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

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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 are discussed. These factors include:

- Trip characteristics
- Land use
- Trip maker demographics
- Public Transport system cost and performance parameters.
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 public transport ridership, one must understand the factors that influence its magnitude and character. The purpose of this exercise is to get you thinking about market factors that affect people and how they make 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 US $0.40 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 US $0.25 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.
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 (initial investment and subsequent operations and maintenance) and operating revenue are directly related to ridership.

In order to analyze or forecast public transport ridership, one must understand the factors that influence its magnitude and character.
Public transport use 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.
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.
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 when the respective trip is made, and its origin and destination. These are discussed in the next three slides.
Trip purpose has an important impact on the decisions of travelers. First, some trip purposes involve group travel (e.g., social-recreational) 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.
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. They are often priced differently than they might be during peak periods when congestion is 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. Off-peak travel destinations tend to be more diffuse.
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 become 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 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, 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 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.
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 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.
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 population
    - Young
    - 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 look at each of these important characteristics.
Low-income people generally have high usage rates of non-motorized vehicles and public transport. They have fewer options available since private motorized travel often is unaffordable. These people 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 travel time so they choose to use faster modes.
This slide illustrates the rising propensity to use autos with rising income. It also illustrates the importance of non-motorized transport among low-income travelers in Bogota, a medium-income, developing city.
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 a single traveler few or no trips to 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 affects 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.
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 proportion 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 using conventional public transport by women 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.
The peak age for public transport use is from 16 to 40 years old 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 such as 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. Also, physical condition starts to impact the ability to walk to and from public transport stops, get on and off vehicles, and travel 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 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.
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?).
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.
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 taxies) 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.
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 affect 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.