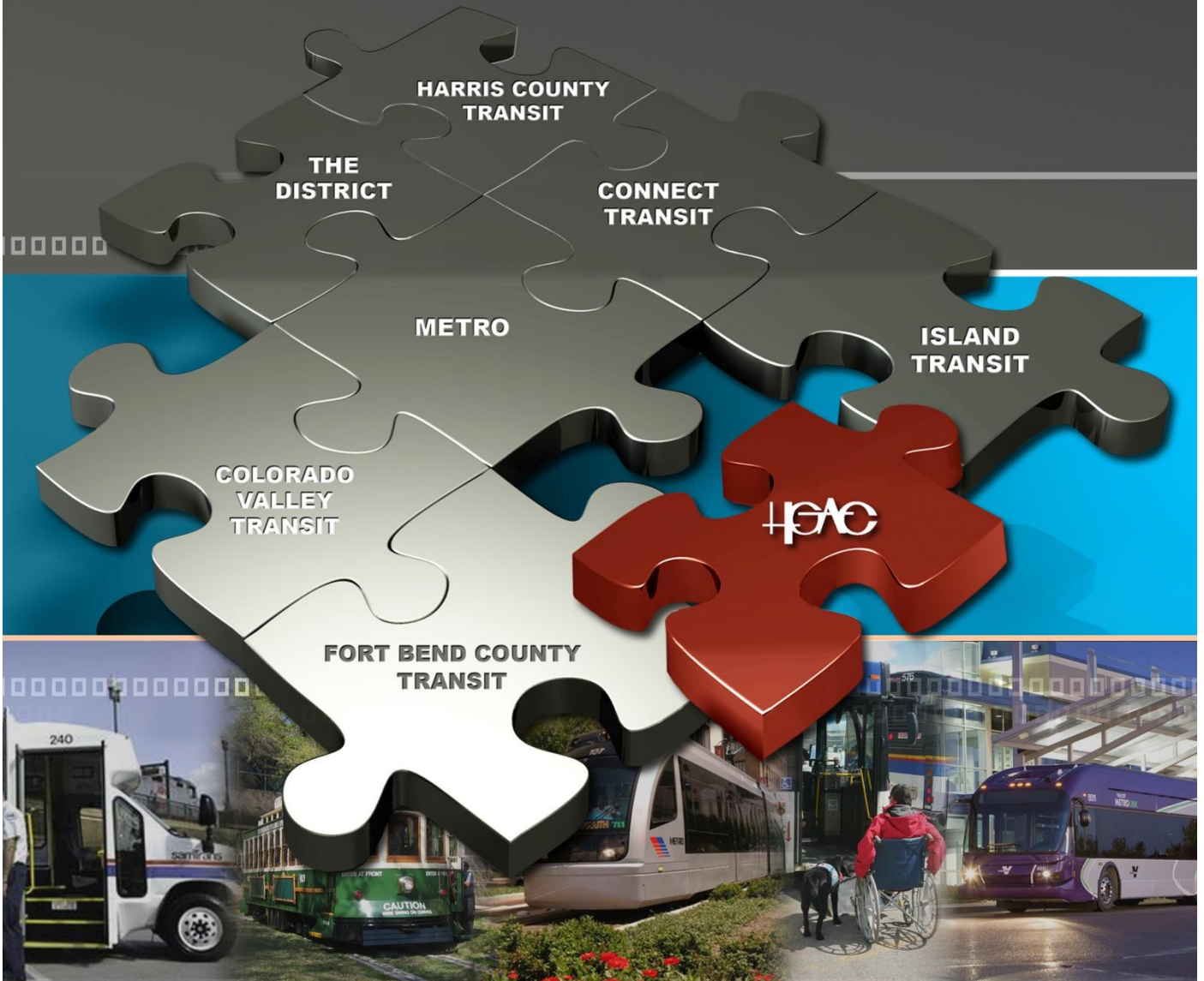


H-GAC REGIONAL TRANSIT FRAMEWORK STUDY – TRANSIT PERFORMANCE STANDARDS AND INDICATORS

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HDR



Transit Performance Standards and Indicators

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Transit Performance Standards and Indicators

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1.0 INTRODUCTION

This paper focuses on defining appropriate performance standards and indicators to measure potential transit investments for the H-GAC Regional Transit Framework Study (RTFS). The standards and indicators will serve as an important planning and analysis tool throughout the RTFS process. Specifically, the performance standards and indicators will:

- Help identify potential transit markets
- Validate transit markets defined by the regional travel demand model
- Assist in identifying appropriate mode
- Support analysis of alternative transit services
- Support analysis of alternative transit scenarios (*services combined*)

Performance standards and indicators are different depending on the level of system evaluated and the phase of the planning and implementation process. The steps from planning to implementation include framework planning, system planning, route planning, construction/implementation, and operations. Each of these steps has different evaluation needs and data types available. The framework planning level requires broader performance standards and indicators to evaluate investments than at an operations level.

1.1 GOALS & PHILOSOPHY

Understanding both the primary goals and the philosophy of the RTFS are essential to the development of appropriate performance standards and indicators. A goal of the study is to determine which investments will allow transit to capture the most transportation market share in highly congested corridors and/or maximize total regional ridership. This is a market based approach that depends on determining what factors affect the choices that transportation system users make when selecting a mode of travel. This market-based approach also needs to be informed by system compatibility factors such as land use, local plans and policies, and other regional and statewide efforts. Additionally, the H-GAC study area is large and includes urban, suburban, and rural areas that have different characteristics and needs for transit service. It is important to not lose sight of other goals of providing transit service such as: to provide service to those without their own transportation, to provide service to all areas of the H-GAC region, and to provide mobility options to the region’s residents and employees.

The optimum result is a set of improvements that captures significant numbers of new transit riders while also enhancing mobility for existing and transit dependent customers without compromising system compatibility. This will be accomplished by:

- Listening to existing transit users through focus groups, telephone surveys and other direct input processes
- Determining mode choice factors for non-transit users through focus groups and market studies
- Incorporating other ongoing efforts and studies





- Gathering input and feedback from local agencies and transit providers
- Addressing local conditions, plans, and desires

This approach will result in:

- “High Leverage” transit investments that are more competitive with other modes in terms of capturing market share
- Improved customer acquisition
- Increased mode competitiveness
- Increased transit market share
- Enhanced mobility for the H-GAC’s residents and employees in urban, suburban, and rural areas
- Attitudinal shift or accommodation regarding transit in the H-GAC region
- Local and regional support for planned transit investments

1.2 SOURCES OF INFORMATION

In order to develop the most robust and comprehensive set of performance measures and indicators possible, a literature review was performed to identify relevant papers, publications, and projects. This working paper references information from the following publications:

- TCRP Report 136: Guidebook for Rural Demand-Response Transportation: Measuring, Assessing, and Improving Performance, 2009 by the Transportation Research Board
- NCHRP 8-36(A)-Task 32: Tools, Techniques, and Methods for Rural Transportation Planning, January 2004 by AASHTO Standing Committee on Planning, prepared by Cambridge Systematics
- TCRP Report 124: Guidebook for Measuring, Assessing, and Improving Performance of Demand Response Transportation, 2008 by the Transportation Research Board
- 2030 Transportation Policy Plan, Appendix G: Regional Transit Standards, January 14, 2009 by the Metropolitan Council, Twin Cities, Minnesota
- TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd edition, 2003 by the Transportation Research Board
- TEA-21 New Starts Planning and Project Development Process, Federal Transit Administration
- TransitWorks Strategic Plan Report, San Diego Metropolitan Transit Development Board, January 2001
- Regional Transit Vision, San Diego Association of Governments, November 2001
- 3C: A Sensible Approach to Land Use and Mobility in the Houston Galveston Region, Houston Galveston Area Council
- Livable Centers, More Choices, Great Places, Houston Galveston Area Council
- FY 2009 New Starts and Small Starts Evaluation and Rating Process, Federal Transit Administration, July 20, 2007
- Guidelines and Standards for Assessing Transit-Supportive Land Use, Federal Transit Administration, May 2004



- Pedestrian Safety Guide for Transit Agencies, Federal Highway Administration, February 2008

The information gleaned from these sources was informed by local conditions in the H-GAC region through a project management\consultant team workshop, Framework Advisory Committee input and relevant transit and land use data. The resulting transit performance standards and indicators thus reflect national trends and experiences as well as local conditions and characteristics in the H-GAC region.

1.3 APPLICABILITY TO THE PROJECT PROCESS

The performance standards and indicators discussed in this paper were developed by combining information from national publications and experience with local conditions to arrive at standards and indicators that could be used to screen potential activity centers, transit corridors, and transit mobility scenarios. The standards and indicators will be applied to determine which transit corridors and service scenarios have the greatest likelihood of attracting higher levels of all transit users including “choice” riders. When used to screen the transit mobility scenarios it is intended that the standards and indicators be divided into primary and secondary influence factors to reflect the higher synergy between the primary influencers and ridership. These classifications will be defined as the project moves into the assessment phase.





2.0 DRIVERS FOR TRANSIT PERFORMANCE STANDARDS & INDICATORS

The proposed performance standards and indicators outlined in this report were developed by considering the following information:

- Focus group input
- Houston METRO Customer Satisfaction Survey (Fall 2008)
- Community values
- Existing service standards, performance indicators, and informing documents

2.1 FOCUS GROUP INPUT

Focus groups for the H-GAC RTFS were conducted from December 2009 to January 2010. A total of 17 focus groups were held in six different counties. Participants for the focus groups were recruited by Decision Information Resources (DIR) through random sampling, recruiting drives, email blasts, and distribution of flyers at various locations in the region. STAR Vanpool and Island Transit also assisted DIR in the recruitment of non-riders in Brazoria and Galveston Counties. A total of 154 persons (66 existing transit users and 88 non-users) participated in the 17 focus groups. Detailed information about each focus group is provided in **Table 1** below.

Each focus group meeting averaged approximately an hour in length and featured a variety of questions to ascertain participants' opinions about and experience with public transit service. The focus groups provided a wealth of information regarding transit service throughout the region.

- Montgomery County focus group participants expressed a strong interest in more transit options to Houston and the surrounding areas.
- Brazoria County non-rider participants talked extensively about building a rail line from Harris County through Brazoria County, while transit riders focused on the need/desire for more park-and-ride locations throughout the county.
- Harris County participants provided feedback regarding improving the entire transit system including the need for more stops, faster travel times, and a more secure travel experience. Non-rider participants favored extending the current Main Street light rail line to more areas within Harris County.
- Fort Bend County participants expressed a need for more park-and-ride locations in the area, as well as the implementation of commuter rail.
- Galveston County non-rider participants talked about having a commuter rail line from Galveston to Houston, while transit rider participants suggested improvements



to the Island Transit System (i.e. additional bus stops, extended service span, increased frequency, etc.).

- Chambers County participants are interested in more transit options within the county, as well as the possibility of commuter rail service.

Table 1: H-GAC Focus Group Summary

H-GAC Focus Group Summary				
Date	Meeting Location		Type (Rider/Non-Rider)	Number of Participants
12/16/2009	Conroe	Montgomery County	Non-Rider	13
12/16/2009	Conroe	Montgomery County	Rider	3
12/22/2009	Pearland	Brazoria County	Non-Rider	6
12/22/2009	Pearland	Brazoria County	Rider	6
1/5/2010	Houston	Harris County	Non-Rider	11
1/5/2010	Houston	Harris County	Rider	12
1/6/2010	The Woodlands	Montgomery County	Non-Rider	8
1/12/2010	Houston	Harris County	Rider	7
1/13/2010	Lake Jackson	Brazoria County	Non-Rider	6
1/13/2010	Lake Jackson	Brazoria County	Rider	10
1/14/2010	Sugarland	Fort Bend County	Non-Rider	14
1/14/2010	Sugarland	Fort Bend County	Rider	6
1/19/2010	Galveston	Galveston County	Non-Rider	10
1/19/2010	Galveston	Galveston County	Rider	11
1/20/2010	Mont Belvieu	Chambers	Non-Rider	9
1/21/2010	Pasadena	Harris County	Non-Rider	11
1/21/2010	Pasadena	Harris County	Rider	11

Source: H-GAC RTFS Team, 2010

2.2 HOUSTON METRO CUSTOMER SATISFACTION SURVEY (FALL 2008)

The first customer satisfaction survey in a decade was completed in the winter of 2009. A representative sampling of 827 interviews were conducted with passengers who were interviewed on board buses on weekday local routes, local weekend routes, park-and-ride routes and at the rail stations. The seven customer satisfaction factors METRO scored highest on were: the transit system’s ease of use, driver's knowledge of routes, knowing where to go if rider has a complaint, driver's driving skills, courtesy of driver, agency doing a good job of telling riders about route/schedule changes, and METRO being a good value for the money. Satisfaction was measured in 13 service areas, including the METRO web site, transit centers and transfers.

The survey concluded that:



- 94 percent of riders are completely (40%) or mostly (54%) satisfied with METRO overall.
- 98 percent of riders would recommend METRO to a friend.
- 96 percent of riders say service has improved over the past year.
- 95 percent of riders say they can rely on METRO to get them where they want to go.

This survey indicated that riders in the current METRO service area are generally satisfied with the service provided. The performance standards and indicators should contain elements that reflect the current transit characteristics to reflect the success of the current METRO system in serving riders.

2.3 COMMUNITY VALUES

Support from local, regional and state agencies and consistency with local plans and values are very important to the success of any transit investment. The performance standards and indicators presented in Chapter 4 recognize this and are a useful means of screening for agency support and consistency with community values.

2.4 EXISTING SERVICE STANDARDS AND PERFORMANCE INDICATORS

This study effort included a review of existing documentation that provides guidance and evaluation criteria for transit systems as well as factors used to evaluate corridor level investments. Understanding how individual corridors are evaluated can provide for a better understanding of the contributing factors of successful transit systems. The documentation review included information from the Federal Transit Administration New Starts Program, SAFETEA-LU, H-GAC Livable Centers Program, and the Transportation Research Board (e.g. TCRP 124 and TCRP 136 regarding rural and dispersed service).

2.4.1 FTA New Start Program

The FTA administers the New Starts Program that provides funding for transit projects through a competitive vetting process. This program focuses on corridor specific investments rather than system wide characteristics. The most relevant information from this source for the H-GAC RTFS is contained in the Project Justification Rating category. This category provides a project rating system based on several factors including mobility improvements, operating efficiencies, and land use synergies. Of particular interest are the Transit Supportive Land Use and Future Patterns Criteria. This can be evaluated for transit mobility scenarios developed in the H-GAC RTFS and applied to system as well as corridor level investments. The FTA New Starts Project Justification Criteria includes:

- Cost effectiveness
 - Incremental cost per hour of transportation system user benefit
- Transit supportive land use and future patterns
 - Existing land use
 - Transit supportive plans and policies





- Performance and impacts of policies
- Mobility improvements
 - User benefits per passenger mile
 - Number of transit dependents using the project
 - Transit dependent user benefits per passenger mile
 - Share of user benefits received by transit dependents compared to share of transit Dependents in the region
- Environmental benefits
 - EPA air quality designation

2.4.2 H-GAC Livable Centers Program

The goal of H-GAC’s Livable Centers Program is to facilitate the creation of walkable, mixed-use places that include residential and commercial components, provide multi-modal transportation options, improve environmental quality, and promote economic development. In order to be a Livable Center, projects must be located in one of the following areas of interest:

- **High-density:** areas with mixed land uses and a traditional street grid system, such as the Urban Core.
- **Regional Centers:** areas of concentrated employment or other major trip generators.
- **Town or Village Centers:** areas with a concentration of housing, retail/office and civic destinations within walking distance of a community gathering place and a good pedestrian network.
- **Transit-Oriented Development:** areas with a high-density mix of uses within walking distance of, and with good access to, a transit facility.
- **Corridor:** roadways that are classified as major collectors or higher that increase multi-modal accessibility and connectivity to major centers or transit facilities.
- **Emerging Centers or Corridors:** areas that are experiencing strong growth and could develop as regional centers.

The four major goals and sub-goals of the Livable Centers program are:

1. Create multi-modal travel choices by facilitating a range of transportation mode opportunities:

- Improve pedestrian/bicyclist/transit user safety.
- Increase accessibility and circulation for all modes.
- Reduce the length and number of trips made by single-occupancy vehicles by concentrating development that would otherwise require multiple trips.

2. Create quality, walkable, mixed-use places:

- Strengthen community identity through quality design.
- Create public spaces for the community.
- Recognize the tradition, character, and culture of the area.



- Revitalize historic areas where they exist.
- Provide residential housing serving the full range of economic groups.

3. Improve environmental quality:

- Improve air quality by making transit, walking/bicycling trips more feasible.
- Incorporate the environment into the planning process by preserving green space and natural resources.

4. Promote economic development:

- Promote value by serving as a catalyst for investment and development.
- Leverage private investment to achieve a balance of land use types.
- Promote efficient use of infrastructure.

The 3C strategies are a key element of the Livable Centers Program. The three Cs represent centers, connections, and context. Collectively, the strategies clearly identify the region’s goal of reducing vehicle trips by creating a greater correlation between land use and transportation.

The 3C’s Program documentation spells out the overview, goals, and tools of the program:

"Most development in the H-GAC region today is vehicle oriented. Transportation investments and market forces have created a cycle of auto-dependency, where the mobility demands of growth are primarily met by roads and parking lots. People increasingly want more choices in how they travel between where they live, work and play. This trend presents a tremendous opportunity for new types of transportation investments that can reduce the growth of vehicle travel, while producing added economic and environmental benefits."

The 3C’s strategies are defined in **Table 2**. **Table 3** identifies a hierarchical classification of livable centers based on surrounding uses, transportation elements and level of development. Criteria associated with potential vehicle trip reduction goals for each classification are also included in **Table 3**.

Table 2: Livable Centers 3C Characteristics and Strategies

3C’s Program	Key Strategies
<p>Centers – Safe Walkable Places</p> <p>Centers are places with concentrations of jobs, public buildings, recreation, housing, or all of thee together. Well-designed Centers provide safe opportunities to walk, bike, utilize transit and “Park Once.”</p>	<p>Centers</p> <ul style="list-style-type: none"> • Reinvest in existing downtown and other already walkable centers and neighborhoods • Promote development of live, work and play opportunities near transit. • Encourage Town and Village Center designs in new development. • Provide a safe and convenient walking environment.
<p>Connections – Convenient Choices</p> <p>Providing better auto, transit, and pedestrian/bicyclist connections between Centers and neighborhoods gives residents, workers and visitors an alternative to congested</p>	<p>Connections</p> <ul style="list-style-type: none"> • Establish excellent transit Connections between Centers. • Provide safe pedestrian/bicyclist access to Centers. • Design local streets networks to give people





thoroughfares.	<i>alternatives to congested thoroughfares.</i>
Context – Collaborative Solutions Early collaboration between stakeholders can produce street designs that meet all user needs providing lasting community benefits.	Context <ul style="list-style-type: none"> Develop "Complete Streets" that are safe, have transit options, sidewalks, bikeways and landscaping appropriate for the surrounding land uses.

Source: *Livable Centers Brochure/Pamphlet, H-GAC*

Table 3: Livable Centers 3C Program Potential

*Reduce Roadway Congestion – Improve Roadway Safety – Create Economic Advantages
 Produce Environmental Benefits – Create Quality Places*

Types of Centers	Vehicle Trip Reductions
Urban Core High-density residential areas with mixed land uses and frequent intersections.	5-20% depending on the concentration of activities, quality of pedestrian environment and level of transit service.
Regional Center Areas of concentrated employment or other major trip generators.	Up to 40% of workday vehicle trips. Up to 55% in highly concentrated areas with an outstanding pedestrian environment.
Town Center Concentration of housing, retail/office and civic destinations within half-mile radius of community gathering place with a good pedestrian network.	5-7% of home based "live, work, play" pedestrian trips. Up to 10% with outstanding pedestrian environment.
Transit Village High-density housing, retail/office and other destinations concentrated within a quarter mile to half mile and with good pedestrian access to a high volume transit facility.	Up to 20% with increased transit sharing of home-based work and other trips and increased pedestrian sharing of non-work trips.
Village Center Clustered neighborhood retail and services with good connections to surrounding neighborhoods.	Up to 6% of some home-based, non-work pedestrian/bicyclist trips with reduced traffic on major roads. Up to 7% with good bicycle access.

Source: *3C's Brochure/Pamphlet, H-GAC*

2.4.3 TCRP 124 AND TCRP 136

The H-GAC region is large and contains urban, suburban, and rural densities and development types. It is very important that the entire region and all service types be represented in the performance standards and indicators for the study. TCRP 124 and TCRP 136 provide detailed information on measuring, assessing, and improving the performance of both urban and rural demand response transit systems. The demand response transit (DRT) systems in place today in the H-GAC region provide critical transportation services to those who cannot or choose not to own or drive a private vehicle. Of particular importance is the provision of these services to transit dependent residents in low density or rural areas.

DRT in rural areas provides a complex array of transportation services. It is often more than just a fleet of smaller vehicles operating in response to calls from passengers or their agents. DRT may also provide weekly scheduled service to and from a distant medical center on an advance reservation basis. DRT may serve outlying communities only on a twice or three times per week basis, with a morning trip into the larger town and a return trip in the afternoon each day of service. Frequently, DRT also provides service for clients of local human service agencies on a contract basis. Rural systems may carry more than passengers. DRT may transport meals to homebound seniors as part of its transportation mission, and there is at least one rural



system that carries bulk mail for the U.S. Postal Service in addition to passengers. DRT may provide all of these services in rural communities and as such often becomes the backbone of transportation and services in rural areas.

For rural DRT systems, a set of six data elements is recommended for performance assessment purposes:

- Vehicle-hours
- Vehicle-miles
- Passenger trips
- Total operating expense
- Accidents/safety incidents
- On-time trips

Additionally, many systems are beginning to include “Transit Impact” performance measures. Since rural transit often serves a predominately transit dependent population, performance measures for a rural DRT system may want to capture its impact on improving the quality of life for those rural residents who rely on DRT service.

A small sample of possibilities includes:

- Rate of use by seniors
- Rate of use by people with disabilities
- Percentage of trips to/from congregate meal sites to total trips
- Percentage medical trips
- Number of employment trips provided per day
- Number of individuals using DRT for independent living
- Passenger feedback on service quality



3.0 BACKGROUND & TRANSIT SERVICE INFORMATION

3.1 DEMOGRAPHICS AND LAND USE

The RTFS area consists of approximately 8,800 square miles in southern Texas. It contains 8 counties, numerous incorporated cities and towns, and extensive unincorporated land. In 2009, more than 5.7 million people lived in the region. The estimated 2035 population for the H-GAC region is approximately 8.7 million people, an increase of nearly 53%. At the same time, the population in the H-GAC region aged 65 and older is expected to increase from approximately 8% in 2009 to nearly 16% in 2035. Several counties have experienced a double-digit growth in population for more than a decade.

Although significant investments have been made in the regional transportation system, peak period congestion continues to last more than six hours a day. According to an analysis from the Texas Transportation Institute (TTI), congestion cost the region nearly \$2.5 billion in 2007 based on travel delays and excess fuel consumption. Development in the region is characterized by a predominance of suburban single-family residential development with centrally located employment centers. Coupled with rapid growth in population and employment, this type of development has placed enormous stress on the region’s transportation infrastructure. State and local governments are struggling to reduce congestion and improve mobility while maintaining the relatively low cost of living that residents have come to expect. H-GAC is addressing these issues through various efforts including the Livable Centers initiative and the 3C’s Program. The H-GAC region is expected to become increasingly conducive to transit service as it experiences anticipated population and employment density increases, due to (a) infill and redevelopment of older urban areas, and (b) continuing urbanization of more suburban areas. Note that the Livable Centers, which include mixed residential and commercial/employment centers designed for efficient transit access and circulation, are expected to grow significantly in the coming years. Future development of vacant land will create the need for a greatly expanded public transit system.

Table 4 on the following page lists existing characteristics of the developed portion of the H-GAC region that are conducive to transit services and ridership, along with others that are not conducive.





Table 4: Conduciveness to Transit of Prevalent Land Use Patterns in the H-GAC Region

Characteristics Conducive to Transit	Characteristics Not Conducive to Transit
Section line grid street layout simplifies navigation.	Much of the region was laid out in an era when transit service was minimal or nonexistent.
Wide right-of-way reserved for arterial streets creates room for stops and waiting areas.	Many planned communities are designed for auto access only, in isolation from public streets and neighborhood services.
H-GAC is encouraging Livable Centers.	Arterial streets are generally spaced far apart (one mile or more).
Increasing urban infill has the potential to raise transit demand in the long run.	Wide roadway sections discourage transfers and deter pedestrians who need access to stops.
Developers are responding to demand for housing along major transit routes.	The regional CBD's are dispersed.
The market has clustered similar uses (e.g., medical facilities) in a manner often convenient to transit users.	Although mid to high density housing does exist, external pedestrian access and circulation is often poor.
Development of relatively self-contained districts has created a niche for local circulator services.	Parking is ample and inexpensive.
Many of the largest employment and activity centers are aligned along a few corridors	Large parking lots often separate non-drivers from their commercial destinations.
The terrain is mostly flat, facilitating pedestrian access to transit stops.	Cul-de-sacs are common in neighborhoods, cutting off residents from transit access.
	Transit passenger facilities are sometimes remote from the uses they are meant to serve.
	Lack of proper shading at passenger waiting areas and vehicles with reliable air conditioning in regions with long, hot summers make using transit uncomfortable.

Source: TCRP Report 100 informed and modified to match local H-GAC Region Characteristics



4.0 PLANNING LEVEL SERVICE PERFORMANCE STANDARDS & INDICATORS

The information presented in chapters one through three has been consolidated into two main categories and nine factors for screening potential system level transit investments. They are:

- Customer Choice Centric Factors
 - Ridership
 - Flexibility and Speed/Travel Time
 - Accessibility/Availability
 - Safety and Security
 - Comfort and Convenience

- System Compatibility Factors
 - Land Use Synergies/Activity Centers/Livable Centers
 - Community Values
 - Mobility Equity
 - FTA New Starts

Since the primary goal of the RTFS is to increase the transit mode share of the transportation market, some of the measures contained in the customer choice centric factors should be used as a first screen of testing potential system investments. These contain the most important factors for determining which investments have the greatest potential to attract new riders to the transit system. At the same time it is important to recognize that the H-GAC region is large and diverse and there is not a one-size-fits-all transit solution. The performance standards and indicators also recognize that there are many transit needs in the region and they include factors such as mobility equity and community values to represent this diversity. The performance measure categories and performance standards/factors for each category are described Sections 4.1 through 4.3.

4.1 CUSTOMER CHOICE CENTRIC FACTORS

4.1.1 Ridership

One key factor, ridership, has an integral relationship to all of the customer choice centric factors as well as the Land Use Synergy factor. A high rating among the other customer choice centric factors will attract more riders to the transit system. Rather than including ridership in every customer choice centric factor, ridership is separated out as its own category for each transit scenario investigated.

4.1.2 Flexibility and Speed/Travel Time

The focus groups, market study, and literature review all indicate that speed and travel time are the most important factors to potential riders who are not using the transit system today. Improvements in system performance related to this factor will result in the largest increase in





market share for the transit mode when compared to improvements in other factors. Potential riders typically ask themselves the following questions related to this factor when making their mode choice:

- Can I get there quickly on transit?
- Do I have multiple transit service options?
- Do I have direct transit service with limited stops?
- Does the transit service have any inherent time advantages over other modes? (transit priority, dedicated facilities, etc., or is the service a “premium” type service such as LRT, Express or Airport Express)

The following measures are useful for evaluating the flexibility and speed/travel time factor at the framework study level:

- Percent of trips requiring one or more transfers
- Average wait time for transfer
- Average travel speed (including stops) for the entire system and by mode:
 - Local bus/circulator
 - Express bus/freeway BRT
 - Arterial BRT (if sufficient data are available)
 - LRT
 - Commuter Rail
- Percent of system miles with transit signal priority or preemption
- Percent of system miles of express or “premium” service
- Percent of system miles with dedicated guideway or exclusive lanes

4.1.3 Accessibility/Availability

The more accessible and available transit service is, the faster the overall trip between destinations occurs. However, this factor also is not just related to the frequency and location of the service but also to the basic availability of service at all times. Potential riders may ask themselves the following questions related to this factor when making their mode choice:

- Is the service close to my home?
- Is the service close to my destination (work, school, shopping, recreation, etc..)?
- Is the service frequent?
- Does the service run when I need it?
- Does the service connect uses that are important to me?

Several measures are useful and appropriate for evaluating accessibility and availability at the framework study level:

- Distribution of routes (excluding express bus/freeway BRT) stratified by the percent of weekday span of service found to be:
 - 14 hours or less





- More than 14 but no more than 16 hours
- More than 16 but no more than 18 hours
- More than 18 hours

- Distribution of routes stratified by weekend span of service (same categories)
 - Percent 14 hours or less
 - Percent more than 14 but no more than 16 hours
 - Percent more than 16 but no more than 18 hours
 - Percent more than 18 hours

- Distribution of routes by peak period headway
 - Percent 10 minutes or less
 - Percent 11-20 minutes
 - Percent 21-30 minutes
 - Percent more than 30 minutes

- Distribution of routes by base period headway (same categories)
 - Percent 10 minutes or less
 - Percent 11-20 minutes
 - Percent 21-30 minutes
 - Percent more than 30 minutes

- Vehicle revenue miles of service per resident of H-GAC region
- Miles of express bus/freeway BRT service per employee in regional centers
- Percent of the H-GAC region population residing within one-fourth mile of a local bus or one-half mile of CRT/LRT/BRT/Express route
- Percent of the H-GAC region employment located within one-fourth mile of a local bus or one-half mile of CRT/LRT/BRT/Express route
- Percent of H-GAC region population within 2.5 miles of a park-and-ride

4.1.4 Safety and Security

Safety and security are important factors in people’s choices about using transit. Potential riders may ask themselves the following questions related to this factor when making their mode choice:

- Does the station feel safe?
- Does the vehicle feel safe?
- Do I generally feel safe using the service?
- Is the stop/station area lighted?

These are difficult questions to answer at the framework study level. Safety and security is often correlated to the integration of the corridor into the surrounding land uses, the volume of transit riders in the corridor, and the frequency of the service in the corridor. One way to quantitatively measure safety and security is to determine off-peak ridership for each corridor. A corridor with





higher off-peak ridership generally has a higher level of all day activity that provides users with a higher perception of safety and security. This concept is supported by Crime Prevention Through Environmental Design (CPTED) principles which have been adopted by the City of Houston, TX Police Department, among others. One of the principles included in CPTED is the concept that places with higher levels of activity have fewer criminal incidents. Schlomo Angel, an early pioneer of CPTED, asserts that crime is inversely related to the level of activity on the street and Oscar Newman's work "Defensible Space – Crime Prevention through Urban Design" states that "defensible space should allow people to see and be seen continuously. Ultimately, this diminishes residents fear because they know that a potential offender can easily be observed, identified, and consequently, apprehended. Second, people must be willing to intervene or report crime when it occurs. By increasing the sense of security in settings where people live and work, it encourages people to take control of the areas and assume a role of ownership. When people feel safe in their neighborhood they are more likely to interact with one another and intervene when crime occurs."

The following measures are useful and appropriate for evaluating safety and security at the framework study level:

- Frequency of evening bus service at major passenger facilities
- Proximity of passenger facilities to popular destinations frequented throughout both the day and evening
- Percent of park-and-ride or station/stop locations that are isolated, stand alone facilities
- General level of potential integration of stations and stops into surrounding land uses (high, medium, low)
- Off peak average passenger loads
- Percent of trips requiring one or more transfers

4.1.5 Comfort and Convenience

Comfort and convenience are also more difficult to measure than speed or availability at the framework study level. Potential riders may ask themselves the following questions when making their mode choice:

- Is there a place to sit? (stations and vehicles)
- Are passenger loads excessive?
- Is the vehicle pleasant?
- Is there shade?
- Is there water available?
- Are there station and vehicle amenities available?
- Is the service reliable? (on-time)
- Is the service expensive?
- Are the vehicles and stations attractive?
- Are transfers required?





Potential passengers are very sensitive to transfers. Transfers add to total travel time, raise the possibility of a missed connection, and increase the complexity of the transit trip. According to TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd edition some studies have found that every minute of waiting time due to a transfer is the same as 2.5 minutes of travel time in terms of riders negative perceptions. Furthermore, TCRP Report 100 indicates that “choice” riders may have an even higher negative perception of transfer wait time for non-work based trips. Transfers are clearly perceived very negatively.

The following measures are useful and appropriate for evaluating comfort and convenience at the framework study level:

- Average load factor on express bus/freeway BRT services (1.0 or less is good)
- Percent of sheltered bus stops with seating
- Number of timed transfers available system wide
- Percent of trips requiring one or more transfers
- Percent of peak period transit service with extreme crowding (load factor greater than 2.0)
- Number of shaded spaces at park-and-ride lots
- Percent of passenger hours of travel spent in stopped vehicles
- Percent of system miles with dedicated guideway

4.2 SYSTEM COMPATIBILITY FACTORS

4.2.1 Land Use /Activity Centers/Livable Centers

The transit system interface with surrounding land use is related to ease of use, availability, and potential transit demand, among other variables. This factor is critical to the ultimate success of a transit system and is analyzed separately in the FTA New Starts process. Questions often asked about a potential transit system related to land use synergies include:

- Does the service access higher densities of population and employment?
- Does the service provide connections to and between regional and local activity centers?
- Does the service support existing and planned transit oriented development and Livable Centers?
- Are the service and passenger facilities integrated with land uses?
- Do local policies, land use patterns, and neighborhood designs support transit?
- Does the service positively affect desired patterns of regional growth and development?

The following measures are useful and appropriate for evaluating the Land Use/Activity Centers/Livable Centers factor at the framework study level:

- Adjacent street patterns (grid/suburban)





- Percent of the H-GAC region population residing within one quarter mile of a local bus or one-half mile of CRT/LRT/BRT/Express route
- Percent of the H-GAC region employment located within one quarter mile of a local bus or one-half mile of CRT/LRT/BRT/Express route
- Number of regional and local activity centers served
- Transit and pedestrian supportive plans and policies in place along majority of route

4.2.2 Community Values

Community values are qualitative and this factor is intended to evaluate local support and benefits from transit investments. Important aspects of a potential transit system related to community values include:

- Is the service consistent with community vision and goals?
- Does the service leverage existing and planned community investments?
- Does the service enhance/reinforce economic opportunities?

The following measures are useful and appropriate for evaluating community values at the framework study level:

- Service characteristic compatibility with local plans, community vision, or goals
- Coordination between the planned service and economic development plans of local communities
- Transit investments have the support of all local agencies
- Leverage existing investments (include HOV system, civic facilities, etc.)

4.2.3 Mobility Equity

This factor is intended to address the diversity of the H-GAC region and the many competing transit needs among its urban, suburban, and rural areas. It is important that this study include and value the need for transit service in all areas of the H-GAC region and recognize the vital importance transit plays in the more rural areas of the region to elderly and transit dependent people. Questions related to mobility equity are:

- Are all areas of the region served by transit?
- Does transit serve elderly and environmental justice communities well?
- Are multiple options available to transit dependent riders?
- Is transit available when transit dependent riders need it and does it go where they need to go?
- Does transit improve the quality of life of residents of the H-GAC region?

The following measures are useful and appropriate for evaluating mobility equity at the framework study level:

- Percent of the region served by transit





- Percent of transit dependent population within one-fourth mile of a local bus or one-half mile of CRT/LRT/BRT/Express route
- Route density/route miles per unit area
- Number of medical related activity centers served
- Distribution of routes and DRT (excluding express bus/freeway BRT) stratified by weekday span of service
 - Percent 14 hours or less
 - Percent more than 14 but no more than 16 hours
 - Percent more than 16 but no more than 18 hours
 - Percent more than 18 hours
- Distribution of routes and DRT stratified by weekend span of service (same categories)
 - Percent 14 hours or less
 - Percent more than 14 but no more than 16 hours
 - Percent more than 16 but no more than 18 hours
 - Percent more than 18 hours

4.2.4 New Starts

It is important for the H-GAC region to develop plans for transit investments that will meet legislative requirements, be consistent with statewide and regional policy goals, and that have a higher likelihood of receiving federal dollars to assist with construction costs. The purpose of this factor is to include a high level assessment of consistency and fundability of potential transit investments in the screening process.

Questions we ask about a potential transit system related to New Starts include:

- Is the service consistent with the criteria?
- Is the service likely to score well among funding criteria?
- Does the service meet the program goals?

These same questions are essentially the appropriate measures for this factor. A qualitative assessment of the service scenarios with respect to these measures will be made and included in the screening process.

4.3 Applicability of Standards and Indicators to Activity Centers, Corridors, and Scenarios

The primary purpose of the performance standards and indicators is to act as a higher level screening tool for scenarios and scenario planning. However, some of the factors are also potentially useful when evaluating activity centers or corridors. **Table 5** below shows the potential applicability of each factor to activity centers, corridors, and scenarios.





Table 5: Performance Standard and Indicator Applicability

Category	Standard/Indicator	Applicability		
		Activity Centers	Corridors	Scenarios
Customer Centric Choice Factors				
Ridership	Number of Riders		X	X
Flexibility and Speed/Travel Time	<ul style="list-style-type: none"> • Percent of trips requiring more than one transfer • Average wait time for transfer • Average travel speed (including stops) for the entire system and by mode. • Percent of system miles with transit signal priority or preemption • Percent of system miles of express or "premium" service • Percent of system miles with dedicated guideway or exclusive lanes 			X
Accessibility/Availability	<ul style="list-style-type: none"> • Distribution of routes stratified by weekday span of service • Distribution of routes by base period headway • Vehicle revenue miles of service per resident of Houston/Galveston area • Miles of express service per employee in the regional employment centers • Percent of the Houston region population residing within one-quarter mile of a local bus or one-half mile of Express route • Percent of the Houston region employment located within one-quarter mile of a local bus or one-half mile of Express route • Percent of Houston region population within 2.5 miles of a park-and-Ride 			X
Safety and Security	<ul style="list-style-type: none"> • Frequency of evening bus service at major passenger facilities • Proximity of passenger facilities to popular destinations frequented throughout both the day and evening • Percent of park-and-Ride or station/stop locations that are isolated, stand alone facilities • General level of potential integration of stations and stops into surrounding land uses (High, Medium, Low) • Off peak average passenger loads • Percent of trips requiring more than one transfer 		X	X
Comfort and Convenience	<ul style="list-style-type: none"> • Average load factor on express bus/freeway BRT services (1.0 or less is good) • Percent of sheltered bus stops with seating • Number of timed transfers available system wide • Percent of trips requiring more than one transfer • Percent of peak period local bus and LRT runs with extreme crowding (load factor greater than 2.0) • Number of shaded spaces at park-and-ride lots • Percent of passenger hours of travel spent in stopped vehicles • Percent of system miles with dedicated guideway 		X	X





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Category	Standard/Indicator	Applicability		
		Activity Centers	Corridors	Scenarios
System Compatibility Factors				
Land Use Synergy	<ul style="list-style-type: none"> • Adjacent street patterns (grid/suburban) • Percent of total Houston region population within one-quarter mile of local bus or one-half mile of Express • Percent of total Houston region employment within one-quarter mile of local bus or one-half mile of Express • Number of regional and local activity centers served • Transit and pedestrian-supportive plans and policies in place along majority of route (includes Livable Centers plans) • Consistent with desired patterns of regional growth and development 	X	X	X
Community Values	<ul style="list-style-type: none"> • Service characteristic compatibility with local plans, community vision or goals • Coordination between the planned service and economic development plans of local communities • Transit investments have the support of all local agencies • Leverage existing investments (include HOV system, civic facilities, etc.) 	X	X	X
New Starts	<ul style="list-style-type: none"> • Is the service consistent with the criteria? • Is the service likely to score well? 		X	

Source: H-GAC RTFS Team 2010



4.4 Where Does Cost Fit In?

Cost is not a preliminary screening factor but an attribute of any potential service scenario that should be considered along with the other attributes developed through the screening process. This will allow for useful mixes of service types to be combined in system service scenarios and then screened by applying the performance standards and indicators described in this paper. Once the screening attributes are known, cost will be calculated and provided for each scenario. Upon the development of the transit service scenarios and completion of a comprehensive financial analysis of each, informed decisions referencing regional system performance and cost can be made.

