

**Evaluating Transit Stops and Stations from the Perspective of Transit
Managers
Interim Deliverable #4**

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EXECUTIVE SUMMARY

What makes a good transit stop or transfer facility? The answer, naturally, depends on who you ask. Passengers, transit system managers, businesses and residents adjacent to stops and stations, and the local governments host to stops and stations can all have strong, and sometimes conflicting, ideas about what makes a good stop, station, or transit facility. Our previous Interim Deliverables for this project have examined the existing literature (Deliverables 1 and 2) and analyzed the transit user's perspective using an extensive passenger survey (Deliverable 3). This report examines this question from the transit system managers' perspective, as well as comments on transit operator's perception of the community's (nearby passenger and non-passenger) viewpoint. Additionally, we conducted telephone interviews with several transit agency employees to gain further insight into the operator's perspective, as well as to gather pertinent anecdotes.

Much of the previous literature on this topic is descriptive, often listing operator-related factors of a good stop/station with little explanatory analysis of (1) how listed factors contribute to transit service connectivity, (2) tradeoffs among factors, and (3) their relative importance. To address these shortcomings, we developed and administered a web-based online nationwide survey of U.S. transit agencies to identify factors that transit managers and planners believe are most important to them and to their riders, and the relative importance that transit operators place on these factors in their planning.

Overall, we found that survey respondents believe that safety, security, and the absence of movement conflicts between transit vehicles and pedestrians are the most important determinants of a good stop/station and transit transfer facility, with safety and security ranking 1st, and minimizing pedestrian conflicts ranking 2nd overall. Ranked just below this was ease of transferring, followed by the reduction of institutional barriers and cost minimization. These findings contribute to our understanding of the factors influencing transit users' "out-of-vehicle" travel experiences and other factors affecting the location and design of transit stops/stations and transfer facilities.

We found several preference patterns among respondent subgroups. For example, we found that survey respondents who identified as having "executive/administrative" occupations actually felt that cost minimization was *less* important than all other respondents in other occupational categories, controlling for the other objectives included in our research. For another respondent subgroup — service area population — we found that respondents from the smallest quarter of participating transit agencies rated "minimize institutional barriers to transferring such as transfer fares, lack of information or poor coordination of schedules" less important than did all other respondents. This is likely due to the relative lack of additional service providers with which to interact and coordinate in these smaller jurisdictions. In another respondent subgroup — agency fleet size — the data suggest that agencies with very large fleets rated the presence of amenities as less important than other agencies. Agencies with large fleets also tend to be located in denser urban areas and such dense areas also provide non-agency related, that is, private retail, amenities to satisfy riders' desires. For the respondent subgroup dealing with the percentage of fixed-route service, agencies with mostly fixed-route service, (largest quartile), generally rated "Maximize operational ease at the station or facility, e.g., vehicle maintenance and storage, ticketing, baggage handling, and/or accounting" much higher than other respondents. This is expected since operators with a large relative amount of fixed-route service have a greater need to coordinate an efficient system for mass vehicle maintenance and storage than other operators.

Our telephone interviews proved illuminating, highlighting foremost that safety and security concerns “trump all”, and that oftentimes other considerations must be foregone in order to achieve maximum safety and security. We further learned that large regional agencies and agencies operating in relative isolation tended to be less concerned with the reduction of institutional barriers than were agencies operating as an element of a larger regional transit system. Flexibility for expansion was important to some of our agencies – both those in fast-growing regions and our one state agency (which contained several fast-growing regions and rapidly increasing congestion), while for other agencies, both service supply and demand were seen as relatively static.

Through our telephone interviews with agency employees, we also learned about the neighboring community’s perspective. They told us that homeowners are often wary of new transit investment, fearing “the wrong element” and reduction in property values. Several interviewees commented that it is much easier to site a transit center during the planning phase of a new district than to insert it later; others commented that in neighborhoods with high residential turnover, it may be easier to site a new facility without attracting criticism. Several interviewees also stressed that certain groups strongly *support* new transit investment, including low-income individuals and communities, the disabled community, and businesses that employ large numbers of low-income individuals.

We learned a great deal about the influence of non-transportation goals in the planning process for transit stops and transfer facilities. Our interviewees commented at length on “political concerns” that often override engineering and transportation concerns. Some respondents told us that politicians often look for a project to “cut a ribbon” on, while other politicians and community advocacy groups look toward transit investment as a way to revitalize a distressed neighborhood or commercial center. Respondents universally expressed frustration at these incidents, though they tended to find them necessary and often useful.

Finally, our online survey results show that, while transit operators appear to have a fairly accurate understanding of what attributes are important to their riders at transit stops and transfer stations, there are several points of disparity. While operators correctly assumed that safety and security were very important to riders, they tended to *underestimate* the importance of specific safety-related amenities, such as security guards and emergency assistance. It also appears that, controlling for other factors, operators may *overestimate* the importance of station cleanliness and schedule information to their riders.

In sum, we learned that, by and large, safety and security are transit agencies’ primary concern at transit transfer facilities. Indeed, as one of our respondents commented, safety concerns tend to “trump” all other concerns, and tradeoffs are nearly always made in favor of safety and security concerns. At a more nuanced level, it is clear that many other tradeoffs are made; our ranking of concerns suggests a framework within which our respondents tend to make these tradeoffs. For example, one interviewee told us of a bus facility where aesthetic and comfort concerns (ranked 8th in our list of 23) were subjugated to the need to minimize pedestrian-vehicle conflicts (ranked 2nd). This ranking serves both to describe more accurately the prioritization of various objectives by transit operators, as well as to serve as a tool in considering transit stop and transfer facility siting, design, operation and maintenance.

Key Words: transit system managers, transit operators, transit stops, transit stations, transfer facilities, web-based survey, evaluation

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1. INTRODUCTION

Unlike door-to-door travel by foot, bicycle, taxi, or private vehicle, public transit passengers typically must wait for and transfer between buses and trains during journeys. As such, the travel time spent outside of transit vehicles waiting and transferring constitutes an important, and under-studied, part of transit travel. Understanding how travelers perceive waits and transfers can help transit managers reduce the burdens of transit travel, thereby increasing the attractiveness of public transit.

When connections are poor, waits and transfers become burdensome for transit users and can discourage transit use¹. Moreover, poor stop and station connectivity

“. . . creates barriers that impede customers’ ability to make efficient multi-operator trips. When connectivity is poor, multi-operator transit trips are frustrating, time-consuming, and costly, lowering service quality for users and making transit unattractive for new customers.”²

Whereas good connectivity is

“reflected in a convenient and ‘seamless’ transit system by reducing travel times, providing more reliable connections, making it easier to pay and ensuring that transfers are easy and safe.”²

The scope and scale of wait/transfer sites vary significantly, from hundreds of thousands of simple bus stops around the U.S. marked by little more than a small sign on a pole, to elaborate and architecturally significant multi-modal commercial hubs, like Union Station in Washington D.C. The attributes of these wait/transfer facilities differ in many ways: physical size and configuration, number of lines, agencies, and modes served, traveler amenities, operating costs, and effects on neighboring communities. Systematically evaluating such heterogeneous places thus poses a significant analytical challenge.

Further, perceptions of the most relevant criteria to evaluate the performance of transit stops and stations can vary significantly depending on the stakeholders involved^{1,3}. These include:

- Passengers/users,
- Transit operators, and
- Businesses and residents adjacent to stops and stations, and the local governments host to stops and stations.

Passengers/users are the *raison d’etre* of transit travel and their perceptions and needs are central¹. Research on the burdens (or “penalties”) of passenger waits and transfers includes: minimum transfer time and distance, convenience, comfort, and safety and security³.

Beyond passenger needs, transit stops and stations must meet operational needs of transit systems as well. These include vehicle queuing and staging areas, adequate road/rail network access, adequate vehicle/passenger segregation, driver break facilities, and so on. When a transit operator directly controls property on which a stop or transfer facility sits, it can largely control stop/station attributes of the station or facility to accommodate operational requirements³. But more often, stops and stations are partially or fully controlled by other governmental agencies – most frequently local governments that control sidewalks – who may have interests different than, and sometimes at odds with, those of transit agencies⁴.

No transit station or transfer facility — whether it is located in the city or suburbs, or whether it serves intra-modal or intermodal transfers — is truly a stand-alone facility. It relates to and interacts with adjacent businesses and homes, both in providing access to nearby parcels as well by generating traffic, noise, emissions, and other negative externalities. Over the longer term, the facility can affect the type and level of adjacent development, sometimes significantly³. In one survey of transit agencies, respondents named the provision of a civic facility and assistance with downtown development as common objectives of transit transfer facilities⁵. Thus, it is essential to consider the relationship between a station or facility and its immediate surroundings in the design process³.

This research is part of a larger, ongoing project comparing and contrasting the perspectives of transit stops and stations among riders, transit managers, and other stakeholders. In this report, we explore the transit operators' perception of various attributes (and their relative importance) of transit stops, stations, and transfer facilities; a better understanding of how operators view their transfer stations and facilities will aid in the development of performance measures. Additionally, we attempted to ascertain the priorities of neighboring community residents and businesses by interviewing transit planners on this subject. Following this introduction, we offer background material based on our review of the transit connectivity literature focusing on the transit operator perspective. We follow this with a discussion — both of our methodology and of our findings — of a nationwide web-based survey of transit agencies that we have conducted to investigate these factors. Finally, the report offers concluding remarks about this research.

2. PREVIOUS WORK

The transit connectivity literature focuses primarily on the physical and geometric design of transfer facilities and their operations. Prior to the mid-1970s, a ‘rule of thumb’ approach was employed to address transit station design. This changed as a result of research sponsored by the National Science Foundation that reviewed the literature of transit facility design as it existed at the time and conducted a seminar on transit facility design that assembled representatives from the architecture, engineering, and transit communities with academic researchers in the transportation field⁶. This work resulted in the development of a more formalized and comprehensive approach for transit station design⁷.

Concurrent research sponsored by the U.S. Department of Transportation^{7, 8, 9} involved the development of a design methodology for interface facilities, which added structure to the conventional ‘rule of thumb’ approach by using a systems analysis approach to develop a methodology for planning, designing, and evaluating urban public transit transfer stations and facilities. In essence, this new methodology devised an approach with which to assess connectivity at transit transfer facilities. While this early research focused on the planning and design of transit transfer facilities as new facilities, the findings from this research have also been applicable to renovation of existing facilities as well⁸.

This newly-developed methodology recognized that perspectives from different stakeholders needed to be acknowledged and included in the development of an interface facility design methodology. The early research considered the perspectives of the 1) conventional traveler, 2) special traveler, e.g., the elderly or disabled, and 3) the operator. Vuchic and Kikuchi¹ developed a variation of this classification and suggested considering the perspectives of the 1) traveler, 2) operator, and 3) community. Because this research was conducted prior to enactment of the Americans with Disabilities Act (ADA, 1990), it was reasonable in the mid-1970s to underscore the disabled community.

Most previous research simply listed factors or attributes considered important by various stakeholders, with little in the way of explanatory information to help understand 1) how and why operator-perspective factors contribute to transit transfer connectivity, 2) how such factors interact with each other and their tradeoffs, and 3) their relative importance. For example, Vuchic and Kikuchi¹ provide the following list of operator-related factors that the design of transfer facilities must satisfy:

- Minimum investment cost,
- Minimum operating cost,
- Adequate capacity,
- Flexibility of operation, and
- Passenger attraction.

Hoel, Demetsky, and Virkler⁷ and ITE Technical Council Committee 5C-1A¹⁰ each identify objectives and, for each objective, criteria against which an evaluation could be conducted together with specific performance measures. These two reports share some operator-related objectives as well as possessing some unique objectives (Table 1).

Horowitz and Thompson^{11,12} recognize that evaluation of transfer facilities requires judgment on many design elements, taking into account costs of individual elements. They also emphasize

the need to incorporate the opinions of transit users, transit operators, government agencies, designers, and the community — from each of the three stakeholder perspectives. This research is the only example that goes beyond a simple listing of factors by classifying operator-related factors and providing information about the relative importance of the operator-related factors in addition to passenger-related and community-related factors.

A list of 70 broadly worded objectives from all three stakeholder perspectives was developed by Horowitz and Thompson based on a review of the literature and interviews with Metropolitan Planning Organization staff, transit users, transit agency planners, and experts in intermodal station design. Horowitz and Thompson define an objective as “a specific statement of a goal for a transit transfer facility,” or a “desired-end-product.” Moreover, each objective is worded in terms of ‘achieving,’ ‘maximizing,’ or ‘minimizing’ something; the 70 objectives were rank-ordered by their aggregate rating based on input from the interviews where each interviewee was asked to rate the objectives on a scale of 0 (Not Important) to 10 (Extremely Important).

Horowitz and Thompson classified each of these objectives using two schemes based on level of specificity. The first classifies each objective as one of ten types:

- transfer (T)
- safety/security (SS)
- access (A)
- efficiency (E)
- financial (\$)
- modal enhancement (M)
- physical environment (PE)
- nonphysical environment (NE)
- space/site (#)
- architectural/building (AB) and
- coordination (C).

The second scheme classifies each objective as one of four generic objective categories:

- 1) system objectives related to the complete regional transportation system (SO);
- 2) internal objectives related to the design of the facility and its site (IO);
- 3) external objectives related to the environment and the surrounding community beyond the site (EO), and
- 4) mode interface objectives related to aspects of the facility directly affecting transfers (MIO).

Table 2 shows an abridged version of Horowitz’s and Thompson’s original list of 70 objectives, focusing on the highest-rated operator-related factors, where the highest possible rating is 10.0.

Table 1 Objectives, Criteria, and Performance Measures

Operator Objectives	Criteria	Performance Measures
<i>Common to Both</i>		
Maximize safety	Safety features on mechanical and electrical systems	Special safety features
Provide proper security	Size of security force; Number of facility levels; Means of escape; Number of exits; Accessibility to station agent's booth and major passenger paths; Surveillance and security patrols	Number of personnel; Number of levels; Type and number of directions for each destination; Number of exits; Distance of discrete areas from agent's booth Percentage of floor area that is part of 'paid area; Number of areas not subject to frequent security patrols or surveillance including parking lots
Minimize maintenance, cleaning, and replacement needs	Maintenance; Cleaning surfaces; Cleaning concessions	Size and cost of maintenance work force
Minimize total cost	Allocated funds; Subsidy required; Public and private investments	Dollars
Exploit joint development potential	Compatibility with community planning and land use goals; Special zoning; Percentage area for non-transport usage	Policy evaluation – a function of location
<i>Unique to Hoel, Demetsky, and Virkler⁶</i>		
Maximize equipment reliability	Back-up facilities in case of breakdown; Inspection procedures	Present or not present; Frequency and type
Efficiently collect fares and control entry	Attraction to robbery or vandalism; Inconvenience to traveler due to method; Technology used	Type of fare collection and safeguards provided; Time required for purchasing and waiting; Passenger processing rate and ability to keep non-payers out
Efficiently process flows	-----	Hourly flow rate of passengers
Provide adequate space	Station size	Square feet
Obtain an efficient return on incremental investment	Additional benefits or objectives met beyond base cost	Benefit-Cost ratio assuming that benefits are convertible to dollars
Receive adequate income from non-transport activities	Cost of facilities vs. income received	Break even or profit; loss must be avoided
Utilize energy efficiently	Total and incremental energy requirements	Kilowatt hours
Provide opportunity for expansion	Expansion potential on ground floor and upward for higher floors	Floor space, local land costs, area around facility, and zoning ordinances
<i>Unique to ITE Journal 5C-1A⁹</i>		
Minimize pedestrian-vehicle conflicts	Measures of crossing flows	Relative volumes (major and minor flows)
Provide sufficient space	Facility size	Square feet
Ensure adequate lighting	Maintenance factors, brightness ratios, glare, reflectance, and emergency lighting	-----
Provide protection from weather	Terminal area exposed	Percent terminal area exposed
Provide design flexibility	Expansion potential, vertical, horizontal, passenger processing, other activity, modular components	Floor space, local land costs, area around station, zoning ordinances
Provide supplementary services	Advertising & Concessions Floor space allocated Percent of total space	Type, size, location Square feet allocated Percent

Source: Hoel, Demetsky, and Virkler (7) and ITE Journal 5C-1A (10)

Table 2 Composite Rankings and Ratings of Top-Rated Objectives

Objective	Type	Category	Average Rating
Maximize security	SS	IO	8.8
Minimize institutional barriers to transferring	T	MIO	8.6
Maximize safety	SS	IO	8.4
Maximize coordination of transfer scheduling	T	SO	8.2
Maximize system coordination of information and fares	T/C	SO	7.6
Maximize directness of paths for modes	E	MIO	7.4
Minimize path conflicts between modes	A	MIO	7.3
Achieve elimination of hazardous materials	PE	MIO	7.2
Minimize costs	\$	SO	7.1
Maximize joint development	\$	EO	7.1
Maximize market areas for each mode	M	SO	7.0
Maximize flexibility for expansion	#	EO	7.0

Note: Type: T-Transfer, SS-Safety/Security, A-Access, E-Efficiency, P-Passenger, \$-Financial, M-Modal Enhancement, PE-Physical Environment, NE-Non-physical Environment, #-Space/Site, AB-Architectural/Building, C-Coordination; Objective category: MIO-Mode Interface Objectives, IO-Internal Objectives, SO-System Objectives, and EO-External Objectives.

Our review of the literature on transit stop/station design identified a set of operator-related factors that were repeated frequently from study to study. Accordingly we developed a generic set of factors in four general categories:

- Fiscal / Costs and Revenues
- Institutional and Coordination
- Passenger Processing
- Environment

We describe each of these in turn below.

Fiscal/ Costs and Revenues

The costs of operating a transit transfer facility are clearly important. A few of the individual fiscal-related factors or objectives identified from the literature include: 1) total cost, 2) operating cost, 3) maintenance (cleaning and replacement), and 4) investment cost (obtaining an efficient return on incremental investment). Other factors, shown in Table 3, are stated in less cost-explicit terms, yet, nonetheless, are very much cost-related^{3, 7, 8, 10, 11, 12}.

Table 3 Cost-Related Objectives

Transit Operator Fiscal / Cost Objectives	Linkage to Fiscal Matters
Achieve elimination of hazardous materials	If the facility contains hazardous materials (such as asbestos) they must be removed prior to new construction or renovation. Occupancy by operator employees and the traveling public cannot be allowed until this has been accomplished, thus contributing to the overall total facility cost.
Minimize wasted space	Unused or un-needed space increases construction and/or renovation costs, increases maintenance costs during operation and requires additional security and environmental controls. All of these are cost drivers for a project.
Maximize income from non-transport activities	Non-transport income could include income from advertising, leases of retail space, concessions, and joint development. These non-transport sources could offset some portion of the cost of operations.
Minimize negative impact on existing transportation services	A facility could have a cost impact on operators that cannot participate or on operators whose routes are disrupted or whose routes face additional competition.
Maximize joint development	Joint development involves the public and private sectors sharing the facility as well as its costs and revenues.
Achieve property rights	For a new facility, required property must be purchased and rights of use and access must be obtained. This contributes to the overall total facility cost.
Maximize flexibility for expansion	Costs may be saved when the facility is designed to just handle anticipated travel demand, yet provision is made for facility expansion in the case of increases in demand or addition of new modes.
Minimize fare inconsistencies	Fare inconsistencies include different rates among operators or inconsistent rates among like modes; such inconsistencies can impact revenues.
Maximize ease of operations of modes	Generally, the more difficult it is for the operator to perform its customary modal operations the more likely will it result in additional expenditure of resources and associated costs.
Utilize energy efficiently	The use of energy for heating and cooling the facility must be paid for and their efficient use will help reduce overall energy costs.
Maximize flexibility of operation	The ability to adapt to operational changes, whether necessary and unexpected or desirable can contribute to lower total costs.

Sources: Horowitz and Thompson^{11,12}, Vuchic and Kikuchi³, Hoel, Demetsky, and Virkler⁷, Demetsky, Hoel, and Virkler⁸, and ITE Technical Council Committee 5C-1A¹⁰.

Institutional and Coordination

Transit transfer facilities, which frequently have multiple lines, modes, and/or service providers, require coordination on many levels, including: transfer fares, schedules, and information dissemination. Generally, there is only one source from the literature — Horowitz and Thompson^{11,12} — that explicitly identifies institutional issues as objectives from the transit operator perspective. These objectives are listed in Table 2; they are “minimize institutional barriers to transferring” and “maximize coordination of transfer scheduling,” which are, respectively, the 4th and 11th ranked objectives (out of 70) with average ratings of 8.6 and 8.2

(out of 10.0). Thus, these objectives are very highly ranked and rated – in fact, *higher* than cost issues in this study.

Passenger Processing

Passenger processing objectives, listed below, refer to the *functional facility* components together with their *arrangements within the facility*. Basic functional facility components consist of 1) internal pedestrian movement facilities and areas (passageways, stairs, ramps, escalators, elevators, moving walkways, etc.), 2) line haul transit access area (entry control and fare collection; loading and unloading of passengers), 3) components that facilitate movement between access modes and the transfer facility such as ramps and automatic doors, and 4) communications (information and directional graphics, public address system). Corresponding criteria and performance measure information for each of these objectives are described in Table 2.

- Maximize equipment reliability
- Efficiently collect fares and control entry
- Efficiently process flows
- Provide adequate space
- Minimize queues
- Minimize pedestrian-vehicle conflicts
- Eliminate physical barriers

Environment

The *environmental* quality of a transit transfer facility involves aspects with which facility users associate their comfort, convenience, safety, and security^{7,8}. There are also transit agency staff members working at larger facilities; their comfort, safety, and security are of concern to transit operators. Typical safety standards include fire prevention and accident reduction measures. Security provisions are used to protect against or in response to crime, vandalism, or terrorism. Amenity-related environmental aspects for comfort and convenience are not directly associated with the movement of people; rather these aspects concern the physical environment through which they move. Basic amenity-related environmental components include the following list; it is interesting to note in the list below that inclusion of “public telephones” is presently quite dated with the nearly ubiquitous use of cellular phones:

- The physical environment (lighting, air quality, temperature, aesthetics, cleanliness)
- Maximize safety
- Non-transport businesses and services
- Restrooms and lounges; first-aid stations, public telephones
- Weather protection

Table 4 presents a summary of the transit operator-related factors that we identified from the literature (after removing redundancies). These factors formed the basis of our design of a survey of managers of U.S. transit agencies to further explore the most important attributes of transit

stops and stations. (Note that certain factors are listed in the literature in very broadly-worded terms, such as “achieve property rights” and “maximize safety,” while others are more specific, such as “Minimize operations and maintenance costs” and “Provide restrooms”).

Table 4 Transit Operators’ Perspective Evaluation Objectives

Categories	Evaluation Objectives
Fiscal / Costs & Revenues	Minimize total, operating, maintenance, and investment costs
	Achieve elimination of hazardous materials
	Minimize wasted space
	Maximize income from non-transport activities
	Minimize negative impact on existing transportation services
	Maximize joint development
	Achieve property rights
	Maximize flexibility for expansion
	Minimize fare inconsistencies
	Maximize ease of operations of modes
	Utilize energy efficiently
Maximize flexibility of operation	
Institutional and Coordination	Minimize institutional barriers to transferring
	Maximize coordination of transfer scheduling
Passenger Processing	Maximize equipment reliability
	Efficiently collect fares and control entry
	Maximize safety
	Efficiently process flows
	Provide adequate space
	Minimize queues
	Minimize pedestrian-vehicle conflicts
Eliminate physical barriers	
Environment	Provide a safe and secure environment
	Provide proper physical environment (lighting, air quality, temperature, aesthetics, and cleanliness)
	Provide restrooms, first-aid stations, public telephones
	Provide protection from the weather

3. METHODOLOGY

Given the 26 stop/station evaluation factors identified from the literature and summarized in Table 4, we developed and administered a nationwide survey of U.S. transit agencies in order to 1) update the evaluation objectives identified in the literature so these factors reflect current circumstances, as some of the information in the literature is now thirty years old, 2) identify other factors important to transit operators not identified from the literature, 3) understand the priorities that transit operators place on these factors and their relative importance, and 4) evaluate whether transit operators understand their riders' priorities when it comes to transit stops and stations. The survey instrument is contained in Appendix A. Furthermore, we conducted telephone interviews with a representative sample of transit operators in the United States in order to gain further insight into the transit operators' perspective, as well as to gather illustrative anecdotes about transit stops and stations. Additionally, we used these telephone interviews to gather data on the role of the neighboring community in the design, implementation, and operation of transit stops and stations, with a particular focus on community advocacy for and opposition to projects. The interview guide is contained in Appendix B.

Designing the Survey Instrument

Our online survey was composed of three parts:

1. Information about the respondent, including respondent name, title and position at work, telephone number, email, and the name and location of the respondent's transit agency:

This first section was used to ensure that no transit agency responded multiple times to the survey, as well as to link the respondents' answers with outside data on the transit agency and its service area (for example, number of routes and service area population).

2. Operators' estimation of how important various evaluation factors are to their passengers:

This second section essentially asked operator-respondents to *guess* how important various transit stop and station attributes are to their riders. This section used the same survey design as we had previously administered to transit riders in Los Angeles (reported on in a previous deliverable for this project). The transit operators' responses were then compared with the answers of Los Angeles area transit users to illuminate possible misperceptions, disparities, as well as similarities between users and operators.

3. Operators' views of what evaluation factors are important from their own perspective:

In designing this final section of the survey, we utilized a 4-point Likert scale methodology to inquire of transit operators their views on how important evaluation factors are: *Very Important*, *Important*, *Somewhat Important*, or *Not Important*. Respondents were also permitted to select *Not Applicable/Do Not Know*. The inventory of factors was based on those listed in Table 4. Some objectives appeared duplicative, and in these instances we collapsed objectives into one broadly-worded category. For example, the criteria "safety" and "security" were combined into one category. We then supplemented these with a few others based on research team discussions, including "Maximize vehicle maneuverability," "Maximize environmental friendliness of station/facility ("green" station/facility)", and "Provide a break area for vehicle

operators.” The survey also allowed respondents to type in other evaluation factors that they deemed to be important but that were not listed in the survey.

Identifying the Participants and Administering the Survey

We used the Federal Transit Administration’s 2005 National Transit Database (NTD) to identify 406 potential participants, all of which operated at least one fixed-route/fixed-schedule transportation mode. The contact person provided by the NTD for each of these agencies was customarily the CEO or the General Manager of the agency. Invitations to participate in the survey were sent by e-mail to potential respondents along with a link to the survey website. The survey website provided a general overview of the project, the purpose of the survey, survey instructions, questions, and a statement assuring confidentiality of identity and individual responses. To gather as representative a sample of U.S. transit agencies with fixed route/fixed schedule as possible, we sent two e-mail reminders to agencies that had not completed the survey or had not even begun the survey. Respondents had had over five weeks to complete the survey.

4. ANALYSIS AND FINDINGS

At survey completion, one hundred ninety-seven (197) potential respondents accessed the survey website. Of these potential respondents, several response sets were excluded from analysis:

- Six (6) potential respondents opted out of participating in the survey after following the link to the survey site.
- Twelve (12) potential respondents agreed to participate in the survey but then provided no answers to questions.
- Four (4) respondents began the survey but did not provide answers to all questions considered in the first part of this report; these response sets *were*, however, retained for analysis of the user-operator comparison, discussed below.

Thus, one hundred seventy-five (175) response sets remained for analysis, for an effective response rate of 43% of invited agencies. Additionally, 20 agencies were contacted to participate in in-depth telephone interviews. These agencies were selected by a weighted sampling methodology, with the probability of inclusion in our sample weighted by the agency’s annual ridership figures.¹ Of these, 8 agencies participated, for an effective response rate of 40%. These 8 agencies represent a wide spectrum of agency types, with small, medium and large agencies at the municipal, regional and state level. Additionally, one agency we interviewed operates bus transit service at a large state university. The telephone interviews lasted 39 minutes on average, with the shortest interview lasting 25 minutes and the longest just under an hour.

Table 5 shows the distribution of respondents to the online survey by occupation category. Respondents were overwhelmingly in executive/administration positions, with 104 respondents (60%) reporting this occupation category. The second-largest group were those respondents in planning occupations, with 23% of respondents in this category. The third-largest group were those reporting “other”, which ranged from recent retirees working as consultants to one respondent working in “statistical analysis”.

¹ We used this methodology to increase the likelihood of randomly selecting one of the nation’s very few very large agencies, which we felt were important elements to this report. Ridership-weighted random sampling essentially creates a random sample by randomly selecting twenty transit trips from all transit trips nationally and then selecting the transit agency that provided the trip.

Table 5 Respondents' Title Categories

Respondent's Title Category	Frequency	Percent
Executive/Administrative	104	60%
Planning	40	23%
Other	16	9%
Operations or Logistics/Scheduling	8	5%
No Response	3	1%
Marketing	2	1%
Finance/Budgeting	2	1%
Total	175	100

Compared with the universe of transit agencies invited to participate in the survey, the survey respondents tended to hail from larger metropolitan areas. Figure 1 shows the distribution of transit agencies by service area population for both the full population of invitees and the set of respondents.

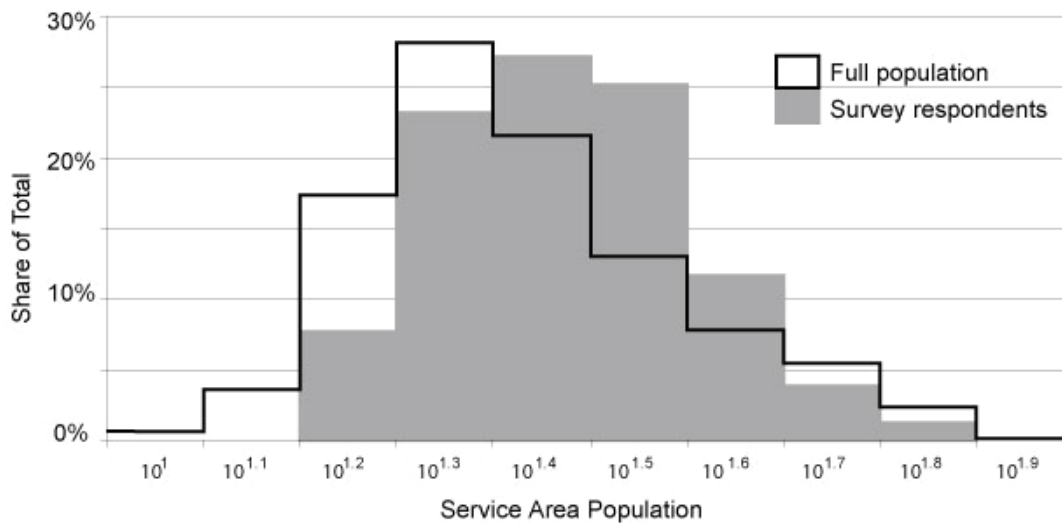


FIGURE 1 Distribution of Transit Agencies by Service Area Population (thousands)

The geographic distribution of respondents also differed somewhat from the survey universe. For example, within states where the research team invited more than five transit agencies to participate in the survey, response rates varied greatly; nine of Ohio’s twelve agencies (75%) responded to the survey, while only one of New Jersey’s fourteen invited agencies (7%) responded.

Participants were asked to rate 23 separate attributes connected with the planning, siting, operation or maintenance of transit stops and transfer facilities using a four-point Likert scale. Table 5 shows the mean attribute scores and standard deviations for all respondents. An average score of 1.00 would indicate that all respondents rated the attribute as “very important”, and an

average score of 4.00 would indicate that all respondents rated the attribute as “not important”. As is typical with Likert-scale measurement, significant response clustering is evident, with nearly all average scores falling within the one-point interval [1.40, 2.40].

The attribute SAFETY (“Provide a safe and secure environment”) was ranked most important by respondents, with an average score of 1.15 and a relatively small standard deviation of 0.39. This score is considerably lower (more important) than the second-most important attribute, PEDCON (“minimize pedestrian-vehicle conflicts”). The remaining attributes are all relatively closely clustered. With a scoring range of only 1.41 through 1.64, the 2nd through 11th ranked factors below were closely bunched:

- Pedestrian/vehicle conflicts,
- Schedule coordination,
- Operating costs,
- Stop/station equipment reliability,
- Comfortable environment,
- Adequate stop/station space
- Inter-agency coordination,
- Facilitate passenger flows,
- Accommodate vehicle movements, and
- Protect passengers from weather,

The remaining 12 factors are not as tightly bunched as the top dozen and, numerically, are all closer to 2.0 or 2.5 than 1.0 or 1.5.

Table 5 further divides the attributes measured in our survey into four groups: the top attribute with an average score near 1.0 (Group 1), and those attributes with average scores near 1.5, 2.0 and 2.5 on the Likert scale, respectively for Groups 2, 3, and 4. More precisely, Group 2 consists of the interval of average scores centered at 1.5 +/- 0.25 and similarly for Group 3 and 4, centered at 2.0 and 2.5, respectively. Group 1 consists of the interval centered at 1 +0.25. While it is not clear-cut, one may observe that lower-score (more important) attribute groups tend to contain more passenger-oriented attributes, while, further down the rank order, attributes tend to be more system- or operator-oriented or focus on facility externalities. For example, Group 2 contains attributes such as minimizing pedestrian/vehicle conflicts (passenger safety), coordinated transfers (passenger convenience), passenger comfort, and protection from the weather. In contrast, Group 3 contains few explicitly passenger-oriented attributes; more typical for this group are attributes that deal with station geometry, the ability for station expansion, the pursuit of joint development opportunities and the provision of an environmentally-friendly (“green”) facility. While there are certainly examples that are counter to this trend (the minimization of costs, an explicitly operator-oriented attribute, ranks 4th), the results of our survey suggest that transit operators value user-oriented attributes (the provision of a seamless and comfortable transfer experience for the passenger) higher than many non-passenger attributes.

Table 6 Average Objective Scores (using mean)

	CODE	OBJECTIVES	MEAN SCORE	STD DEV	
1	SAFETY	Provide a safe and secure environment.	1.15	0.39	GP 1
2	PEDCON	Minimize pedestrian-vehicle conflicts.	1.41	0.62	
3	TRANSF	Maximize coordination of scheduling to accommodate transfers.	1.48	0.61	GROUP 2
4	MNCOST	Minimize total cost of operations (including maintenance costs).	1.5	0.67	
5	RELIAB	Maximize reliability of station/stop equipment.	1.52	0.66	
6	COMFRT	Provide a comfortable physical environment with respect to lighting, temperature, and cleanliness.	1.54	0.63	
7	ASPACE	Provide adequate station/stop space.	1.54	0.62	
8	INSTBR	Minimize institutional barriers to transferring such as transfer fares, lack of information or poor coordination of schedules.	1.57	0.66	
9	PASFLW	Efficiently process rider flows.	1.63	0.63	
10	MANEUV	Maximize vehicle maneuverability (turning radii, etc).	1.64	0.77	
11	WEATHR	Provide protection from the weather.	1.64	0.72	GROUP 3
12	FARECT	Efficiently collect fares and control entry to station/stop/vehicle.	1.76	0.71	
13	OPEASE	Maximize operational ease at the station or facility, e.g., vehicle maintenance, vehicle storage, ticketing, baggage handling, and/or accounting.	1.87	0.79	
14	FLXINC	Maximize flexibility for expansion to handle an increase in demand or addition of new modes.	1.99	0.75	
15	BREAKS	Provide a break area for vehicle operators.	2.03	0.83	
16	FARESC	Minimize fare inconsistencies, i.e., different fare rates across operators or inconsistent rates across like modes.	2.12	0.94	
17	GREENS	Maximize environmental friendliness of station/facility ("green" station/facility).	2.17	0.79	
18	JOINTD	Maximize joint development, i.e., involving the public and private sectors in sharing the facility and its costs and revenues.	2.21	0.89	
19	TOITEL	Provide restrooms, first-aid supplies, and public telephones.	2.28	0.94	GROUP 4
20	QUEUES	Minimize queues.	2.30	0.9	
21	WASTSP	Minimize wasted space in station/stop design because large spaces increase construction costs and require more maintenance, security, and environmental controls.	2.31	0.86	
22	COMPET	Minimize negative impact on existing transportation services, i.e., on operators who cannot participate or on operators whose routes are disrupted or whose routes face additional competition.	2.37	0.91	
23	ADSVND	Maximize income from non-transport activities, such as advertising and vending.	2.56	0.99	

Respondents clearly believe safety and security to be more important factors than all others, with the most important (safety and security) and 2nd most important (minimize pedestrian conflicts) attributes relating this topic. Ease of transferring was also an important factor for respondents; the 3rd most highly-ranked attribute ranked was TRANSF (“maximize coordination of scheduling to accommodate transfers”). Cost-related factors (MNCOST) rated 4th most important, followed by considerations of equipment reliability (RELIAB) (though, again, the 2nd through 11th ranked factors are very closely bunched). It should be noted that some confusion may have arisen around the attribute RELIAB, with respondents perhaps uncertain whether rolling stock or station equipment (our intention) was meant.

Comfort considerations (COMFRT) and the provision of adequate space (ASPACE) received nearly equal ratings (1.55 and 1.56, respectively), followed closely by the absence of institutional barriers to transferring (INSTBR). Further down the list were the efficient processing of passenger flows (PASFLW), protection from the elements (WEATHR), and adequate space for vehicle maneuverability (MANEUV).

At the other end of the spectrum, ADSVND (“maximize income from non-transport activities, such as advertising and vending”) ranked least important, with an average score of 2.51 and a very high standard deviation of 0.97; for some operators, this factor was “very important” (26 cases), while for many others this factor was “not important” (29 cases). This large degree of variation may be due, for example, to the variability in agency income derived from advertising. Indeed, of respondent agencies, the ratio of non-transport to transport revenue varies greatly, with an average of 0.11 and a standard deviation of 0.24 (National Transit Database, 2005). This likely reflects that oftentimes it is local governments that control advertising on bus benches, shelters, and even in off-street facilities; thus, it is these local governments that reap income from transit stops and stations, and not the transit operators. Thus, the disinterest of many respondents to the collection of non-transport revenues likely reflects that such revenues go to other entities (4). Accordingly, respondents from agencies with high levels of non-transport income were slightly less likely to rate ADSVND as “not important” than did respondents from other agencies, though this correlation is minor (Pearson correlation=0.058) and insignificant.

Similarly, COMPET (“Minimize negative impact on existing transportation services, i.e., on operators who cannot participate or on operators whose routes are disrupted or whose routes face additional competition”) ranked quite low among respondents, with an average score of 2.35 and a high standard deviation of 0.93. Further, the minimization of wasted space (WASTSP) and queues (QUEUES) as well as the provision of amenities such as restrooms and telephones (TOITEL) also ranked low on the list of attributes, at about 2.30 each.

Several questions elicited a large number “Not Applicable/Don’t Know” responses or received no answer at all. Respondents skipped COMPET (“Minimize negative impact on existing transportation services, i.e., on operators who cannot participate or on operators whose routes are disrupted or whose routes face additional competition”) 61 times (35% of respondents), while 34 (19%) skipped FARESC (“Minimize fare inconsistencies, i.e., different fare rates across operators or inconsistent rates across like modes”). Both of these questions pertain to operations that interface with other agencies; presumably many respondent agencies operate in relative isolation, and this may account for a significant number of non-responses here. However, the complex phrasing of COMPET may also have contributed to the large number of non-responses.

The preceding analysis used mean Likert scores. Perhaps another more suitable, though less straightforward, method of analysis is the non-parametric Friedman rank test. Developed by economist Milton Friedman, this method better accounts both for differential usage of the scale and for non-normal distributions across respondents, such as U-shaped distributions, where many respondents rate an attribute as either “very important” or “not important”, with few respondents selecting the middle two categories.

This method produces rank values for each respondent’s answers across categories; these individual rank scores are then aggregated to the full sample. The Friedman rank test essentially places each respondent’s response – say, a “very important” for SAFETY – in the context of that respondent’s propensity to select that response – in this case, his or her propensity to select “very important”. In cases where a respondent rates multiple attributes equally (for example, rating both nighttime safety and daytime safety as “very important”), a tie rank score (the midpoint of the tied rank range) is given to all tied attributes. Table 6 shows standardized Friedman rank scores for our operators’ response set. The table may be interpreted thusly: the most important attribute (in our case, SAFETY) is assigned a value of 1, and all other attributes’ Friedman rank scores are scaled in proportion to SAFETY.

While perhaps less intuitive, this methodology gives us a better understanding of the magnitude of differences between attributes and places them on an easily-understood scale. Again, we group objectives together by similar values; using this method, we find that our second-ranked attribute PEDCON (“Minimize pedestrian-vehicle conflicts”) advances in magnitude of importance relative to the third-ranked attribute, transfer coordination. For this reason, we place this objective in a group of its own. However, as this objective is intimately linked with the first-ranked attribute, SAFETY, one might also simply group these objectives together.

By and large, the rank order remains the same using this analytical method as it was using mean values. However, there are a few interesting exceptions. First, using this more nuanced method, we find that both of our objectives related to the interface with outside agencies become significantly more important. (This finding is in accord with Horowitz and Thompson’s findings, shown in Table 2 above.) The objective INSTBR (“Minimize institutional barriers to transferring, such as transfer fares, lack of information or poor coordination of schedules) rises from rank 8 to rank 4 using the Friedman test. Similarly, the objective FARESC (“Minimize fare inconsistencies, i.e. different fare rates across operators or inconsistent rates across like modes”) rose in rank from position 16 to position 14. These changes reflect the high relative importance of these two attributes to *some* of our respondents even given their low level of importance to others.

In addition to the rating of listed attributes, respondents were asked to provide additional attributes they felt were important to the siting, design, and operation of transit transfer facilities. Thirty-nine respondents (22%) provided additional input through this option. The most frequently mentioned attribute among these responses was easy pedestrian accessibility to the transfer facility (7 responses). The second-most frequently mentioned attribute was the provision of real-time information through “next bus” or “next train” electronic signs (6 responses). The third-most frequently mentioned attribute was the centrality of the transfer facility siting (4 responses), with respondents citing the need for “proximity to rider destinations” and location in “urban centers rather than in remote locations.” Another four respondents cited adherence to Americans with Disabilities Act provisions for station accessibility.

Table 7 Average Objective Scores (using standardized Friedman rank score)

	CODE	OBJECTIVE	STD. FRIEDMAN SCORE	
1	SAFETY	Provide a safe and secure environment.	1.00	Gp. 1
2	PEDCON	Minimize pedestrian-vehicle conflicts.	0.78	Gp. 2
3	TRANSF	Maximize coordination of scheduling to accommodate transfers.	0.71	GROUP 3
4	INSTBR	Minimize institutional barriers to transferring such as transfer fares, lack of information or poor coordination of schedules.	0.69	
5	MNCOST	Minimize total cost of operations (including maintenance costs).	0.67	
6	RELIAB	Maximize reliability of station/stop equipment.	0.65	
7	ASPACE	Provide adequate station/stop space.	0.64	
8	COMFRT	Provide a comfortable physical environment with respect to lighting, temperature, and cleanliness.	0.63	
9	PASFLW	Efficiently process rider flows.	0.62	
10	WEATHR	Provide protection from the weather.	0.61	
11	MANEUV	Maximize vehicle maneuverability (turning radii, etc).	0.60	
12	FARECT	Efficiently collect fares and control entry to station/stop/vehicle.	0.58	
13	OPEASE	Maximize operational ease at the station or facility, e.g., vehicle maintenance, vehicle storage, ticketing, baggage handling, and/or accounting.	0.50	GROUP 4
14	FADESC	Minimize fare inconsistencies, i.e., different fare rates across operators or inconsistent rates across like modes.	0.50	
15	BREAKS	Provide a break area for vehicle operators.	0.48	
16	FLXINC	Maximize flexibility for expansion to handle an increase in demand or addition of new modes.	0.47	
17	JOINTD	Maximize joint development, i.e., involving the public and private sectors in sharing the facility and its costs and revenues.	0.45	
18	GREENS	Maximize environmental friendliness of station/facility ("green" station/facility).	0.43	
19	WASTSP	Minimize wasted space in station/stop design because large spaces increase construction costs and require more maintenance, security, and environmental controls.	0.41	
20	COMPET	Minimize negative impact on existing transportation services, i.e., on operators who cannot participate or on operators whose routes are disrupted or whose routes face additional competition.	0.41	
21	QUEUES	Minimize queues.	0.41	
22	TOITEL	Provide restrooms, first-aid supplies, and public telephones.	0.40	
23	ADSVND	Maximize income from non-transport activities, such as advertising and vending.	0.39	

In addition, three respondents each identified the following factors: (1) schedule adherence in the operation of a transit transfer facility and the provision of “realistic schedules,” (2) non-interference with the efficient flow of existing automobile traffic, (3) high-quality customer service (noting that the “quick” and “efficient” resolution of customer complaints and enquiries is desirable), and (4) providing parking areas at transit transfer centers, especially for “express” and BRT services. Finally, a number of other individual comments were made, including the provision of functioning clocks and support from local government officials.

Analysis by Subgroups

Certainly, not all kinds of respondents rated objectives in the same way. To some extent, variation in responses may be due to differential use of the Likert scale, random error, or even personal whim. There is, however, likely a sizeable amount of variation within the data that can be explained by characteristics of the respondent and the respondent’s transit agency. For example, respondents in temperate cities may value shelter from the elements *less* than respondents from very hot or very cold climates. Indeed, within respondents, several subgroups can be created, and these subgroups can be compared to one another.

Occupational Category

The first subgroups we analyze are the respondents’ occupational categories. For example, we hypothesized that CEOs may value the objective of cost minimization more highly than his or her colleagues in the planning department. Indeed, when using the nonparametric Mann-Whitney U test (similar to the Friedman rank test), we discovered three statistically significant ($p < 0.10$) differences between “Executive/Administrative”-respondents and all others. We report a “standardized Mann-Whitney rank ratio” – the inverse ratio of one subgroup’s mean rank to that of the other group.

- MNCOST (standardized Mann-Whitney rank ratio = 0.86) “Minimize total cost of operations (including maintenance costs).” Controlling for all other objectives analyzed here, “executive/administrative” respondents, on average, felt that cost minimization was *less* important than did their colleagues in other occupational categories. The standardized Mann-Whitney score suggests that executive/administrative respondents felt this objective was approximately only 86% as important as all other respondents. This result is contrary to our expectation. Perhaps, however, it is project managers (and *not* CEOs) who feel most acutely the anxiety of budget adherence; these project managers may self-categorize as “planning” rather than “executive/administrative”, explaining the observed result.
- WEATHR (1.15) “Provide protection from the weather.” Controlling for all other objectives, “executive/administrative” respondents felt that protection from the weather was *more* important than did all other respondents. Similarly, in all further subgroup comparisons, the objective WEATHR was found to be significantly different at the $p < 0.10$ level. It is likely that this is the product of regional climate and of chance, and not of a systematic difference of opinions. For this reason, WEATHR is excluded from further analysis by subgroupings.

- MANEUV (1.18) “Maximize vehicle maneuverability (turning radii, etc).” On average, executive/administrative respondents rated maneuverability significantly more important than other respondents.

In addition to analyzing the survey results by occupation category, we joined our response sets with attributes about the transit agencies from which respondents hailed. We obtained data on agency and service area size and the agency’s transportation offerings from the 2005 National Transit Database. Creating subgroups by quartile, we asked whether, for example, very small agencies had unique views on transit stops and stations, or whether those agencies with rail service felt that certain attributes were more important than did their counterparts at bus-only agencies. Our analysis again uses the nonparametric Mann-Whitney U test of equal distributions, and we report for all statistically significant objectives ($p < 0.10$) the degree to which one subgroup’s average Mann-Whitney ranking differs from the other.

Service Area Size

The data suggest that agencies in service areas of different population sizes have differing opinions on various objectives at transit stops and stations:

- **Smallest service areas** (first quartile, fewer than 135,000 people): The smallest quarter of our survey participant agencies (by service area population) rated INSTBR (“Minimize institutional barriers to transferring such as transfer fares, lack of information or poor coordination of schedules”) less important than did all other respondents. Agencies within small service areas had a standardized average Mann-Whitney rank ratio of 0.80, suggesting that, controlling for other objectives included in the analysis, agencies in small service areas felt that the reduction of institutional barriers was about 80% as important as their counterparts in larger service areas. This is likely due to the relative lack of additional service providers with which to coordinate in small cities.
- **Largest service areas** (fourth quartile, greater than 790,000 people): the largest quarter of our survey participant agencies (by service area population) rated the following attributes *less* important than all other agencies:
 - TOITEL (standardized Mann-Whitney rank ratio of 0.74) “Provide restrooms, first-aid supplies, and public telephones.” Agencies in large service areas found the presence of such amenities to be *less* important than did agencies in smaller service areas. One possible explanation is that larger cities tend also to be denser, allowing for non-agency amenities (such as coffee shop bathrooms) to satisfy rider needs.
 - WASTSP (0.79) “Minimize wasted space in station/stop design because large spaces increase construction costs and require more maintenance, security, and environmental controls.” Controlling for all other objectives in the analysis, respondents from populous service areas rated this objective as less important than all other respondents.
 - GREENS (0.84) “Maximize environmental friendliness of station/facility (“green” station/facility).” Controlling for all other objectives studied here, respondents from transit agencies in large service areas tended to rate environmental

friendliness as *less* important than other respondents. One possible explanation for this finding is that larger service areas tend also to have older transit systems; these older systems may be more cumbersome to retrofit “green” than is the case for a new facility elsewhere.

- FLXINC (0.84) “Maximize flexibility for expansion to handle an increase in demand or addition of new modes.” Controlling for other objectives, respondents from large service areas tended to rate flexibility for expansion as *less* important than other respondents. Again, a possible explanation for this finding is that large service areas may tend to grow at a slower rate than do smaller service areas; thus, the need for expansion is less acute in these areas.
- MANEUV (0.85) “Maximize vehicle maneuverability (turning radii, etc).” Again, respondents from agencies with populous service areas tended to rate this objective as *less* important than other respondents.

Agency Fleet Size

The data suggest that agencies with very large fleets (fourth quartile, more than 208 vehicles) rated, on average, the presence of amenities such as toilets, telephones, and first aid supplies (TOITEL) as *less* important than other agencies, with a standardized Mann-Whitney rank ratio of 0.80. Again, as above, we suggest that agencies with larger fleets may also be located in denser areas, and that these dense areas provide non-agency (private retail) amenities to satisfy rider needs.

Percent Fixed-Route

- Agencies with relatively little fixed-route service (first quartile, less than 63% fixed-route) had several statistically significant differences from other agencies:
 - ADSVND (standardized Mann-Whitney rank ratio of 1.20) “Maximize income from non-transport activities, such as advertising and vending.” Controlling for all other objectives analyzed here, respondents from agencies with relatively little fixed-route service (that is, with a relatively large share of paratransit service) felt that income from advertising and vending was more important than other respondents. This is contrary to our expectation; one would expect that agencies with little fixed-route service would also have little advertising space from which to gain income. Again, we suggest that responses to ADSVND are related to unobserved factors, such as ownership of advertising space.
 - TRANSF (1.18) “Maximize coordination of scheduling to accommodate transfers.” Respondents from paratransit-heavy agencies also tended to rate schedule coordination as *more* important than other respondents. While this may seem contrary to common sense, it seems likely that transit agencies with low levels of fixed-route transit may also run those routes with long headways; this low service frequency results in a greater need to ensure properly timed transfers.
- Agencies with mostly fixed-route service (fourth quartile, more than 86% fixed-route) had several statistically significant differences from other agencies:

- OPEASE (standardized Mann-Whitney rank ratio of 1.34) “Maximize operational ease at the station or facility, e.g., vehicle maintenance, vehicle storage, ticketing, baggage handling, and/or accounting.” Agencies with mostly fixed-route service tended to rate operational ease much higher than other respondents. This makes sense, since operators with a large amount of fixed-route service have a greater need to coordinate an efficient system for mass vehicle maintenance and storage, as well as to reap large efficiency gains even from small improvements across a large fleet.
- QUEUES (1.29) “Minimize queues.” Agencies with mostly fixed-route service felt, on average, that queue minimization was significantly *more* important than did their counterparts at other agencies. This finding meets our expectation, as paratransit requires no queues, but fixed-route service often does.

Presence of Fixed-Guideway Transit

- Agencies with fixed-guideway transit (rail) had several statistically significant differences from those agencies without:
 - TOITEL (standardized Mann-Whitney rank ratio of 0.76) “Provide restrooms, first-aid supplies, and public telephones.” Agencies with fixed-guideway service tended to rate these amenities as significantly less important than other respondents. Again we conjecture that the higher levels of density associated with rail transit also provide for significant non-transit (private retail) amenities to satisfy rider needs.
 - TRANSF (0.79) “Maximize coordination of scheduling to accommodate transfers.” Similarly, respondents from agencies with fixed-guideway rated transfer coordination as less important than their colleagues from agencies without fixed-guideway service. As above, we conjecture that the shorter headways often associated with rail rapid transit reduce the need to time transfers. Additionally, several respondents in this subcategory hailed from regional rail agencies; the hub-and-spoke nature of most American commuter rail systems (with few rail transfer points and many passengers arriving by automobile), likely reduces the sense of urgency for timed transfers in these systems.
 - RELIAB (1.29) “Maximize reliability of station/stop equipment.” Controlling for other objectives analyzed here, respondents from agencies with fixed-guideway service tended to rank station equipment reliability as far more important than their counterparts at other agencies. The greater reliance on station equipment at rail facilities (for example, fare vending machines and fare barriers) suggests an explanation for this greater concern for equipment reliability.

Telephone Interviews

Our telephone interviews provided further insight into the relative importance to transit operators of some of the objectives studied above. For several of the objectives we looked at, interviewees had little to say, and these objectives are not mentioned specifically below. The objectives that garnered the most attention were:

- **Safety and Security:** All interviewees agreed that safety was the primary concern. One interviewee from a medium-sized agency remarked that safety “trumps all”, and this theme was repeated in nearly all interviews. Many interviewees related anecdotes in which safety and security concerns forced agency planners to design a station in such a way that other objectives were compromised. For example, one interviewee from a large transit agency told us of several bus stops that were relocated to locations that felt safer, but were less productive from a connectivity and accessibility standpoint. Another respondent from a city with a “very high murder rate” told us that city police are present at station design meetings, and that personal safety and security concerns always outweigh aesthetic, design, and passenger comfort concerns. Several respondents commented on security concerns, and all claimed that these concerns had grown in recent years since the terrorist attacks September 11, 2001. Our two agencies with extensive rail operations were particularly concerned with security, and both stated that they were working with federal agencies on this issue.
- **Pedestrian-vehicle conflicts and interference with existing transportation:** One interviewee related an anecdote in which a bus transit center was re-designed to reduce conflicts with pedestrians and automobiles. The result, she claimed, was a facility that functioned safer, but was less aesthetically pleasing and more cumbersome for passengers arriving on foot. No other interviewees commented extensively on this objective, other than to mention that it was very important, but a “sort of a given” and part of the standard engineering and design process.
- **Institutional barriers to transferring:** Several interviewees from large urban areas remarked that inter-agency cooperation was very important in order to provide the passenger with “seamless” service. Each of these interviewees remarked that interagency cooperation had improved in recent years. Other respondents from smaller urban areas remarked that, as one respondent noted, they were “the only game in town”. One Sunbelt agency told us that, as its urban area continues to grow, it is slowly meeting up with another nearby urban area; this growing-together of cities has prompted initial meetings with the transit agency operating in the adjacent region.
- **Minimize cost:** Interviewees had very differing opinions on this topic; their views varied according to characteristics of their service area, but also by the interviewee’s job title. For example, both of our engineer interviewees told us that they viewed cost considerations as negligible – that costs were fixed by the time they begin working on a project in earnest. Other interviewees told us that costs associated with transit stops and stations tended to be minimal compared to costs associated with vehicles and labor. Another interviewee mentioned that his agency had “fared well” in the most recent round of federal transportation earmarking, and that cost concerns were less important than they had been previously. Another two interviewees from rail-heavy agencies replied that cost considerations were enormous; both told us that the uncertainty associated with

maintaining and refurbishing historic train stations leads to frequent cost overruns. As one told us, “we inherited a 150-year old system, but only 50 years of records. The location of a lot of utilities is unknown.”

- **Provide adequate space:** Only one respondent commented extensively on this objective. He commented that his agency (largely a bus-operating agency in a dense urban environment) “deals in imaginary space; the stop is created by the bodies that occupy that space [near the bus stop sign]. There’s not much that we do to influence that.” Another interviewee commented briefly that space concerns are not yet important to his agency, but that with population growth (and ridership growth), this will likely become a concern at some stations.
- **Comfort:** Most interviewees agreed that passenger comfort was very important, though how they described achieving this objective differed. Two interviewees discussed at great length the removal of graffiti and trash. Another commented that “all the five senses should be pleased,” and that this is a very difficult task, especially with older shelters and stations that tend to attract more vandalism. One respondent told us that his transit agency was looking to engage in public-private partnerships at major transit agencies, and that it was looking to offload cleaning responsibilities to another party. Another interviewee told us that it was important to provide comfortable seating at most stops and stations, though “not every rider needs a seat.” Further, he told us, security concerns led to small, uncomfortable seats that are not conducive to sleeping (for example, by homeless individuals) – but, he told us, these seats are also not conducive to sitting.
- **Weather:** Nearly all respondents mentioned protection from the weather. This objective was of particular concern to our two respondents from very hot climates, both of whom used “mushroom-shaped” canopies at bus stops; this design allows for shade, while permitting a breeze and blocking no sightlines – important for passengers’ perception of safety. Another respondent told us of a rail station where aesthetic concerns had led to a rail station design that, though attractive, that does not protect adequately from rain storms.
- **Flexibility for expansion:** Expansion was an important topic for some interviewees, and for others it was unimportant. Our interviewees from regional and state agencies tended to find the need for expansion more important than our municipal and university-based transit agencies; at these large geographic scales, even static-population regions experience localized pockets of growth. One interviewee from a large state agency told us that increasing capacity on existing rail lines and adding additional service was the agency’s top priority. Another interviewee from a medium-sized regional agency in a fast-growing area commented that bus stops were constructed in a modular fashion in order to accommodate future growth. He further commented that his agency often acquires extra land and constructs additional bus bays in anticipation of future growth. However, one respondent from a municipal transit agency in a large city commented that his agency did not anticipate the need for expansion of transit stops or stations, and that, for the most part, transit service was fixed.
- **Joint development:** Nearly all interviewees spoke at length about joint development, and those who did were of one mind – that joint development was highly desirable but extremely difficult. Indeed, though most commented that the pursuit of joint development

projects had become increasingly important in recent years, these same interviewees told us about failed or stalled projects and frustration. One interviewee went so far as to tell us that “joint development never works; developers want to move a lot faster than [the agency] is willing to move.” Other interviewees told us how difficult it is for transit agencies to work within the relatively short time horizon of real estate development. One told us that her transit agency, in order to avoid this problem, has decided to build retail space “on speculation”, thus avoiding the need to work on a developer’s schedule – and that this space has typically found tenants. Another interviewee from a large public university told us that there could be a lot more of this kind of on-site retail development, telling us that “students don’t take transit because they can’t get Starbucks [coffee] on transit.” A respondent from a smaller transit agency told us that joint development had not occurred yet in his region; instead, the transit agency is chasing breakneck development, accommodating new shopping mall growth, for example, by building new transit centers. Only one of our respondents told us of a success story; at his agency, the real estate development department had grown from a few employees to an entire division. However, he noted that the bulk of joint development is the result of political maneuverings by members of the board, some of whom are real estate developers themselves.

Additionally, interviewees provided us with some objectives that we had not included in our online survey:

- **Station/stop spacing:** Of particular interest to two of our respondents were station spacing concerns; these respondents felt that it was extremely important to maintain appropriate station spacing, and that planners should attempt to accommodate other concerns within these parameters.
- **Transit-Oriented Development:** Another interviewee told us that transit-oriented development (as distinct from joint development) was a growing objective for his transit agency, and that the agency was doing everything it could to assist this type of development. He noted that transit-oriented development was a stated goal of municipal and state governments in his region.
- **Legibility:** Beyond the need for clear signage, one respondent commented that a transit system should be “legible”. She clarified by stating that the passenger should feel that all aspects of the transit system (station designs and corridor layouts as well as fare structures and routes) should make intuitive sense to the passenger, and should be kept as simple and straightforward as possible.

In addition to comments pertaining to the objectives analyzed above, telephone interviewees provided insight into many other aspects of siting, designing, operating and maintaining transit stops and stations. Of particular interest to us were obstacles to the implementation of a desired plan for a new or existing transit stop or station. Several themes emerged:

- **Undesirable element:** Six of our eight interviewees mentioned the perception of transit (especially bus transit) being a mode for “undesirable” people. This view, most interviewees agreed, came mostly from homeowners, both individually and as formal organizations. One interviewee commented that, especially at bus stops, it can appear that waiting passengers (particularly youths, he noted) may appear to be simply “hanging out”,

even when they are waiting for a bus. This perception can lead to fear in some nearby residents, he found.

- **Traffic:** Several respondents told us that community opposition often arises around the siting of new transit facilities (especially new train stations and multi-line bus transit centers) due to the perception that these facilities will cause an increase in road traffic.
- **“Citification”:** One interviewee commented that the presence of transit facilities often sparks opposition from residents who wish to maintain a suburban/rural character to their community. These opponents feel that transit is the beginning of a “citification” process that they find distasteful.
- **Pollution:** Though most interviewees commented that this was not a major concern, a few stated that at *specific* transit centers where buses tend to dwell for longer periods, both vibration and air pollution can be an issue for residents – particularly those residents who live directly adjacent to the facility. One agency re-timed its routes to accommodate residents who had complained of noise and vibration.
- **The approval process:** The process by which transit facilities are approved for construction varied greatly across agencies, with some requiring formal approval from many jurisdictions and agencies (municipalities, departments of transportation and environmental protection, and so forth), while other agencies only provided “courtesy briefings” to these stakeholders, but required no formal approval. Especially at one large regional agency in a highly fragmented metropolitan area, obtaining formal approval from multiple (often uncooperative) stakeholders proved to be perhaps the most important obstacle to project completion.
- **“Coming late”:** Many of our respondents stressed that trying to add a transit stop or station to an existing neighborhood or commercial district was much harder than integrating a facility into the planning of a new area. Two important patterns emerged from our discussions:
 - First, two of our respondents commented that their agencies used the design review and planning approval process of local municipalities to incorporate bus stops and transit centers into the design of new shopping malls, subdivisions, and office parks. One transit agency was successful in obtaining “most” of its land for free by asking city planning officials to include transit “extractions” as part of the approvals process.
 - Second, transit operators in two rapidly-growing Sunbelt cities and one in a high-turnover university setting commented that siting a new transit center or making significant changes to existing facilities was less difficult in areas with high residential or commercial turnover (for example, in neighborhoods with many students or in neighborhoods composed of mostly young people). These interviewees commented that, in this way, transit may not have necessarily been there from the beginning of the neighborhood, but from the beginning of most current residents’ knowledge of – *and sense of investment in* – the neighborhood.
- **“Political concerns”:** This category encompasses a large and complex set of comments our interviewees made. In general, respondents expressed concern for the large number of non-transportation concerns that influence the planning process, such as:

- **Ribbon-cutting:** Some respondents perceived that a politician’s desire to inaugurate a new facility led to the siting of a facility that made little sense from a strictly transportation-oriented perspective.
- **Ubiquity:** One respondent claimed that political desires for ubiquity of service over a large geographic area led to a thinning of resources that degraded system productivity.
- **Parity:** One respondent claimed that parity concerns – whereby politicians in one geographic area felt they deserved a rail line because another geographic area had seen one built – had led to a transportation system that would likely not have been built otherwise.
- **Local economic revitalization:** Several respondents mentioned that politicians had pressed for a new transit facility with the hope that this construction might spark the redevelopment of an economically depressed area. In some cases, these transit facilities appeared to our interviewees to make little transportation sense.
- **Personal feelings:** One interviewee told us how a Member of the Board at his transit agency cancelled a transit project because he believed that a landowner he disliked would benefit financially from the project.

While most comments involving the community pertained to community opposition to planned changes, several respondents did mention community *support* for new service or service improvements.

- **The poor:** One respondent from a large state agency commented that, especially in poor urban areas, community leaders often advocate for additional and improved transit service, as well as for investments in the appearance and comfort level of transit stops and stations.
- **The disabled:** Two respondents told us that the disabled community had been particularly active in advocating for transit improvements such as new stops and transfer stations in their regions.
- **Retailers:** Other respondents commented that some businesses see transit as a way to increase their customer base; a prime example of this was a group of local businesses served by the university transit agency we spoke to.
- **Social services:** Another interviewee told us that social service agencies in one region had been particularly adamant in getting transit service to service sites; however, this interviewee told us that social service agencies tended to be transient, and that they are often priced out of transit-accessible locations.
- **Large employers:** In two other interviews, we heard that large employers, especially of low-wage workers (such as discount superstores and large telemarketing firms), encouraged transit service to their locations in order to get workers to the jobsite.

We also asked interviewees to tell us about community involvement in the planning process for new stops and stations, rehabilitations, and ongoing operations and maintenance of facilities. Responses to these questions varied considerably. Most interviewees told us that their agencies

included community input mostly during the later stages of planning, and several told us that the agency sought community involvement most actively during the architectural design phase, for example through design charettes. By and large, our respondents told us that community involvement was largely reactionary in nature, with residents and businesses responding to most proposed changes that the agency announces. Some responses come from individuals and businesses themselves, though the bulk of community input, most agreed, came through mediated sources, such as politicians and community leaders.

Operator – User Comparison

In addition to surveying transit operators on their perceptions of various attributes at transit transfer facilities, stops and stations, we sought to understand the degree to which transit operators understood their users' perceptions of transit stops and stations. Transit operators may find insight into any 'disconnect' between transit users and transit providers that is valuable in re-assessing assumptions about riders' expectations.

In pursuit of this goal, we asked operators nationwide to estimate the level of importance of various attributes from their riders' perspective. Using the same seventeen attributes included in the Los Angeles-based on-site user perception survey described in Deliverable Two of this project, operator-respondents were asked the question, "How important do you think the following stop and station attributes are to *your passengers*?" Responses were coded using the same four-point Likert scale of *not important* to *very important* used in the Los Angeles transit user questionnaire. All 406 invited survey participants were given the opportunity to respond to this question block. Of 197 responses to our online survey, all 175 response sets used above were retained, and 4 additional partially-completed response sets were re-introduced. (These response sets lacked answers to questions discussed above but did have answers to questions considered in this section.) Thus, 179 respondents provided answers to the question block pertinent to this analysis, for an effective response rate of 44%.

For all but one attribute (on-time performance), the operators' mean rating was consistently higher (less important) than the users' mean rating. (See Table 8) Lower-ranked attributes tended to have larger differences of means than did higher-ranked attributes. This suggests that operators may have been more willing to select "somewhat important" and "not important" than were transit users.

Table 8 Attribute Rankings and Average Rating Score, Operators and Users

Attribute	Operators Rank	Users Rank	Difference of Ranks	Operators Mean	Users Mean	Difference of Means
On-time	1	1	0	1.25	1.29	-0.04
Safety (night)	2	3	-1	1.40	1.31	0.09
Safety (day)	3	2	1	1.47	1.29	0.18
Find platform	4	6	-2	1.50	1.36	0.14
Easy to transfer	5	7	-2	1.52	1.37	0.15
Lighting	6	5	1	1.54	1.32	0.22
Signage	7	9	-2	1.66	1.42	0.24
Short wait	8	8	0	1.66	1.39	0.27
Shelter from weather	9	10	-1	1.66	1.42	0.24
Cleanliness	10	14	-4	1.71	1.57	0.14
Schedule and route info	11	11	0	1.72	1.49	0.22
Easy to get around	12	13	-1	1.76	1.54	0.22
Emergency help available	13	4	9	1.84	1.32	0.51
Places to sit	14	16	-2	2.20	1.78	0.42
Restrooms	15	15	0	2.40	1.68	0.72
Guards	16	12	4	2.50	1.50	0.99
Food and drink	17	17	0	3.22	2.29	0.92

The large and consistent gap between users’ average ratings and operators’ average ratings likely represents a differential understanding or implementation of the rating system itself. For example, the consistent differential may be evidence of “hypothesis guessing” by one or both of our survey groups. For example, transit users may believe that the research team will use the results of this survey to direct funding for facility upgrades toward specific stops and stations; thus, these users would feel it is in their interest to overstate the importance (and their dissatisfaction with) attributes at *their* stations, thereby skewing their answers upwards from the true mean. On the other hand, transit operators and planners may correctly believe that their input is being used to create a rank-order list by importance of transit stop and stations’ attributes; thus, they may purposely “stretch out” their answers, attempting to use most or all of the Likert scale responses in their response set. This form of hypothesis guessing may skew operators’ responses downward from the true (latent) mean.

In light of this possible differential understanding of the Likert scale itself, perhaps a better method of analysis is by comparing the relative rankings of attributes. Table 8 shows attributes, ranked by operators’ average scores, as well as the users’ ranking of that attribute and the difference of those ranks. By analyzing rankings instead of raw mean scores, the potential for

distortion caused by differential understandings of the Likert scale is minimized. By and large, attributes are ranked in roughly the same order by both groups; most attributes have a difference of order of just one or two ranks. However, there are a few notable exceptions:

- **Cleanliness:** Transit operators ranked the attribute “the station/stop areas are clean” 10th-most important (of 17), while transit users ranked this attribute 14th, for a difference of ranks of 4. This suggests that transit operators may over-estimate the importance of station area cleanliness to their users, compared with the other 16 attributes analyzed here.
- **Emergency help available:** Transit operators ranked the attribute “there are ways for riders to get help in an emergency” 13th-most important, while transit users ranked this attribute 4th-most important, for a large difference of ranks of 9 ranks (of 17). This suggests that transit operators greatly underestimate the importance of emergency help to their users, compared with the other 16 attributes analyzed here.
- **Guards:** Transit operators ranked “riders are made to feel safer by the presence of security guards” 16th-most important, while transit users ranked this attribute 12th-most important, for a difference of ranks of 4. This suggests that transit operators may underestimate the importance of security presence at transit stops and stations, compared with the other 16 attributes analyzed here.

Our use of this methodology rests upon several assumptions. The first assumption is that Los Angeles transit users are a representative sample of national transit users. This assumption may hold for some attributes analyzed here, but for others, this may not be the case. For example, weather concerns may be less important in the relatively pleasant climate of Los Angeles than in, say, Minneapolis or Houston. Similarly, security-related attributes may be more important to transit riders in a major metropolitan area such as Los Angeles than they would be to, say, users of a small-town transit system. The second assumption, discussed above, is that all subgroups of respondents will, on average, use the Likert scale in the same fashion. As already discussed, this assumption may not hold for this study.

Again, we used the more nuanced non-parametric Friedman rank test to further analyze our results. Table 9 shows standardized Friedman rank scores for both operators and users. The table may be interpreted thusly: for each subgroup (operators and users), the most important attribute (in our case, nighttime safety for both subgroups) is assigned a value of 1, and all other attributes Friedman rank scores are scaled in proportion to the Friedman score of “nighttime safety”. Thus, transit operator respondents ranked, on average, the availability of food and drink only 39% as important as night-time safety and on-time performance.

Table 9 Ranking Using Standardized Friedman Non-Parametric Test: Operators and Users

Attribute	Operators Standardized Friedman Rank	Users Standardized Friedman Rank	Operators Rank	Users Rank	Difference of Ranks
Safety (night)	1.00	1.00	1	1	0
On-time	1.00	0.95	2	4	-2
Safety (day)	0.90	0.99	3	2	1
Lighting	0.89	0.95	4	5	-1
Easy to transfer	0.88	0.94	5	7	-2
Find platform	0.87	0.94	6	6	0
Signage	0.78	0.92	7	8	-1
Shelter from weather	0.77	0.91	8	10	-2
Schedule and route info	0.76	0.83	9	13	-4
Short wait	0.71	0.92	10	9	1
Cleanliness	0.71	0.85	11	12	-1
Easy to get around	0.69	0.82	12	14	-2
Emergency help available	0.68	0.96	13	3	10
Places to sit	0.54	0.76	14	16	-2
Restrooms	0.51	0.79	15	15	0
Guards	0.49	0.86	16	11	5
Food and drink	0.39	0.62	17	17	0

Again, the Friedman scores indicate that transit operator respondents were more willing to make use of the entire Likert scale; their Friedman rank scores have a much broader range (0.39 to 1.00) than do users' average Friedman scores (0.62 to 1.00). Again, both subgroups ranked attributes in roughly the same order, with differences of ranks of just one or two; however, there are again several notable exceptions:

- **Schedule and route information:** Nationwide, transit operators overestimated the relative importance of schedule and route information at transit stops, ranking this attribute 9th-most important, while Los Angeles transit users ranked this attribute 13th-most important, for a difference of ranks of 4.
- **Emergency help available:** Again, transit operator respondents far underestimated the importance of the availability of emergency assistance. Operators ranked this attribute, on average, 13th-most important, while Los Angeles transit users ranked this attribute third-most important, for a very large difference of ranks of 10.
- **Guards:** Using the Friedman methodology, transit operators ranked “riders are made to feel safer by the presence of security guards” on average as 16th-most important, while transit users ranked this attribute 11th-most important, for a difference of ranks of 5.

Compared with the 16 other attributes analyzed here, transit operators may underestimate the importance of security guards at transit facilities.

As above, these results should be interpreted with caution. Los Angeles transit users are likely not a representative sample of transit users nationwide. For example, in a large city such as Los Angeles, transit users may rank the availability of guards and emergency call-boxes higher than in other cities in the United States. Further analysis should use a scale-free method of analysis, such as conjoint analysis. This methodology would correct for the possible differential perceptions of scale encountered in this analysis. Ideally, the geographic scale of users' and operators' surveys should match: both, for example, could be conducted statewide in California.

5. CONCLUSIONS

So what makes a good transit stop or station? While the literature provides numerous examples of attributes and evaluation factors, it collectively provides scant information on (1) the factors that transit managers believe to be most important to a good stop/station, (2) what stop/station attributes transit managers believe are most important to their riders, and (3) the relative importance that transit operators place on these various factors in their planning. The findings of this research contribute to our understanding of the factors influencing the “out-of-vehicle” travel experience of transit users as well as the many other factors affecting the location and design of transit stops and stations. This research is part of a larger, ongoing project comparing and contrasting the perspectives of transit stops and stations among riders, transit managers, and other stakeholders.

To address these shortcomings in the literature, we developed and administered a web-based online nationwide survey of 406 U.S. transit agencies obtaining a 43% response rate. We then conducted telephone interviews with a small representative sample of transit agencies. Our findings strongly suggest that transit operators believe that passenger safety and security are, by far, the most important determinants of a good stop/station. This primary finding coincides with a previous survey of transit passengers that our team conducted earlier in this study, who also felt that safety and security far outweighed other attributes at transit stops, stations, and transfer facilities.

Following safety and security, ten other factors cluster relatively closely as important factors in the views of the transit managers surveyed. They are (in order): (2) pedestrian/vehicle conflicts, (3) schedule coordination, (4) operating costs, (5) stop/station equipment reliability, (6) comfortable environment, (7) adequate stop/station space, (8), inter-agency coordination, (9) facilitate passenger flows, (10) accommodate vehicle movements, and (11) protect passengers from weather.

The survey results further suggest that transit operators value user-oriented attributes such as physical comfort and seamless transferring higher than other non-user-oriented attributes. This may be due to the immediacy and constancy of user-related factors; while joint development typically occurs infrequently, the provision of clean, comfortable transfer stops and stations is an ongoing concern for most transit operators.

Our telephone interviews served to highlight these findings. Interviewees relayed to us anecdotes where safety and security concerns “trumped” all other concerns. For example,

comfort concerns (ample and comfortable seating) often defer to security concerns (benches that are not conducive to sleeping). Less obvious and more nuanced tradeoffs are made throughout the spectrum of objectives; our ranking serves to describe the propensity of transit operators to value one attribute more highly than others, and assigns estimates of the magnitude of these propensities.

Additionally, we talked to transit operators about the role of the community in planning, operating, and maintaining transit stops and transfer facilities. We heard from many respondents that the community serves often as opposition, and that its input comes indirectly through politicians and community leaders. Furthermore, we heard that community concerns are typically voiced in response to planned changes, rather than during initial planning stages.

Finally, our online survey results show that, while transit operators appear to have a fairly accurate understanding of what attributes are important to their riders at transit stops and transfer stations, there are several points of disparity. While operators correctly assumed that safety and security were very important to riders, they tended to *underestimate* the importance of specific safety-related amenities, such as security guards and emergency assistance. It also appears that, controlling for other factors, operators *overestimate* the importance of station cleanliness and schedule information to their riders. However, as noted above, our comparison suffers from a mismatch in geographical coverage; our riders' survey collected data from Los Angeles area transit riders, while our operators' survey collected data nationwide. It is likely that this mismatch has overemphasized some disparities, while downplaying others. Further research should examine both subgroups that cover the same general location.

Our research has clarified and quantified the prioritization (by both transit operators and passengers) of various objectives and attributes of transit stops and transfer stations. We have found that safety and security are, by far, the most important priorities for both groups. Our rankings, together with the findings from the transit rider survey, provide the rudiments of a tool for prioritizing improvements to existing transit stops and transfer stations, as well as for the design of new facilities. This tool, we hope, will help transportation planners leverage limited transportation funds for maximum benefit at transit stops and transfer stations.

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APPENDIX A

ONLINE SURVEY INSTRUMENT

About our Study

We are part of a team of researchers at the Institute of Transportation Studies at the Berkeley and Los Angeles campuses of the University of California under the direction of Professor Brian Taylor (UCLA) working on a project sponsored by the California Department of Transportation (Caltrans) that is evaluating connectivity performance at transit stops, stations, and transfer facilities. We are studying how transit users perceive transfers and we have already conducted a user survey of more than 700 rail and bus passengers at over a dozen sites in the greater metropolitan Los Angeles area. That survey asked passengers to evaluate transit stops and stations, taking into account the level of importance they place on various attributes.

We are also studying the extent to which particular attributes of transit stops, stations, and transfer facilities are of use to transit operators providing services at these facilities. For example, such attributes include those dealing with safety and security, access, information, and amenities. Our aim is to provide transit operators with a comprehensive and useful assessment of such attributes to help them increase the attractiveness of their services.

As part of this investigation, we are conducting this online survey of U.S. public transit operators to learn more about the attributes of stops, stations, and transfer facilities that they are familiar with.

About Your Informed Consent to Participate

This survey should take about 20 minutes to complete and because it is conducted online, if you do not complete the survey today, your responses may be saved and you can return later if you so choose. You will need to resume the survey on the same computer though. However, you are under no obligation to complete the survey once you have started it. Your participation in this survey is completely voluntary and you are free not to participate. You may refuse to answer any questions and may stop taking part in the survey at any time.

Individual responses by your agency will be viewed only by project researchers and will not be shared with Caltrans, or any other individuals or organizations. Further, none of your responses will be presented in any publications or other materials produced from this research in a way that identifies you or your transit agency without your explicit and previous authorization.

There are no foreseeable risks to you from participating in this research. There are, in fact, potentially direct benefits to your transit agency because our primary deliverable for this project will be a tool that transit agencies can use to help them evaluate how their transit transfer facilities are functioning. There will be no costs to you, other than your time to complete the survey.

All of the information that we obtain from you during the research will be kept confidential. Prior to starting the survey, we will request your name, work telephone number, and work e-mail address; this information will be stored in a database on a password-protected computer with access given only to our Project Manager and his Graduate Student Researcher. Your name or other identifying information will absolutely not be used in any reports stemming from this research. Moreover, this personal information (name, telephone number, e-mail address) will be deleted from the database once the survey has been administered. One final item: All information you provide is transmitted over a secure network with SSL encryption.

Professor Brian Taylor's contact information is provided below if you would like to contact him about this research. If you have questions regarding your rights as a research subject, you may contact the UCLA Office for Protection of Research Subjects at 310-825-8714.

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Email: btaylor@ucla.edu

If you want to participate, then please click "Yes" below. By clicking "Yes", you have given your informed consent to participate and you will then have the opportunity to complete this survey. If you do not want to participate, simply click "No". In either case, after providing your answer, click "Save and Go to Next Page >>".

Thank you very much.

Yes

No

Online Survey Instructions

Save your Responses -- To save your responses on any page of the survey, simply click on "Save and Go to Next Page >>" at the bottom of that page. So, if you do not complete the survey in a single session, click "Save and Go to Next Page >>" then click "EXIT THIS SURVEY >>" in the top right hand corner of the page. When you leave the survey you will be taken to the UCLA Institute of Transportation Studies web site.

Return at a Later Time -- To return to the survey later, simply click on the same link (on the same computer) you received in our e-mail message to you. Upon your return, you will be brought to the page immediately following the page you saved and you will need to click "<< Go Back" to pick up where you left off.

Edit your Responses -- You may go back and change your existing responses until you complete and submit the survey. Once you have hit the "Submit this Survey >>" button on the last page, you will not be able to re-enter the survey.

Answer your Questions -- If you have questions about the survey, please contact Mark Miller, the Project Manager, by phone at (415) 250-5415 or by e-mail at mamiller@path.berkeley.edu.

Information About You

Before you start the survey, we request some information about you.

What is your name?

What is your title at work?

What is your position at work?

- Planning
- Operations or Logistics/Scheduling
- Research
- Marketing
- Executive/Administrative
- Finance/Budgeting
- Other

If you checked "Other" in the question immediately above, please provide additional detail here; otherwise, proceed to the next question.

What is your telephone number at work?

What is your e-mail address at work?

Information About Your Transit Agency

Where is your transit agency located? Please make your selection from this drop-down menu.

Alabama Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

Alaska Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

Arizona Transit Agencies

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Arkansas Transit Agencies

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California Transit Agencies

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Colorado Transit Agencies

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Connecticut Transit Agencies

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Delaware Transit Agencies

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Washington D.C. Transit Agencies

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Florida Transit Agencies

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Georgia Transit Agencies

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Hawaii Transit Agencies

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Idaho Transit Agencies

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Illinois Transit Agencies

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Indiana Transit Agencies

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Iowa Transit Agencies

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Kansas Transit Agencies

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Kentucky Transit Agencies

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Louisiana Transit Agencies

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Maine Transit Agencies

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Maryland Transit Agencies

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Massachusetts Transit Agencies

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Michigan Transit Agencies

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Minnesota Transit Agencies

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Mississippi Transit Agencies

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Missouri Transit Agencies

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Montana Transit Agencies

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Nebraska Transit Agencies

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Nevada Transit Agencies

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New Hampshire Transit Agencies

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New Jersey Transit Agencies

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New Mexico Transit Agencies

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New York Transit Agencies

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North Carolina Transit Agencies

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North Dakota Transit Agencies

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Ohio Transit Agencies

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Oklahoma Transit Agencies

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Oregon Transit Agencies

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Pennsylvania Transit Agencies

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Puerto Rico Transit Agencies

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Rhode Island Transit Agencies

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South Carolina Transit Agencies

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South Dakota Transit Agencies

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Tennessee Transit Agencies

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Texas Transit Agencies

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Utah Transit Agencies

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Vermont Transit Agencies

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Virginia Transit Agencies

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Washington State Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

West Virginia Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

Wisconsin Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

Wyoming Transit Agencies

What is the name of your transit agency? Please make your selection from this drop-down menu.

Your Passengers' Perspective

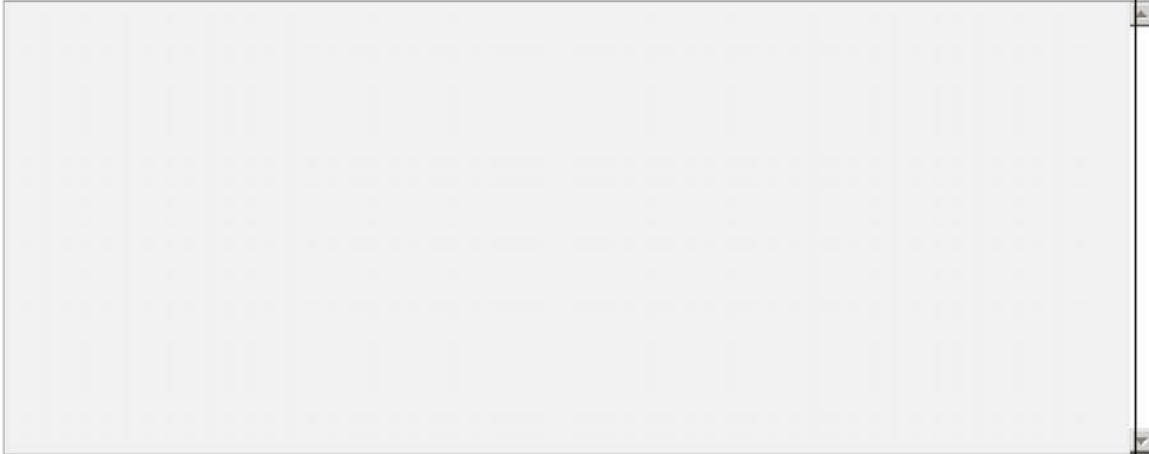
How important do you think the following stop and station attributes are to *your passengers*? For each attribute, please select one of the following: "Very Important", "Important", "Somewhat Important", "Not Important".

If you do not know how important a specific attribute is for your passengers or do not think the attribute applies to your passengers, please select the "Not applicable/Do not know" option.

If you need to exit the survey before making your selection for each item on this page, note that when you return to this page later the items on this list may appear in a different order.

	Very Important	Important	Somewhat Important	Not Important	Not Applicable/Do No Know
Riders usually have a short wait to catch buses/trains.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are shelters at the stations/stops to protect riders from the weather, e.g., sun, rain, snow, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The buses/trains are usually on time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The signs at the stations/stops are helpful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to get schedule and route information at the stations/stops.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Riders are made to feel safer by the presence of security guards.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy for riders to find the platforms or stops.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Riders feel safe at the stations/stops at night.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are places for riders to buy food or drinks nearby.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The stations are well lit at night.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The station/stop areas are clean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are enough places to sit.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to get around the stations/stops.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are ways for riders to get help in an emergency.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Riders feel safe at the stations/stops during the day.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The stations/stops are easy places to transfer to other buses or trains.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are public restrooms nearby.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please use the space below if you would like to offer additional information regarding any of these attributes for any specific stop, station, or transfer facility you are familiar with.



Your Perspective as the Transit Operator

How important are the following statements from your perspective as the transit operator? For each statement, please select one of the following: "Very Important", "Important", "Somewhat Important", or "Not Important".

If you do not know how important a specific statement is from your perspective or do not think the statement is applicable, please select the "Not applicable/Do not know" option.

If you need to exit the survey before making your selection for each item on this page, note that when you return to this page later the items on this list may appear in a different order.

	Very Important	Important	Somewhat Important	Not Important	Not Applicable/Do Not Know
Minimize fare inconsistencies, i.e., different fare rates across operators or inconsistent rates across like modes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimize pedestrian-vehicle conflicts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Minimize negative impact on existing transportation services, i.e., on operators who cannot participate or on operators whose routes are disrupted or whose routes face additional competition.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimize queues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimize total cost of operations (including maintenance costs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimize wasted space in station/stop design because large spaces increase construction costs and require more maintenance, security, and environmental controls.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Minimize institutional barriers to transferring such as transfer fares, lack of information or poor coordination of schedules.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

We continue this question on the next page.

Your Perspective as the Transit Operator (continued)

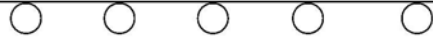
How important are the following statements from your perspective as the transit operator? For each characteristic, please select one of the following: "Very Important", "Important", "Somewhat Important", or "Not Important".

If you do not know how important a specific statement is from your perspective or do not think the statement is applicable, please select the "Not applicable/Do not know" option.

If you need to exit the survey before making your selection for each item on this page, note that when you return to this page later the items on this list may appear in a different order.

	Very Important	Important	Somewhat Important	Not Important	Not Applicable/Do Not Know
Maximize reliability of station/stop equipment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize income from non-transport activities, such as advertising and vending.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize flexibility for expansion to handle an increase in demand or addition of new modes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize joint development, i.e., involving the public and private sectors in sharing the facility and its costs and revenues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize vehicle maneuverability (turning radii, etc).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize environmental friendliness of station/facility ("green" station/facility).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maximize coordination of scheduling to accommodate transfers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Maximize operational ease at the station or facility, e.g., vehicle maintenance, vehicle storage, ticketing, baggage handling, and/or accounting.



We continue this question on the next page.

Your Perspective as the Transit Operator (continued)

How important are the following statements from *your* perspective as the transit operator? For each statement, please select one of the following: "Very Important", "Important", "Somewhat Important", or "Not Important".

If you do not know how important a specific statement is from your perspective or do not think the statement is applicable, please select the "Not applicable/Do not know" option.

If you need to exit the survey before making your selection for each item on this page, note that when you return to this page later the items on this list may appear in a different order.

	Very Important	Important	Somewhat Important	Not Important	Not Applicable/Do Not Know
Efficiently collect fares and control entry to station/stop/vehicle.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide a break area for vehicle operators.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide a comfortable physical environment with respect to lighting, temperature, and cleanliness.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide protection from the weather.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide restrooms, first-aid supplies, and public telephones.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Efficiently process rider flows.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide a safe and secure environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide adequate station/stop space.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are there attributes that you think are important from *your* perspective as the transit operator but were not listed on the previous three pages? If so, please list up to five of them here and also identify whether they are "Very Important", "Important", or "Somewhat Important".

- a.
- b.
- c.
- d.
- e.

Receiving the Findings of this Research

Given that you have taken the time to complete this survey, you likely have an interest in transit connectivity. If you or someone from your agency would like to receive a copy of the report on this research when it is completed, please tell us below to whom we should send it. This project will be completed in early Fall 2007.

Are you or is someone else in your agency interested in receiving a copy of the Final Report on this research?

- No
- Yes

If you answered "No" above, click "Save and Go to Next Page >>". If you answered "Yes" above, please provide the appropriate contact information here, then click "Save and Go to Next Page >>":

Name	<input type="text"/>
Title	<input type="text"/>
Agency	<input type="text"/>
Address_1	<input type="text"/>
Address_2	<input type="text"/>
City	<input type="text"/>
State	<input type="text"/>
Zip	<input type="text"/>
E-mail Address	<input type="text"/>

Thank You!

On behalf of the entire Project Team, thank you for your time. To exit this survey, simply click on "EXIT THIS SURVEY >>" in the top right corner of this page and you will be returned to your web browser at the UCLA Institute of Transportation Studies website.

Brian Taylor
Principal Investigator, Transit Transfer Project
UCLA Institute of Transportation Studies

Thank You!

On behalf of the entire Project Team, thank you very much for participating in this survey and contributing to this research.

Brian Taylor
Principal Investigator, Transit Transfer Project
UCLA Institute of Transportation Studies

APPENDIX B

TELEPHONE INTERVIEW GUIDE

1. INTERVIEW GUIDE

Operator's Agency Name:
Transit Facility:
Contact Person Name:
Phone:
Fax:
E-mail:
Time of interview: ___/___/___ :___ AM/PM

Statement of Purpose

We are part of a team of researchers working on a project for the California Department of Transportation that evaluates the connectivity performance at transit stops, stations, and transfer facilities. Our goal is to better understand how transit users perceive transfers to help transit agencies increase the attractiveness of their services.

We have already conducted a user survey of more than 700 rail and bus passengers at over a dozen sites in the greater metropolitan Los Angeles area. This survey asked passengers to evaluate transit stops and stations, taking into account the level of importance they place on various factors.

In our conversation with you today, we want to ask you — the transit expert — what you think is most important about transit stops and stations your perspective as an operator of transit services and the perspectives of residents and businesses located adjacent to and near transit stops and stations, that is, from the neighboring community perspective.

Thank you for working with us in this important research investigation.

We'd like to speak with you first about your general experience with transit stops, stations, and transfer facilities from your perspective as the operator and then from the neighboring community perspective.

Operator's Perspective

Questions

1. What are the factors that play a significant role in the design, siting, operation, and maintenance of major stops, stations, and transfer facilities?

DESIGN

SITING

OPERATION

MAINTENANCE

NOTE TO INTERVIEWER: Please bring up the following factors IF the interviewee does NOT mention them, but DO NOT mention them first as examples because that will lead the respondent:

- Cost-related factors
- Opportunities for joint development
- Institutional barriers to transferring
- Process of collecting fares and controlling entry to vehicle area
- Pedestrian/vehicle conflicts
- Providing a safe and secure environment.

2. What have been the major challenges or obstacles in the design, construction or improvement of major stops, stations, and transfer facilities?

NOTE TO INTERVIEWER: Please bring up the following factors IF the interviewee does NOT mention them, but DO NOT mention them first as examples because that leads the respondent on:

- Engineering issues
- Providing adequate vehicle and pedestrian circulation space
- Processing passenger flows efficiently
- Providing proper physical environment
 - Lighting
 - Temperature
 - Aesthetics
 - Cleanliness
- Existing and conflicting land uses or rights-of-way
- Funding: certainty / uncertainty
- Interagency coordination for facilities with multiple operators
 - Conversely, did the presence of another agency or agencies at the site provide your agency with additional options or resources in the implementation of this transfer facility?
- Joint development with the private sector and other members of public sector
 - Conversely, did joint development provide your agency with additional options or resources in the implementation of this facility?

3. Was the certainty or uncertainty of ridership estimates a concern in planning this facility?

Community Perspective

Now, we'd like to focus on neighboring communities' response to transfer facilities – during the planning stage, during siting or re-siting, the construction phase, or in the operations phase. We are interested in hearing about community and business groups – organized or unorganized – or even individual neighbors that in some way influenced the implementation of sites you are familiar with. We are interested in both opposition (e.g. NIMBY-type) to and support for such facilities.

Questions

1. How did community concerns influence the implementation of transfer facilities?

2. Do community concerns continue to play a significant role?

3. Which type of community groups played a significant role in the planning of this transfer facility?

4. Where does most of the opposition come from, the commercial sector – business groups or individual businesses – community groups, individual residents?

5. What reasons have been given for opposing stations and transfer facilities, especially during the planning stage?

NOTE TO INTERVIEWER: Please bring up the following factors IF the interviewee does NOT mention them, but DO NOT mention them first as examples because that will lead the respondent:

- Scale of facility
- Architectural quality or lack thereof
- Aesthetic quality or lack thereof
- Noise pollution
- Air pollution
- Light pollution
- Blocked sightlines
- Change for the worse in neighborhood's character
- Attraction of "wrong" element to the facility
- Long dwell times at the transfer facility

6. Where does most of the support come from, the commercial sector – business groups or individual businesses – community groups, individual residents?

7. What reasons have been given in support of stations and transfer facilities?

NOTE TO INTERVIEWER: Please bring up the following factors IF the interviewee does NOT mention them, but DO NOT mention them first as examples because that will lead the respondent:

- Source of community pride
- Architectural gem
- Helps provide a source of employment during construction and operation
- Urban renewal
- Offers opportunity for joint development or commercial tenancy

8. To what extent have community groups been involved in the planning process for facilities? In terms of its architectural or aesthetic qualities?

9. How did your agency support community participation?

NOTE TO INTERVIEWER: Please bring up the following factors IF the interviewee does NOT mention them, but DO NOT mention them first as examples because that will lead the respondent:

- Public meetings
- Hosting of design charettes
- Dissemination of information on internet, customary mailings

10. At this time, could you please choose a specific site and talk about it in terms of our previous discussion, that is, its operational and community perspectives?