Evaluating Transit Stops and Stations from the Perspective of Transit Users

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Executive Summary

Travel by public transit involves much more than moving about on buses or trains. A typical door-to-door trip entails walking from one's origin to a bus stop or train station, waiting for one's vehicle to arrive, boarding the vehicle, traveling in the vehicle, alighting from the vehicle, and then walking to one's final destination. In many cases, the trip involves transfers; travelers frequently alight from one transit vehicle, move to a new stop or platform, wait for another transit vehicle, and board that vehicle. Transit travelers expend a great deal of time and energy on this out-of-vehicle walking and waiting, which plays greatly into their perceived burden of transit travel. Despite the importance of out-of-vehicle transit travel, the in-vehicle travel experience has tended to garner the lion's share of attention from transit managers and researchers. Accordingly, this study is concerned with the out-of-vehicle segments of transit travel and with ways to reduce the burdens of walking, waiting, and transferring.

What are the best ways to reduce these out-of-vehicle travel burdens? Are some approaches to improving the "interconnectivity" among transit lines, modes, and systems more cost-effective than others? Can improvements be made in a stand-alone fashion, or do they need to be implemented in concert with other improvements? Do different types of transit travelers tend to perceive the burdens of walking, waiting, and transferring differently? These are some of questions we aim to address in this research. To do so, we have developed a methodology based on travel behavior research, which we use to evaluate the components of the out-of-vehicle travel experience. Such information should help transit planners cost-effectively improve operations at transit stops and stations.

In this report, we focus on factors that are important from the passengers'/users' perspective. More specifically, the analysis presented in this report has sought to address the generally absent causal clarity that plagues most previous research on transit stops and stations. Accordingly, we have examined: (1) how passengers evaluate transit stops and stations, taking into account the level of importance passengers place on each factor, and (2) what factors influence passengers' evaluation of transit stops and stations using the five evaluation criteria developed from the transfer penalties causal framework developed in a previous report:

1) *access*,
2) *connection and reliability*,
3) *information*,
4) *amenities*, and
5) *security and safety*.

Using this framework we designed a survey to examine user perceptions of each of these five evaluation criteria and administered the survey to 749 transit passengers at twelve transit stops and stations (which ranged from adjacent corner bus stops to a large enclosed multi-modal transit center) around metropolitan Los Angeles. In particular, we asked transit passengers to assess the level of importance of multiple service features, and their level of satisfaction at the stop or station where the survey was administered under the current conditions on a four-point scale from "very important" to "not important", and "strongly agree" to "strongly disagree", respectively. The demographics and travel patterns of those surveyed generally mirror those of southern California transit users in general.

Drawing on the data collected from this survey, we conducted two types of analyses: First, we conducted an *Importance-Satisfaction Analysis* to identify which attributes passengers found most important (importance) and which needed the most improvement (satisfaction). Second, we used *chi-square tests*, *correlation tests*, and *multiple regression analyses* to determine the relative importance of the five-category attributes to users' satisfaction with the transit facility and to examine which transit stop and station attributes measured in the physical inventory were related to the satisfaction level of transit users.

From these analyses, one principal finding stands out loud and clear: the most important determinant of user satisfaction with a transit stop or station has nothing (directly) to do with physical characteristics of that stop or station – it is frequent, reliable service in an environment of personal safety. In other words, most transit users would prefer short, predictable waits for buses and trains in a safe, if simple or even dreary, environment, over long waits for late-running vehicles in even the most elaborate and attractive transit station, especially if they fear for their safety. While this finding will come as no surprise to those familiar with past research on the perceptions of transit users, it does present a contrast to much of the descriptive, design-focused research on transit stops and stations.

In total, we examined sixteen stop and station attributes and, of these, users ranked safety and service quality factors as most important:

<u>Most Important</u>

1. I feel safe here at night (78%)
2. I feel safe here during the day (77%)
3. My bus/train is usually on time (76%)
4. There is a way for me to get help in an emergency (74%)
5. This stop/station is well lit at night (73%)
6. I usually have a short wait to catch my bus/train (70%)

In contrast, stop and station-area amenities – the ostensible focus of this research – were ranked as least important by users:

<u>Least Important</u>

11. It is easy to get route and schedule information at this stop/station (62%)
12. There is a public restroom nearby (59%)
13. This stop/station is clean (58%)
14. It is easy to get around this stop/station (57%)
15. There are enough places to sit (50%)
16. There are places for me to buy food or drinks nearby (34%).

This is not to say that such amenities are not important to travelers – more than half ranked information, a public restroom, cleanliness, and ease of navigation – as important. Rather, *ceteris paribus*, travelers prefer safe, frequent, reliable service over these factors.

However, when we statistically related users' satisfaction with various stop/station attributes with their overall satisfaction with their wait/transfer experience, we got similar, though not identical, results:

Most Important

1. It is easy to get around this stop/station.
2. I feel safe here during the day.
3. Having security guards here makes me feel safer.
4. It's easy to find my stop or platform.
5. The stop/station is well lit at night.
6. My bus/train is usually on time.

Least Important

11. This stop/station is clean.
12. There is shelter here to protect me from the sun or rain.
13. There is a way for me to get help in an emergency.
14. There are enough places to sit.
15. There are places to buy food or drinks nearby.
16. There is a public restroom nearby.

Following this, we then employed a logistic regression model to measure the influence of each of 16 attributes on overall satisfaction, while simultaneously controlling for the effects of all other measured attributions on satisfaction. This sort of an analysis tends to eliminate all but one of closely related factors (such as "I feel safe here at night" and "This stop/station is well-lit at night") while elevating ostensibly less-important factors that independently influence users' overall levels of satisfaction:

Most Important

1. My bus/train is usually on time.
2. Having a security guard here makes me feel safer.
3. This stop/station is well lit at night.
4. I feel safe here during the day.
5. It is easy to get around this station/stop.
6. The signs here are helpful.

Finally, we performed an extended series of statistical tests in an attempt to relate the physical attributes of stops and stations (as collected in our station inventories) with the surveyed passengers' perceptions of these attributes. These results were largely as expected. While we were not able to draw firm conclusions regarding how these various attributes were related to overall user satisfaction levels, we did identify specific attributes that predict users' satisfaction levels. These attributes include graffiti, visibility, and the presence of seating area, restroom, and shelter. At the same time, we found the results of other variables, such as the availability of services, call boxes, protection from rain, utilization of the stop or station, and the presence of hiding areas, to be counter-intuitive. Many of this last set of findings, however, are best viewed as preliminary, and likely require further investigation.

While perhaps surprising to those interested in the influence of urban design on travel, these findings should be heartening to transit managers focused on delivering quality transit service to users. While comfortable, informative and attractive stops and stations can indeed make traveling by public transit more agreeable, all things being equal, what passengers want most is safe, frequent, and reliable service – plain and simple.

Key words: travel behavior, transit user perceptions, out-of-vehicle travel, wait/transfer burden, transit stops, transit stations, transfer facilities, user satisfaction survey, Importance-Satisfaction analysis, ordered logit analysis

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1. PREFACE

Travel by public transit involves much more than moving about on buses or trains. A typical door-to-door trip entails walking from one's origin to a bus stop or train station, waiting for one's vehicle to arrive, boarding the vehicle, traveling in the vehicle, alighting from the vehicle, and then walking to one's final destination. In many cases, the trip involves transfers; travelers frequently alight from one transit vehicle, move to a new stop or platform, wait for another transit vehicle, and board that vehicle. Transit travelers expend a great deal of time and energy on this out-of-vehicle walking and waiting, which plays greatly into their perceived burden of transit travel. Despite the importance of out-of-vehicle transit travel, the in-vehicle travel experience has tended to garner the lion's share of attention from transit managers and researchers. Accordingly, this study is concerned with the out-of-vehicle segments of transit travel, and with ways to reduce the burdens of walking, waiting, and transferring.

What are the best ways to reduce these out-of-vehicle travel burdens? Are some approaches to improving the "interconnectivity" among transit lines, modes, and systems more cost-effective than others? Can improvements be made in a stand-alone fashion, or do they need to be implemented in concert with other improvements? Do different types of transit travelers tend to perceive the burdens of walking, waiting, and transferring differently? These are some of questions we aim to address in this research. To do so we have developed a methodology based on travel behavior research, to evaluate the components of the out-of-vehicle travel experience. Such information should help transit planners cost-effectively improve operations at transit stops and stations.

The research project, *Tool Development to Evaluate the Performance of Intermodal Connectivity (EPIC) to Improve Public Transportation*, will assist the California Department of Transportation, regional and local transportation related entities, transit operators, and other stakeholders in understanding which attributes of transit stops and stations are important to users, operators, and communities. Our study evaluates interconnectivity issues pertaining to travel and identifies opportunities and solutions for improving transportation systems.

This report is the third deliverable of this effort; the first two deliverables documented our reviews of the literature. In the first deliverable, we focused on factors at transit stops and stations that influence transit users' experience in transit trips. Reviewing a large number of studies conducted on the subject of travel behavior, we developed a transfer penalties framework to relate transit waiting time, walking time, and transfers to people's generalized cost (or utility) in their transit trips. Based on this framework, we also suggested a classification of factors relating to out-of-vehicle travel time (waiting, walking, transferring, etc) to examine which part of transfer penalties would likely be affected by various improvements to transit service, stops, and stations. This framework provides a theoretical basis for developing methods to evaluate the connectivity performance of transit stops and stations systematically and meaningfully. This approach is very different from a vast majority of past studies, which have focused heavily on design aspects. In these design-focused studies, most of the suggested improvements have seemed intuitively correct, though the actual effects on travel behavior remain relatively ambiguous and unexamined.

Three important findings from the first deliverable are: 1) that we should include both *intermodal* and *intramodal* transfers in the study of transit stops and stations, 2) that we should

include attributes in the operation and management aspects as well as attributes of the physical environment in our evaluation of transit stops and stations, and 3) that evaluation methods can be either qualitative or quantitative or both.

In the second deliverable, we focused on the evaluation of connectivity performance at transit stops and stations by identifying those evaluation criteria or factors that are relevant to understanding the achievement of transit connectivity. We formulated a three-branch classification system of such factors important to 1) passengers/users, 2) transit operators/managers, and 3) the neighboring communities' perspectives. This and subsequent project deliverables investigate those factors at transit stops and stations that are important from each of these perspectives.

In this third deliverable, we report o ur research on factors that are important from the passengers'/users' perspective. More specifically, we address questions on: 1) how passengers evaluate transit stops and stations, taking into account the level of importance passengers place on each factor, and 2) what factors influence passengers' evaluation of transit stops and stations. To collect data for this analysis, we conducted a survey of transit passengers in metropolitan Los Angeles, asking a series of questions about their experiences at transfer stops and stations.

This component of the research helps us to achieve the project's central goal of developing the means by which transit stakeholders may assess the performance of transit connectivity. The findings from this research form the basis for the project's continuing process in identifying and investigating the important factors of transit stops and stations influencing people's travel behavior and their contribution to growth in ridership.

2. INTRODUCTION

As cities have grown more dispersed and auto-oriented, the relative burdens of out-of-vehicle time in transit trips have increased. In an effort to accommodate increasingly dispersed patterns of trip-making, many transit systems in U.S. metropolitan areas now require transit users to make frequent transfers among lines, modes, and operators. In metropolitan areas with large transit systems, transit stops and stations are central parts of the transit network, playing an important role in connecting multiple transportation systems — both *intermodal* and *intramodal*. The effectiveness of connectivity influences travelers' experience at transit stops and stations, and, in turn, their choice of whether or not to take a particular transit trip. Given the importance of out-of-vehicle times on travel choices, good connectivity at such transit stops and stations is a critical part of overall transportation network effectiveness.

While many previous studies have investigated the improvements at transit stops and stations, this past research has, in general, lacked causal clarity of how such improvements can increase transit ridership. Most of these studies were conducted from a design perspective, and suggest improvements at transit stops and stations that are often obvious (e.g. providing more seats and shelters, improving lighting, keeping facilities clean). However, these studies do not show the relative importance of various stop/transfer factors in actually influencing people's travel behavior, or how they might work in concert (Rabinowitz et al. 1989; Fruin 1985; Kittelson & Associates 2003; Vuchic and Kikuchi 1974; Evans 2004). This lack of clarity or causality is a problem, making it difficult for transit managers to improve the quality of waiting and transfers at transit stops and stations cost-effectively.

The focus of this report is on the evaluation of the waiting and transfer experiences from the passengers' perspective. Specifically, we examine: 1) how passengers evaluate transit stops and stations, taking into account the level of importance passengers place on each factor, and 2) what factors influence passengers' evaluation of transit stops and stations. Throughout this report, we use the five evaluation criteria of transit stop and station attributes drawn from the transfer penalties causal framework developed in a previous report for this project:

1) *access*,
2) *connection and reliability*,
3) *information*,
4) *amenities*, and
5) *security and safety*.

This classification helps us identify how different *types* of improvements at transit stops and stations can affect people's travel behavior through transfer penalties and, thus, affect transit system use.

Our investigative method centers on the use of a survey instrument designed to collect data from passengers at transfer stops and stations in the metropolitan Los Angeles area. We also conducted an inventory of the quality of service and attributes at the same transfer stops and stations.

The analysis presented in this report has two parts. The first analytical method, *Importance-Satisfaction Analysis*, allows us to identify the priority that users place on improving the various facility attributes included in our study. *Importance-Satisfaction Analysis* allows us to make recommendations that will maximize the impact that new investments have on customer satisfaction by emphasizing improvements in those areas where the level of satisfaction is relatively low and the perceived importance of the issue is relatively high. In the second part of our analysis, we use the chi-square test, correlation test, and advanced regression analysis to examine which attributes at transit stops and stations measured in the inventory are related to the satisfaction level of transit users.

In summary, we find that improvements of (1) service quality (i.e. good *connection and reliability*) and (2) personal *safety and security* are much more important to transit users than physical conditions of transit stops and stations. In addition, while the analysis showed the highest need for improvement in the *amenities* category, transit agencies do not always have jurisdictional authority to change the physical aspects of the transit stations and stops.

We found in our regression analysis that the passenger's level of satisfaction with attributes in the categories of *connection and reliability* and *safety and security* significantly affect the passenger's overall satisfaction level with a transit stop or station. We also found satisfaction with attributes related to *access* and *information* were important determinants of overall satisfaction. On the other hand, none of the variables related to *amenities* were found to be important in determining overall satisfaction levels. While we were not able to draw firm conclusions regarding how these *amenity* attributes were related to overall user satisfaction levels, we did identify specific station inventory elements that predict users' satisfaction levels in intuitive ways. These attributes include graffiti (lower satisfaction), visibility, and the presence of seating areas, restroom, and shelter (higher satisfaction). At the same time, we found the

results for other variables to be counter-intuitive, such as the availability of services, call boxes, protection from rain, utilization of the stop and station, and the presence of hiding areas. Many of these findings, however, are best viewed as preliminary, and require further investigation.

Following this introduction, we describe the design, administration, and implementation of the transit user perception survey and our researcher-identified inventory of attributes at transit stops and stations. We then report on our analysis of the demographics of survey respondents and the characteristics of their trips. Following this section, we report the results from our *Importance-Satisfaction (IS) Analysis* and other statistical analyses. Finally, we conclude with a summary of our findings.

3. TRANSIT USER PERCEPTION SURVEY AND FACILITY INVENTORY

Transit User Perception Survey

Transit stops and stations are an essential part of transit service. It is therefore important to consider these facilities from the point of view of the customer ─ both new and experienced riders. To gain this perspective, we designed a user survey to identify potential improvements to the transit transfer process. The questionnaire contained 29 self-administered questions to assess passenger perceptions of transit stops and stations, and was made available in English and Spanish. Appendix 1 contains a copy of the survey.

The development of the user survey was based on the travel behavior literature and transfer penalties framework, which identified the attributes of transit stops and stations where transit agencies can reduce wait, walk, and transfer penalties for facility passengers (Rabinowitz et al. 1989; Fruin 1985; Kittelson & Associates 2003; Vuchic and Kikuchi 1974; Evans 2004; Iseki and Taylor 2007). Such attributes can be classified into one or more of the following five impedance factor categories: 1) *access*, 2) *connection and reliability*, 3) *information*, 4) *amenities*, and 5) *security and safety*. The development of these five categories of transit stop attributes originated with work at the Department of the Environment, Transport and the Regions (DETR) in the United Kingdom, which produced the "Guidance on the Methodology for Multi-Modal Studies (GOMMMS)" to provide an appraisal framework to evaluate the impacts of different transportation options (Department for Transport 2003). After examining all references to these categories in the literature reviews (Iseki and Taylor 2007), we disaggregated each category into further sub-groupings and removed all duplicates. We also examined numerous existing onboard surveys conducted by transit agencies, and incorporated basic ideas of questions into our questionnaire in an effort to increase comparability with existing research.

Our objective in designing a survey instrument was to address one of the primary weaknesses of the literature ─ that existing studies have only provided simple unranked lists of transit stop and station attributes; there has been no mention of the relative importance or comparison across such factors from the users' perspective. Overall, there is little mention in the literature of facility evaluation factors from the users' perspective. Taking into account these objectives, we concluded that both a quantitative and qualitative approach was necessary to combine observational data of transit stop and station attributes with users' perceptional data for each of the five impedance categories. Observations alone would not suffice, as these do not tell the whole story of users' perceptions, which play a significant role in understanding travel behavior and the use of public transportation.

The survey is useful in assessing both the current state of passengers' feelings about transit stops and stations, as well as opportunities for facility improvements. By knowing the users' needs, a priority can be placed on improving those areas that are of most importance to the user. The survey included questions regarding trip purpose, available mode alternatives, station accessibility, and various demographic elements. It further provided respondents the opportunity to rate transit stop and station attributes according to satisfaction and importance. The user survey allowed us to gauge the relative importance of the five attributes from the users' perceptions and correlate it with our findings from the site visits.

Discussion of Treatment and Control Variables

The survey included both treatment and control variables. The treatment variables are independent variables based on the five criteria associated with transit stop and station attributes thought to affect transfer penalties. We identified five key control variables that were used to help analyze the relationship between other variables. The following list summarizes the treatment and control variables used in the creation of the survey.

Treatment Variables:

1) **Safety & Security**
    - **a.** Security personnel (guards, transit police)
    - **b.** Video surveillance equipment
    - **c.** Visibility/lighting
    - **d.** Emergency communication devices (telephones, call boxes)
    - **e.** Infrastructural safety (visible and/or tactile strips at edge of loading areas, guardrails to control circulation at points of crowding)
2) **Amenities**
    - **a.** Comfort (TV, benches, restrooms, telephones, lockers, water fountain, smoking room, etc.)
    - **b.** Service (commercial enterprises to purchase items such as food, photo shop, shoe shining, flowers, cigarettes, etc.)
    - **c.** Weather protection (shelters)
    - **d.** Aesthetics/cleanliness (absence of graffiti and litter)
3) **Access**
    - **a.** Outside:
        - **i.** Flow control management/Infrastructure (physical)
        - **ii.** Directional Information
    - **b.** Inside:
        - **i.** Flow control management/Infrastructure (physical)
        - **ii.** Directional Information
4) **Information**
    - **a.** What, where, and how do passengers access information?
5) **Connection & Reliability**
    - **a.** Connection (distance and time it takes to make connections)
    - **b.** Reliability (on-time performance/frequency-headway)

Control Variables:

1) **Transfer facility type** (Level 1 – 5)
    - *Level 1* is the simplest form of transfer facility, such as a local stop serving a single transit mode ─ an on-street curb loading area which serves any number of bus routes, and a station with a grade-level platform for rail.
    - *Level 2* is a slightly upgraded form of facility ─ an on-street bus turnout serving two or more routes with loading bays separated from regular traffic lanes, and a passenger-car level, raised platform rail station, which may have auto parking and vehicle interface facility.
    - *Level 3* is a transfer facility completely off-street. A bus transfer facility at this level is an off-street turnout and loading platforms serving multiple routes. A rail station is an at-grade but raised platform station with a possible pedestrian overpass or underpass, auto parking, and bus transfer facilities.
    - *Level 4* is an urban grade-separated multi-modal transit facility with exclusive bus access provisions and elevated or subway rail access. It may have large parking areas, and a level 2 or 3 bus-transfer facility. This level facility could be incorporated into a major activity center with joint development by others.
    - *Level 5* is a major center-city, regional, grade-separated, multi-modal, multi-level bus or rail-transfer facility. The significant capital investment is spent in pedestrian circulation elements, waiting room, ticket selling and other passenger processing facilities, and concession spaces. An example is the Trans-Bay Bus Terminal in San Francisco.
2) **Modes**
    - Bus only
    - Rail only
    - Bus & Rail
3) **Passenger loading**
    - On-street
    - Off-street
4) **Time of day**
    - Morning commute (before 9:00 AM)
    - Mid-day (9:00 AM- 4:00 PM)
    - Evening commute (4:00 PM- 7:00 PM)
5) **Weather**

Table 1 Passengers/Users Perspective Evaluation Criteria

Physical Attribute Category	Evaluation Criteria
Security and Safety	Security personnel
	Video surveillance equipment
	Extent of visibility and lighting
	Means of communication for emergencies
	Infrastructure
	Maximize safety & security
Amenities	Comfort/convenience
	Service/commercial enterprises
	Weather protection
	Aesthetically pleasing/clean environment
	Maximize amenities
Information	What information is provided
	Where the information is provided
	How the information is conveyed
Access	Passenger flow management
	Physical infrastructure
	Directional information
Connection and Reliability	Schedule adherence/reliability of vehicle
	Connection/completing transfer (Distance and Time)

Survey participants were asked to rate the importance of service features and their level of satisfaction with each feature on a four-point scale from "very important" to "not important" and "strongly agree" to "strongly disagree" (Appendix 1). The results from this section were used for the *Importance-Satisfaction (IS) Analysis* to illustrate which particular attributes passengers felt were most important and which needed the most improvement.

Selection of Sites

We selected twelve transfer facility sites in Los Angeles County to reflect varying degrees of station types, station levels, and facility amenities (Figure 1). The primary criteria we used to select these sites stemmed from a desire to examine a broad spectrum of site types: both rail and bus facilities; sites which included transit dependents and choice riders at the same or different facilities; and sites with varying levels of amenities. As described above, we classify transit stops and stations into five levels based on the following factors: 1) volume of passengers and activities, 2) number of interfacing routes, 3) number of interfacing modes, 4) physical configuration, 5) investment in facilities, 6) transit center type (community, regional, or other), and 7) whether or not it is a joint development with commercial use of facility (Fruin 1985).

Transit stops and stations are clearly not all equal and, and they may differ on a multitude of variables. For example, a transfer facility can be a simple on-street bus stop with no schedules posted and no bench for waiting passengers to sit on. This transfer facility has only the bare minimum of attributes. It is quite different from, for example, the Los Angeles Union Station, which, as an off-street facility, accommodates both intermodal and intramodal (bus, shuttles, light rail, heavy rail, commuter rail, and inter-city rail) transfers among different transit agencies and different lines of the same agency. These two examples of transfer facilities differ relative to numerous attributes such as physical size, travel modes serving the facility, number of lines per transit agency, number of transit agencies, and amenities offered to travelers using the facility.

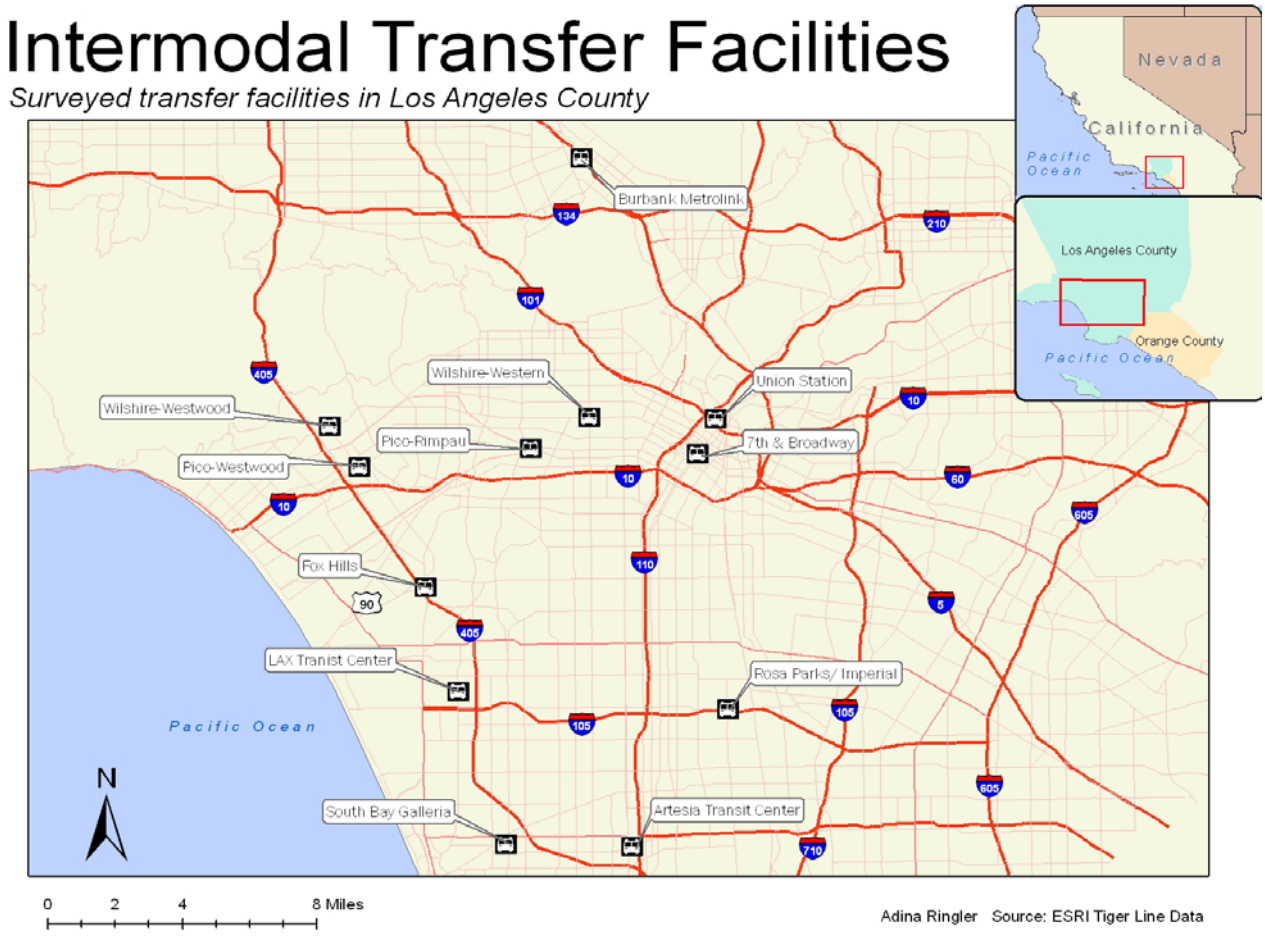

Figure 1 Location of Surveyed Transit Stops and Stations in Los Angeles County

Site Descriptions

1. **Wilshire/Western (WW):** Wilshire/Western (Figures 2 and 3) is a transfer point between heavy rail and bus, which are both operated by the Los Angeles County Metropolitan Transportation Authority (Metro). The heavy rail is Metro's Red Line

subway, which connects with Metro's light-rail Blue Line in downtown Los Angeles and provides service between Union Station, Hollywood, and the San Fernando Valley where it meets the Metro Orange Line Bus Rapid Transit (BRT). Bus service consists of Metro's local and Rapid services along Wilshire Boulevard and Western Avenue. The **Wilshire/Western** station (see picture below) is considered a *Level 4* facility because it is an urban grade-separated multi-modal transit facility with bus access provisions and subway rail access. The station is located in the Mid-Wilshire district near Koreatown.

Figure 2 Wilshire Western Metro Rail Station (Underground)

Figure 3 Wilshire Western Metro Rail Station (Street Level)

2. **L.A. Union Station (USR & USB):** Two separate areas of Union Station were surveyed – Union Station Rail (USR) (Figure 4) and Union Station Bus (USB) (Figure 5). **Union Station** in downtown Los Angeles, which opened in May 1939, is known as the 'Last of the Great Railway Stations' built in the United States, but even with its massive and ornate waiting room and adjacent ticket concourse, it is considered small in comparison to other major railway stations in the United States. Metro provides service to Union Station in the form of three rail lines (Red, Purple, and Gold); and eleven bus lines. Amtrak, Amtrak California, and Metrolink, a regional commuter rail service, serve the station as well. Furthermore, Los Angeles World Airports recently initiated service of an express bus service to Los Angeles International Airport called *FlyAway*. This station is considered a *Level 5* facility because it is a major center-city, regional, grade-separated, multi-modal, multi-level bus or rail-transfer facility. A significant capital investment was spent in pedestrian circulation elements, waiting room, ticket selling and other passenger processing facilities, and concession spaces.

Figure 4 Union Station Rail

Figure 5 Union Station Bus

3. **South Bay Galleria Transit Center (SBG):** South Bay Galleria Transit Center is a bus-only transfer facility with eight bus bays (Figure 6). The facility is horseshoe-shaped and lies adjacent to the parking structure for the South Bay Galleria Mall. The station is considered a *Level 3* facility because it is a transfer facility completely off-street with loading platforms serving multiple routes. This station is located near Redondo Beach and is on the western side of Mall's parking structure. Passengers need to either walk through the parking facility or go around it to access the Mall.

Figure 6 South Bay Galleria Bus Station

4. **LAX Bus Center (LAX):** LAX Bus Center is an off-street bus transfer facility with 14 bus bays (Figure 7). The facility is a horseshoe-shaped and adjacent to long-term parking lots for LAX. The station is considered a *Level 3* facility because it is a transfer facility completely off-street with loading platforms serving multiple routes. This station is located near LAX International Airport adjacent to a long-term airport parking lot.

Figure 7 LAX Bus Center

5. **Imperial/Wilmington (IW):** Imperial/Wilmington (also known as Rosa Parks Station) is a light rail station at the intersection of the Metro Blue and Green lines (Figure 8). The Metro Blue Line runs north and south between Long Beach and Los Angeles. The Metro Green Line, which crosses the Blue Line, runs east and west between Norwalk and Redondo Beach, curving south near the Los Angeles International Airport. This station is considered a *Level 4* facility because it is an urban grade-separated multi-modal transit facility. This station is located near Compton, Los Angeles. The picture below shows a Green Line train headed east toward Norwalk. The right-of-way of the Green Line between I-405 (San Diego Freeway) on the west and I-605 on the east in Norwalk is in the median of I-105 (See picture of Green Line below).

Figure 8 Imperial/Wilmington Metro Rail Station (Green Line)

6. **Fox Hills Transit Center (FH):** Fox Hills Transit Center is a bus-only facility with six bus bays that is horseshoe-shaped (Figure 9). Both the Culver City Bus and Los Angeles Metro transit agencies operate buses at this facility. There is a freeway overpass with parking immediately below that separates the Transit Center from the Fox Hills Mall. This station is considered a *Level 3* facility because it is completely off-street with loading platforms serving multiple routes. This station is located near the Marina Freeway (State Route 90) in Culver City.

Figure 9 Fox Hills Transit Center

7. **Pico/Rimpau Transit Center (PR):** The Pico/Rimpau Transit Center is an outside off-street bus-only facility with 11 bus bays (Figure 10). This station is considered a *Level 3* facility because it is completely off-street with loading platforms serving multiple routes. This station is located in Los Angeles.

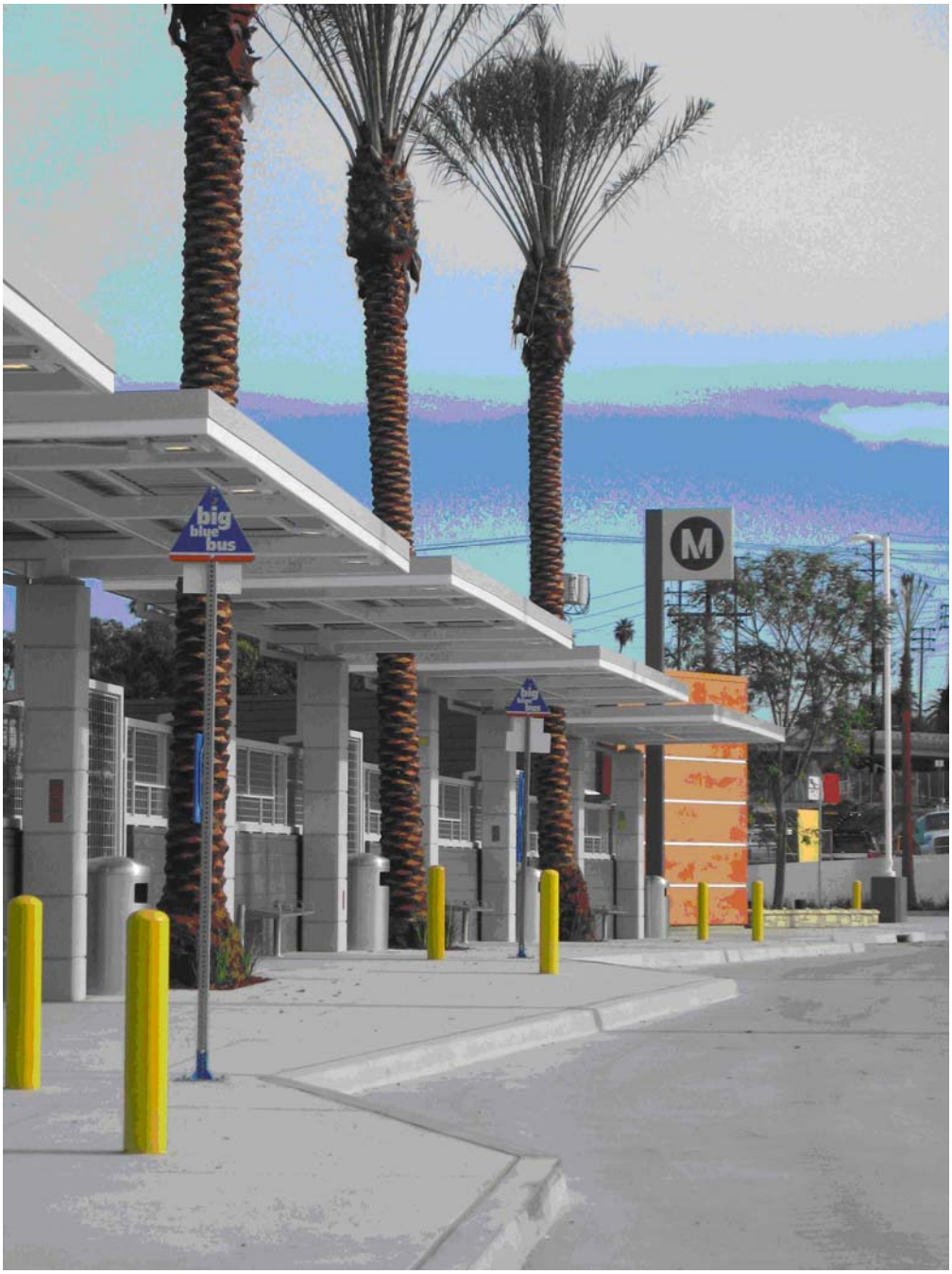

Figure 10 Pico/Rimpau Transit Center

8. **Artesia Transit Center (ATC):** Artesia Transit Center is an outside off-street bus-only facility with 12 bus bays (all Metro) (Figure 11). Artesia Transit Center is a large bus transfer station on Metro's Harbor Transitway. The station is located at the southwest corner of the interchange of Interstate 110 (Harbor Freeway) and California State Route 91 (Gardena Freeway). This station is considered a *Level 3* facility because it is completely off-street with loading platforms serving multiple routes. This station is located in the city of Artesia, near neighboring Carson.

Figure 11 Artesia Transit Center

9. **Burbank Metrolink Station (BUR):** The Burbank Metrolink Station, sometimes referred to as the Burbank Transportation Center, is a Metrolink commuter rail station (Figure 12). It is served by Metrolink's Antelope Valley Line to Lancaster and the Metrolink Ventura County Line to Montalvo; both have downtown terminals at Los Angeles Union Station. This station is also served by local bus lines and is considered a *Level 3* facility because it is a raised-platform rail station with pedestrian access, parking, and bus transfer facilities. This station is located near downtown Burbank, California.

Figure 12 Burbank Metrolink Station

10. **Pico & Westwood (PW):** Pico-Westwood is a bus-only transfer point. This stop can be considered a *Level 1* facility because it is the simplest form of a transfer facility ─ a local stop serving a single transit mode ─ an on-street curb loading area that serves three bus routes. This stop is located near the Westside Pavilion Mall, at the intersection of Pico Blvd. and Westwood Blvd. in West Los Angeles. Figure 13 below shows the south-east corner of the Pico/Westwood intersection with a Santa Monica Big Blue Bus, which is facing north, boarding and alighting passengers.

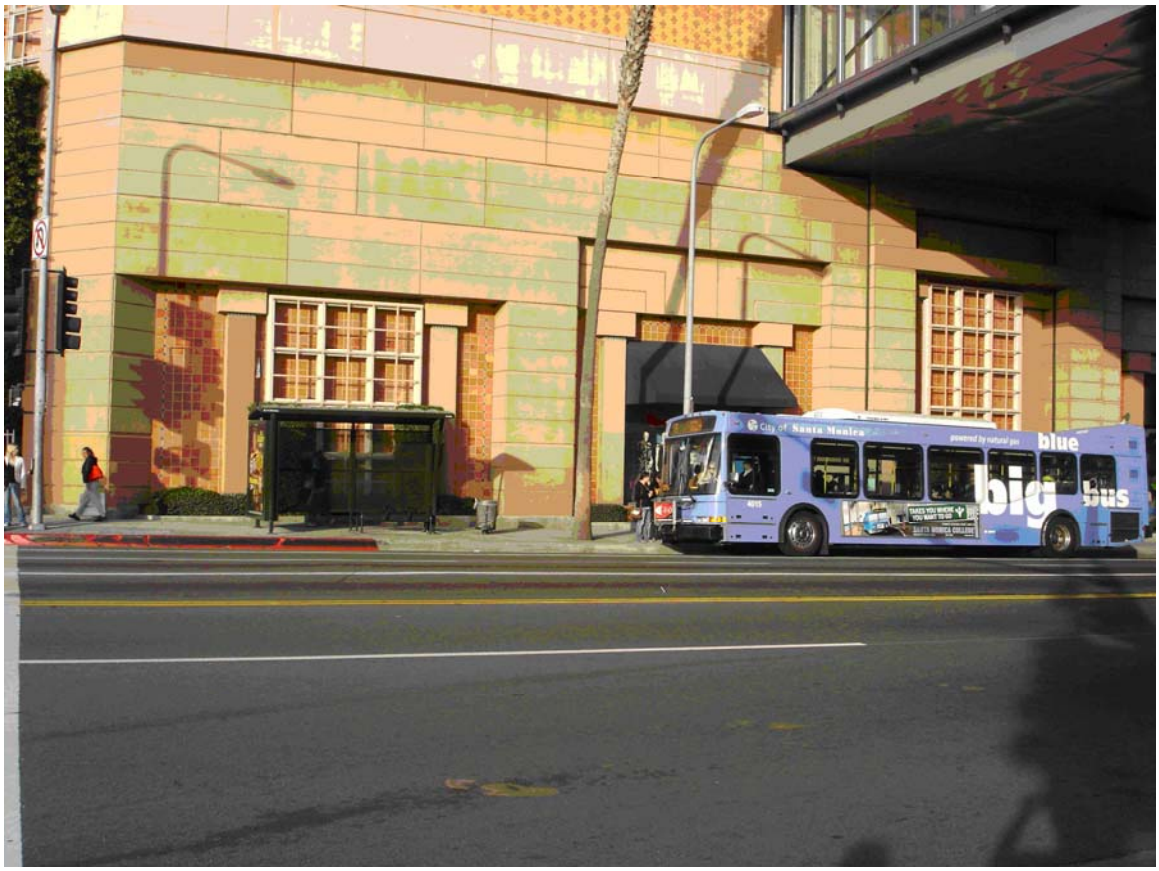

Figure 13 Intersection of Pico and Westwood Boulevards

11. **Wilshire & Westwood (WEST):** Wilshire and Westwood is a bus-only transfer point. This stop can be considered a *Level 1* facility because it is the simplest form of a transfer facility ─ a local stop serving a single transit mode ─ an on-street curb loading area that serves multiple bus routes. This stop is located in Westwood, near the UCLA campus and the Wilshire/Westwood business district. Figure 14 below shows one of Metro's new articulated Metro Rapid buses facing east on the south-east corner of the intersection.

Figure 14 Intersection of Wilshire and Westwood Boulevards

12. Broadway & 7th Street (B7): Broadway & 7th is a bus-only transfer point. This stop can be considered a *Level 1* facility because it is the simplest form of a transfer facility ─ a local stop serving a single transit mode ─ an on-street curb loading area that serves multiple bus routes. This stop is located near the Jewelry district in Downtown, Los Angeles. Figure 15 below shows passengers waiting for one of Metro's buses on the north-east corner of the Broadway and 7th Street intersection.

Figure 15 Intersection of Broadway and 7th Street (Downtown Los Angeles)

Table 2 summarizes these surveyed transit stops and stations in terms of station type and level of facility.

Table 2 Summary of Surveyed Transit Stops and Stations

Station Name	Station Type	Level
Wilshire/Western Metro Red/Rapid Station	Bus-Rail	4
L.A. Union Station	Bus-Rail-Commuter Rail	5
Galleria at South Bay Transit Center	Bus	3
LAX Bus Center	Bus	3
Imperial/Wilmington (Blue & Green LRTs)	Bus-Light Rail	4
Fox Hills Transit Center	Bus	3
Pico/Rimpau Transit Center	Bus	3
Artesia Transportation Center	Bus	3
Burbank MetroLink Station	Bus-Commuter Rail	3
Pico & Westwood	Bus	1
Wilshire & Westwood	Bus	1
Broadway & 7th (Metro Center)	Bus	1

Implementing the Survey

Our approach was to create a short passenger survey (roughly 5 minutes to complete) that could be conducted at various sites. The surveys were printed on one legal size page, contained 29 questions and were available in both English and Spanish. A team of surveyors from UCLA were given satchels containing survey materials including questionnaires in English and Spanish, pencils, badges with UCLA identification, and a UCLA hat. Surveyors approached passengers who had either just alighted from a bus or train or were waiting to catch their next bus or train. Patrons were asked if they were willing to participate in this voluntary study by filling out the questionnaire by hand. The research team emphasized that the survey was anonymous and no individual would be identified. If the patron agreed to participate, the questionnaire was handed to the respondent on a clipboard to be filled out immediately at the transit station/stop.

The main part of the passenger survey was conducted during the months of December 2006 and January 2007. Additional surveying was conducted on an as-needed basis during February-March of 2007 to increase the number of surveys collected on key sites or key sample times, particularly nighttime service. A total of 749 riders were surveyed. For each station, interviewing would begin at a randomly selected time and day of the week. Time categories included morning commute (before 9:00AM), mid-day (9:00 AM – 4:00 PM), and evening commute (4:00 PM – 7:00 PM). Researchers attempted to collect at least 50 surveys per site.

Facility Inventory

In conjunction with the administration of transit user perception surveys, the team of UCLA researchers conducted an inventory of the facility attributes at each location. The team of researchers noted the presence or absence of facility attributes, including lighting, security guards, video surveillance and/or an emergency call box, linkages to the street and ease of connecting to nearby bus/train, platform identification, litter and/or graffiti, restrooms, seating, shelter, as well as noting the clarity of existing signs, maps, and schedule information.

Surveyors numerically coded the observational data collected for the visited sites. For example, for *safety and security*, we have five sub-categories: security personnel, video surveillance equipment, visibility/lighting, emergency communication devices, and infrastructural safety measures. Each category was coded with a "0" or a "1", meaning that the site does not have or does have such components, respectively (Appendix 2). These observations were used in tandem with user perceptions to come up with an understanding of their relationship, that is, their correlation. This information will help assess user perceptions based on observations at other sites ─ not part of the data collection effort ─ in order to make recommendations on what transit agencies could do to improve user perceptions at those sites especially under circumstances of tight agency budgets.

4. BASIC DEMOGRAPHICS OF SURVEY RESPONDENTS AND TRIP CHARASTERISTICS

The purpose of the user survey was to provide an accurate portrait of transit riders at the system-wide level, by service-type, by time of day/time of week, and by location. This portrait includes the following information:

- *Demographic characteristics* of riders at every transit transfer facility in terms of age, sex, income, race, car availability, and modal preference;
- *Trip characteristics* such as trip purpose, pre- and post-trip mode, transfer rate, time of day/time of week, and service type;
- *Frequency of Use*;
- *Evaluation of Transit Services and Amenities*

Rider Demographics

The following section examines the demographics of transit riders from our 12 survey sites. We administered our survey to 749 transit users at these transit stops and stations; however in total we approached 1,023 transit users and 274 of them refused to participate in the survey yielding a 73% response rate. It must be noted, however, that the 749 surveys were not all completely filled out as some users had to stop providing responses to catch their bus or train. These characteristics include sex, ethnicity, age, household income, and other household and personal information.

Sex

Consistent with other mass transit studies, our survey indicated that women made up a greater proportion of transit ridership (51.4%). The female-male split of our survey responses is shown in Figure 16. According to the 2002 Metro On Board Passenger Survey, weekday Metro Bus riders are 57% female and 43% male, with little difference by Metro (geographic) service sector

(Los Angeles Metropolitan Transit Authority (LAMTA) 2002). Possible reasons for the greater number of women are the lower rates of access to and ownership of cars among low-income women than among low-income men (Blumenberg, 2004). Over half of the women surveyed (54.4%) were transit dependent riders, meaning they have no car, do not drive, or were not licensed drivers.

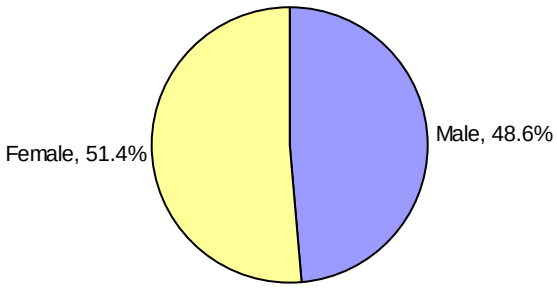

Figure 16 Sex

Age

The age distribution of our survey responses is shown in Figure 17. Approximately half (48.4%) of surveyed transit riders were within the age range of young adults (18 to 34). Overall, seniors comprise a relatively small proportion of surveyed transit riders (2.4%). About five percent of surveyed riders were of school age, and 44.2% were older adults (35-64). The vast majority of surveyed transit riders (92.6%) were of working age (18-64). The average age of the surveyed transit riders was 35.8 years old. The mean age of Los Angeles Metro weekday riders is 39.6 (Los Angeles Metropolitan Transit Authority (LAMTA) 2002).

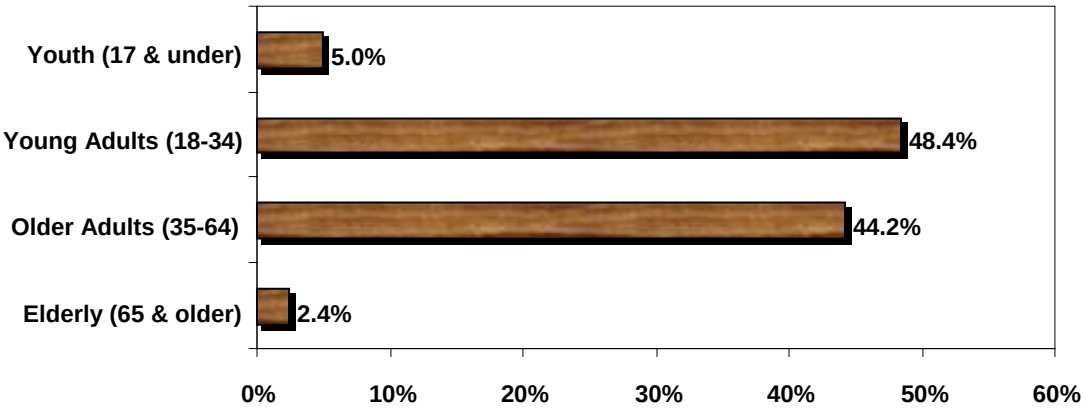

Figure 17 Age

Race and Ethnicity

The race and ethnicity distribution of our responses is shown in Figure 18. Forty percent of the surveyed transit riders were Hispanic/Latino, while Anglo/White and African-American/Black riders each comprise approximately one-fifth of the ridership (20% and 19.1% respectively). Twelve percent of riders were of Asian/Pacific Islander descent and 1.5% of riders were Native American Indian. Approximately 7% of surveyed transit riders indicated that they were of more than one race or ethnicity or "Other".

According to the 2002 MTA On Board Passenger Survey of weekday Metro Bus riders, Latinos were the largest ethnic group among weekday riders (58%). African-Americans were 20% of the ridership, and Whites and Asians are 12% and 8%, respectively (Los Angeles Metropolitan Transit Authority (LAMTA) 2002). Our findings showed a similar demographic for race and ethnicity, with Latinos as the highest percentage, followed by African-Americans. However, our sample contained a slightly higher percentage of Anglo/White riders (19% compared to 12% from the MTA). This could be attributed to the commuter rail and heavy rail stations we surveyed, which are more heavily patronized by Anglo/White riders. For example, 49% of surveyed riders in the Burbank Metrolink commuter rail station were Anglo/White.

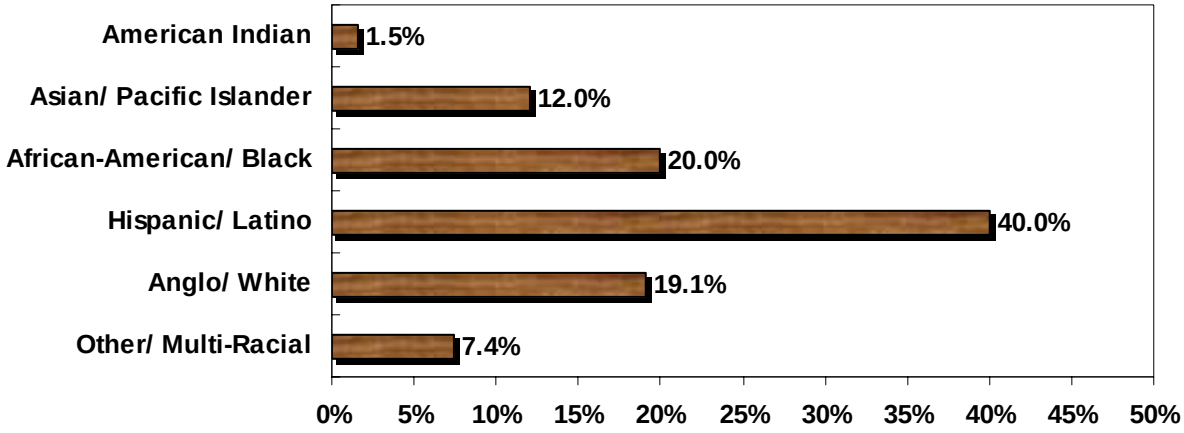

Figure 18 Race and Ethnicity

Language of Survey

While most surveys distributed were in English, 19% were in Spanish (Figure 19). It is not possible to determine what percent of transit riders were bilingual or have English as a second language, but the number of passengers requesting surveys in other languages suggests that many passengers may need transit information provided in Spanish.

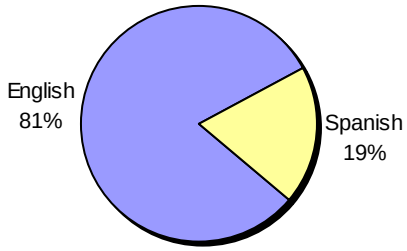

Figure 19 Survey Language

Household Income

More than half (53.8%) of surveyed transit riders reported an annual household income of less than $35,000, while almost two thirds (63.4%) of the ridership reported an annual household income of less than $50,000 (Figure 20). The relatively low household income among transit riders was consistent with the tendency of public transportation to serve lower income populations.

According to the MTA On Board Passenger Survey (2002), median annual household income for weekday bus riders was $12,000 per year, with little difference by service sector (Los Angeles Metropolitan Transit Authority (LAMTA) 2002). This amount is significantly lower than our survey sample because we surveyed passengers on commuter rail and heavy rail lines, which are generally patronized by more affluent passengers; the MTA surveyed only bus lines, which are generally patronized by lower income passengers. For example, the average annual household income for surveyed passengers at Union Station Rail (USR) was between $50,000 and $74,999, whereas the average annual household income for surveyed passengers at Pico-Rimpau was between $15,000 and $24,999.

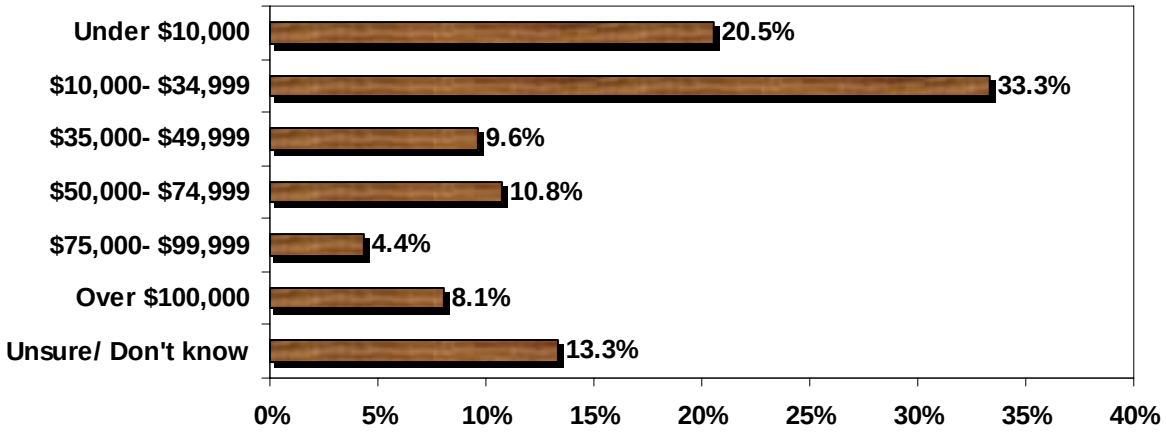

Figure 20 Household Income

Transit Dependency

Among surveyed transit riders, 25.8% were non-discretionary or transit dependent riders, meaning they reported that they have no access to a car, do not drive, or were not licensed drivers and 23.1% would have difficulty accessing a car (Figure 21). Transit dependent riders include riders with disabilities and elderly riders. Nearly half of the survey sample (48.9%) stated that they either had limited or no access to an automobile. The other half of the surveyed users could have had access to a car, but chose to ride transit instead. Patrons who choose to use transit instead of an available automobile are generally happier with the transit service – this follows logically because these riders made the conscious choice to forego their automobile to use public transit, indicating a preference for transit for that trip.

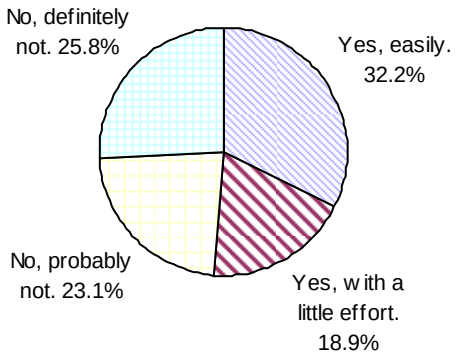

Figure 21 Transit Dependency

Trip Characteristics

The following section explores how surveyed transit riders were using the transit stop/station at the time they were surveyed, and how they used the facility in general for their transportation needs. Riders were asked to describe how often they rode the bus or train and for what purpose, how they got to and from stops, and how long they expected to wait for their next bus or train.

Trip Purpose ─ What is the purpose of your trip today?

Passengers were asked where they were coming from and where they were going to on this trip and results are shown in Figure 22. The majority of transit trips were to or from work (65.4%). The second most common trip purpose was shopping or errands (17.3%), followed by college or school (15.1%) and visiting family or friends (12.2%). Other trips not listed on the survey accounted for a very small portion of trips (8%) and included doctor's appointment, church, court house, museum, and the beach. Percents do not add up to 100% because some passengers had multiple trip purposes for their transit trip. This phenomenon shows that trip chaining is a large part of users' transit trips. Empirical evidence points to a secondary role for the work trip, which provides an opportunity to link non-work travel (McGuckin, 1995). The work trip is

becoming more complex as workers incorporate personal, household, and child-care activities into their commutes.

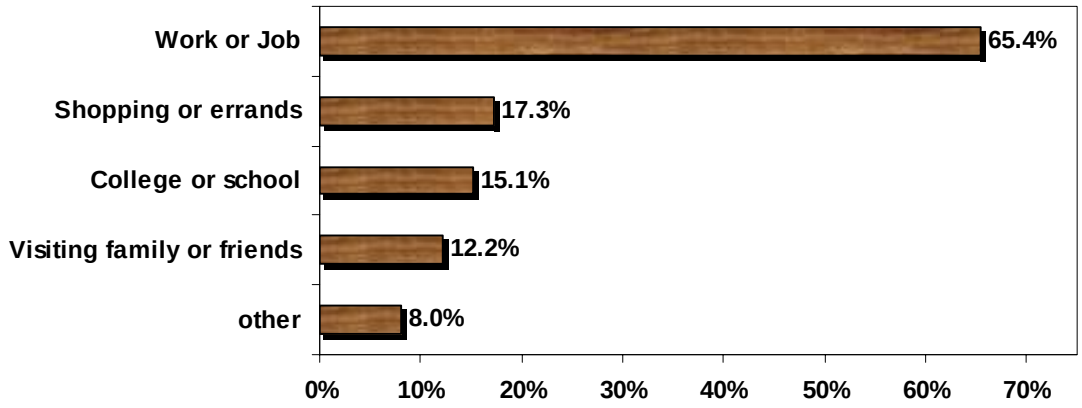

Figure 22 Trip Purpose

Trip Frequency—How often do you make this trip?

Trip frequency distribution is shown in Figure 23. The majority of surveyed riders made their trip regularly (79.4%). These findings are consistent with the MTA On Board Passenger Survey (2002), which found that most riders (82%) used MTA buses 5 or more days per week and were regular users (Los Angeles Metropolitan Transit Authority (LAMTA) 2002). The remaining riders (20.6%) were not regular users—10.4% made the trip 'sometimes;' 7.8% made the trip 'not often;' and 2.4% had never made the trip before. It is important, however, that the information available at these facilities accommodates these non-regular users.

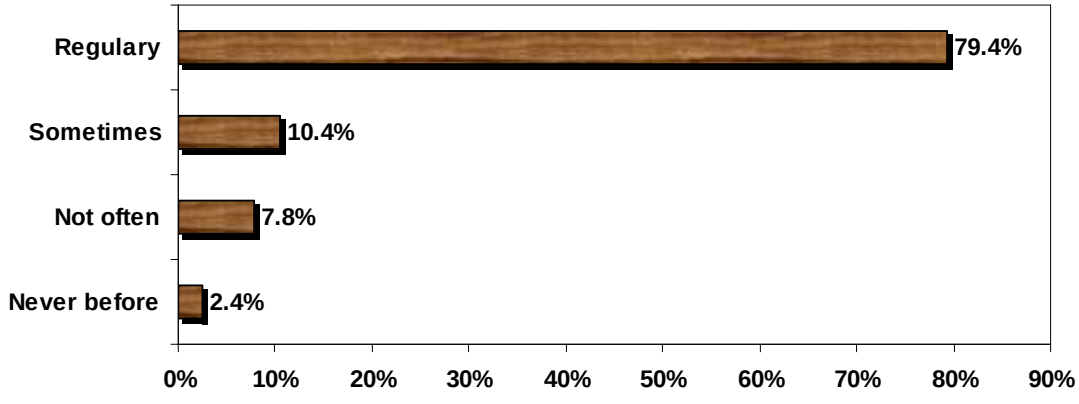

Figure 23 Trip Frequency

Mode of Travel To and From Transit Facility

Riders were asked to indicate how they arrived at the station/stop for their current trip, and how they would continue to their final destination from the stop/station where they would alight. The users' indicated mode of travel to and from stations helps to determine the transfer rate. The access mode is the way in which passengers travel to the bus/train on which they were surveyed. Access mode is important because it supports the planning of service improvements that increase the ease of access and potentially ridership levels. These two questions were important because it showed transferring plays are major role for all surveyed stations/stops. According to the MTA On Board Passenger Survey (2002), a large majority of weekday Metro Bus riders (74%) used more than one bus or train in the course of their one-way trip (Los Angeles Metropolitan Transit Authority (LAMTA) 2002).

Our findings were consistent with the MTA study and are shown in Figures 24 and 25. We found that the majority of users were using the station/stop as a transfer facility, indicating that they used more than one bus or train in the course of their trip. Sixty nine percent of the surveyed passengers accessed facility by bus or train. The next most frequent access mode was walking (12.7%), followed by driving alone (9.7%) and carpooling (4.3%). Overall, few riders used a private vehicle, either as driver or as passenger, to get to or from the facility (15%). Bicycling and taxi or shuttle/van service accounted for a very small percent of access mode (0.7% and 1% respectively). Other/multiple modes accounted for 2.4% of station access. For passengers who walked to the facility, their average reported walk time was 10 minutes.

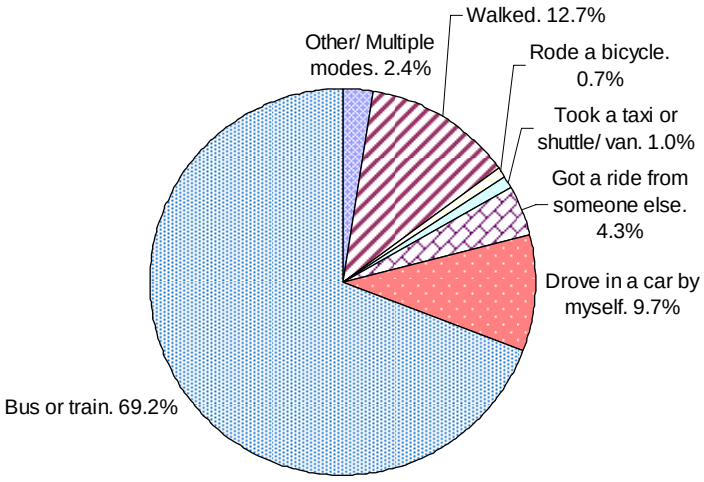

Figure 24 Transit Facility Access

When asked how they will reach their final destination, the majority of passengers responded that they would take a bus or train (81.1%). Walking was next most frequent mode of egress, at 11.8%. For those who walked, the average walk time was 8 minutes. The remaining modes comprised of a very small amount of station egress.

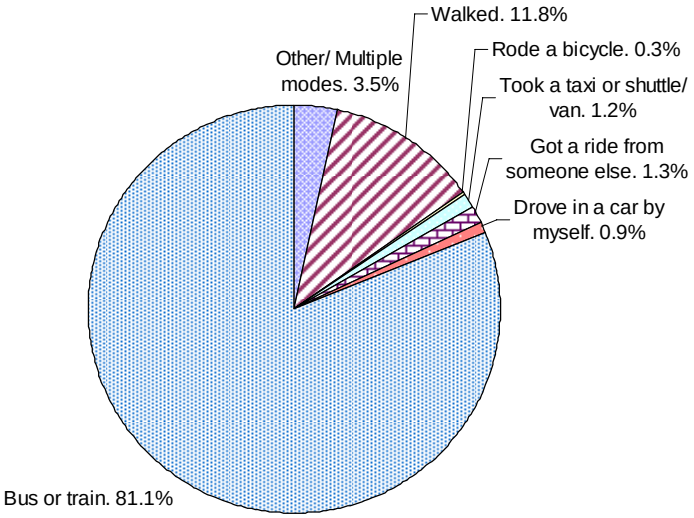

Figure 25 Transit Facility Egress

Mode Preference

Over a third of surveyed transit users would have strongly preferred to have made their trip using a private vehicle, rather than public transportation (Figure 26). A passenger's preferred choice of mode can reflect how satisfied the user is with the facility. A fifth of users strongly preferred to travel by bus or train. Overall there is nearly an equal split between users who strongly or usually prefer private auto and those who strongly or usually prefer bus or train.

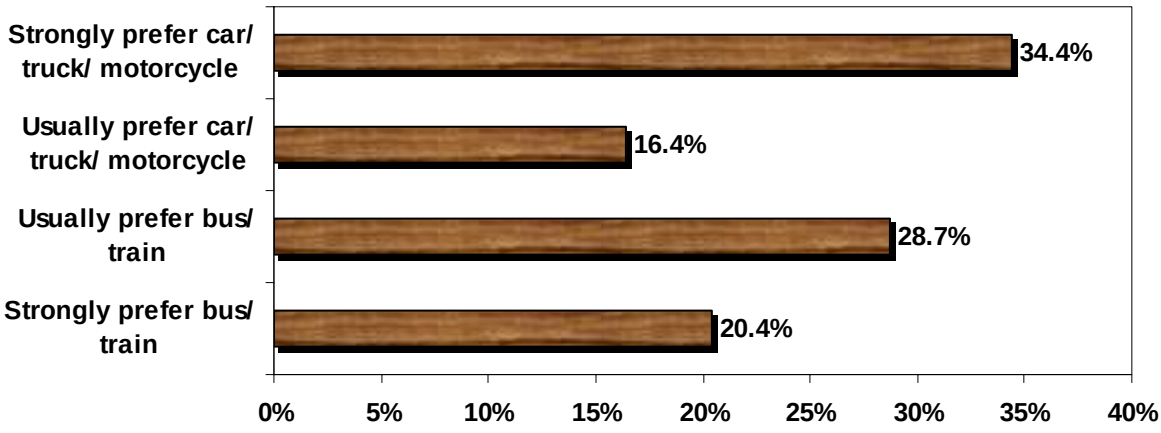

Figure 26 Mode Preference

5. ANALYSIS, FINDINGS, AND DISCUSSION

Importance-Satisfaction Analysis

Importance-Satisfaction (IS) Analysis can be a valuable tool to help transportation planners and managers evaluate the relative priority that should be placed on various transportation issues (Tennessee Department of Transportation Office of Strategic Planning 2006). IS-Analysis maximizes the impact that new investments have on customer satisfaction by emphasizing improvements in areas where both the reported level of customer satisfaction is relatively low and where customers' perceived importance of the issue or factor is relatively high (Tennessee Department of Transportation Office of Strategic Planning 2006). Accordingly, we apply IS-Analysis here to evaluate transit policies, facilities, and services.

The user survey in this study asked travelers to assess the level of importance that they place on particular aspects of the facility and the level of satisfaction that they have under the present situation. Based on these two measures ─ importance and satisfaction ─ we use IS-Analysis to provide indices of improvement need (IS ranking), which are used to determine the order of priority to be given to each factor examined. The basic concept in IS-Analysis is that agencies should invest their resources on aspects of higher priority in order to maximize customer satisfaction.

We applied IS-Analysis to our study to assess the quality of various attributes at transit stops and stations in the Los Angeles regional transit system based on users' evaluation of the quality of service at these facilities. As previously described in the methodology section, we asked transit users to rate the level of importance and the level of satisfaction using a four-level scale. To obtain the importance rating, we calculated the proportion of survey respondents who placed the highest importance rating on an attribute ("Very important" in the survey) among the total number of respondents who answered a question on this particular attribute.[1] To obtain the

[1] The original importance-satisfaction analysis uses responses from a survey in which users are asked to *choose* a certain number of issues that they think most important and are most satisfied with among given options. For

satisfaction rating, we calculated the proportion of survey respondents who indicated a positive level of satisfaction on an attribute among the total number of respondents who answered a question on this particular attribute ("Strongly agree" or "Agree somewhat" in the survey). These ratings are expressed in percentages. Based on these ratings among 16 attributes, we determined the ranking for importance and satisfaction.

Then the Importance-Satisfaction (IS) rating is computed for each attribute by multiplying the importance rating by 1 minus the satisfaction rating.

IS = [Importance x (1-Satisfaction)]

= [Importance x Dissatisfaction] (Eq-1)

The maximum rating of 1.00 is obtained when all respondents consider an attribute "Very important" but no respondents are satisfied with the current quality of this attribute (in other words, no respondents chose "Strongly agree" or "Agree somewhat" in the survey). The minimum rating of 0.00 is obtained when *one of the following* occurs in the survey responses:

1. No respondents consider an attribute "Very important"
2. All respondents are at least somewhat satisfied with the current quality of this attribute; All respondents chose "Strongly agree" or "Agree somewhat" in the survey

The IS rating is an index used to assess the need for improvement. The higher the IS rating, the higher the improvement need. Therefore, an agency should prioritize the improvement of attributes with the highest IS ratings. After calculating the IS rating, we also ranked attributes from 1 through 15 based on the IS ratings.

Importance Rating and Ranking

Table 3 shows the proportion of respondents who placed the highest level of importance on each issue in the question on the survey (rating) and ranking from 1 to 16 based on the ratings.

example, Tennessee Department of Transportation asked respondents to choose what issue of highways, such as highway congestion level, high road surface condition, water drainage on highways, signs on highways, they think most important and are most satisfied with (Tennessee Department of Transportation Office of Strategic Planning 2006). Then the importance rating and the satisfaction rating are calculated by summing the percentage of respondents who selected an item as one of the most importance and the most satisfactory. In this sense, our I-S analysis is slightly different from the original IS analysis, although the basic concept is the same.

Table 3 Importance Rating and Ranking Table

Question on the Survey	Category	Importance	
		Rating	Ranking
This station /stop area is clean.	Amenities	58%	13
There are enough places to sit.	Amenities	50%	15
There are places for me to buy food or drinks nearby.	Amenities	34%	16
There is a public restroom nearby.	Amenities	59%	12
There is shelter here to protect me from the sun or rain.	Amenities	69%	8
The signs here are helpful.	Information	69%	9
It is easy to get schedule and route information at this station.	Information	62%	11
I usually have a short wait to catch my bus/train.	Connection & Reliability	70%	6
My bus/train is usually on time.	Connection & Reliability	76%	3
It's easy to find my stop or platform.	Access	70%	7
It is easy to get around this station/stop.	Access	57%	14
I feel safe here during the day.	Security & Safety	77%	2
I feel safe here at night.	Security & Safety	78%	1
There is a way for me to get help in an emergency.	Security & Safety	74%	4
This station is well lit at night.	Security & Safety	73%	5
Having security guards here makes me feel safer.	Security & Safety	67%	10
This is an easy place to transfer to another bus or train.	Overall	73%	-

Table 3 shows that 'safety at night' received the highest importance ranking (78%), followed by the 'safety during the day' (77%).[2] This indicates that, overall, passengers felt that safety and security is very important when making a transit trip. The third most important attribute indicated by passengers was under the category of *connection and reliability*, and had to do with schedule adherence (76%). Improving transit service quality, including travel reliability reduces unit travel time costs.

The importance level within categories of *amenities*, *information*, and *access* varies somewhat. For *access*, 70 percent of respondents who answered this question placed the highest level of importance on finding a way to a stop and/or platform, while 57 percent gave "getting around a station or stop" a very high importance rating. Within the category of *amenities*, shelter from the sun or rain received the highest importance rating (69%), while availability of places to buy food or drinks received the lowest importance (34%). Overall, two questions on *connection and reliability* received a relatively higher level of importance, following the *safety and security* issues.

[2] It should be noted that small differences in percentages in Table 3 and Table 4 may not be statistically significant.

Satisfaction Ratings and Ranking

Table 4 shows the proportion of respondents who placed the highest and second highest levels of satisfaction ("Strongly agree" or "Agree somewhat") on each issue ("rating") and ranking from 1 to 16 based on the ratings ("ranking"). This means that a ranking of "1" indicates that surveyed passengers were most satisfied with that particular attribute.

Table 4 Satisfaction Rating and Ranking Table

Question on the Survey	Category	Importance	
		Rating	Ranking
This station/stop area is clean.	Amenities	78%	6
There are enough places to sit.	Amenities	65%	12
There are places for me to buy food or drinks nearby.	Amenities	57%	14
There is a public restroom nearby.	Amenities	40%	16
There is shelter here to protect me from the sun or rain.	Amenities	69%	8
The signs here are helpful.	Information	81%	4
It is easy to get schedule and route information at this station.	Information	66%	11
I usually have a short wait to catch my bus/train.	Connection & Reliability	66%	9
My bus/train is usually on time.	Connection & Reliability	67%	10
It's easy to find my stop or platform.	Access	89%	2
It is easy to get around this station/stop.	Access	89%	1
I feel safe here during the day.	Security & Safety	85%	3
I feel safe here at night.	Security & Safety	57%	13
There is a way for me to get help in an emergency.	Security & Safety	55%	15
This station is well lit at night.	Security & Safety	74%	7
Having security guards here makes me feel safer.	Security & Safety	79%	5
This is an easy place to transfer to another bus or train.	Overall	88%	-

Most people who responded to the survey (88%) are at least somewhat satisfied with the overall quality of the stop or transit stops and stations where they were surveyed. Among the five categories examined, *access* received the highest satisfaction ratings (89%). Respondents were satisfied with the ease of navigating to, from, and within the facility. Within the *information* category, *signs* received a very high satisfaction rating, while *availability of schedule and route information* at the site had a lower rating. The category of *connection and reliability* received a relatively low rating, indicating that passengers were generally not satisfied with schedule adherence and wait times.

Within categories of *amenities* and *security and safety*, the ratings varied significantly. In the *amenities* category, the availability of public restroom received the lowest satisfaction rating (40%), which is also the lowest among all items. Not surprisingly, very few of the transit stops

and stations that we surveyed had access to a public restroom. Passengers were generally satisfied with the cleanliness of the facility (78%). In the safety and security category, there was a large gap in the level of satisfaction between daytime and nighttime. Most respondents did not seem to have a problem with safety during the day (85%), while 43 percent of people did not feel safe at night. The surveyed transit users appear to be satisfied with lighting and the presence of security guards, but were concerned about the case of an emergency. Because of its high level of importance, nighttime safety should be improved by providing a way to get help in an emergency.

Importance-Satisfaction Ratings and Ranking

Table 5 shows the *importance-satisfaction (IS) rating*, which combines the level of importance that users placed on each facility attribute with the level of satisfaction users had. Codes in Table 5 are used in Figure 27.[3]

Table 5 Importance-Satisfaction Rating and Ranking

Question on the Survey	Category	Code	Importance	
			Rating	Ranking
This station/stop area is clean.	Amenities	A1	13.1%	13
There are enough places to sit.	Amenities	A2	17.5%	9
There are places for me to buy food or drinks nearby.	Amenities	A3	14.8%	10
There is a public restroom nearby.	Amenities	A4	35.5%	1
There is shelter here to protect me from the sun or rain.	Amenities	A5	21.2%	7
The signs here are helpful.	Information	I1	13.3%	12
It is easy to get schedule and route information at this station.	Information	I2	21.4%	6
I usually have a short wait to catch my bus/train.	Connection & Reliability	CR1	23.7%	5
My bus/train is usually on time.	Connection & Reliability	CR2	25.0%	4
It's easy to find my stop or platform.	Access	AC1	7.6%	15
It is easy to get around this station/stop.	Access	AC2	6.2%	16
I feel safe here during the day.	Security & Safety	SS1	11.3%	14
I feel safe here at night.	Security & Safety	SS2	33.1%	3
There is a way for me to get help in an emergency.	Security & Safety	SS3	33.7%	2
This station is well lit at night.	Security & Safety	SS4	18.9%	8
Having security guards here makes me feel safer.	Security & Safety	SS5	13.9%	11
This is an easy place to transfer to another bus or	Overall	-	8.6%	-

[3] It should be noted that small differences in percentages in this table may not be statistically significant.

Based on the IS rating, availability of public restroom (35.5%), an emergency contact method (33.7%), and safety at night (33.1%) are the top three attributes which require improvement in the system. The high IS ranking for restrooms indicates that passengers felt public restrooms should be provided at transit stops and stations. An emergency communication device and general safety at night are also top concerns for transferring riders. Two items in the category of *connection and reliability* follow, regarding schedule adherence (25%) and wait time (23.7%). The reliability of transit service scheduling is very important to the customer, yet very little information is actually available as to how reliable the services at a given facility. Many customers plan their trips based on published (printed and online) schedule information, and can be greatly inconvenienced if the service does not arrive or depart at the expected time. Access to and within a facility received the two lowest priority items in the list, based on the IS rating.

Figure 27 shows the importance rating on the X-axis and the satisfaction rating on the Y-axis respectively (the codes in this figure relate to those presented in Table 5). This figure visually summarizes the relationship between the relative importance transit users attach to each service feature and the level of satisfaction they experience with each feature. By combining the importance and satisfaction ratings relative to their means, transfer facility attributes are classified into four categories.

Attributes that fall in the bottom-right box ("Needs Improvement") require substantial attention for improvement due to the lower satisfaction level relative to the high importance level. These attributes include an emergency communication device (SS3), overall safety at night (SS2), availability of a public restroom (A5), schedule adherence (CR1), and wait time (CR2).

The top-right portion of Figure 27, labeled "Continue Improvement" depicts attributes that surveyed users have rated as "very important". For this reason transit agencies need to continue to maintain them so that customers continue to be satisfied with these attributes. The attributes in this category fall under *safety & security*, *access*, and *information*, and include station lighting (SS4), presence of security guards (SS5), general safety during the day (SS1), ease of accessing schedule and route information(I1), and ease of locating the stop or platform (AC2).

Two attributes receive very high satisfaction ratings, while their importance ratings are lower than the average in the top-left box ("Exceeding Expectations"). Under the *access* category, passengers are most satisfied the ease of navigating around the station or stop (AC1); under the *amenities* category, passengers are satisfied with the cleanliness of the facility (A1). The transit facilities in the Los Angeles transit system are exceeding the users' expectations for the quality of these two attributes.

The last group of attributes located in the bottom-left box ("Less Important") was, on average, given a relatively lower importance level by surveyed transit users; these respondents also gave these attributes a lower than average satisfaction level. These attributes are seating (A2), places to buy food or drink (A3), shelter from the rain or sun (A4), and the helpfulness of the signs at the station/stop (I2).

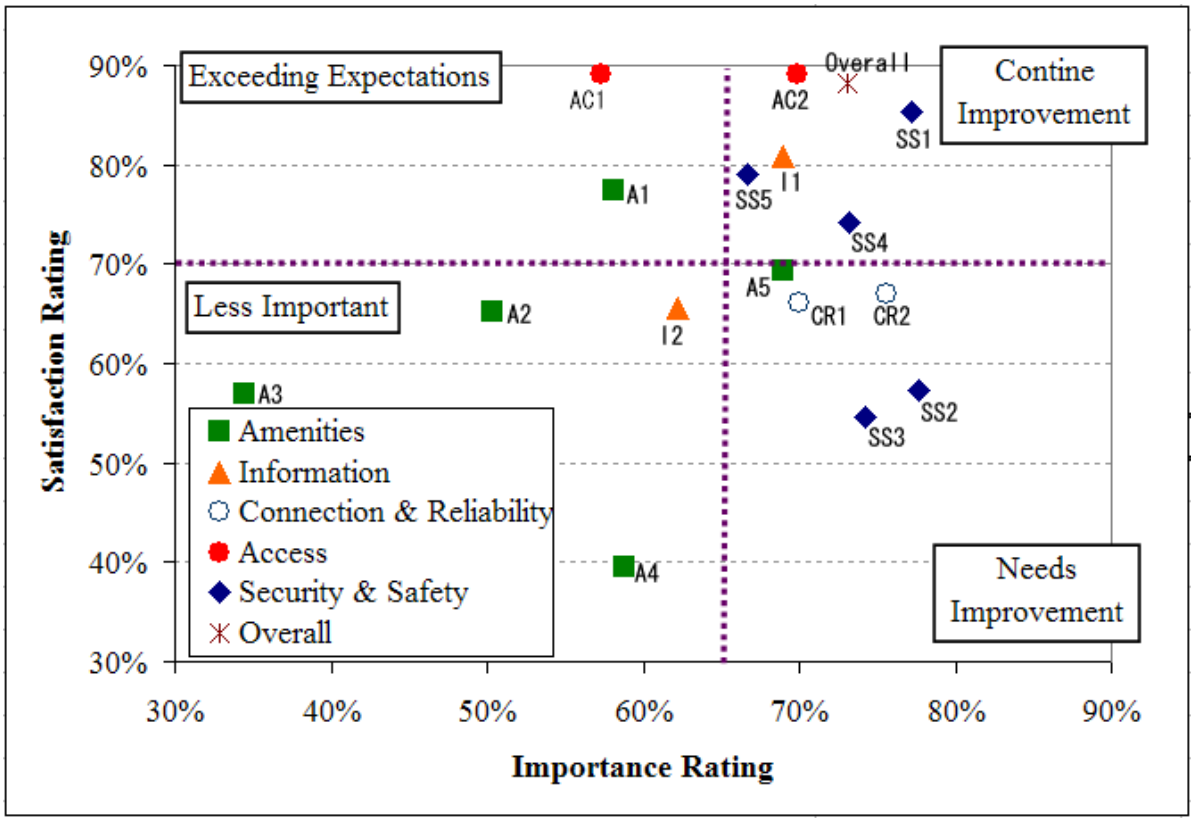

Figure 27 Four Categories of Importance and Satisfaction Levels

Comparison by Attribute Category

In order to make comparisons by category, the un-weighted means of importance ratings, satisfaction ratings, and IS ratings and rankings for each category are shown in Table 6. This table summarizes information from the IS-Analysis and shows the relative importance and satisfaction in each category.

As Table 6 shows, the IS rating by category suggests that, on average in our sample, *connection and reliability* requires the most improvement compared to the four other categories[4]. This IS rating results from the high importance rating and the relatively low satisfaction rating. We can thus expect that improvement of on-time performance and reducing transfer time by timed transfers would likely have significant impact on users' satisfaction. Although *safety and security* received the highest importance level, it had a moderate satisfaction rating, which placed *safety and security* as the second highest IS rating. *Safety and security* is the most important factor in our sample in determining whether travelers use transit and can increase perceived costs related to waiting infinitely; if travelers feel a waiting location is so unsafe that he or she may be mugged (or worse), most will not take the risk of using public transit (ITE Technical Council

[4] While we have attempted to include a wide array of transit stops and stations in our analysis, we are reporting on the experience of users of these facilities in Los Angeles County. Drawing general conclusions about the state of stops and stations generally is probably premature at this point.

Committee 5C-1A 1992). In this sense, respondents in this survey, who are *already* traveling by transit, may have a higher satisfaction level than the general population.

Table 6 Importance-Satisfaction Analysis by Attribute Category

	Importance		Satisfaction		I-S Rating (Index for improvement need)	
	Ave. Rate	Rank	Ave. Rate	Rank	Ave. Rate	Rank
Amenities	54.1%	12.8	61.7%	11.2	20.4%	8.2
Information	65.6%	10.0	73.2%	7.5	17.3%	9.0
Connection & Reliability	72.8%	4.5	66.6%	9.5	24.3%	4.5
Access	63.6%	10.5	89.1%	1.5	6.9%	15.5
Security & Safety	73.8%	4.4	70.1%	8.6	22.2%	7.4
Overall	73.1%		88.3%		8.6%	

Note: A smaller number for "Rank" in the "Importance" column represents the higher importance that users place on these attributes. A smaller number for "Rank" in the "Satisfaction" column represents the higher satisfaction level that users have. A smaller number for "Rank" in the "IS-Rating" column represents a higher improvement need.

While respondents did not generally consider *amenities* as important as other attributes at transit stops and stations, respondents did indicate a very low level of satisfaction with the amenities in place. This low satisfaction level placed the *amenities* category at third in the IS rating. Finally, the relatively high satisfaction level that survey respondents had with the level of access to and within the facilities gave the *access* category the lowest IS rating overall.

Importance-Satisfaction Analysis by Location

In this section we discuss our analysis for each of the five attribute categories by the facility sites that were surveyed and we illustrate how user perceptions of these facilities vary. While this analysis contributes to our understanding of the evaluation of transit stops and stations relative to the five attribute categories, its usefulness is likely to be more robust toward transit stops and stations in southern California than for other stops and stations outside the region.

Figure 28 shows the average IS rating by attribute category by location. Table 7 that follows Figure 28 lists the full name of facilities that are indicated by abbreviation in this figure. While the order based on IS rating varies by transit facility (or location), there are some clear patterns we can observe from this figure.

Access and Information

Access consistently received the lowest IS rating at all locations and *information* generally received the second lowest ratings among the five categories. Clear exceptions to this pattern are Burbank Metrolink (BUR) and Pico & Westwood (PW). Both BUR and PW have *information* as the highest ranked attribute according to IS ranking. At these facilities, surveyor-administered inventories indicate that the provision of signs and maps were not sufficient and schedule information was either moderate (BUR) or not available (PW). PW is a Level 1 on-street bus

stop that does not have any significant infrastructure or signage. Because BUR is a commuter rail station that typically caters to regular users, there was also minimal signage present at this facility.

One way to improve the transferring experience is to provide better signage within the facility of the available transfer services. Information is necessary to direct passengers to connecting bus stops, shuttle stops, taxi stands or bicycle and pedestrian pathways in the surrounding community. In addition, signs are helpful to assist passengers in accessing elevators, escalators, station exits, fare machine or other services. Because the availability of signage was low at BUR and PW, first time users may have a hard time making connections or finding their platform.

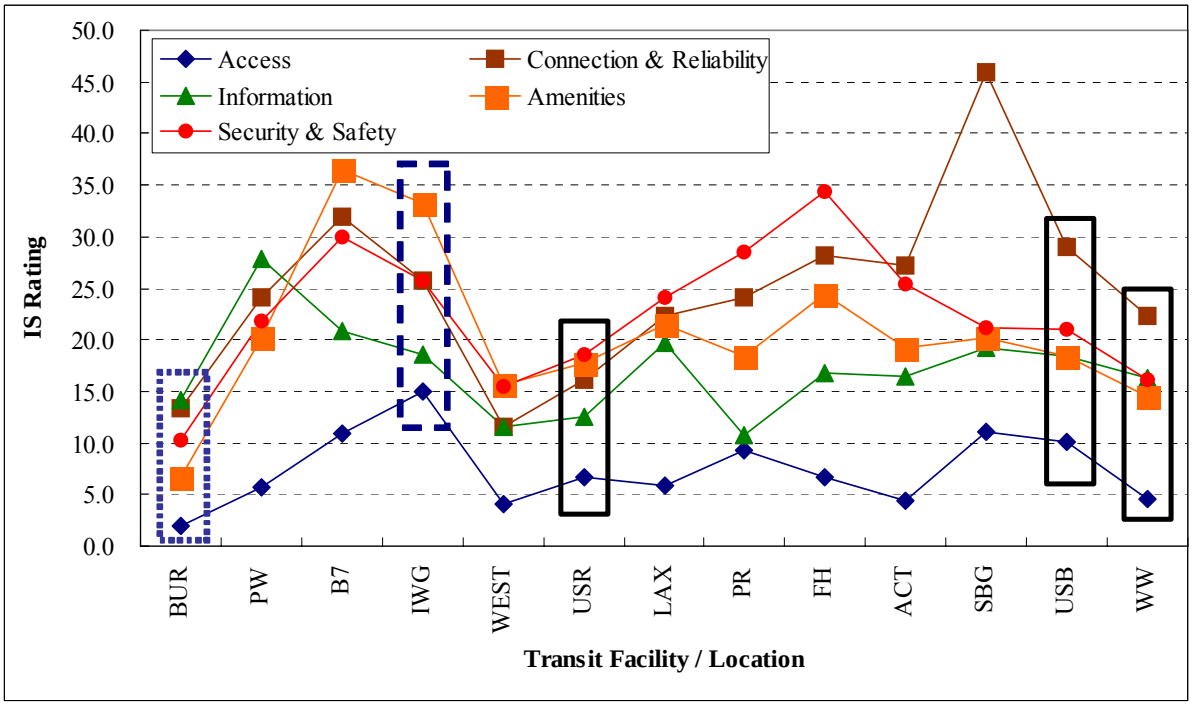

Figure 28 Importance-Satisfaction Analysis by Location

Note: BUR is marked by a dotted-line rectangular to indicate it as a commuter rail station. IWG is marked by a dashed-line rectangular to indicate it as a transfer station between two light rail lines: the Blue Line and Green Line. USR, USB, and WW are marked to indicate it as a station with rail lines.

Table 7 Importance-Satisfaction Analysis by Location

Abbreviation	BUR	PW	B7	IWG	WEST	USR	LAX	PR	FH	ACT	SBG	USB	WW	Average	Standard Deviation
Location	BUR Metrolink	Pico & Westwood	Broadway & 7th	Imp/Wilm (BlueXGreenLRT)	Wilshire&Westwood	Union Station (RAIL)	LAX City Bus Center	Pico & Rimpau	Fox Hills	Artesia Transit Center	So.Bay Gall	Union Station (BUS)	Wilshire/Western		
Type	Com. Rail	Bus	Bus	LR/ Bus	Bus	Bus/ Rail	Bus	Bus	Bus	Bus	Bus	Bus/ Rail	HR/ Bus		
Access	2.0	5.7	10.8	15.0	4.1	6.7	5.9	9.3	6.7	4.4	11.1	10.1	4.5	7.4	3.6
Connection & Reliability	13.3	24.2	31.9	25.7	11.6	16.1	22.3	24.2	28.2	27.1	46.0	28.9	22.2	24.8	8.8
Information	14.1	27.8	20.9	18.6	11.5	12.6	19.7	10.7	16.8	16.4	19.2	18.4	16.3	17.2	4.5
Amenities	6.6	20.2	36.6	33.3	15.6	17.8	21.5	18.4	24.4	19.3	20.2	18.4	14.4	20.5	7.7
Security & Safety	10.3	21.8	30.0	25.8	15.5	18.6	24.2	28.5	34.3	25.3	21.1	21.0	16.1	22.5	6.5
Mean	5.4	7.1	10.4	9.7	3.0	7.8	6.1	15.0	10.5	6.5	12.8	4.2	16.3	8.8	4.1
Standard Deviation	5.0	8.5	10.2	7.1	4.7	4.9	7.4	8.3	10.7	9.0	13.2	6.7	6.4	7.9	2.5
Access	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0	0.0
Connection & Reliability	2	2	2	3	3	3	2	2	2	**1**	**1**	**1**	**1**	1.9	0.8
Information	**1**	**1**	4	4	4	4	4	4	4	4	4	3	3	3.4	1.1
Amenities	4	4	**1**	**1**	**1**	2	3	3	3	3	3	4	2	2.6	1.1
Security & Safety	3	3	3	2	2	**1**	**1**	**1**	**1**	2	2	2	4	2.1	1.0

The other three categories ─ *safety and security*, *connection and reliability*, and *amenities* ─ share the highest, second highest, and third highest IS ratings respectively. When we look more closely at the rankings (Table 7, bottom), we find that *safety and security* and *connection and reliability* have almost equal numbers of 1s and 2s (first and second highest IS rating), which are greater than the number of 1s and 2s that *amenities* have. This results in the overall higher IS ratings for *safety and security* and *connection and reliability* that we found in Table 7.

Safety & Security

LAX Transit Center (LAX), Pico-Rimpau (PR), Fox Hills Transit Center (FH), and Union Station Rail (USR) have *security and safety* as their highest IS rating, though the ratings at USR are very close among categories. USR differs from the other three facilities, given that it is a Level 5 major center-city, grade-separated, multi-modal transfer facility, as opposed to an off-street bus facility. The high concern for *safety and security* at USR could at least in part be attributed to post-9/11 security concerns. Although this station had security guards present throughout the facility, passengers were still concerned with their safety and security.

LAX, PR, and FH did not have security guards present at the time the survey was conducted. The presence of security guards, transit police or other security personnel is an important concern for passengers, especially during night hours. A security guard can make passengers feel more comfortable in making trips during the less-busy hours by discouraging inappropriate behavior by fellow- and non-passengers. Fox Hills (FH) had the highest IS rating for *safety and security*. Fox Hills is a bus terminal in Culver City where buses operated by Culver City, Santa Monica Big Blue Bus, and Metro converge. While the facility is located in the middle of the shopping mall parking lot, safety measures are insignificant at this location. LAX, PR, and FH

are all bus-only, off-street stations, adjacent to large parking lots and a busy street and/or freeway nearby. Because there is not a lot of street life surrounding the facility, passengers may feel unsafe while waiting for their next bus. According to the surveyor-administered inventory, each station had adequate to good levels of lighting and high occupancy (ranging from 50-75%). For each facility, the inventory data reported presence of litter and graffiti. The level of cleanliness of the facility is an important factor, as it shows that the facility is well maintained.

At LAX and FH, distance from the parking lot to the facility was also an important issue. It took the longest time (roughly 5 minutes) to travel between the park & ride lot and the transit facility. Liggett, Loukaitou-Sideris, and Iseki (2002) found the number of crimes at park and ride facilities at light rail stations on the Metro Green Line is significantly higher than the number of crimes at the stations themselves (Loukaitou-Sideris, Liggett, and Iseki 2002). They conclude that this is because the environment at park and ride facilities is much worse than that of stations ─ lower lighting, fewer people, and no security guards. These attributes, together with the fact that park and ride facilities consist of parked vehicles with a multitude of hiding places, could account for why passengers feel the need for improvements in safety and security at these facilities.

Connection & Reliability

Artesia Transit Center (ATC), South Bay Galleria (SBG), Union Station Bus (USB), and Wilshire/Western (WW) have the highest IS rating for *connection and reliability*, while the ratings at ATC are very close among categories. These stations are used primarily as transfer facilities, not as origin/destination stations. This may account for why *connection and reliability* is ranked the highest according to the IS rating.

Long or uncertain wait times at these facilities can seem particularly onerous depending on whether or not waiting is productive, whether or not a wait is forced, and whether or not a traveler knows the arrival time of the next bus. Thus, although actual waiting time is determined by the difference in arrival time of a user and a vehicle at a boarding location, perceived waiting time can be substantially longer depending on waiting conditions, and therefore the generalized cost of waiting time can become higher in facilities which are not surrounded by a mixture of land uses (Iseki and Taylor 2007).

In addition, SBG's IS rating for *connection and reliability* is much higher than ratings for other categories. SBG is a bus terminal in Redondo Beach, where people make transfers among many buses operated by different municipal operators and Metro. It is a common problem that different transit operators do not work together for their time schedule to minimize transfer time for users. SBG was surveyed during night time hours when it was cold outside, which could have added to the perception of wait time. Wait time is perceived especially burdensome when travelers have to wait in difficult environments, such as in cold weather, or in a seemingly unsafe or insecure condition.

Amenities

The availability of *amenities*, such as weather protection, seating, restrooms, public telephones, audio announcements and the opportunity to purchase transit tickets, snacks, flowers, or newspapers, can enhance the passenger's experience. Broadway & 7th Street (B7) and Imperial

Wilmington (IW), had the highest IS ranking (indicating the highest improvement needs) for *amenities* among the attribute categories, while the IS rating for *amenities* was almost the same as that for *security and safety* at WEST. B7 is located in the middle of downtown Los Angeles. It is not a distinct transit facility with infrastructure beyond a sign, and the environment surrounding bus stops is not maintained by transit agencies. The location experiences a great deal of pedestrian activity, automobile traffic, and there are retail shops and fast food restaurants nearby. There is not any designated seating for people waiting for the bus, nor any weather protection from the sun or rain. The bus stops are not clearly marked and there are not any maps or schedule information present. This kind of environment significantly degrades the quality of *amenities* at this place.

The stations/stops at B7, IW, and WEST do not have public restrooms and have minimal to no available seating. WEST had the most favorable IS ranking for *amenities* despite not having available restrooms and few seats, which may be explained by the fact that the stop is located in a pleasant commercial neighborhood with coffee shops and restaurants (where restrooms are readily available) nearby. IW is a station where two light rail lines ─ Green Line and Blue Line ─ intersect with each other. It is located in central Los Angeles, and has a significant number of users. This station is located adjacent to a freeway, tends to be very noisy, and only minimal amenities nearby.

Table 7 and Figure 29 show the mean and the standard deviation of IS ratings by location. Wilshire and Westwood (WEST) and Union Station Bus Terminal (USB) received the lowest (most favorable) and second lowest IS rating. In addition, the standard deviation of IS ratings is high for South Bay Galleria (SBG), Fox Hills (FH) and Broadway & 7th St. (B7), and low for Wilshire and Westwood (WEST) and Union Station Rail Station (USR).

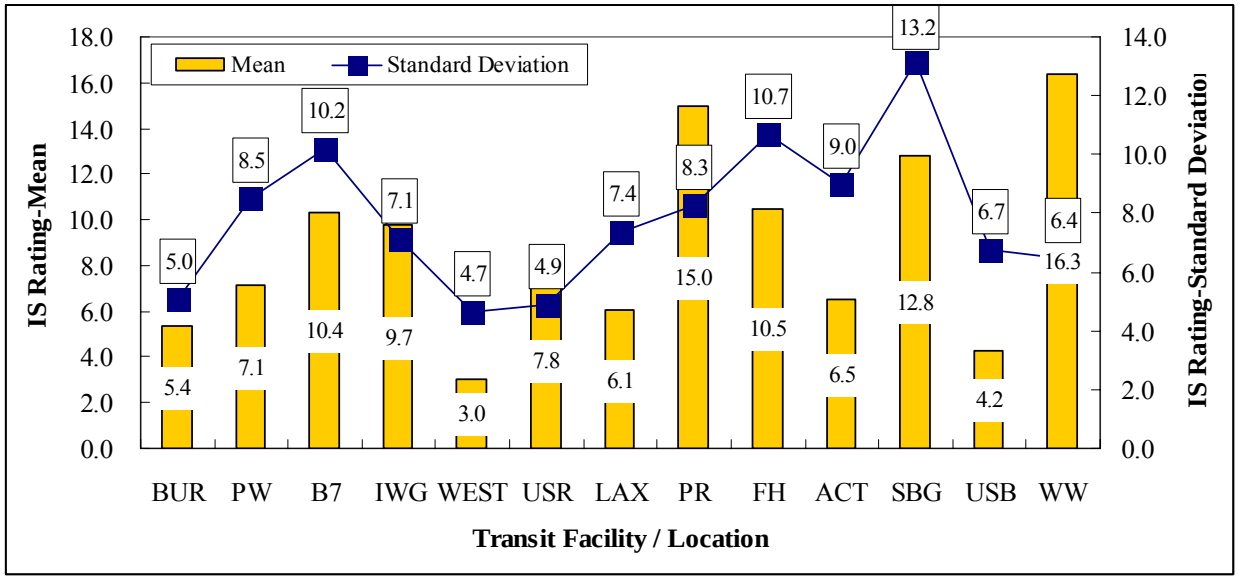

Figure 29 Mean and Standard Deviation of IS Rating by Transfer Facility

Our findings generally show that the facilities with a higher percentage of choice riders, such as USR, USB, BUR, and WEST, tend to be the most satisfied with the transfer facility and have the lowest mean IS rating. This may be because many users at these facilities chose to forego their car in order to use public transit. This finding could indicate that the attributes present at a transit facility do not play a significant role in influencing passenger satisfaction.

Relative Importance of Transfer Facility Attributes based on Satisfaction Ratings

One of the central questions motivating this research is which transit stop and station attributes most influence traveler's use of public transit. The more satisfied transit users are with their waiting and transferring experiences, the more likely they are to take transit.

In order to examine relative importance of transit stop and station attributes, we conducted chi-square tests and ordered logit regression (OLR) analyses, using the various satisfaction ratings described above.[5] In our survey, the dependant variable had four ordinal categories: strongly agree, agree, disagree, and strongly disagree.

First, we conducted chi-square tests to determine whether any of the answers by survey respondents in questions A through P (questions about the individual characteristics of the wait or transfer) influence the distribution of responses for question Q (which is their overall evaluation of the stop or station). Table 8 summarizes results from chi-square tests.[6]

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[5] The chi-square test is a method used to examine whether the distribution of observations among categories of a dependant variable is influenced by another categorical variable (Fox 1997; StataCorp LP 2005). Ordered logit regression is a method used to examine the relationships between a series of independent variables and an ordinal dependant variable. As in other logit regression models, the dependant variable is not continuous, but categorical. In an ordered logit, the particular order of values in the dependent variable is important, while differences between two consecutive values of a dependent variable are not. More details on the use of ordered logit model can be found in STATA manuals (2005) and other advanced statistics textbooks.

[6] Note that the there were four possible responses to question Q, but this was reduced to three in our analysis, combining responses of "disagree" and "strongly disagree." This was done to prevent the number of observations in each cell of a bivariate table from being no less than five. As a result, the degrees of freedom (D of F) are six in all of these chi-square tests.

Table 8 Chi-square Test Results

	Survey Question	Category	No. of Obs	Pearson chi2	D of F	Prob
A	This station / stop area is clean.	Amenities	496	61.04	6	0.00
B	There are enough places to sit.	Amenities	496	46.80	6	0.00
C	There are places for me to buy food or drinks nearby.	Amenities	470	32.41	6	0.00
D	There is a public restroom nearby.	Amenities	462	24.67	6	0.00
E	There is shelter here to protect me from the sun or rain.	Amenities	468	54.21	6	0.00
F	The signs here are helpful.	Information	490	103.52	6	0.00
J	It is easy to get schedule and route information at this station.	Information	480	99.01	6	0.00
H	I usually have a short wait to catch my bus / train.	Connection & Reliability	481	79.22	6	0.00
I	My bus / train is usually on time.	Connection & Reliability	486	113.28	6	0.00
G	It's easy to find my stop or platform.	Access	486	117.92	6	0.00
K	It is easy to get around this station / stop.	Access	488	175.03	6	0.00
L	I feel safe here during the day.	Security & Safety	492	124.02	6	0.00
M	I feel safe here at night.	Security & Safety	475	78.29	6	0.00
N	There is a way for me to get help in an emergency.	Security & Safety	477	54.20	6	0.00
O	This station is well lit at night.	Security & Safety	485	115.12	6	0.00
P	Having security guards here makes me feel safer.	Security & Safety	494	121.81	6	0.00

As you can see in the "Prob" column, the probability that the distribution of responses to question Q is related to questions A through P is in all cases less than 0.05. While the chi-square test does not take into account the order of responses, we can conclude that responses to each of the questions about individual transit stop or station attributes influence the users overall satisfaction in a statistically significant sense.

Following these chi-square tests, we performed a series of a simple ordered logit regression analyses, including variables from one question at a time. Since the explanatory variables are also ordinal variables, three dummy (or dichotomous [0, 1]) variables were used to differentiate the four levels of responses. The results are shown in Table 9. In this table, positions of questions G and J are flipped so that questions in the same category are next to one another. "Pseudo R2" in this table is similar to R-squared in the Ordinary Least Regression (OLS) model; it compares the goodness of fit of different models.[7] Based on the results in Table 9, the variance of responses to the question about getting around the station /stop (K: Access) explains more of the variance of responses in the overall rating (question Q) than any other explanatory variable, having the highest pseudo R-squared value of 0.16. The questions about on-time performance (I: Connection & Reliability) and finding stop or platform (G: Access) have the second highest pseudo R-squared value of 0.12. On the other hand, the variance of questions about amenities (D, C, and B) does not explain much of variance of the overall ratings, having the three lowest pseudo R-squared values among 16 questions.

The columns labeled "probability" show which level of response is statistically significant in the ordered logit model. Here, the level of response means: 1-strongly disagree, 2-disagree, 3-agree, and 4-strongly agree with a statement that the user is satisfied with each attribute at the transit facility. For all individual attributes, the level 4 (strongly agree) response is statistically significant at the 95 percent confidence level. Questions H, L, and O also statistically significant at the 95 percent confidence level for level 3 (agree) responses. Questions I, K, and M are significant at the 95 percent confidence level for response levels 2 (disagree), 3 (agree), and 4

[7] The "log likelihood" with the same degrees of freedom would be technically the more appropriate statistic here.

(strongly agree). In addition to a variable that is statistically significant at the 95 percent confidence level, Questions A, F, and H have another variable statistically significant at the 90 percent confidence level (last column in Table 9).

Considered collectively, overall ease of navigation at the transfer center, personal safety, and service reliability are the most important factors in explaining a passenger's overall satisfaction with a stop or station. For example, "It's easy to get around this station/stop" (pseudo-R2 = 0.16, significant at 3 response levels) is most important overall, "I usually have a short wait to catch my bus/train" (pseudo-R2 = 0.12, significant at 3 response levels) is second, "It's easy to find my stop or platform" (pseudo-R2 = 0.12, significant at 1 response level) is third, "This station is well lit at night" (pseudo-R2 = 0.11, significant at 2 response levels) is fourth, and "Having security guards here makes me feel safer (pseudo-R2 = 0.10, significant at 1 response level) is fifth.[8] On the other hand, station amenities and cleanliness (public restrooms, food/drink sales, places to sit, shelter from sun/rain, and cleanliness) all ranked at the bottom of importance.

Table 9 Results of Simple Ordered Logit Regression Analysis

	Survey Question	Category	No. of Obs	Pseudo R2	Probability 0.05-0.00	Probability 0.05-0.10
A	This station / stop area is clean.	Amenities	496	0.06	4	3
B	There are enough places to sit.	Amenities	496	0.04	4	-
C	There are places for me to buy food or drinks nearby.	Amenities	470	0.03	4	-
D	There is a public restroom nearby.	Amenities	462	0.02	4	-
E	There is shelter here to protect me from the sun or rain.	Amenities	468	0.06	4	-
F	The signs here are helpful.	Information	490	0.09	4	3
J	It is easy to get schedule and route information at this station.	Information	480	0.09	4	-
H	I usually have a short wait to catch my bus / train.	Connection & Reliability	481	0.08	3,4	2
I	My bus / train is usually on time.	Connection & Reliability	486	0.12	2,3,4	-
G	It's easy to find my stop or platform.	Access	486	0.12	4	-
K	It is easy to get around this station / stop.	Access	488	0.16	2,3,4	-
L	I feel safe here during the day.	Security & Safety	492	0.10	3,4	-
M	I feel safe here at night.	Security & Safety	475	0.07	2,3,4	-
N	There is a way for me to get help in an emergency.	Security & Safety	477	0.05	4	-
O	This station is well lit at night.	Security & Safety	485	0.11	3,4	-
P	Having security guards here makes me feel safer.	Security & Safety	494	0.10	4	-

Next, we conducted an ordered logit regression analysis including responses from more than one question for 512 observations. After numerous iterations where we sought to identify a set of statistically significant variables, while taking into account collinearity among variables, we obtained the results shown in Table 10, which lists the variables in the order of the scale of their coefficients.

The pseudo R-squared in this model indicates that approximately 27 percent of variance of an outcome (dependant) variable is explained by the variance of all variables included in the

[8] While most safety attributes were ranked as relatively important, "There is a way for me to get help in an emergency" did not. This is perhaps due to the ubiquity of mobile phones, even among low-income travelers, which may obviate the need for emergency phones and the like.

regression model. All variables included in this parsimonious model are statistically significant at the 95 percent confidence level.

Since all variables are dummy (dichotomous variables) to indicate whether the overall satisfaction response is something other than "strongly disagree," we can compare coefficients among variables directly.[9]

Table 10 Final Ordered Logit Model of Factors Predicting Users Overall Satisfaction Level with their Transit Stop or Station

Nnumber of observations: 512						
LR chi2(8) = 255.37		Prob > chi2 = 0.0000				
Log likelihood = -349.8149		Pseudo R2 = 0.2674				
	Survey Questions	**Category**	**Coef.**	**Std. Err.**	**z**	**P>|z|**
I-4	My bus / train is usually on time.	Connection & Reliability	1.270	0.397	3.20	0.00
P-4	Having security guards here makes me feel safer.	Security & Safety	1.244	0.228	5.45	0.00
O-4	This station is well lit at night.	Security & Safety	1.102	0.330	3.34	0.00
L-4	I feel safe here during the day.	Security & Safety	1.049	0.310	3.39	0.00
L-3			0.961	0.265	3.63	0.00
K-4	It is easy to get around this station / stop.	Access	0.934	0.282	3.31	0.00
F-4	The signs here are helpful.	Information	0.555	0.262	2.12	0.03
G-4	It's easy to find my stop or platform.	Access	0.516	0.256	2.02	0.04
Cut point between "strongly disagree and disagree" & "agree"			-0.175	0.235	(Ancillary	
Cut point between "agree" and "strongly agree"			2.262	0.265	parameters)	

The penultimate row shows the cut point (threshold value) separating those who disagree and strongly disagree with a statement that they are satisfied overall with the transit stop or station (in other words, that they are unsatisfied or very unsatisfied with the stop or station overall), and those agree with the statement that they are satisfied with the stop or station. Likewise, the last row shows the cut point between those who are satisfied with the stop or station, and those who are very satisfied.[10] It should be noted that we obtained a similar result using the statement "I feel safe here at night" (M) instead the statement "I feel safe here during the day" (L). Due to the high correlation between these two variables, we decided to use variables for the statement "I feel safe here during the day" (L).

The difference between this logit analysis and the chi-square analysis presented earlier is that this analysis attempts to consider the influence of each of many stop or station attributes while controlling, to the extent possible, for the influence of other attributes. Thus, the scale of

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[9] This is not a linear regression model, however, so interpretation of coefficients calls for caution. To see how these coefficients affect the probability of the overall satisfaction level, see Table 11 below.

[10] Cut point values are used to compute probabilities that each observation with certain values of independent values fall within each category of a dependant variable, taking into account the disturbance factor, which is assumed to be logistically distributed (StataCorp LP 2005). For example, when all independent values of the obtained regression model are zero, then probabilities for each of three categories (1&2, 3, and 4) are 0.456, 0.449, and 0.094 respectively.

coefficients in Table 10 indicates the relative importance of the explanatory variables examined. Significantly, the most important factor in determining users' overall satisfaction with a transit stop or station has nothing to do with the stop or station; it is the on-time performance of the transit service. This is an important finding, though it should not come as a surprise to anyone familiar with travel behavior research. In other words, the perceived burden of waiting for or transferring between transit vehicles is reduced substantially by reliable (and frequent) service. This finding is all the more reliable because the respondents of this survey were aware that the foci of our analysis were transit stops and stations.

Following schedule adherence, the next three most important stop or station attributes concern personal safety (security guards, lighting, and overall perceptions of security). And following perceptions of personal safety are three factors related to the navigatability of the stop or station (easy to get around, signs are helpful, easy to find stop or platform).

To see how a response to the quality of each attribute influences the overall satisfaction level for the facility, probabilities for the overall satisfaction level were calculated from the estimated coefficients in Table 10 using the mean values for all variables in the regression model (Table 11). In Table 11, the satisfaction level for each of the final model's attributes clearly influences the overall satisfaction level with the transit stop or station. For example, when a transit user is strongly satisfied with on-time performance (I), the probability that this person is strongly satisfied with the overall quality of the transit facility increases from 0.41 to 0.71. The same interpretation applies to all variables.

Table 11 Probability of the Overall Satisfaction Level for Transfer Facilities

	Survey Questions	Category	Response	Mean Probability of Responses		
				#	Agree	Strongly Agree
I	My bus / train is usually on time.	Connection & Reliability	*	0.11	0.48	0.41
			Strongly Agree	0.03	0.25	0.71
P	Having security guards here makes me feel safer.	Security & Safety	*	0.13	0.50	0.37
			Strongly Agree	0.04	0.29	0.67
O	This station is well lit at night.	Security & Safety	*	0.11	0.48	0.41
			Strongly Agree	0.04	0.28	0.68
L	I feel safe here during the day.	Security & Safety	#	0.16	0.52	0.32
			Agree	0.07	0.38	0.55
			Strongly Agree	0.06	0.36	0.57
K	It is easy to get around this station / stop.	Access	*	0.12	0.49	0.39
			Strongly Agree	0.05	0.33	0.62
F	The signs here are helpful.	Information	*	0.11	0.47	0.42
			Strongly Agree	0.07	0.39	0.55
G	It's easy to find my stop or platform.	Access	*	0.11	0.47	0.42
			Strongly Agree	0.06	0.38	0.56

*: Strongly disagree, disagree, and agree combined; #: Strongly disagree and disagree combined.

Overall, the results of this ordered logit regression are consistent with our findings from the importance-satisfaction analysis. *Connection and reliability* factors are the most important,

followed by *security and safety* factors. A few attributes in the access and information categories also significantly influence users' satisfaction levels, but amenities in general are not nearly as important as the other attributes tested.

Relationship between Facility Attribute Characteristics and Users' Perceptions

In the final stage of the analysis, we related our observed levels of quality from our facility inventory to the overall satisfaction ratings in our user survey.[11] First, we related each survey question to each of the facility attributes inventoried, and then we conducted chi-square and correlation tests to test whether the distribution of responses to the overall satisfaction question varies by the score we assigned in our facility attribute inventory. Tables 12 through 15 summarize our results for the four categories of transit stop and station attributes.[12]

The first column in each of the following tables indicates questions from the user survey. The second column indicates a transit facility attribute that is related to the question in the first column. The third through fifth columns show results from chi-square tests: the numbers in the third, fourth and fifth columns are the Pearson test statistic, degrees of freedom, and a chi-square probability respectively. Chi-square probabilities of less than 0.05 are shown in **bold** type. Since the number of seats is a continuous variable (unlike most of our other inventory variables), we obtained a correlation coefficient and a measure of its statistical significance for this variable.

For the stop and station amenities – except litter for question A and fast food and restaurant for question C – the inventory score is related to the satisfaction level in the user survey (Table 12). For the "information" variable, the results indicate that responses in overall satisfaction levels are independent from our inventory scores (Table 13). In other words, we could not establish a relationship between our visual survey of information quality at each of the stops and stations inventoried and users' reported levels of satisfaction with attributes related to information at those stops and stations.

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[11] We initially sought to conduct regression analyses relating the transfer facility inventory data to users' reported overall levels of satisfaction. However, we did not find statistical significance in chi-square tests and correlation analysis between the overall rating and many variables from our stop/station inventory. This is almost certainly due to a lack variance in the inventory data, and not by the number of facilities in the survey. Thus, a lack of variance in the inventory data in relation to the overall rating prevented us from developing the hoped-for multiple regression model to allow us to compare a relative importance of transfer attributes from the facility inventory. In selecting our survey sites we sought to chose stops and stations that were as different from one another as possible, but unfortunately the scope and scale of our survey effort did not permit us to survey the vary large number of stops and stations that would have been necessary to achieve the needed inventory variables across all of the variables of interest. We hope to address this issue in a subsequent phase of this research.

[12] Unfortunately, we were not able to obtain objective measures of the connectivity and reliability of transit service at the stops and stations inventoried, since the attributes in this category required difficult-to-obtain schedule-adherence data for each line at each stop and station.

Table 12 Chi-square and Correlation Test Results of the Relationship between our Inventory of Stop/Station Inventory of Facility Attributes and Users' Perceptions of Amenities

Question	***Amenities***	Chi-squared or Correlation*		
		Pearson chi2	DoF	Prob
A: Cleanliness	Graffiti	17.96	6	**0.006**
	Litter	9.84	6	0.131
B: Seating	Seating	91.00	6	**0.000**
	Number of full seats*	0.36	-	**<0.05**
C: Food / drink services	Services (food/drinks/newspaper)	21.83	6	**0.001**
	Vending machines	10.67	3	**0.014**
	Kiosk	7.90	3	**0.048**
	Fast food/ restaurant	6.90	3	0.075
D: Public restroom	Restroom	51.44	3	**0.000**
	Restroom entrance visible	26.65	3	**0.000**
	Restroom well-lit	32.69	3	**0.000**
E: Protection	Shelter	45.46	6	**0.000**
	Protection from wind	10.46	3	**0.015**
	Protection from sun	27.34	3	**0.000**
	Protection from rain	60.67	3	**0.000**

Table 13 Chi-square Test Results of the Relationship between Stop/Station Inventory Attributes and Users' Perceptions of Information

Question	***Information***	Chi-squared		
		Pearson chi2	DoF	Prob
F: Signs	Signs/ maps	8.74	6	0.19
J: Information	Schedule info	13.57	9	0.14

For the group of access attributes, the distribution of responses for question G ─ facility identity ─ depends only on the level of stop/station visibility identified in the inventory (Table 14). The distribution of responses for question K ─ getting around ─ is related both linkage of the stop/station to the street network and linkage of the stop/station to connecting buses or trains.

For security and safety, there appear to be several attributes whose inventory scores influence the distribution of responses in the satisfaction levels with safety, both during day and at night (Table 15). The distribution of responses in the satisfaction with level of lighting is highly related to the inventory score. However, for emergency call boxes and security guards, Pearson test statistics are statistically significant at a 90% confidence level, but not at the stricter 95% confidence level.

Table 14 Chi-square Test Results of the Relationships between Stop/Station Inventory Attributes and Users' Perceptions of Access

Question	***Access***	Chi-squared		
		Pearson chi2	DoF	Prob
G: Facility identification (1&2, 3, 4)	Linkage to street (3)	2.14	4	0.710
	Visibility	6.09	2	**0.048**
	Platform ID	6.49	4	0.166
K: Getting around a facility (1&2, 3, 4)	Linkage to street	9.80	4	**0.044**
	Linkage to Connecting bus/train	15.26	6	**0.018**

Table 15 Chi-square Test Results of the Relationship between Stop/Station Inventory Attributes and Users' Perceptions of Security and Safety

Question	***Safety & Security***	Chi-squared		
		Pearson chi2	DoF	Prob
L: Safety during day (1&2, 3, 4)	Security guards	19.65	4	**0.001**
	Utilization of station	15.08	6	**0.020**
	Utilization of parking lot	31.81	6	**0.000**
	Call box	16.76	2	**0.000**
	Hidden Area	27.25	4	**0.000**
	Video Surveillance	1.56	2	0.459
	Graffiti	1.13	4	0.889
	Litter	2.20	4	0.698
M: Safety at night (1&2, 3, 4)	Lighting	7.90	4	0.095
	Security guards	9.03	4	0.060
	Utilization of station	15.75	6	**0.015**
	Utilization of parking lot	25.05	6	**0.000**
	Call box	27.30	2	**0.000**
	Video Surveillance	0.58	2	0.750
	Hidden Area	14.59	4	**0.006**
	Graffiti	9.01	4	0.061
	Litter	7.75	4	0.101
N: Help for Emergency	Call box	7.73	3	0.052
O: Lighting	Lighting	13.64	6	**0.034**
P: Security Guards	Security guards	12.34	6	0.055

For questions for which chi-square and correlation tests showed statistical significance at the 95 percent confidence interval, we conducted a series of ordered logit regression analyses using users' satisfaction with each factor as the dependant variable. These questions are on 1) cleanliness (A), seating (B), food/drink services (C), public restroom (D), and protection from the weather (E) in the amenities category, 2) facility identification (G) and getting around a facility (K) in the access category, and 3) questions safety during day (L), safety at night (M), and lighting (O) in the security and safety category, but do not include questions in the information category.

Tables 16, 17, and 18 show the results for each category tested. In these tables, the first column shows question of interest from the user survey. When the scales of satisfaction were reduced from four to three in the process of analysis, it is shown by the code "1 & 2, 3, 4", indicating the levels 1 ("Strongly disagree") and 2 ("Disagree") were combined together. The second column shows the related stop/station attribute from the inventory. The third, fourth, and fifth columns show the number of observations, log-likelihood, and pseudo R-squared. The sixth column shows the dummy variable used. For example, graffiti was scored using the following ordinal ranking: 0) none, 1) minimal, 2) moderate, and 3) a lot, though no stop or station in our sample was categorized as having a lot of graffiti.[13] In the regression analysis in this case, two separate dummy variables were created to indicate "1. minimal" and "2. moderate" different from "none". Columns seven through 11 show estimated coefficients, standard error, z-value, and probability that an estimated coefficient is not different from zero.

Table 16 Ordered Logit Regression Analysis on Satisfaction Scores in the Amenities Categories

		Ordered Logit Regression							
	Amenities	No.Obs	LL	PseudoR2	Var	Coeff	Std.Err.	Z	P>|Z|
A	Graffiti	596	-710.50	0.01	1	-0.517	0.204	-2.53	0.01
					2	-0.752	0.233	-3.22	0.00
B	Number of full seats	584	-741.57	0.05	no_seat	0.027	0.003	8.59	0.00
C	Services	542	-735.02	0.01	1	-1.3148	0.382	-3.44	0.00
					2	-0.647	0.250	-2.59	0.01
	Fast food/ restaurant				1	0.481	0.181	2.66	0.01
D	Restroom	521	-671.40	0.05	1	1.146	0.166	6.92	0.00
E	Shelter	528	-651.74	0.05	3	0.713	0.199	3.59	0.00
	Protection from rain				1	1.252	0.207	6.06	0.00

Table 16 shows that all five user queries about stop/station amenities in our survey have at least one associated variable from our stop/station inventory. The coefficients for graffiti with question A are negative, indicating that more graffiti leads to less satisfaction ─ an expected finding. The coefficients for services for question C are also negative, suggesting that the more services observed at the stop or station, the less satisfied users are with service ─ a decidedly counter-intuitive result. This *services* measure is a composite of more discrete attributes—vending machines, kiosks, and nearby fast food or restaurants with table service. Given that we

[13] See Appendix 3 for *Transit Transfer Stop/Station Characteristics' Template*.

do observe the expected relationship between fast food restaurants and satisfaction with stop and station services, it may be that combining various services into a single composite variable compounds too many factors, obscuring the results. The other estimated coefficients in Table 16 are both positive and expected, indicating that the higher the ranking of particular amenity attributes in our stop/station inventory, the more transit users tend to be satisfied with those attributes.

Table 17 shows the OLR analysis results for question G ─ facility identification. Although the chi-square test showed the dependency of responses in question K, no inventory variables were found to be statistically significant with user perceptions of identity at the 95 percent significance level. Further, and somewhat surprisingly, the estimated coefficient is negative, indicating that users are less satisfied with facility identification when visibility in our inventory was rated as adequate ─ the opposite of what we expected. However, when we examined the tabulation of the responses to question G with the visibility scores from our field inventory, we found that most respondents indicated that they either strongly agreed or agreed somewhat with question G while the few negative responses tended to be distributed somewhat randomly. Thus, combining these two responses ("strongly agree" and "agree somewhat") into a single category produced apparently counter-intuitive results. However, when we examined the distribution of "strongly agree" responses with the ratings of the facilities from our inventory, we found that "strongly agree" responses were much more common in the highest rated facilities in our inventory, and much less common in the lowest rated facilities in the inventory – exactly as we would expect.

Table 17 Ordered Logit Regression Analysis of User Satisfaction Scores in the Access Categories

		Ordered Logit Regression							
	Access	No.Obs	LL	PseudoR2	Var	Coeff	Std.Err.	Z	P>|Z|
G 1&2, 3, 4	Visibility	543	-513.54495	0.0044	3	-0.390	0.185	-2.11	0.04

Table 18 shows the OLR analysis results for questions L (safety during a day), M (safety at night), and O (lighting). The number of satisfaction levels for L and M were reduced down from four to three as indicated ("1&2"). For safety and security, regardless of whether respondents were traveling during the day or at night, the level of station utilization had a negative coefficient. Station utilization refers to how many patrons were surrounding the station/stop area at the time the survey was conducted. This suggests that travelers tend to feel less safe and secure when more people are around. These results are difficult to interpret; the presence of people is often considered to be a form of natural surveillance, which should increase perceptions of safety at more crowded stops. The coefficients for the presence of a call box and security guards are positive, as expected, while the coefficient for the presence of hiding spaces is positive, which is not as expected. While this result calls for further examination, perceptions of safety at a stop or station are related to a wide variety of factors, and it may be that those stops and stations more prone to crime in our small sample happen to have had few nooks and crannies to shelter nefarious activities. For question O ─ lighting ─ the positive estimated coefficient suggests that more lighting observed in our inventory is closely related to the level of satisfactions with lighting expressed by users in our survey – an expected result. Finally, we again treated the two

safety and security survey questions (L and M) as composite indices, and again obtained mixed results. This suggests that a future iteration of this survey should disaggregate safety and security factors as discretely as possible.

Table 18 Ordered Logit Regression Analysis of Satisfaction Scores in the Safety and Security Categories

		Ordered Logit Regression							
	Safety and Security	No.Obs	LL	PseudoR2	Var	Coeff	Std.Err.	Z	P>|Z|
L	Utilization of station	525	-507.47795	0.034	3	-0.407	0.189	-2.15	0.03
1& 2, 3, 4					4	-1.178	0.402	-2.93	0.00
	Security guards				2	0.417	0.239	1.74	0.08
	Call box				1	0.443	0.222	2.00	0.05
	Hide area				2	0.762	0.233	3.27	0.00
M	Utilization of station	497	-514.55795	0.034	3	-0.449	0.191	-2.35	0.02
1& 2, 3, 4					4	-0.742	0.383	-1.94	0.05
	Call box				1	0.780	0.197	3.96	0.00
	Hide area				2	0.652	0.217	3.01	0.00
O	Lighting	495	-607.31173	0.0099	2	0.485	0.283	1.71	0.09

We examined the relationship between the overall satisfaction level and the inventory data on stop and station attributes. As noted in Footnote 9 above, however, very few variables were found to be statistically significant in either chi-square or correlation tests. The results are shown in Appendix 3.

6. CONCLUDING REMARKS

The analysis presented in this report has sought to address the general lack of causal clarity that plagues most previous research on transit stops and stations. Accordingly, we have examined: (1) how passengers evaluate transit stops and stations, taking into account the level of importance passengers place on each factor, and (2) what factors influence passengers' evaluation of transit stops and stations using the five evaluation criteria categories developed from the transfer penalties causal framework developed in a previous report:

1) *access*,
2) *connection and reliability*,
3) *information*,
4) *amenities*, and
5) *security and safety*.

Using this framework we designed and administered a survey to 749 transit users at twelve transit stops and stations (which ranged from adjacent corner bus stops to a large enclosed multi-modal transit center) around metropolitan Los Angeles. The demographics and travel patterns of those surveyed generally mirror those of southern California transit users in general.

Drawing on the data collected from this survey, we conducted two analyses: First, we conducted an *Importance-Satisfaction Analysis* to identify the priority that users in our sample place on improving transit stop and station attributes. Second, we used *chi-square tests*, *correlation tests*, and *multiple regression analyses* to examine which transit stop and station attributes measured in the inventory were related to the satisfaction level of transit users.

From these analyses, one principal finding stands out loud and clear: the most important determinant of user satisfaction with a transit stop or station has nothing (directly) to do with physical characteristics of that stop or station ─ it's frequent, reliable service in an environment of personal safety. In other words, most transit users would prefer short, predictable waits for buses and trains in a safe, if simple or even dreary, environment, over long waits for late-running vehicles in even the most elaborate and attractive transit facility, especially if they fear for their safety. While this finding will come as no surprise to those familiar with past research on the perceptions of transit users, it does present a contrast to much of the descriptive, design-focused research on transit transfer facilities.

Of our sixteen stop and station attributes, users ranked safety and service quality factors as most important:

Most Important

1) I feel safe here at night (78%)
2) I feel safe here during the day (77%)
3) My bus/train is usually on time (76%)
4) There is a way for me to get help in an emergency (74%)
5) This stop/station is well-lit at night (73%)
6) I usually have a short wait to catch my bus/train (70%)

In contrast, stop and station-area amenities ─ the ostensible focus of this research ─ were ranked as least important by users:

Least Important

1) It is easy to get route and schedule information at this stop/station (62%)
2) There is a public restroom nearby (59%)
3) This stop/station is clean (58%)
4) It is easy to get around this stop/station (57%)
5) There are enough places to sit (50%)
6) There are places for me to buy food or drinks nearby (34%).

This is not to say that such amenities are not important to travelers ─ more than half ranked information, a public restroom, cleanliness, and ease of navigation ─ as important. Rather, *ceteris paribus*, travelers prefer safe, frequent, reliable service over these factors.

When we statistically related users' satisfaction with various stop/station attributes with their overall satisfaction with their wait/transfer experience, we obtained similar, if not identical, results:

Most Important

1. It is easy to get around this stop/station
2. I feel safe here during the day
3. Having security guards here makes me feel safer
4. It's easy to find my stop or platform
5. The stop/station is well lit at night.
6. My bus/train is usually on time

Least Important

1. This stop/station is clean
2. There is shelter here to protect me from the sun or rain
3. There is a way for me to get help in an emergency
4. There are enough places to sit
5. There are places to buy food or drinks nearby
6. There is a public restroom nearby

We then employed a logistic regression model to measure the influence of each of 16 attributes on overall satisfaction, while simultaneously controlling for the effects of all other measured 'satisfaction' attributes. This sort of an analysis tends to eliminate all but one of closely related factors (such as "I feel safe here at night" and "This stop/station is well-lit at night") while elevating ostensibly less-important factors that independently influence users' overall levels of satisfaction:

Most Important

1. My bus/train is usually on time
2. Having a security guard here makes me feel safer
3. This stop/station is well-lit at night
4. I feel safe here during the day
5. It's easy to get around this station/stop
6. The signs here are helpful

Finally, we performed an extended series of statistical tests in an attempt to relate the physical attributes we inventoried at the stops and stations with the surveyed passengers' perceptions of these attributes. These results were largely as expected. While we were not able to draw firm conclusions regarding how these various attributes were related to overall user satisfaction levels, we did identify specific attributes that predict users' satisfaction levels. These attributes include graffiti, visibility, and the presence of seating area, restroom, and shelter. At the same time, we found the results of other variables, such as the availability of services, availability of call boxes, protection from rain, utilization of facility, and the presence of hide area, are counter-intuitive. Many of this last set of findings, however, are best viewed as preliminary, and likely require further investigation.

While perhaps surprising to some, these findings should be heartening to transit managers focused on delivering quality transit service to users. While comfortable, informative and attractive stops and stations can indeed make traveling by public transit more agreeable, what passengers *really* want most is safe, frequent, and reliable service ─ plain and simple.

7. ACKNOWLEDGMENT

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Appendix 1 User Survey Instrument

UCLA Transportation Survey - Tell us what you think!

UCLA researchers are assisting the State of California in improving transportation services. Part of this work includes asking people like you about your views on bus stops, train stations, and the like. This survey should take only a couple of minutes to complete and is completely voluntary. You are under no obligation to take this survey, or even to complete it once you have started. Further, the survey is anonymous and no individuals will be identified in any of the work produced from this research. Are you willing to participate in this survey?

_____ YES _____ NO

1. How many days in a typical week do you ride a bus, train, or subway?

_____ days per week

☐ less than once a week

2. What is the purpose of your trip today? *(check all that apply)*

☐ (1) work or job
☐ (2) shopping or errands
☐ (3) college or school
☐ (4) visiting family or friends
☐ (5) other: _____

3. How often do you make *this* trip?

☐ (1) regularly
☐ (2) sometimes
☐ (3) not often
☐ (4) never before

4. Could you have made this trip today by car / truck / motorcycle instead of by bus / train?

☐ (1) yes, easily
☐ (2) yes, with a little effort
☐ (3) no, probably not
☐ (4) no, definitely not

5. How did you get to this station / stop today?

☐ (1) bus or train
☐ (2) drove in a car by myself
☐ (3) got a ride from someone else
☐ (4) took a taxi or shuttle / van
☐ (5) rode a bicycle
☐ (6) walked _____ minutes
☐ (7) other: _____

6. From this station / stop, how will you reach your next destination?

☐ (1) bus or train
☐ (2) drive in a car by myself
☐ (3) get a ride from someone else
☐ (4) take a taxi or shuttle / van
☐ (5) ride a bicycle
☐ (6) walk _____ minutes
☐ (7) other: _____

7. How long do you expect to wait before leaving?

_____ minutes ☐ don't need to wait ☐ unsure

8. Would you have preferred to make this trip by car / truck / motorcycle rather than by bus / train?

☐ (1) I strongly prefer car / truck / motorcycle
☐ (2) I usually prefer car / truck / motorcycle
☐ (3) I usually prefer bus / train
☐ (4) I strongly prefer bus / train

9. Are you: ☐ (1) male ☐ (2) female

10. What is your background? *(check all that apply)*

☐ (1) American Indian
☐ (2) Asian / Pacific Islander
☐ (3) African-American / Black
☐ (4) Hispanic / Latino
☐ (5) Anglo / White
☐ (6) other: _____

11. In what year were you born? 1 9 ___ ___

12. About how much is your yearly household income?

☐ (1) Less than $10,000
☐ (2) $10,000 - $14,999
☐ (3) $15,000 - $24,999
☐ (4) $25,000 - $34,999
☐ (5) $35,000 - $49,999
☐ (6) $50,000 - $74,999
☐ (7) $75,000 - $99,999
☐ (8) $100,000 - $149,999
☐ (9) $150,000 - $199,999
☐ (10) $200,000 or more
☐ (11) unsure / don't know

		Do you agree or disagree?				How important is it to you?			
		Strongly Agree 4	Agree Somewhat 3	Disagree Somewhat 2	Strongly Disagree 1	Very Important 4	Important 3	Somewhat Important 2	Not Important 1
A	This station / stop area is clean.								
B	There are enough places to sit.								
C	There are places for me to buy food or drinks nearby.								
D	There is a public restroom nearby.								
E	There is shelter here to protect me from the sun or rain.								
F	The signs here are helpful.								
G	It's easy to find my stop or platform								
H	I usually have a short wait to catch my bus / train.								
I	My bus / train is usually on time.								
J	It is easy to get schedule and route information at this station.								
K	It is easy to get around this station / stop.								
L	I feel safe here during the day.								
M	I feel safe here at night.								
N	There is a way for me to get help in an emergency.								
O	This station is well lit at night.								
P	Having security guards here makes me feel safer.								
Q	This is an easy place to transfer to another bus or train.								

Thanks for helping us improve public transit!

Appendix 2 Transit Transfer Stop/Station Characteristics' Template

Station Name: _____

Date & Time: _____

Rules of Thumb

- Nominal or categorical variables will be coded by a set of dummy (0 or 1) variables to represent all categories
- Orderly variables, in which the order is important but differences among choices do not mean anything, will be coded either a set of dummy variables or numbers in order. In any case, I need to re-code after looking at the data.
- Scale variables will be coded using numbers, while a unit of numbers may not be clear.
- Continuous variables should be coded as numbers or percentages as much as possible. Avoid collecting them in other ways, which result in a loss of information.

For all variables, which require some subjective judgment (e.g. graffiti), the team initially defined as clearly as possible each level and the followed the definition (or standard) as much as possible regardless of survey location. Our objective in developing this inventory was to be as detailed as possible in our collection of site-specific information that could subsequently be aggregated later if necessary; subsequent coding of the data would be based on our definitions of each level; it was important to identify variability in measurements among the sample locations.

Control Variables

Station Type	Bus only __0__	Rail only ____1_	Bus & Rail ___2__
Surrounding Environment	Urban ___1__ Suburban ___0__		
Transfer Facility Type	Level 1-5 __1 through 5____		
Passenger Loading	On-street __0____	Off-street ___1____	
Park-and-Ride	Yes/ No _____	# of Spaces ___	

Approximate Time to Walk between Park-and-Ride and Platform

Comments

_____

_____

Treatment Variables

I. Safety & Security:

Lighting

None____0__ _Minimal ____1___ Average ____2____Adequate ____3___

Security Guards/Police Officers

Always ___2___ Sometimes____1___ Never ____0_____

Comments

_____

_____

Utilization of Station Mostly empty _0__ 1/3 filled _1__ ½ filled _2__ ¾ filled __3_ Full __4___

In Percentage) _____ %

Comments

_____

_____

Utilization of Parking Lot

Mostly empty _0__ 1/3 filled _1__ ½ filled _2__ ¾ filled __3_ Full __4___

In Percentage _____ **%**

Comments

_____

_____

Emergency Communication Device

Call Box __Yes 1, No 0 Video Surveillance _ Yes 1, No 0 Both __ Not needed_____

Comments (location and relative distance)

_____

_____

II. Access:

Linkage to Street

Stairway _1__ Underpass __2_ Overpass _3__ Access to Sidewalk _4__ Elevator/ Escalator__5_

Other (explain) _____

Comments (indicate how easy or difficult it is for pedestrians to access the station)

_____

_____

Linkage to Connecting Bus/Train

Stairway _1__ Underpass _2__ Overpass __3_ Sidewalk _4__ Elevator/ Escalator__5__

Other (explain) _____

Comments (indicate how easy or difficult it is for pedestrians to transfer to another bus or train)

_____

_____

Visibility from Surroundings

Minimal _1___ (hard to see surroundings)

Moderate __2__ (partial visibility)

Adequate _3___(open space)

Comments

_____

_____

Hidden Areas (under stairs, behind walls, nooks, bushes, etc.)

Count the number of hidden areas, in addition to qualitative observation

Comments

_____

_____

Platform Identification

Minimal ____1____ (loading area not identified)

Moderate ____2____ (not clearly identified)

Adequate ____3_____ (clearly marked)

Comments

_____

_____

III. Amenities:

Cleanliness/Presence of:

Graffiti	None __0_	Minimal __1__	Moderate __2_	A lot __3__
Litter	None __0_	Minimal __1__	Moderate __2_	A lot __3__

Comments

_____

_____

Restrooms (location of restrooms-if any- relative to platform)

Restroom	Yes 1, No 0
Entrance visible	Yes 1, No 0
Well-lit	Yes 1, No 0

Comments

_____

_____

Seating Minimal ___1_____ Moderate _____2____ Adequate ___3_____

Seating Capacity

Full-seat # _____

Half-seat (those which you can sit on in a standing position) # _____

Comments

_____

_____

Services Minimal ____1____ Moderate _____2____ Adequate ___3_____

Vending machines	Yes 1, No 0
Kiosk (can buy newspaper, drinks)	Yes 1, No 0
Fast food or regular restaurants with seating	Yes 1, No 0

Comments (location)

_____

_____

Shelter Minimal _____ Moderate _____ Adequate _____

Shelter from wind Yes 1, No 0

Shelter from sun Yes 1, No 0

Shelter from rain Yes 1, No 0

(It is important to check if you can see the next vehicle's arrival from the shelter.)

Comments

IV. Information:

Signs/ Maps

None __0__ (not posted)

Minimal ___1_____ (hard to find/not clearly marked)

Moderate ___2_____ (easy to identify)

Adequate ___3_____ (centrally located/clearly marked)

Comments

_____

_____

Schedule Information

None __0__ (not posted)

Minimal ___1_____ (present but hard to find)

Moderate ___2_____ (clearly posted in one area)

Adequate ___3_____ (clearly posted throughout the station)

Comments

_____

_____

Availability of Multiple Languages

Check multiple languages for some information that should be communicated through text

Spanish Yes 1, No 0

Korean Yes 1, No 0

Chinese Yes 1, No 0

STATION NEIGHBORHOOD CHARACTERISTICS

(1/4 mile from station platform)

Station Name _____

Land Uses (check all that apply)

Residential Single Family	____
Residential Duplexes	____
Residential Multifamily	____
Mixed Use	____
Office (low rise)	____
Office (medium rise)	____
Office high rise	____
Retail neighborhood	____
Retail "Big Box"	____
Industrial light	____
Industrial heavy	____
Vacant Land	____
Parking lots	____
Parking garages	____
Open Space (e.g. parks)	____
Other (specify)	

Comments (note the approximate proportion of each land use)

_____

_____

Density

Residential	High ___	Medium ___	Low ____
Commercial	High ___	Medium ___	Low ____

Comments

_____

_____

Street Traffic (adjacent to station)

Heavy ____	Moderate ____	Low _____
(busy street)	(moderate traffic flow)	(few cars passing)

Pedestrian Traffic (adjacent to station)

Heavy ____	Moderate ____	Low _____
(many people nearby)	(few passer-byes)	(little/ no pedestrians)

Comments

_____

_____

Specific Land Uses (note the existence and number of the following)

	Number
Parks	_____
Schools	_____
Restaurants	_____
Cafes	_____
Banks	_____
Civic Buildings	_____
ATMs	_____
Check Cashing	_____
Pawn Shops	_____
Alleys	_____
Liquor Stores	_____

Motels _____

Abandoned Buildings _____

Other _____

Sense of Safety[14]

Good _____ Average _____ Poor _____

Comments (explain your answer)

_____

_____

[14] This is a rather subjective and impressionistic measure, but we want to know if based on what you see you feel safe in this neighborhood? Some things to consider include: Do you see other people in the neighborhood? Do you see fenced windows and doors? Are there homeless, beggars, or transients, etc.?

Appendix 3 Inventory Variables Affecting the Overall Satisfaction Rating

We examined the relationship between the overall satisfaction level and the inventory data on stop and station attributes. In Table A-1 below, however, very few variables (in bold type) were found to be statistically significant in either chi-square or correlation tests.

Table A-1 Chi-square and Correlation Tests to Examine the Relationship between Users' Overall Satisfaction Levels and the Stop/Station Attribute Inventory

Transfer Attribute Categories	Transfer Facility Attribute from the Inventory	Chi2 with Qeusetion Q (1&2, 3, 4)		
		Pearson chi2	DoF	Prob
Amenities	Graffiti	0.346	4	0.483
	Litter	1.290	4	0.863
	Restroom	1.350	2	0.509
	Restroom entrance visible	1.132	2	0.568
	Restroom well-lit	0.883	2	0.643
	Seating	3.846	4	0.427
	Number of full seats	0.070*	-	>0.10
	Services	**8.547**	**4**	**0.073**
	Vending machines	1.814	2	0.404
	Kiosk	3.976	2	0.137
	Fast food/ restaurant	1.568	2	0.457
	Shelter	**11.927**	**4**	**0.018**
	Protection from wind	1.730	2	0.421
	Protection from sun	**10.979**	**2**	**0.004**
	Protection from rain	**7.736**	**2**	**0.021**
Information	Signs/ maps	2.342	6	0.886
	Schedule info	4.503	6	0.609
Access	Linkage to street	8.680	8	0.370
	Linkage to Connecting bus/traing	1.613	6	0.952
	Visibility	3.737	2	0.154
	Platform ID	0.062	4	1.000
Safety & Security	Lighting	4.912	4	0.296
	Security guards	5.906	4	0.206
	Utilization of station	7.606	6	0.268
	Utilzation of parking lot	4.404	4	0.354
	Call box	2.430	2	0.297
	Hidden areas	1.317	4	0.859
	Video Surveillance	0.922	2	0.631

The variables that did prove statistically significantly related to overall satisfaction levels were services, shelter, protection from sun, and protection from rain. Unfortunately, shelter, protection from sun, and protection from rain all have a high degree of correlation with one other (0.42-0.75). These factors are, ironically, some of the least important factors identified in our more preliminary analyses reported above. Based on these chi-square and correlation tests, therefore, we expect that most of variables gathered for our inventory will not prove to be statistically significant in a regression analysis. And, indeed, this was the case. The reason, as discussed above, is almost certainly due to the high degree of correlation among the various

inventory variables in our study sites. In other words, stops and stations with good signs tend to have lots of seats, plenty of shelter, and so on. It will take a much larger sample of stops and stations ─ perhaps in a later stage of this research ─ to meaningfully test overall user perceptions of the stop/transfer experience with the wide array of physical stop/station attributes simultaneously.