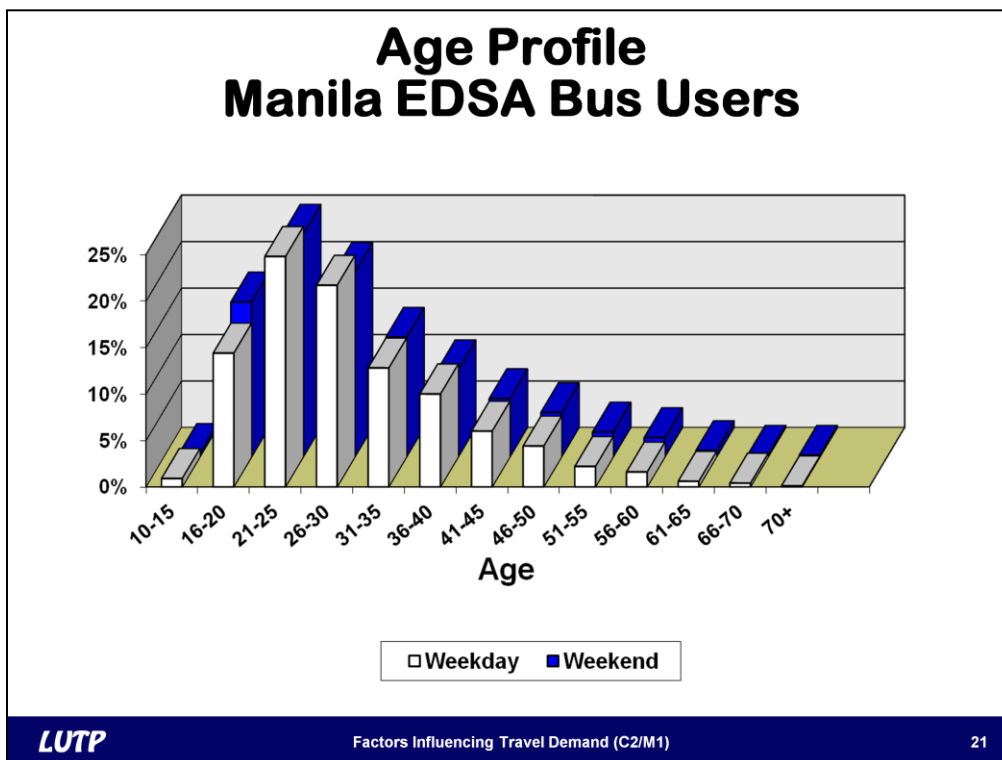
- **Majority of PT users between 16 – 40**
 - **Workers**
 - **Students**
- **Fewer older workers, students**
 - **They may have money for taxis and other forms of private transport**
- **More younger travelers on weekends**



The peak age for public transport use is from 16 to 40 in most developing cities. Below that age, travel is more limited, trip lengths are shorter and many more trips are made by walking.

Above 40 years of age, incomes are higher. Therefore, the possibility of using motorized modes, motorcycle, three and four wheeled taxis and autos is much higher.

Above 65 years of age, people make less trips in general, work trips in particular. The physical condition also starts to impact the ability to walk to and from public transport stops, on vehicles, and within stations and terminals.



Note that public transport use on Edsa bus routes is higher on weekends both for the young (16-20 years of age) and old (>45 years).

Public Transport System Factors

- **Levels and quality of public transport service**
 - **Travel times, transfer requirements, reliability**
 - **Convenience, comfort**
 - **Access/egress difficulty**
- **Public transport fares**
 - **If affordable, availability of other travel options**
- **Characteristics of other modes**
 - **Travel times**
 - **Costs**



Public transport system factors is the last category of market factors affecting public transport use. The characteristics of the public transport system play a huge role in the travel decision process both in absolute terms and relative to other available options. The level of service, cost and “quality” of public transport are of paramount importance irrespective of incomes. In contrast, the notion of public transport as an alternative to driving is important only to auto owners, particularly when the difficulty and cost of driving becomes high relative to public transport .

For low income travelers in developing cities, the most important alternatives to public transport are bicycling which become more attractive as fares rise. Higher income travelers look for higher quality and fast motorized travel options.

The amount and quality of public transport has both short and long term impacts. In the short term, it impacts the frequency of trip making and modes and routes taken. In the long term, it affects land use as is discussed in another module.

Levels and Quality of PT Service

- **Frequency is important**
 - Meet user's specific departure/arrival times
 - Impacts waiting times
- **All travel time not the same**
 - Waiting, transferring, walking time more important than riding time
 - Amenities can mitigate some impacts
- **Reliability as important as travel time**
- **Comfort/crowding key quality factor, particularly for:**
 - Women
 - Older people
 - Travelers with choices



Travel times and reliability are the most important factors, and they increase in importance as incomes rise. The time spent in all parts of a trip are not viewed as equally onerous by travelers. Walking, waiting and transfer times are viewed by travelers as over 2 times as problematic as time spent riding.

Initial waiting and subsequent transfer times are directly related to public transport frequency. When a transfer is required for a particular origin-to-destination trip, it can be as onerous as adding 10 minutes of riding time. The exact "penalty" depends on the type of trip, the traveler, and the transfer environment.

As incomes increase, travel times, comfort and convenience become increasingly important. Measures of comfort include whether a seat is available and the level of crowding (especially important for women). Convenience is most often related to service frequency (can I arrive at a stop randomly and not have to wait too long?) and span of service (If I leave work late, will public transport be available?).

Availability of Safe, Secure Non-Motorized Access

- **Availability and management of safe, secure access are important determinants of PT use**
 - **Pedestrian access**
 - Sidewalk coverage
 - Crossings
 - Lighting
 - **Bicycle facilities**
 - Bikeways
 - Bicycle parking
 - **Stations**
 - Shelter
 - Lighting



A critical, but often overlooked demand factor, is the ease of getting to the public transport stop. Not everyone can have a short, easy walk to and from public transport, so ridership is heavily dependent on making traveling to and from stops as easy as possible. This means improving the walking environment through better sidewalks, street crossings and lighting. It also means providing bikeways and secure parking for bicycles

Fare Impact on Public Transport Use

- **Affordability**
 - Is Public Transport a feasible option?
- **Relative prices of feasible alternatives**
 - Bicycle purchase
 - Taxi fares
 - Two-wheeler/auto fuel, parking

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Out of pocket travel costs are important, especially for lower income travelers. As incomes and fares rise, the number of available options increases. Absolute affordability is an issue as are costs compared to other non-motorized and motorized (e.g., motorcycle taxis) options which offer a similar level of mobility.

For discretionary trips (e.g., shopping, social-recreational) , higher fares may lead to trip chaining with an essential (e.g., work) trip, using a non-motorized mode or not making the trip at all.

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Summary



- **A variety of factors influence travel demand**
 - Trip characteristics
 - Land use
 - Trip maker characteristics
 - Public transport system factors
- **Cities and corridors have unique transport markets and mixes of these factors**
 - Case-by-case travel analysis needed for good transport decision making
- **Land use and transport interventions can affect travel demand**
 - Transport interventions have short/long term impacts
 - Land use interventions have long term impacts

This presentation provided an overview of the factors that affect travel demand. Understanding these factors is critical to designing and operating good public transport.

We covered the four basic set of factors that affects the use of public transport —, trip characteristics, land use, trip maker characteristics, and public transport system factors.

The vast variety of combinations of these factors means that no two cities or even corridors in a single city will have precisely the same public transport travel market. Public transport systems that do the best job of serving all their customers recognize that each market is unique. They offer an array of different services that are best suited for the different travel markets in their cities.