Travel Demand Management:

A Toolbox of Strategies to Reduce Single-Occupant Vehicle Trips and Increase Alternate Mode Usage in Arizona

Final Report 654
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16. Abstract The report provides a suite of recommended strategies to reduce single-occupant vehicle traffic in the urban areas of Phoenix and Tucson, Arizona, which are presented as a travel demand management toolbox. The toolbox includes supporting research on how to deliver, monitor, and fund implementation of the strategies, and a framework for the development of performance measures to assess their effectiveness. The research effort included studies of travel behavior in Phoenix and Tucson, reviews of best-practice measures nationally, and those in use in Arizona today, and interviews with local and national TDM professionals.		

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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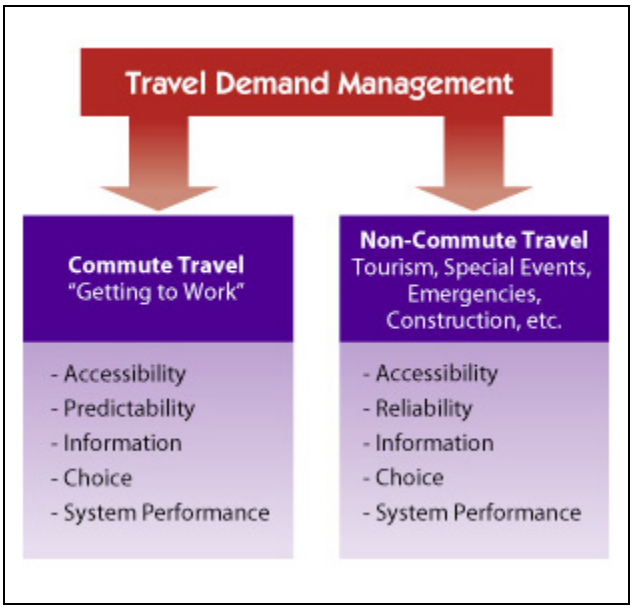
CHAPTER 1. INTRODUCTION

BACKGROUND

Travel demand management (TDM) is a diverse host of actions that are employed to improve the efficiency of the transportation system. These actions modify the demand placed on a transportation system by reducing single-occupancy vehicle (SOV) trips, encouraging off-peak travel, and/or reducing trip time or length.

Traditionally, communities have implemented TDM programs that encourage commuters who normally drive alone to choose higher-occupancy modes or nonmotorized modes. These can be programs that increase the use of transit, carpooling, vanpooling, bicycling, walking, telework, or alternative work schedules. Recently, the Federal Highway Administration (FHWA) broadened the definition of TDM to include the many technological advances that now enable individuals to receive real-time information about the transportation system to help them choose their routes, their travel start times, and their destinations (FHWA 2008). In addition, many communities implement TDM programs for non-commute travel purposes, such as tourism, special events, construction mitigation, and emergencies. This broad definition of TDM for commute and non-commute travel can be diagrammed as shown in Figure 1. TDM helps travelers use the transportation system more efficiently by providing information and a range of modal choices, and making that system more accessible, predictable, and reliable.



(FHWA 2008)

Figure 1. FHWA Definition of Travel Demand Management.

Agencies and organizations that implement TDM do so through incentives, education, and marketing in concert with valued travel services in order to manage congestion and

vehicle miles traveled (VMT). As these strategies encourage travelers to use high-occupancy modes or travel along different routes or at different times, accessibility and mobility are enhanced.

Altogether, TDM comprises three integrated components:

- The first component involves ***providing travel services and options*** that can compete with the automobile for convenience and cost-effectiveness.
- The second component involves ***educating travelers*** on the availability of alternatives. Marketing and other activities promote non-SOV options to those travelers who may not have tried them in the past.
- The third component, ***using pricing*** to manage the demand for services and infrastructure, balances the price of services with demand. Examples of pricing as applied in TDM include parking pricing, tolls, and tiered fares for transit and vanpools.

Successful TDM programs utilize all three components, and are oriented toward reducing vehicular trips by combining various strategies and modal alternatives (Rowell et al. 1997). This research, sponsored by the Arizona Department of Transportation (Arizona DOT), identified specific TDM alternatives:

- **Regional**: Service improvements to transit services, provision of preferential access for high-occupancy vehicle (HOV) users, and application of area-wide cost surcharges or subsidy measures.
- **Employer-based**: Company provision of ride-matching, vanpools, and financial incentives to encourage HOV use, flex-time scheduling, and telecommuting from home.

REPORT PURPOSE AND ORGANIZATION

The purpose of this research was to investigate and recommend a suite of TDM measures to reduce SOV traffic in the urban areas of Phoenix and Tucson, Arizona. The research effort included studies of travel behavior in Phoenix and Tucson, reviews of best-practice measures nationally and those in use in Arizona today, and interviews with local and national TDM professionals.

This research helped refine a suite of recommended strategies for implementation in Phoenix and Tucson, as well as potential application in smaller urban regions across Arizona. These strategies are presented in this report as a TDM Toolbox. The Toolbox contains:

- A detailed review of five categories of TDM strategies, with supporting case studies from around the nation.
- A framework for the development of performance measures to assess the strategies' effectiveness.

- A discussion of the issues surrounding implementation of TDM strategies.

Chapter 2 of the Toolbox describes five categories of TDM strategies:

- Social marketing and individualized marketing.
- Telework.
- Transit subsidies and promotional campaigns.
- Parking management.
- Shuttle and circulator links to regional transit.

The text for each strategy area includes three sections:

- A description of the strategy.
- Case examples and results.
- Potential opportunities for Phoenix and Tucson.

Chapter 3 of the Toolbox describes the use of performance measures to assess the effectiveness of TDM strategies.

Chapter 4 provides a guide to implementing effective TDM programs that are appropriate to the land use and transportation environment where they will be carried out. This chapter assists organizations in selecting TDM strategies, addressing the following topics:

- Challenges to implementing effective TDM programs.
- Integrating TDM into the built environment.
- Funding mechanisms for TDM.
- Evaluating and monitoring the impacts of TDM programs.

Chapter 5 presents the report's conclusions.

An assessment tool to assist in the selection of appropriate TDM strategies for a given land use is provided in Appendix A. Appendix B supplies a glossary of relevant TDM strategies.

CHAPTER 2. TDM STRATEGIES FOR PHOENIX AND TUCSON

Five categories of TDM strategies are recommended for implementation in the Phoenix and Tucson regions:

- Social marketing and individualized marketing.
- Telework.
- Transit subsidies and promotional campaigns.
- Parking management.
- Shuttle and circulator links to regional transit.

The strategies were selected in coordination with this study's Technical Advisory Committee (TAC) members to ensure that they were applicable to the Phoenix and Tucson metropolitan areas.

Each category of TDM strategies presented in this chapter includes three sections:

- A description of the strategy.
- Several case examples of where and how the strategy has been implemented, and the results of the implementation. The case examples were developed by meeting and interviewing representatives of local agencies and TDM providers nationwide.
- Potential opportunities for application in Phoenix and Tucson.

SOCIAL MARKETING AND INDIVIDUALIZED MARKETING

Description

The social marketing process involves identifying the barriers to a behavior, developing and piloting a program to overcome these barriers, implementing the program across a community, and evaluating the effectiveness of the program.

Similarly, individualized marketing takes the principles of social marketing and customizes them to the individual traveler. The approach is simple: give customized information, training, and incentives to people who are open to changing the way they travel. Identifying people who are open to travel by alternative modes is achieved through pre-surveys of the population to determine who uses transportation alternatives currently, who is interested in using them more, and who would not consider ever using them. Typically, most resources of individualized marketing programs are spent on individuals who are interested in—or open to—trying transportation alternatives, but who do not use them currently.

Case Examples and Results

The following projects are featured as case examples of social marketing and individualized marketing:

Social Marketing:

- Drive Less Denver Challenge, Denver, Colorado.
- "Designed to Ride" Campaign, Denver, Colorado.
- SmartCommute Challenge 2008, Triangle Region, North Carolina.
- In Motion Program, Columbia City, Washington.

Individualized Marketing:

- Individualized Marketing Demonstration Program, FTA, various locations.
- Eastside Hub Project, Portland, Oregon.
- Smart Trips Summit-U Program, Summit-University neighborhood, St. Paul, Minnesota.

Drive Less Denver Challenge, Denver, Colorado

In this program, sponsored by the Downtown Denver Partnership in May 2006 and May 2007, interested participants took the challenge of not driving for an entire month. To keep momentum strong, mini-challenges were sponsored all month long and participants were rewarded with hundreds of dollars in prizes and incentives, from weekend hotel stays to amusement park tickets and restaurant gift certificates. Participants also received a wealth of free incentives, including transit passes, bike gear, books, gift certificates, and a messenger travel bag.

The Drive Less Denver Challenge engaged 120 participants, who traveled over 45,000 miles using alternatives to driving alone during the challenge period. A follow-up survey of 2007 participants revealed that 67 to 75 percent of participants planned to increase their use of transportation alternatives to get to work (67 percent), to run errands (75 percent), or for social trips (72 percent). In addition, 10 percent of participants said it was extremely likely that they would sell one of their cars due to their participation in the challenge. The challenge was broadcast on local news stations and local radio programs, as well as featured in a live, nationally televised interview on MSNBC. The reduction in vehicle miles traveled (VMT) and number of trips as a result of the challenge are summarized in Tables 1 and 2 (UrbanTrans Consultants 2007a).

Table 1. Drive Less Denver Challenge:
Impact on Vehicle Miles Traveled by Mode.

	2006 Challenge			2007 Challenge		
	VMT			VMT		
Mode	**Campaign**	**Baseline**	**Change**	**Campaign**	**Baseline**	**Change**
Drive Alone	7,960	10,577	-2,617	398	4,705	-4,307
Bike	585	538	48	2,909	1,092	1,817
Bus/Light Rail	3,526	1,155	2,371	8,587	6,809	1,778
Carpool	15,468	9,721	5,747	11,368	5,453	5,915
Walk	1,016	255	761	1,071	401	670
Telework/Other	29	9	20	584	0	584

(UrbanTrans Consultants 2007a, page 20)

Table 2. Drive Less Denver Challenge:
Impact on Number of Trips by Mode.

	2006 Challenge			2007 Challenge		
	Trips			Trips		
Mode	**Campaign**	**Baseline**	**Change**	**Campaign**	**Baseline**	**Change**
Drive Alone	269	492	-233	54	558	-504
Bike	203	94	109	438	170	268
Bus/Light Rail	285	105	180	506	288	218
Carpool	419	337	82	512	264	248
Walk	406	114	292	471	151	320
Telework/Other	29	9	20	33	15	18

(UrbanTrans Consultants 2007a, page 20)

Two levels of participation were associated with the Drive Less Denver Challenge: the Gold Level and the Silver Level. The Gold Level participants pledged to leave their car home for every trip for the entire month of May and received a full transit pass, messenger bag, and high-dollar-value incentives (raffle for hotel stays, etc.). Silver Level participants committed to using transportation alternatives at least three days per week and received a few transit passes and fewer incentives. In 2006, Gold Level participants reduced their drive-alone mode share from 43 percent to 17 percent, while their 2007 peers achieved a more dramatic decrease from 39 percent to 3 percent. Silver Level participants reduced their drive-alone mode share for work trips from 45 percent to 18 percent. The follow-up survey of 2006 participants indicated that nine out of 10 participants can be expected to continue to make fewer drive-alone trips a full year after participating in the program.

"Designed to Ride" Campaign, Denver, Colorado

Transportation Solutions, a transportation management association (TMA) in the southeast portion of Denver, Colorado, targeted "transit by choice" riders with a program

to increase ridership and improve the transit experience in a southeast section of the city. With the approval of the transit provider, the TMA adopted a strategy akin to a rebranding of the bus service in this affluent part of Denver served by nine transit routes. The program began in 2007 with an inventory of over 60 bus stops in the project area.

The inventory revealed:

- Bus stop signage was either incorrect or inconsistent.
- Many bus stops lacked appropriate amenities and information.
- The basic task of locating the stops was difficult, as stops often blended into the landscape.

By conducting a survey and several focus groups, Transportation Solutions uncovered the local opinion on current bus stops as well as proposed changes. The survey and focus group efforts revealed:

- Current bus stops were “invisible” and “hard to read/understand.”
- New bus stops should be unique in color, shape, and/or other visual aspects.
- Maps and route information provided at bus stops must be easy to understand (this was noted as the most important amenity to improve).
- Comfort and convenience of the stops should be improved.

Transportation Solutions hired an artist and design firm to create vibrant new bus stop elements such as colorful signage and enhanced route maps and schedules (Figure 2).

Figure 2. Designed to Ride Bus Stop, Denver, Colorado.

Survey instruments were used before and after the project to gauge the impact of the efforts. Results clearly demonstrated the direct influence of the project on improved perceptions of bus transportation in the area (UrbanTrans Consultants 2007b). Ridership increased by 7 percent on the routes surveyed (increasing from 1091 to 1167). Transportation Solutions also estimated a corresponding VMT reduction of 507,400 annually (based on the assumption of daily ridership and an average trip length of 12.4 miles). Other highlights from the survey include:

- A 17 percent increase in the response "I know which bus routes to take to work/school."
- A 19 percent increase in the response "Bus stops in Cherry Creek provide the information I need to ride the bus."
- A 26 percent increase in the response "Bus stops in Cherry Creek are attractive."
- A 19 percent increase in the response "I feel safe waiting at bus stops."
- A 12 percent increase in the response "People like me ride the bus."

SmartCommute Challenge 2008, Triangle Region, North Carolina

The Triangle Region of North Carolina has annually offered residents in Durham, Raleigh, Chapel Hill, and the surrounding suburbs an incentive to ride transit as part of a larger regional SmartCommute Challenge. The results summarized in this report are from the 2008 SmartCommute Challenge. Any commuter or college student who took part in the SmartCommute Challenge pledged to use a transportation alternative at least once between April 15 and May 30, 2008. Based on what transportation mode they pledged to use, participants received bike maps, walking kits, carpool match information, or a one-day free regional bus pass. The bus pass could be used for a full day of travel on Capital Area Transit (CAT), Cary Transit, Durham Area Transit Authority (DATA), Triangle Transit, Chapel Hill Transit, and the North Carolina State University buses.
The 2008 challenge received 12,210 pledges. Based on these pledges and follow-up surveys, the following results were documented (SmartCommute Challenge 2009):

- A 19.5 percent increase in transit use during April 2008 and a 7.8 percent in May 2008.
- SmartCommute Challenge participants utilized transit, carpools, telework, and biking or walking to collectively reduce VMT that would have otherwise been driven in single-occupant vehicles by 1,899,225 miles.

In Motion Program, Columbia City, Washington

King County Metro (the county transit agency) targeted three neighborhoods within its service area for a social marketing pilot project. This project utilized incentives, direct mail, posters, focus groups, events, design, and the distribution of new branding and marketing materials to promote transit. To assess the program's effectiveness, Metro conducted before and after surveys of participants and conducted bus ridership counts.

The cost of the program was $250,000, distributed across all three neighborhoods. The following annualized results of the program were observed by comparing the before and after surveys:

- 2564 trips shifted from cars to alternative modes.
- Reduction of 31,522 VMT.

Individualized Marketing Demonstration Program, FTA, Various Locations

The Federal Transit Administration (FTA) sponsored a pilot program in four cities nationwide, with each target area consisting of 400 households. This Individualized Marketing Demonstration Program (IMDP) covered all modes of travel, and focused on motivation techniques such as direct contact via mail, telephone, and door hangers. Participants completed before and after surveys, as well as travel diaries. The total cost of the pilot program across the four areas was $1,000,000. As a result of the pilot program, the four participating cities observed changes in travel behavior that are displayed in Table 3 (MELE Associates 2006).

Table 3. Impact of Individualized Marketing Demonstration Program.

Mode	Bellingham	Sacramento	Cleveland	Durham
Walking	+8%	+15%	+13%	+15%
Cycling	+13%	+30%	+33%	+25%
Public transit	+14%	+43%	+26%	+35%
Car as driver	-8%	-2%	-4%	-7%
Car as passenger	+10%	+1%	+5%	+7%

Eastside Hub Project, Portland, Oregon

The city of Portland, Oregon, used individualized marketing and outreach efforts on a target group of 50,000 people. The $398,000 program included direct contact by mail, Internet, and door hangers, as well as before and after participant surveys. As a result of the city's efforts, participants reported the following travel changes:

- A 7 percent increase in walking.
- A 23 percent increase in bicycling.
- A 41 percent increase in public transit use.
- No change in carpooling.
- A 9 percent reduction in drive-alone trips.

Smart Trips Summit-U Program, Summit-University Neighborhood, St. Paul, Minnesota

The Smart Trips Summit-U Program was an individualized marketing program that targeted the Summit University neighborhood in St. Paul, Minnesota, in the summer of 2008. Program components included newsletters, delivery of informational materials ("Smart Trip kits") via bike, and organized bike rides, walks, and classes. The initial newsletter was sent to 7100 neighborhood households; 8.6 percent of these households ordered a total of 612 Smart Trip kits. A survey of participants after the program concluded revealed:

- A 33 percent increase in biking and walking trips.
- A reduction of approximately 2,289,000 VMT per year.
- A reduction in greenhouse gas emissions of 990 metric tons per year.

Potential Opportunities for Phoenix and Tucson

Phoenix opened its first light rail line in December 2008, and Tucson began construction on a streetcar line in 2011. As a means of attracting people to these systems, marketing campaigns could target neighborhoods surrounding the rail lines with information on hours of service, service frequency, parking, connecting transit, transit pass purchase options, etc. Station area maps could be designed and distributed to all locations within a quarter-mile of each station to alert potential riders to destinations that are accessible by transit and minimal additional walking distances.

Phoenix and Tucson could also:

- Market bus transit to teen and elderly populations through the distribution of information at community centers, retirement communities, high schools, recreation centers, and libraries.
- Market services to commuters, such as express buses, in neighborhoods within three miles of major park-and-ride lots.
- Market ridesharing opportunities to neighborhoods not well served by transit and where park-and-ride lot capacity is minimal.
- Market transit to residents who are not proficient speakers of English through partnerships with English as a Second Language programs at schools, workplaces, and community colleges.

While individualized marketing campaigns can target any of the above-mentioned groups, they may also be used to promote new transit programs or services such as:

- New transit lines.
- New transit pass or fare programs.
- New park-and-ride lots.

- New ridesharing programs.
- New services such as an improved website or real-time email alerts from the 511 traveler information service.

Individualized marketing can also focus on neighborhoods that fit the demographic profile of likely transit riders, but show lower-than-average ridership. If a transit agency desires to make a route more productive through an individualized marketing program, a first step could be to survey the targeted area to identify the number of residents and employees who may be willing to try transit and who therefore may be interested in enrolling in these programs. Marketing to an interested population enables an individualized marketing program to focus its resources on a group with the highest potential for changed travel behavior.

TELEWORK

Description

Telework is a work arrangement program whereby employees work at a location other than the conventional office, usually from home or a remote office close to home such as a telework center. Telework can be a strong component of an overall congestion management strategy given that it is the most effective method of fully removing commute trips from the roadway system while simultaneously reducing parking demand. Often telework programs allow employees to work at home on an occasional or part-time basis, typically once per week. Telework programs can also set a goal for the number of hours an employee may spend teleworking, such as 10 percent of the employee's total monthly work hours.

Case Examples and Results

The case studies featured in this section include:

- State of Arizona, Telework Arizona Program.
- U.S. Patent and Trademark Office, Trademark Work-at-Home Program.
- State of Georgia, Work Away Program.
- Georgia Power, Telework Program.
- Sun Microsystems, iWork Program.

State of Arizona, Telework Arizona Program

Telework Arizona is a telework program operated by the Arizona Department of Administration with coordinators in participating state agencies. The program is focused on Arizona state employees in Maricopa County, which encompasses the Phoenix metropolitan area. The program began in the fall of 1989 as a pilot program with the state of Arizona and AT&T. An evaluation of the program revealed that more than 75 percent of supervisors approved of the program and appreciated the resulting increases in

employee productivity and morale. As a result of the pilot, the Arizona governor issued Executive Order 93-16 in 1993 to create the State of Arizona Telework Program and authorize every state agency to implement telework programs in Maricopa County. Since that time, the program has evolved into a key strategy for reducing congestion and improving air quality.

In 2002, the governor strengthened the state's commitment by requiring 20 percent of the state workforce in Maricopa County to actively telework. By 2007, state agencies, boards, and commissions reported that more than 20 percent of state employees in Maricopa County telework. Telework Arizona estimates that these workers saved 5,250,000 miles of vehicle travel and 181,000 hours of personal commute time in 2008 (State of Arizona Telework Program 2011).

U.S. Patent and Trademark Office (USPTO), Trademark Work-at-Home Program

In 1996, USPTO initiated the Trademark Work-at-Home Program, which began with 18 patent examiners as participants. Today, USPTO's telework program is fully operational, with 46 percent of its more than 9000 nationwide employees teleworking at least weekly. Eligible employees are encouraged to conduct a self-assessment to determine if teleworking is feasible for them. Ineligible positions include those that require face-to-face interaction with the public. USPTO conducts annual job assessments to determine changes in position eligibility status, which varies by business unit.

Survey results of employees show 46 percent of 9000 employees telework at least once per week, eliminating 4140 people making at least two weekly trips. This represents an annualized trip reduction of at least 430,560 one-way trips.

To estimate VMT savings from this reduction in trips, a review of research conducted by the National Environmental Policy Institute found that the average round-trip commute distance for teleworkers is 36.1 miles, and that on the days they telework they saved an average of 26.3 miles (Best Workplaces for Commuters 2005). Applying the average measure of 26.3 miles to the annual trip reduction of 215,280 round-trip trips (or 430,560 one-way trips), the USPTO telework policy is responsible for an estimated annual VMT savings of 5,661,864 miles.

State of Georgia, Work Away Program

What initially began as a six-month pilot project with four agencies has grown into a mandate encouraging all state agencies and departments to implement telework initiatives. The initial stages of implementation included pre- and post-pilot surveys, management training, and monthly reporting. While in its initial phase, a Telework Advisory Committee was formed to guide the program's development and implementation; the committee consisted of a cross-section of representatives of various agencies, the Georgia Law Department, and local environmental groups.

Five percent of Georgia's 80,000 state employees participate in the Work Away telework program. If those 4000 employees telework at least once a week, 416,000 trips are saved per year. Using the average round-trip commute distance savings of 26.3 miles for teleworkers used in the USPTO case example above (Best Workplaces for Commuters 2005), this equates to an estimated VMT savings of 5,470,400 miles annually.

Georgia Power, Telework Program

A total of 8800 employees work for Georgia Power, and 475 telework once or more per week. Georgia Power first allowed its employees to telework in 1993, and formally adopted teleworking policies in 2004. Georgia Power also developed a comprehensive telework manual that provides guidelines on every aspect of telework, from selection of personnel to termination of the arrangement. Georgia Power has a remote-access infrastructure in place and strict guidelines on the security and safety of its data and information. For example, if a teleworker introduces a virus into the workplace three times, that employee's remote-access capability is permanently disabled. The company hosted several two-hour training sessions to familiarize teleworkers and their managers with these policies and guidelines (Georgia Clean Air Campaign and Downtown TMA 2005).

Prior to teleworking, 70 percent of the participants drove alone; after teleworking, the drive-alone rate dropped to 44 percent, with 28 percent of the change attributed to teleworking. Georgia Power reported that this equates to an annual VMT reduction of 2,596,350 miles, an annual reduction of 3.2 tons of volatile organic compounds (VOC), and an annual reduction of 2.7 tons of nitrogen oxides (NO_x) (Georgia Clean Air Campaign and Downtown TMA 2005).

Teleworkers also reported an increase in productivity. Eighty percent of teleworkers reported that productivity increased an average of 27 percent while teleworking. Forty percent of managers believed productivity had increased by 5 percent as a direct result of teleworking, while 60 percent of managers thought that productivity had stayed the same.

Sun Microsystems, iWork Program

Nearly 15,000 Sun Microsystems employees participate in Sun's iWork program, which enables employees to work from home, from drop-in centers, or at different campuses throughout the country. Employees at Sun's major campuses around the country also receive transit subsidies or prepaid transit passes to encourage and facilitate the use of public transit. In addition, Sun operates a large transit shuttle program in the San Francisco Bay Area, with six vehicles operating seven shuttle routes each workday. In the first eight months of 2005, the number of employees riding shuttles rose by 15 percent, from 7700 employees to 8700. Sun also distributes information about commuter benefits and other regional commute programs via email and the SMART (Sun Microsystems Alternative Resources for Transportation) internal commute program website. Sun's comprehensive Commute Benefit program has resulted in fewer commute trips being

made by Sun employees, less air pollution, reduced stress, and lower commuting costs (Best Workplaces for Commuters 2007).

Assuming that 15,000 employees participate in the iWork program and telework at least once per week, an estimated 1,560,000 one-way trips (780,000 round trips) are saved per year. Using the average round-trip commute savings of 26.3 miles for teleworkers used in the USPTO case example above (Best Workplaces for Commuters 2005), this equates to a VMT savings of 20,514,000 miles annually.

Potential Opportunities for Phoenix and Tucson

Telework is robust in Arizona, particularly among state employees working in Maricopa County and participating in the Telework Arizona program. Valley Metro, the Phoenix public transit system, also provides technical assistance on teleworking to other entities in Maricopa County.

Using their collective knowledge of how to implement successful telework programs, regional and state partners could continue to identify the characteristics of organizations and settings where telework programs are successful. Valley Metro is a valuable resource for public and private organizations seeking to acquire information on how to establish and maintain telework programs for their employees.

TRANSIT SUBSIDIES AND PROMOTIONAL CAMPAIGNS

Description

To encourage more people to ride public transit, some transit agencies have created discounted pass programs and promotional campaigns to recruit new riders. By offering programs where companies can subsidize their employees' transit use through the provision of reduced-price transit passes, agencies hope that the reduced cost of riding transit for these employees will outweigh other barriers to using transit (e.g., increased travel time) and result in higher ridership. To encourage transit ridership among the general public, some transit agencies implement promotional campaigns and offer a set number of transit trips, or transit service during certain times, at free or reduced rates.

Case Examples and Results

Case examples featured in this section include:

- Neighborhood Transit Passes, Boulder, Colorado.
- "Five Free Rides" Program, Utah Transit Authority, Salt Lake City, Utah.
- "Shop Tops, Ride Home for Free" Program, Greater Cleveland Regional Transit Authority, Cleveland, Ohio.
- National surveys of employer transit programs by the Transit Cooperative Research Program.

Neighborhood Transit Passes, Boulder, Colorado

In November 2000, residents of Boulder's Forest Glen neighborhood voted to form a General Improvement District (GID) to levy an assessment on all residential property to create the revenue necessary to pay for transit passes for all neighborhood residents. Today, all Forest Glen residents, including homeowners and renters, are eligible to receive a Regional Transportation District (RTD) Eco Pass. The RTD Eco Pass allows unlimited riding on all RTD buses, light rail service to Denver International Airport, and Eldora Mountain Resort buses.

At the time of this writing, no information is available on this program's ridership results.

"Five Free Rides" Program, Utah Transit Authority (UTA), Salt Lake City, Utah

During the summer of 2001, the UTA introduced a "Five Free Rides" promotion to encourage people to try UTA's bus service, particularly during the summer months when ridership tends to decrease. The campaign was launched with television, radio, and newspaper advertising inviting people to request the five free passes. The free rides were valid on all forms of transit, including bus and rail.

The Five Free Rides promotion ran through August 2001 and targeted 550,000 households within the Salt Lake City metropolitan area. By the end of 2001, bus ridership had increased 2.61 percent over 2000 ridership totals, and overall system ridership had increased 1.8 percent, or by approximately 574,300 transit trips (UTA 2003).

"Shop Tops, Ride Home for Free" Program, Greater Cleveland Regional Transit Authority (GCRTA), Cleveland, Ohio

In July 2001, GCRTA and a grocery store chain, Tops Friendly Markets, partnered to implement the "Shop Tops, Ride Home for Free" program. Together they sponsored a three-month promotion to offer a free ride home via a GCRTA Community Circulator to customers who bought at least $15 in groceries at Tops Friendly Markets. The promotion was considered successful enough to be converted into an ongoing program.

GCRTA Community Circulators generally ran from 7 a.m. to 7 p.m. Monday through Saturday, and served Tops stores every 20 to 30 minutes. In part because of this promotion, as well as other marketing efforts, ridership rose 1.5 percent from 2002 to 2003 and 5.5 percent in the last six months of 2003. During the first four months of 2004, ridership rose 4.5 percent (GCRTA 2005).

National Surveys of Employer Transit Programs by the Transit Cooperative Research Program

Research conducted in 2005 by the Transit Cooperative Research Program compared the results of employer transit pass programs launched by seven major transit agencies

throughout the United States. The systems were selected to represent varying system sizes and transit mode offerings. Overall, the research concluded that ridership increased as a result of the launch of employer transit pass programs, and that after implementation pass holders composed a substantial part of total ridership (from 5 to 25 percent, depending on the program). In addition, the analysts found that the transit pass programs also generally increased transit revenues. The results are provided in more detail in Tables 4 and 5 (ICF Consulting and CUTR 2005).

Table 4. Revenue Impacts of Employee Transit Pass Programs.

Transit Agency	Program Name	Annual Revenue (millions)	% of Revenue from Program	Agency's Perception of Impact on Revenues
Washington Metropolitan Area Transit Authority (WMATA)	Metrochek	$177.0	30%	Increase
	Smart Benefits	$13.8		
	Total	$190.8	30%	
Metropolitan Atlanta Rapid Transit Authority (MARTA)	Partnership Program	$20.0	11% (est.)	Increase
King County Metro	Flex Pass	$6-$7	8-10%	Increase
	UPass and GoPass	$10.7	14%	
	Retail programs	$9-$12	13-17%	
	Voucher programs	$6.7	N/A	
	Total	$25.7-$29.7	35-41%	
Regional Transportation District (RTD), Boulder, Colorado	Eco Pass	$8.1	17%	Unclear
Metro Transit (Minneapolis/St. Paul, Minnesota)	Metropass	$15.1	25%	Neutral
	TransitWorks!	$10.0	17% (est.)	
	Total	$25.1	42% (est.)	
Santa Clara Valley Transportation Authority (VTA)	EcoPass	$1.7	5%	Neutral
Valley Metro	Bus Card Plus	$3.6	N/A	Increase

(ICF Consulting and CUTR 2005, page 68)

Table 5. Participation in Employee Transit Pass Programs.

Transit Agency	Program Name	Number of Participating Employees	% of All Riders Using Employer Passes
WMATA	Metrochek	189,067	N/A
	Smart Benefits	18,933	N/A
	Total	208,000	25%
MARTA	Partnership Program	30,700	<10%
King County Metro	Flex Pass	38,000-40,000 (est.)	6 to 8%
	UPass and GoPass	48,600	<10%
	Retail programs	10,000-14,000 (est.)	3%
	Voucher programs	N/A	N/A
	Total	95,000-103,000	20 to 22%
RTD	Eco Pass	52,700 (est.)	12 to 21%
Metro Transit	Metropass	15,000	7%
	TransitWorks!	12,000	5% (est.)
	Total	27,000	12% (est.)
VTA	Eco Pass	42,800 (est.)	5%
Valley Metro	Bus Card Plus	12,189	11%
	Private Outlet	12,000 (est.)	11%
	Total	Over 24,000	22%

(ICF Consulting and CUTR 2005, page 65)

In 2005, the Transit Cooperative Research Program conducted a second and more comprehensive survey of 22 transit systems that had implemented transit passes. The intent of this survey was to learn the effects of these programs on employee commute behavior. Although the results varied widely, ridership increases were reported on most systems following the establishment of the new transit pass programs. More than half of the agencies surveyed reported an increase in transit riders of between 10 and 40 percent, and nearly one-quarter reported increases of more than 60 percent. Two surveys, one in San Jose in 1997 and one in Atlanta in 2003, suggest that transit ridership more than doubled after a transit benefits program was implemented.

In contrast, the data sets from areas affected by state Commute Trip Reduction (CTR) legislation—Washington state, Southern California, and Pima County, Arizona—indicate very small changes in transit ridership on average, with a very slight decline in Tucson (Pima County, Arizona), and increases of only 3 percent in Southern California and 6 percent in Washington (ICF Consulting and CUTR 2005). Such legislation typically requires larger employers to promote SOV commuting alternatives, including transit.

While there is no data to explain the difference in transit ridership in CTR program areas, researchers offered the theory that ridership increases appeared largest in systems with comparatively low transit ridership prior to the legislation's implementation. Therefore,

systems in mandatory CTR areas, which have higher transit ridership in comparison with their local surroundings, showed lower percentage increases due to the pass programs. Transit mode shares increased by nearly 2 to 17 percentage points on average. In other words, a work site with 100 employees that offers a transit benefit might expect the equivalent of 2 to 17 employees to switch to riding transit full-time. The data sets from the mandatory CTR program areas, however, reported on average less than one new transit rider per 100 employees (ICF Consulting and CUTR 2005). Researchers also felt that ridership decreases such as those in Pima County could have been due to differences in program administration and reporting at different work sites, survey administration issues, or external factors such as changes in the economy and employment levels.

Potential Opportunities for Phoenix and Tucson

Because Phoenix and Tucson have larger-than-average populations of retired citizens, either of the local transit agencies could consider a partnership with local grocery stores similar to the "Shop Tops, Ride Home for Free" example, in order to target greater transit ridership among senior populations who may have relatively low incomes and/or no longer own or operate a private vehicle.

Similarly, transit agencies could consider marketing a program similar to "Five Free Rides" to residential areas within three miles of major or underutilized park-and-ride lots. As a larger promotion, "try transit" campaigns could be effective in capturing a greater share of secondary school students, university students, and teachers. In these campaigns, bilingual communication should be considered, given each metropolitan area's diversity.

Because Phoenix and Tucson have historically been areas of rapid and large population growth, the transit agencies in both regions might also consider promotions targeting new residents. Promotional programs could be marketed, in particular, to new residents of apartments or condominium communities adjacent to light rail or bus lines.

PARKING MANAGEMENT

Description

Commuters can also be influenced to change their mode of travel through parking-related programs or regulation of parking pricing. This section presents two sets of parking management concepts. The first features "parking cash-out" programs where employees agree to exchange their employer-paid parking space for a transportation allowance paid by the employer to offset the costs of using transportation alternatives. The second set of case studies is from cities that have engaged in active parking management by setting vehicle occupancy requirements for parking spaces, varying the parking price by time of day or day of week, and utilizing technology to provide commuters with real-time parking occupancy information and, in some cases, reserved parking spaces.

Case Examples and Results

The case examples featured in this section include:

Parking Cash Out:

- California parking cash-out pilot projects, various employers.
- King County, Washington, parking cash-out pilot projects, various employers.

Parking Management:

- Downtown Development Authority, Ann Arbor, Michigan.
- Lloyd District, Portland, Oregon.
- City of Aspen, Colorado.
- BART Station Parking Reservation Project, Oakland, California.

California Parking Cash-Out Pilot Projects, Various Employers

In 1992 California enacted legislation requiring many employers who subsidize commuter parking to offer parking "cash-out" programs, in which employees receive a transportation allowance in lieu of a parking space (California Code 2010). A 1997 study of eight California employers found that parking cash-out programs decreased the number of SOV trips per employee per day by 13 percent (Shoup 1997).

The eight employers included in the study were an accounting firm, a bank, a government agency, a managed-care medical provider, a video post-production company, and three law firms. These employers ranged in size between 120 and 300 employees, combining for a total of 1694 employees. Two of the employers were located in downtown Los Angeles, three were in Century City (a high-density regional center in West Los Angeles), two were in Santa Monica, and one in West Hollywood. The 1997 price of parking at the work sites ranged from $36 to $165 a month (Shoup 1997).

Benefits of the cash-out programs studied included greater use of alternate modes of travel among program participants and reduced carbon dioxide emissions. The number of carpoolers increased by 64 percent, the number of transit riders increased by 50 percent, and walking and bicycling combined increased by 39 percent. VMT for commuting to the eight firms fell by 12 percent. Carbon dioxide emissions from commuting fell by 367 kilograms per employee per year, and the benefit/cost ratio of the eight cash-out programs was at least four-to-one. The results of the study by work site are presented in Table 6.

Table 6. Results of Parking Cash-Out Programs in California.

Case/Location	Solo Drive Share (percent change)	Vehicle Trips per Employee per Day (percent change)	VMT per Employee per Year (percent change)
Downtown L.A.	-22%	-24%	-24%
Downtown L.A.	-16%	-16%	-16%
Century City	-13%	-9%	-11%
Century City	-12%	-9%	-9%
Century City	-12%	-5%	-5%
Santa Monica	-8%	-5%	-5%
Santa Monica	-7%	-9%	-9%
West Hollywood	-3%	-5%	N/A
Weighted Average	**-13%**	**-11%**	**-12%**

(Shoup 1997, page 204)

King County, Washington, Parking Cash-Out Pilot Projects, Various Employers

The Marketing Development Division of King County, located in the Seattle region of Washington, surveyed seven employers between September and December 1994 to measure the effectiveness of charging for parking at employers located on suburban campuses. The employers selected were among the 500 affected by the Commute Trip Reduction legislation that in 1995 applied a goal for employers with over 100 employees to reduce their workers' SOV trip rate to 15 percent below the 1993 rate (King County 1995). The case studies include the following:

- In 1993, Cellular One began charging employees $50 per month for covered parking and $30 per month for uncovered parking as a means of encouraging alternate modes of travel in order to meet the requirements of the CTR law. The parking fee was determined based on local and peer parking rates, and adjusted to a level that the employee transportation coordinator believed was "still reasonable." The new parking charges were deducted from each employee's paycheck. Management also offered free parking for carpools and vanpools, ride-match services, and transit and vanpool subsidies of $57.50 per month.

  During the first year after the program was implemented, the number of carpools operating among Cellular One's 321 employees rose from two to 25. Before the parking program was implemented, the SOV mode share was 74 percent. Within two years of the program's implementation, the SOV trip rate had dropped to 71 percent.

- In 1989, the City of Bellevue, Washington, imposed a parking fee on its employees as a means of deterring SOV trip growth and as an alternative to supplying additional parking at its downtown office location. To determine the fee, the city surveyed employers in downtown Bellevue, took the average of the rates charged

for parking, and charged that rate to city employees. No incentives were introduced with the fee, but the city had introduced a ridesharing program the previous year that included free parking to carpoolers; a $15 monthly subsidy to carpoolers, bicyclists, walkers, and drop-offs; fully subsidized bus passes; and vanpools subsidized to $39.50 per month. Five years after implementing the parking fee, the employee SOV trip rate dropped from 65 percent to 56 percent.

- In 1994, as a means of decreasing SOV trip rates to meet the 1995 CTR goal, the Olin Aerospace Corporation implemented a $5 per month parking fee. The amount was set arbitrarily, but with the intent of discouraging SOV travel without overburdening employees at the lowest wage rate. Management directed the employee transportation coordinator to create any transportation program of his choosing, as long as the program did not incur additional costs or change the work week. The parking fee met both requirements, and in lieu of an incentive package, the fee was waived for employees who found alternate means to driving alone to work a minimum of eight times per month. After the fee's implementation, the employee drive-alone rate dropped from 90 to 67 percent.

- In 1991, the Sverdrup Corporation relocated its offices to a new suburban building that charged for parking. Management decided to pass the parking expense onto the firm's 120 employees given that parking rates were low compared with downtown rates ($35 per month for covered parking, and $20 per month for uncovered parking). The company implemented the parking fee within a transportation management program that also included free carpool parking, a subsidy for carpools and vanpools, transit pass subsidies, bicycle parking, and company fleet vehicles for emergencies. Following these actions, SOV travel rates dropped from 90 percent in 1991 to 70 percent in 1993.

Downtown Development Authority, Ann Arbor, Michigan

In 1992, the city of Ann Arbor gave control of its seven parking structures to a newly created Downtown Development Authority (DDA). This quasi-public agency agreed to finance a $40 million garage repair and replacement program, using funds from a tax increment financing district. Since the creation of DDA, the agency successfully revitalized the garages; passed a new parking plan; helped implement a universal transit pass program (participating employers pay $5 for annual, unlimited-ride bus passes for their employees); helped implement a fare-free circulator bus service between the University of Michigan and downtown with over 800 riders per day; and launched the getDowntown program, which promotes multimodal commuting to downtown jobs (Brown and Fields 2008).

While DDA's intention was that parking should pay for itself, the agency also used parking revenues to support the TDM programs active within the district. District parking management practices included:

- No minimum parking space requirements for individual land uses downtown.

- Reliance of nearly all downtown trip generators on a consolidated inventory of shared public parking.
- Control of all public off-street parking facilities by the DDA or the University of Michigan–Ann Arbor.

On June 11, 2007, the DDA's programming expanded when the City Council approved recommendations for a downtown parking policy. The recommendations included:

- Create a parking benefit district pilot program in a section of downtown where the concept was well-received; the program included setting meter rates based on availability targets and returning revenue to local improvements.
- Implement commuter express bus service.
- Initiate valet parking services.
- Modify pricing strategies by replacing fixed monthly permits with permit program for occasional parking.

Lloyd District, Portland, Oregon

The Lloyd District is a mixed-use neighborhood northeast of downtown Portland, Oregon. In addition to commercial office space, the area accommodates a variety of uses that include restaurants, shops, hotels, condominiums, and apartments. In the past two decades, the district has supported over 1.3 million square feet of new public and private development and has seen the commercial office vacancy rate drop from 12 percent to 3 percent.

In the early 1990s, the Lloyd District partnered with the city of Portland and TriMet, the area's public transportation provider, to develop transit improvements and incentives paired with a parking management program to encourage new commercial development in the district. These improvements and incentives included:

- Development of transit-oriented development guidelines.
- Establishment of a new direct bus route connecting homes with destinations in the Lloyd District.
- Establishment of the Lloyd District Passport Program, an annual employee transit pass program.
- Revenue sharing of transit pass sales.
- Restrictions on future development of surface parking lots.
- Restrictions on parking near the MAX light rail station and development of transit-oriented guidelines.
- Elimination of free on-street parking, installation of parking meters, and development of a parking meter revenue sharing plan.

In part due to these measures, land used for parking has decreased from 3.5 spaces per 1,000 square feet to 1.95 per 1,000 square feet. This has resulted in an estimated savings of over $35 million in parking development costs (estimated based on a construction cost of $25,000 per space in the Lloyd District) (Wilbur Smith Associates 2007).

In addition, the district has quantified the impact of the measures described in terms of use of transit by district employees. Before the measures were implemented, the transit mode share by office employees was 8 percent. By 2000, the drive-alone commute share had dropped to 56 percent (Bianco 2000).

City of Aspen, Colorado

The city of Aspen, Colorado, maintains several parking policies to maximize the efficiency of the city's transportation system, including a "Pay and Display Parking System" for on-street parking, free parking for carpoolers, park-and-ride lots, and residential parking permits. The city has created a larger and better-managed supply of on-street parking, discouraged spillover employee parking in residential areas, and improved the aesthetics of the streetscape. After removing parking meters and parking stall markings, the city installed single "pay stations" on each block where customers can pay by coin or credit, debit, or smart card.

BART Station Parking Reservation Project, Oakland, California

A parking reservation concept was tested from December 2004 to April 2006 at the Rockridge station of the Bay Area Rapid Transit (BART) system in Oakland, California. The smart parking concept utilized several technologies that were new at the time, including changeable message signs located on the highway that displayed real-time parking availability information for motorists; a wireless counting system in the station parking lot to provide data for these updates; and parking reservations facilitated through the Internet and an interactive voice response system (Shaheen and Kemmerer 2007).

The results of a survey conducted on the project showed that 30 percent of respondents indicated that the program encouraged them to use BART instead of driving alone to their typical place of work. Furthermore, the program attracted a new user population to BART. Forty-nine percent of survey respondents did not use BART to commute to work before the reservation program, but were encouraged to use BART more often because they were assured a parking space at the station (Shaheen and Kemmerer 2007).

Potential Opportunities for Phoenix and Tucson

Downtown Phoenix, Scottsdale, and Tucson, as well as university and community college campus areas, are the areas with the greatest potential to establish successful parking cash-out programs. In addition, several suburban employers in Chandler, Mesa, Glendale, Scottsdale, and Tucson could initiate a pilot program of charging for parking, even just once per week or one week per month. Implementing a charge for parking or a parking cash-out program may be more effectively marketed if treated more as a parking

"district" (covered in more detail in the next section) where the funds are used for employee benefits such as shaded outdoor lunch or recreation areas, subsidized gym passes, or bike lockers, or as a donation to charity.

The case examples also show that parking management programs are most successful in areas with significant attractions, which tend to have high parking demand and turnover. In addition, areas that can centralize control over parking supply through a parking district can manage demand and implement TDM programs more effectively. Parking districts may work well in and around new rail corridors, and candidate locations might include:

- Downtown Phoenix, Old Town and downtown Scottsdale, or Glendale.
- Downtown Tucson and St. Philips Plaza.
- Major shopping malls, with proceeds invested in shaded walkways and transit shelters.

SHUTTLE AND CIRCULATOR LINKS TO REGIONAL TRANSIT

Description

As a means of better linking potential passengers with a regional transit system, some transit agencies offer shuttle circulators that serve residential areas, activity centers, or downtown locations. These often-free routes connect neighborhoods with activity centers and transit hubs, thereby extending the geographic reach of fixed-route bus and high-capacity transit systems. They also provide additional mobility within downtown or activity centers to support commuters' midday travel needs, making it more feasible for them to use transit on their commute. The case studies featured in this section include shuttle feasibility studies, as well as currently operating shuttles, both in downtown and in residential areas:

- Boulder Community Transit, Boulder, Colorado.
- Broward County Circulators, Broward County, Florida.
- Miami Beach Electrowave, Miami, Florida.
- LINK, Ann Arbor, Michigan.
- Chattanooga Electric Bus, Chattanooga, Tennessee.
- Downtown Circulators, Tampa, Florida.
- Coral Gables Circulators, Miami, Florida.
- Lynx Lymmo, Orlando, Florida.
- BART Shuttle Feasibility Surveys (2005 and 2006).

Case Examples and Results

Boulder Community Transit, Boulder, Colorado

In 1989 the city of Boulder, Colorado, initiated a demonstration transit service with a fleet of small, colorfully designed buses that provided high-frequency, inexpensive, and direct service within the city (City of Boulder 2010). Today, six bus routes operate in the Community Transit Network, which is funded by the city of Boulder, Boulder County, the University of Colorado, and the Regional Transportation District (RTD). Each route has a unique identity and amenities shaped by community input and direction. In 1990, transit ridership averaged 5,000 riders daily for all local and regional routes. In 2002, ridership reached a daily average of about 26,000, representing a 500 percent increase.

The community transit network concept used in Boulder offers many potential benefits:

- Provides a convenient transit alternative to SOV travel.
- Uses neighborhood-scaled vehicles to fit the context of the community.
- Strengthens the local economy by providing easy access around Boulder and to and from surrounding communities.
- Provides wheelchair-accessible transportation.
- Alleviates traffic congestion.
- Reduces the need for roadway expansion.
- Provides reliable, high-frequency service.
- Promotes a positive transit image with attractive vehicles and ongoing marketing support.
- Accepts Eco Passes (transit passes for students and residents of certain neighborhoods).
- Provides bike racks on buses to allow for integration of travel.

Broward County Circulators, Broward County, Florida

Broward County, Florida, initiated a number of residential shuttle circulators with the intent of increasing mobility and decreasing the need for more expensive door-to-door paratransit services. Cities offering the service are expected to maintain ridership levels of at least five passengers per hour in order to receive county funding. A 2004 inventory of the residential shuttles found that the eight local circulator systems reviewed carried an average of 14.2 passengers per hour with an average cost per passenger on the local circulators of $2.18. Paratransit costs approximately $17 per passenger (Chavarria and Volinski 2004). More detail on the performance of the circulators is provided in Table 7.

Table 7. Local Demographics and Characteristics of Circulators in Broward County, Florida.

City	Population Density (Persons per square mile)	Household Median Income	Owner HH without car	Renter HH without car	Service Frequency	Fare	Pass. per Hour	# of Connecting Routes
Dania Beach	3,272	$32,043	5.4%	19.6%	40 min	Free	7.05	7
Cooper City	3,317	$69,995	2.1%	8.3%	60 min	Free	5.48	4
Coral Springs	5,548	$52,946	3.9%	11.5%	60 min	Free	12.38	6
Lauderdale Manors	6,542	$29,417	8.0%	32.9%	60 min	Free	16.0	2
Margate	5,773	$45,697	8.0%	12.7%	60 min	$0.25	11.54	9
Plantation	4,920	$45,272	7.0%	12.0%	45 min	Free	6.47	13
Miramar	4,434	$44,786	6.8%	12.4%	60 min	$0.25	7.2	8
Lauderhill	8,179	$32,070	15.0%	20.0%	45 min	Free	22.0	13

(Chavarria and Volinski 2004, page 52)

The study found that demographic factors such as population density (shown in Table 7 as persons per square mile), car ownership, and median household income highly correlate with transit use at the local circulator level, as they do with regional transit service. However, the study also found that while seniors and other typical paratransit riders travel on the circulator shuttles, the shuttles are also used by teens, students, and commuters.

Miami Beach Electrowave, Miami, Florida

In the late 1990s the Miami Beach Transportation Management Association (MBTMA) instituted a circulator service in the South Beach area, operating seven electrically powered vehicles. South Beach had been experiencing parking shortages, air pollution, and difficulty connecting low-income residents with the local service economy. Compared with Miami-Dade Transit's existing fleet of large diesel buses, the new vehicles offered clean operation and a small maneuverable size more appropriate for the pedestrian environment in South Beach. A funding partnership to support the new circulator service raised $3.5 million for capital and operating expenses in its first year. The partnership was composed of MBTMA, the city of Miami Beach, Florida DOT, Florida Power and Light, the Florida Alliance for Clean Technologies, the Clean Cities Coalition, the Florida Department of Environmental Protection, and the International Council for Local Environmental Initiatives. The service operated on headways of 10 to 15 minutes, 18 to 20 hours per day, 365 days per year, and charged a fare of $0.25. In 1998, the "Electrowave" was used by over 1 million passengers during its first 35 weeks of operation.

Miami-Dade County agreed to take over responsibility for the service, and it is now called the "SoBe Local."

LINK, Ann Arbor, Michigan

In September 2003, LINK shuttle service began connecting Ann Arbor's four main retail areas: Main Street, State Street, Kerrytown, and South University. The route traveled within one block of all major parking facilities, and was designed to increase connections to other municipal and university shuttle routes. By 2004 daily ridership averaged 625, and ridership grew to 800 by 2005. In late 2005, LINK service was combined with one of the university shuttle routes in order to take advantage of different funding streams. The funding package, which replaced an expired federal grant, comprised state revenue, municipal bus advertising revenue, university funds, and Downtown Development Authority funds (see the Parking Management section of this chapter for more information about the DDA) (Perk et al. 2005).

Chattanooga Electric Bus, Chattanooga, Tennessee

In 1984, the city of Chattanooga launched the revitalization of its downtown through the Vision 2000 project. At the time, the major downtown corridor extended for two miles, parking lots were at capacity, and more than 65 percent of the land in the downtown area was used for vehicle parking. City planners conceptualized a new downtown transportation plan, and collaborated with the Chattanooga Area Regional Transportation Authority (CARTA) to design a downtown circulator system.

Because the effective transportation of visitors, employees, and commuters was such a prominent goal in the plan, the new shuttle service had to be frequent and free of charge. In addition, city planners wanted the design and operation of the vehicle to be environmentally friendly. When it was determined that no manufacturer of electric buses could meet their needs, project leaders facilitated the creation of Advanced Vehicle Systems, Inc., with the purpose of building electric shuttle buses for CARTA and other transit operators worldwide. Concurrently, CARTA and other partners created the Electric Transit Vehicle Institute, a nonprofit organization charged with promoting the design, production, and utilization of battery-powered electric buses (Perk et al. 2005).

In 1992, CARTA placed the first electric shuttle into service in the downtown corridor, planning to support its operational costs with revenue from the parking garages. By 1993, six vehicles were running on five-minute service headways, and the fleet size has since grown to 23.

Downtown Circulators, Tampa, Florida

Downtown Tampa is populated by a government center, a major sports arena, office developments, an arts center, the county's convention center, and a number of hotels. It is also within a half-mile of another business center on Harbor Island and new residential development that surrounds it. Circulator services were first considered in the mid-1990s as an amenity to help attract conventions and meetings to the city. The service became a higher priority when the automated people-mover service between downtown and Harbor

Island was terminated. Ultimately, a rubber-tired trolley service composed of two routes—Route 96 and Route 98—was implemented.

Ridership has fluctuated since the service's inception (see Table 8) and decreased by 20 percent in 2003 when the service transitioned from being free to charging $0.50 per ride.

Table 8. Downtown Tampa Circulator Performance Measures.

Year	Route 96 Ridership	Route 96 Passengers per Hour of Operation
2000	141,931	15.8
2001	201,953	22.4
2002	136,499	14.9
2003	90,537	7.5
2004	129,193	10.7
2005	110,281	10.8

(Perk et al. 2005, page 47)

Coral Gables Circulator, Miami, Florida

The city of Coral Gables is located four miles west of downtown Miami and four miles south of the Miami airport. More than 175 multinational corporations, as well as the University of Miami, are located in the city. During a typical workday, the city's employee population exceeds 7000. The Coral Gables Circulator serves these employees and other travelers along its route on Ponce de Leon Boulevard. Over 6.5 million square feet of office space are within walking distance of the route.

The circulator service took several years to develop from conception to launch. In 2001, the local MPO funded a planning effort to study how a circulator could serve the growing employee population by connecting workers to Metrorail service (running every 6 minutes during peak hours) and local bus routes (running every 15 to 30 minutes). Miami-Dade County then purchased five new buses to dedicate to the service, and in 2002 voters approved the People's Transportation Plan, a half-cent general sales tax to fund public transportation. Finally, a grant from Florida DOT completed the funding necessary to begin service in November 2003.

By the end of the first six months of service, ridership had grown to 2000 passengers per day, with service headways every 10 minutes (this was double the initial demand estimates). By the end of the first 10 months, service was every six minutes and ridership averaged 2500 passengers per day (30 passengers per hour). When school opened in August 2005, ridership exceeded an average of 3000 passengers a day. By the end of September 2005, the Coral Gables circulator was attracting over 4000 passengers per day (almost 50 passengers per hour), well above the regional system average of 35 passengers per hour (Perk et al. 2005).

Lynx Lymmo, Orlando, Florida

The Lynx Lymmo serves employment centers, government centers, shopping, restaurants, and parking garages in Orlando, Florida. The service targets commuters who drive into downtown, park, and then need to access multiple downtown destinations. With headways of five minutes, the Lymmo carries 50 passengers per hour. The annual operation costs are approximately $1.2 million (Chavarria and Volinski 2004).

BART Shuttle Feasibility Surveys (2005 and 2006)

The BART system in San Francisco conducted surveys in 2005 and 2006 to determine the feasibility of new shuttle service areas to attract more riders to the BART system. Similar research may be helpful to communities around the Phoenix light rail line and the Tucson streetcar line.

In 2005, analysts from the Center for Urban Transportation Research (CUTR) surveyed 800 BART passengers who accessed the system at urban and suburban stations. The purposes of the study were to determine the market potential of a rail feeder shuttle and the extent to which it could increase the BART system's capture area, and to analyze the factors that affect a rider's willingness to use shuttle service, such as cost, schedule, and accessibility. The motivation for the study was the growing concern that BART was losing potential riders due to a lack of suburban accessibility created by parking constraints and a lack of alternate means of access to suburban stations. Responses were compared for urban and suburban commuters, and also summarized by demographic categories (age, racial background, etc.).

Overall, 20 percent of respondents to the 2005 survey indicated they would be "very willing" to use a shuttle that would take them round-trip to and from BART stations; 40 percent indicated they would be "not at all willing." The analysts also found that regardless of location, there is "significant interest in using rail feeder shuttles, as long as they have acceptable fares, wait times, trip lengths, and scheduling times." Willingness to wait and willingness to pay for shuttle service varied widely among age and income categories. However, suburban commuters were willing both to wait longer and to pay more for a rail feeder shuttle than were urban commuters. The survey also found that "three mode choice groups, in particular, show promise as target groups: noncommuting SOV users, noncommuting transit users in urban areas, and rail users who access stations by transit in urban areas. In terms of socioeconomics, women, younger, and elderly people also show promise" (Anspacher et al. 2005).

In 2006, another survey was conducted around a BART system suburban station (the Castro Valley station). The survey asked 400 respondents to characterize their willingness to use a smart shuttle, their willingness to pay for a smart shuttle, and what additional services or attributes could entice them to use a smart shuttle instead of their own car (a smart shuttle was described as an on-demand service with real-time locators that could notify potential passengers of arrival and departure times to enable them to better plan their trip).

Survey results showed that of the 400 respondents, 72 percent accessed the BART station by driving alone, 3 percent carpooled, and 17 percent walked. Eighty percent said that parking was free, 13 percent reported paying for parking themselves, 5 percent said their company pays for parking and 2 percent shared parking costs with their company. Approximately 40 percent of the participants expressed a high likelihood that they would use the shuttle service. They also said they would be more likely to use BART if a shuttle service were available, estimating that they would use BART eight or more times a month because of the shuttle service (Yim and Ceder 2006). When asked about the characteristics of the service, respondents reported that the three most important service qualities are, in order:

- Cost.
- Overall travel time (including wait time).
- Reliability.

Respondents indicated that they expected no more than four to five stops per shuttle ride (between their pickup point and the station), and about 10 riders per shuttle. The study found that interest was higher among women, minorities, and zero-car households than among other segments of the population.

Potential Opportunities for Phoenix and Tucson

Phoenix and Tucson operate residential, downtown, and activity center shuttles. However, as park-and-ride and station area parking capacities diminish, or in residential areas where transit use is lower than expected given residents' demographics and travel patterns, transit agencies in both cities might consider developing additional services. As shown by the BART surveys, shuttles help connect off-peak and other nonwork trips to the regional transit system. Candidate locations in the Phoenix and Tucson areas for additional shuttles may include:

- Park-and-ride reliever or connector service at heavily used park-and-ride lots.
- End-of-line connections to major activity centers.
- Connections from the new rail lines to other major transit or activity centers.

Since many bus routes have been revised to serve the new rail stations, it may only be necessary to "rebrand" or market the local buses to increase passenger awareness of their function.

SUMMARY OF TDM BENEFITS

The benefits detailed for each TDM program in this chapter are summarized in Tables 9 through 13.

Absent from the summary is a calculation of the cost-effectiveness of the various TDM programs, which could aid agencies in assessing the value of various strategies and in developing programs that deliver strong results. However, the inconsistency in the type of available data renders a reliable determination of cost-effectiveness and an "apples-to-apples" comparison among programs impossible. Following Table 13 is a description of performance measures and methods, including those that address cost-effectiveness, that could be applied to TDM programs.

Several important points to consider when comparing TDM programs include:

- **Goals and objectives.** The intent of TDM programs can be to increase awareness of options, increase ridership, reduce parking, reduce congestion, and many other objectives. Each TDM program serves a different purpose. For example, parking cash-out programs are site-specific and are intended to reduce parking demand. In contrast, many of the transit strategies are applied regionally and are intended to boost bus ridership.
- **Different markets.** Each TDM program is applied in a different market, with considerable differences in the types of travelers served by the program.
- **The modes of transportation available in each market are also very different.** The modes available to people and the constraints of using these modes (e.g., the convenience and time cost of using transit) vary from region to region.
- **Positive aspects of TDM programs are not necessarily captured by traditional measures.** Because a central purpose of many TDM programs is to raise awareness of transportation alternatives to a wide audience, it is difficult to capture all the VMT and trip reduction benefits associated with larger marketing programs.
- **Lasting impacts of TDM programs.** While some programs are likely to be more effective than others, TDM has inspired change in the travel habits of participants.

Table 9. Estimated Costs and Benefits of Selected Social Marketing and Individualized Marketing Programs.

Program	Cost	Benefit			
		Number of Trips Reduced	Percentage Reduction in SOV Traffic	VMT Reduced	Ridership Increase (Transit Strategies Only)
Drive Less Denver, 2006	$110,000	223 trips (May 2006; 30 participants)	25% average decrease in SOV use by participants	2,617 mi (May)	n/a
Drive Less Denver, 2007	$110,000	504 trips (May 2007; 75 participants)	39% average decrease in SOV use by participants	4,307 mi (May)	n/a
Designed to Ride	$108,000	n/a	n/a	5,073,990 mi (annual; estimate)	76 new riders
SmartCommute Challenge, 2008	$103,000	n/a	n/a	1,899,225 mi during challenge period	19.5% in April 2008; 7.8% in May 2008
In Motion Program	$250,000	2,564 trips	n/a	31,522 mi	n/a
FTA Demonstration Program	~$250,000 per city (4 cities selected within $1M pilot program)	n/a	2% to 8%	n/a	n/a
Eastside Hub Project	$398,000	n/a	8.6%	n/a	n/a
Smart Trips Summit-U Program	$134,000	n/a	n/a	2,289,000 mi	n/a

Table 10. Estimated Costs and Benefits of Selected Telework Programs.

Program	Cost	Benefit			
		Number of Trips Reduced	Employee Participation Rate	VMT Reduced	Ridership Increase (Transit Strategies Only)
Telework Arizona	No cost	n/a	20% of employees (4,300 people) participate	5,250,000 mi saved annually	n/a
U.S. Patent and Trademark Office	Cost data not available.	430,560 trips	46% of employees (4,140 people) telework at least once per week	5,661,864 mi saved annually (estimate)	n/a
State of Georgia "Work Away" Program		*IF* the employees telework at least once per week, 416,000 trips saved annually.	5% of employees (4,000 people) participate	*IF* the employees telework at least once per week, 5,470,400 mi saved annually.	n/a
Georgia Power		n/a	5% of employees (475 people) telework once per week	2,596,350 mi saved annually	n/a
Sun Microsystems		*IF* the employees telework at least once per week, 1,560,000 trips saved annually.	15,000 employees participate	*IF* the employees telework at least once per week, 20,514,000 mi saved annually.	n/a

Table 11. Estimated Costs and Benefits of Selected Transit Subsidy Programs and Promotional Campaigns.

Program	Cost	Benefit			
		Number of Trips Reduced	Percent Reduction in SOV Traffic	Vehicle-Miles of Travel (VMT) Reduced	Ridership Increase (Transit Strategies Only)
Five Free Rides (Salt Lake City, Utah)	$1,004,500	n/a	n/a	n/a	System ridership increased by 1.8% (574,300 trips)
Shop Tops, Ride Home for Free (Cleveland, OH)	Cost data not available	n/a	n/a	n/a	Annual ridership increased system-wide 4.5%, in part due to program
National Survey	Cost data not available	n/a	n/a	n/a	Fare elasticity is between -0.34 and -0.44 (for every dollar increase in price, ridership decreases between 34%-44%)

Table 12. Estimated Costs and Benefits of Selected Parking Management Programs.

Program	Cost	Benefit			
		Number of Trips Reduced	Percent Reduction in SOV Traffic	Percent Vehicle-Miles of Travel (VMT) Reduced	Ridership Increase (Transit Strategies Only)
California cash-out examples	$22,000 ($100 per employee enrolled in program; 220 employees enrolled)	22,960 trips reduced for month period	13%	12%	n/a
Cellular One	$2,530 monthly, $30,360 annually (calculated using a cash-out average of $57.50/employee/mo)	50 people participate in cash out program (25 carpools with an average of 2 occupants). 12,000 trips reduced/year	3%	n/a	n/a
City of Bellevue	$11,929 monthly, $143,148 annually (calculated using a cash-out average $39.50/employee/mo)	302 people participate in cash-out program (151 carpools with an average occupancy of 2 occupants) 72,480 trips reduced/year	9%	n/a	n/a

Table 12. Estimated Costs and Benefits of Selected Parking Management Programs. *(continued)*

Program	Cost	Benefit			
		Number of Trips Reduced	Percent Reduction in SOV Traffic	Vehicle-Miles of Travel (VMT) Reduced	Ridership Increase (Transit Strategies Only)
Olin Aerospace	No cost. Olin began a $5/day charge and did not offer transportation subsidy in return.	n/a	23%	n/a	n/a
Sverdrup Corporation	$390 monthly, $4,680 annually (calculated using a cash-out average of $15/employee/mo)	n/a	20%	n/a	n/a

Table 13. Estimated Costs and Benefits of Selected Shuttle and Circulator Programs.

Program	Cost	Benefit			
		Number of Trips Reduced	Percent Reduction in SOV Traffic	Vehicle-Miles of Travel (VMT) Reduced	Ridership Increase (Transit Strategies Only)
Miami Beach Electrowave	Operating and capital cost: $8,750 per day (calculated based on $3.50/passenger cost)	n/a	n/a	n/a	126 passengers per hour (2,500 riders per day, 20-hour service day)
Broward County Shuttles (8 shuttle systems combined)	Operating cost only: $370.60 per day (calculated based on $2.18/passenger cost)	n/a	n/a	n/a	14.2 passengers per hour (170 riders per day, 12-hour service day)
Lynx Lymmo, Orlando, FL	Operating and capital cost: $2,624 per day (calculated based on $3.28/passenger cost)	n/a	n/a	n/a	50 passengers per hour (800 riders per day, 16-hour service day)

CHAPTER 3. TDM PERFORMANCE MEASURES

This chapter defines performance measures and methods that could be applied to the TDM programs described in Chapter 2:

- Social marketing and individualized marketing.
- Telework.
- Transit subsidies and promotional campaigns.
- Parking management.
- Shuttle and circulator links to regional transit.

The basic performance measurement tools for any of these programs are *mode split* and *vehicle counts*. Mode split represents the percentage of travelers who use each type of transportation mode and is typically compiled from participant surveys. Vehicle counts are usually monitored at a key entrance or exit point for the area under analysis. These two tools complement each other in that mode split documents the extent to which transportation alternatives are being used compared with driving alone, while vehicle counts can be performed before and after a TDM program is implemented to determine the actual number of vehicles removed from traffic.

With mode split and vehicle count information, the following variables could be calculated for any of the TDM programs listed above (Schreffler 2000):

- **Vehicle trip reduction:** The number or percentage of automobiles *removed* from traffic. To determine the number of trips removed, vehicle trip counts must be taken before and after a TDM program is implemented.
- **VMT reduced:** The number of trips reduced multiplied by the average trip length.

These two indicators are the typical performance measures collected to demonstrate the impact of a TDM program. However, to better understand the impact of a TDM program, other variables can be considered as well. These variables include:

- **Energy and emission reductions:** Calculated by multiplying VMT reductions by average vehicle energy consumption and emission rates.
- **Cost-effectiveness:** Calculated by dividing program costs by a unit of change. For example, the cost-effectiveness of various TDM programs could be compared based on cost per trip reduced and/or in tons of emitted air pollutants eliminated.
- **Number of parking spaces reduced:** A count of the number of parking spaces reduced as a result of a TDM program.
    - **Note:** Trip reduction and parking space reduction are not synonymous. Physical parking spaces can be used by multiple users in a 24-hour period, particularly if shared parking is permitted at a mixed-use development. Therefore, one trip reduced does not equal one parking space reduced.

Ideally, parking occupancy counts can show the real parking space reductions realized by a TDM program. If a site has flexibility in leasing parking for residents or employees, TDM programs can lead to significant long-term parking cost savings. This is an important additional factor in determining cost-effectiveness.

- **Awareness:** Number of potential users who are now aware of a program or service as a result of a TDM program.
- **Participation:** Number of people who responded to an outreach effort or request to participate in a program.

These performance measures are a sample of the quantification transportation organizations may employ to demonstrate the impact of a TDM program. For example, a cost-effectiveness analysis can be augmented by an analysis of the air quality benefits, local economic development benefits, mobility enhancements, and reduction in personal vehicle costs (gas, parking, maintenance, etc.) that may also be attributed to a TDM program. Each program's performance measures will be unique to the information required by the funding agency, the goals of the community, and the monitoring required by the agency.

PERFORMANCE MEASUREMENT BASICS

To assess the performance of any TDM program, a few basic strategies should be followed. These are summarized below.

- **Define the baseline.** Before any TDM program is implemented or augmented, a baseline should be defined to understand the travel patterns of the population *before* the program was implemented. Without this important piece of information, an objective determination of the impact of the TDM program is unlikely. An accurate baseline is needed to reliably attribute behavior change caused by implementation of the TDM program.
- **Define a control group.** Ideally, a project assessment would identify and survey a control group before and after the TDM program was implemented. This would help clarify the true impacts of the TDM program versus other external factors that affect travel behavior (gas prices, time of year variations, etc.).
- **Craft measurement tools that are repeatable before and after.** Measuring the population with the same or nearly the same tools before and after the TDM program is implemented is an important performance measurement basic. For example, if a vehicle count is the tool used to monitor the impact of a TDM program, a vehicle count would also need to be taken before the program started.
- **Measure the *community* benefits of the TDM program.** The performance of some TDM programs could be monitored based on benefits to the community in addition to vehicle trips and miles reduced. These benefits could include tons of pollutants saved, calories burned by walking or biking, or the number of trips to

local retail and services via foot, bicycle, or bus if a TDM program was launched in support of economic development.

PERFORMANCE MEASUREMENT ALTERNATIVES

Since surveys and vehicle counts can be expensive to implement, many TDM program professionals have sought alternative methods to track vehicle trips and miles reduced. These options include:

- **Online trip-tracking tools.** Such tools require individual user accounts through which participants in a program record their travel behavior and, particularly, the times at which they use transportation alternatives. These tools are especially appropriate for carpool programs, vanpool programs, incentive campaigns, and individualized marketing programs to help track participation.
- **Workweek scheduling.** The reductions in average vehicle trips and miles of travel can be calculated from the amount of time employees spend teleworking or working alternative schedules, such as compressed work weeks.
- **Transit pass use.** For TDM programs with transit incentives, the use of transit passes can be tracked with "smart card" technologies. More and more transit agencies are developing such technologies to track the use of their services more effectively. Typically, individual passes are scanned upon entry into a transit vehicle, and the fare for the journey is subtracted from the balance remaining on the card (or eventually billed to the rider). At a minimum, this information could provide TDM program administrators with a count of the number and timing of transit trips. In many cases, these would represent vehicle trips reduced, especially for commuting employees.
- **Decreases in parking permit sales.** In a situation where parking permits are sold or distributed periodically to employees (e.g., a large medical campus with a monthly permit program), simply tracking the number of permits sold and distributed before and after the implementation of a TDM program is a basic measure of trip reduction. However, an important component of this approach is a method to track occasional parking by employees who use transportation alternatives, since most will not be able to forego driving altogether. This may be accomplished through the smart-card technologies that most modern parking programs integrate into employee identification badges to track parking use.

CHAPTER 4. IMPLEMENTING EFFECTIVE TDM PROGRAMS

CHALLENGES TO IMPLEMENTING EFFECTIVE TDM PROGRAMS

Implementing effective TDM programs such as those described in this report entails the integration of TDM elements into planning practice, as well as infrastructure investments. This section details the challenges in implementing effective TDM programs in Phoenix and Tucson and recommends policy and planning tools to address these issues.

The findings of this research are best applied to communities in the Phoenix and Tucson regions that desire to make an area that is *currently* automobile-dominated more conducive in the *future* to walking, bicycling, and using transit. Communities most likely to fulfill this vision are those that carefully develop a mix of uses and appropriate land-use densities, invest in physical transportation infrastructure, and develop TDM programs and services. Investing in TDM programs and services is a critical component in changing travel habits in an area that has primarily served the single-occupant vehicle, even if planning decisions will change the built environment significantly over the long term.

Government Roles and Responsibilities

Local governments and employers, the state of Arizona, and the federal government all have roles and responsibilities in supporting the integration of TDM into the planning and development of new neighborhoods, employment centers, and commercial districts. Local government has the largest role to play by integrating TDM review into planning, policy, and development review processes. The success of TDM also relies, to some extent, on the commitment of developers, employers, and community leaders who see the potential benefits to business and the community of attracting more people to non-SOV transportation alternatives. Finally, implementation of effective TDM programs also benefits from financial support from state and federal agencies responsible for funding transportation programs.

Specific Challenges to Implementing TDM in Phoenix and Tucson

The challenges involved in implementing effective TDM programs in Phoenix and Tucson are policy-driven, as well as implementation-driven. These challenges are summarized
below.

- Developing a “business approach” to marketing TDM to employers by conveying the financial benefits of implementing TDM programs that:
    - Improve employee retention.
    - Provide affordable transportation options to employees.
    - Use land for the highest and best purpose instead of surface parking.

    - Ease congestion around the business site.
    - Develop a practical, measurable commitment to sustainability.

- Implementing programs that respond to the specific needs of Phoenix and Tucson travelers.
- Securing long-term funding to support marketing of alternative transportation and TDM programs.
- Securing long-term funding to support financial incentives that encourage SOV drivers to try alternative transportation.
- Monitoring and evaluating the impact of TDM strategies on trip reduction and traffic congestion.

Addressing these challenges in the long term can include integrating TDM planning and practice into broader planning efforts in communities (e.g., comprehensive land use and transportation plans) and development review policies and procedures, as well as securing buy-in from the local business community to fund TDM programs in the long term. Often, the most overlooked challenge is the planning of the transportation system, including how to incorporate TDM programs and how to implement programs that can sustain themselves over a long time frame.

Considering these challenges, this section details the following recommendations and examples for implementing effective TDM programs in the Phoenix and Tucson urban areas:

- Integrating TDM into planning for new developments, and appropriately matching TDM programs and services to existing built environments.
- Financing TDM programs for the long term.
- Developing methods to monitor and evaluate the impact of TDM programs.

INTEGRATING TDM INTO THE BUILT ENVIRONMENT

While the built environments of Phoenix and Tucson make it challenging to use transportation alternatives at many work sites, a variety of programs and strategies are available and appropriate for many different land uses. This section details the general parameters to be considered when implementing TDM strategies in different land use and transportation environments. The heart of the section focuses on a decision matrix through which TDM program recommendations can be developed for a particular land use and transportation environment.

The first step in this process is to analyze the current and/or future land uses of the site in question. This assessment will help determine the TDM programs and strategies that are appropriate for a particular built environment. The assessment consists of four steps:

1. A **land-use assessment**, including a review within a half-mile of the center of the existing or planned development, of:
    a. Land-use mix.
    b. Density.
    c. Pedestrian accessibility.

2. A **transit service assessment** that determines the type of transit service within walking distance of the site as well as its frequency.
3. The recommendation of **a set of TDM strategies** for the site considering the land-use and transit service assessments.
4. Estimation of the **potential peak-hour SOV trip reduction** expressed as a percentage from a calculated baseline of trips for a given land-use type.

It is only *after* progressing through the first three steps that a vehicle trip reduction percentage factor is chosen as a fourth and final step.

Each of the steps in the TDM review process is outlined in more detail below.

Step 1: Land-Use Assessment

The land-use assessment consists of three components. These components are a mix of uses, density, and pedestrian accessibility. Within each of these three components is a series of questions that indicate whether a site has a "high" or "low" potential for impact of TDM programs on vehicle trip reduction.

Note that a "low" ranking in these categories does not imply that TDM programs should not be implemented in these areas. On the contrary, this ranking indicates that these environments do not lend themselves naturally toward the use of those transportation alternatives, and the active management of alternatives through TDM is critical. However, one should not expect the same level of vehicle trip reduction in these environments compared with those with a higher degree of land-use density and mixing.

Importantly, the peer-reviewed research examined to develop the land-use assessment showed that density has the most significant influence on the use of transportation alternatives when compared with land-use mix or pedestrian accessibility (Cervero and Kockelman 1997; Dunphy and Fisher 1996; Ewing and Cervero 2001). Therefore, the density threshold described next must be exceeded to achieve a "high" ranking from the land-use assessment.

While adequate density is required for any site to receive a high ranking, only *one* of the other two components must have all questions answered affirmatively (land-use mix or pedestrian accessibility). This allows for flexibility in assessing how a specific existing or new development's built environment will influence travel behavior, but still requires a site to fulfill more than the density component to achieve a high ranking. However, note that all *three* components should always be considered.

To facilitate the decision-making process associated with each of the three components below, the questions associated with each component have been summarized on printable forms in Appendix A for use by local agencies and organizations.

Land-Use Mix

The series of questions required to determine whether the land-use mix in and around an existing or proposed development warrants a "high" ranking include:

1. Are residential uses present within a half-mile radius of the development?
2. Is at least 100,000 square feet of office or commercial space available within a half-mile radius of the development?
3. Is a grocery or supermarket retail store present within a quarter-mile radius of the development? (This question is not required for commercial-only developments.)
4. Are eight or more "other" uses present beside grocery/supermarket?
    - **Note:** These eight uses should be neighborhood, small-scale uses accessible by foot, such as schools, restaurants, cafes, clothing stores, post offices, banks, dry cleaners, fast food restaurants, and bookstores. Retail stores greater than 50,000 square feet with large off-street surface parking are not considered part of this category unless they are constructed immediately adjacent to the development, or the project itself is a redevelopment of a large regional shopping center complex.

The four questions must all be answered affirmatively to receive a "high" ranking for the land-use mix component of the land-use assessment. It is important to identify not only that an adequate quantity of other residential and commercial uses are present near the site, but also that existing convenience retail and other uses are within walking distance.

Again, the rank of "high" or "low" for this category simply indicates what types of TDM programs or strategies could complement this built environment from a land-use mix perspective. A "low" score does *not* indicate that no TDM programs should be implemented.

Density

This component of the land-use assessment is composed of three questions:

1. Are there at least 15 housing units per acre?
2. Is the population density greater than or equal to at least 30 people per residential acre?
3. Are there at least 50 workers per commercial acre?

Any *one* of these questions must be answered affirmatively for an existing or proposed development to receive a score of "high" on the density component of the land-use

assessment. The flexibility in requiring only one question is important for this component because various types of sites and new projects are good candidates for different TDM programs and services. Some areas may only contain or be planned for residential uses (with no major commercial uses planned), others only commercial (with no residential planned), and still others a mix of both. By requiring a project to affirmatively answer only one of the questions above, this tool allows flexibility in making TDM program decisions for a wide variety of land-use environments.

Pedestrian Accessibility

This component of the land-use assessment contains a series of questions focused on the pedestrian-level transportation infrastructure in and around an existing or proposed development. Of the three components of the land-use assessment, this is the most sensitive to determining how well the average person driving alone will be likely to use transportation alternatives for the first time. For example, if a potential user cannot easily and safely access transit service by walking in a given built environment, other alternatives such as vanpooling, carpooling, or telework could be established.

To receive a "high" pedestrian accessibility score, an existing site or proposed development must meet criteria for conditions within a quarter-mile of the center of the development. A high score is achieved through affirmative answers to these questions:

1. Are paved sidewalks at least four feet wide located on both sides of all streets?
2. Is lighting adequate to provide visibility along sidewalks?
3. Is the terrain flat (less than 5 percent slope)?
4. Along roadways with two or more lanes in each direction and speed limits in excess of 30 miles per hour, are median buffers provided between the curb and the sidewalk? (Median buffers are any feature that separates vehicles from pedestrians. Examples include sidewalks wider than four feet, planted medians, hardscape medians, on-street parking, and bike lanes.)
5. Is the average block length, including all cul-de-sacs and pedestrian cut-throughs, less than 600 feet?

These five questions can be answered through a field review of the current conditions in and around the existing or proposed site. Emphasis should be placed on reviewing the pedestrian infrastructure in sites adjacent to the existing or proposed development, as well as the site itself. Most new developments will pass this test easily because they will be built according to current design practices and local design review policies; the bigger issue is whether the existing pedestrian infrastructure that is adjacent to a new development (and possibly built decades earlier under different design practices) also provides a high degree of pedestrian accessibility.

Land-Use Assessment Summary

The land-use assessment will help to determine whether a development has high or low potential for SOV trip reduction due to its density, mix of land uses, and pedestrian accessibility. This initial assessment stage does not consider TDM strategies themselves; instead, the existing or planned conditions of the built environment are being considered to help guide TDM strategies that are recommended for a particular site.

The next step in the assessment is to review the transportation services offered in an existing or planned site. Specifically, a transit assessment can be performed as described below.

Step 2: Transit Service Assessment

The transit service assessment is composed of three questions regarding the type and frequency of transit service (bus or rail) in the existing or proposed development's location. This assessment, in combination with the land-use assessment described above, is used to help select appropriate TDM strategies for the site.

For planned projects, it is important to consider the transit service that will be available upon completion of the existing or proposed development. Full completion is likely to occur several years, if not decades, into the future for most new development projects. In some locations, this is important because transit service may change significantly over time.

The three transit service assessment questions are:

1. Is the development within a half-mile of frequent light rail service and/or short bus headways? ("Frequent" headways are defined as headways under 15 minutes during peak hours and under 30 minutes during off-peak times.)
    a. If yes, this is a "Class A" transit service environment.
2. Is the development farther than a half-mile from frequent transit service, but connected to the service via frequent headways through shuttles or circulators? ("Frequent" headways are defined as headways under 15 minutes during peak hours and under 30 minutes during off-peak times.)
    a. If yes, this is a "Class B" transit service environment.
3. Are there no frequent transit services or shuttle/circulator connections to frequent transit services available in the vicinity of the development?
    a. If yes, this is a "Class C" transit service environment.

The guidelines of this assessment are rough approximations used to gauge the types of TDM programs and services that could be used under specific transit conditions. The tools needed to complete the transit assessment are basic and can typically be accessed on the Internet. These include use of: (1) online mapping websites to determine the distance to transit service from an existing or proposed development, and (2) a review of the local

transit agency's website to survey the frequency and type of transit service available at a given location.

Once the level of available transit service is determined through this assessment, the review process moves to Step 3: TDM Recommendations.

Step 3: Recommendation of TDM Strategies

The TDM strategies suitable for a specific development are primarily chosen according to the results of Steps 1 and 2 (land-use and transit service assessments).

For example, if an existing office development is determined to have a "high" trip-reduction potential based on the land-use assessment (Step 1) and is located in a "Class A" transit service area (Step 2), a set of pedestrian and transit-oriented TDM strategies are strongly recommended over other TDM strategies such as carpooling.

The recommended TDM strategies that consider the land use and transportation environment are displayed in Tables 14 and 15. With the results of Steps 1 and 2 from the sections above, readers can navigate these tables to find which TDM strategies are recommended for residential (Table 14) or office (Table 15) sites.

The TDM strategies outlined in Tables 14 and 15 can be divided into seven categories as follows:

1. Basic strategies.
2. Bicycle and pedestrian programs.
3. Transit programs.
4. Marketing programs.
5. Parking programs.
6. Rideshare programs.
7. Alternative work schedule programs.

Note that the strategies are recommended with three degrees of emphasis (high, medium, or low applicability as represented by solid, partially filled, and hollow circles). Most strategies should be implemented in conjunction with other strategies in order to achieve their maximum effectiveness and vehicle trip reduction.

Table 14. Residential TDM Strategies.

Level of Transit Service:	Class A: Within 1/2-mile of rail and short bus headways		Class B: to moderate bus/shuttle headways		Class C: No transit service	
Land-use Assessment Score:	High	Low	High	Low	High	Low
TDM Program or Strategy:						
Basic Strategies						
Bike Racks	●	●	●	●	●	●
Bus Benches	●	●	●	●	●	●
Information Kiosks	●	●	●	●	●	●
General Marketing Materials	●	●	●	●	●	●
On-site Transportation Fairs	●	●	●	●	●	●
Pedestrian Facilities	●	●	●	●	●	●
On-site Program Manager	●	●	●	●	●	●
Van-accessible Parking and Drop-off	●	●	●	●	●	●
Website	●	●	●	●	●	●
Bicycle and Pedestrian Programs						
Bike Lockers	●	●	●	⊙	⊙	⊙
Bike Routes/Lanes	●	●	●	⊙	⊙	⊙
Bike Paths	⊙	⊙	⊙	⊙	⊙	⊙
Transit Programs						
Bus Shelters	●	●	⊙	⊙	○	○
Incentive Campaigns (e.g., TryTransit)	⊙	⊙	●	●	○	○
Real-time Transit Information	●	●	⊙	⊙	○	○
Reduced-cost Transit Passes	⊙	●	⊙	●	○	○
Shuttle	○	⊙	⊙	⊙	●	●
Marketing Programs						
Access Guide	○	⊙	●	●	⊙	○
Bricks and Mortar Commuter Store	⊙	○	⊙	○	○	○
Incentive Programs	●	●	●	●	●	●
Customized Travel Plans/Profiles	○	⊙	●	●	●	●
Individualized Marketing Programs	●	●	●	●	●	●
Live-near-work Marketing	⊙	○	⊙	○	⊙	○
Off-peak Travel Programs	⊙	⊙	⊙	⊙	⊙	⊙
Shop-near-home Marketing	⊙	○	⊙	○	●	○
Parking Programs						
Paid Parking	⊙	⊙	⊙	⊙	○	○
Unbundle and Share Parking	⊙	⊙	⊙	⊙	○	○
Rideshare Programs						
Vanpool Program	⊙	⊙	⊙	⊙	●	●
Site-based Carpool Matching	○	⊙	○	⊙	●	●
Alternative Work Programs						
Business Center	●	●	●	●	●	●
Other Programs						
Car-Share Program	●	●	⊙	○	⊙	○
Concierge Service	⊙	⊙	⊙	⊙	⊙	⊙

● High applicability ⊙ Medium applicability ○ Low applicability

Table 15. Office TDM Strategies.

Level of Transit Service:	Class A: Within 1/2 mile of rail and short bus headways		Class B: Connectivity to rail and/or short to moderate bus/shuttle headways		Class C: No Transit Service	
Land-use Assessment Score:	High	Low	High	Low	High	Low
TDM Program or Strategy:						
Basic Strategies						
Bike Racks	●	●	●	●	●	●
Carpool and Vanpool Preferred Parking	●	●	●	●	●	●
General Marketing Materials	●	●	●	●	●	●
Information Kiosks	●	●	●	●	●	●
On-site Transportation Fairs	●	●	●	●	●	●
Pedestrian Facilities	●	●	●	●	●	●
Pre-tax Commute Benefit (IRS 132(f))	●	●	●	●	●	●
Program Manager	●	●	●	●	●	●
Vanpool-accessibile Parking and Drop-off	●	●	●	●	●	●
Bicycle and Pedestrian Programs						
Bike Lockers	●	◎	◎	◎	◎	◎
Shower Facilities	●	◎	◎	◎	◎	◎
Bike Routes/Lanes	◎	◎	◎	◎	◎	◎
Bike Paths	◎	◎	◎	◎	◎	◎
Transit Programs						
Bus Benches	●	●	◎	◎	○	○
Bus Shelters	●	●	◎	◎	○	○
Free Transit Passes	◎	◎	●	●	○	○
Real-time Transit Information	●	●	◎	◎	○	○
Reduced-cost Transit Passes	◎	●	◎	●	○	○
Shuttles/Circulators	○	◎	◎	◎	●	●
Marketing Programs						
New Employee Information	○	◎	●	●	◎	○
Bricks and Mortar Commuter Store	◎	○	◎	○	○	○
Customized Travel Plans/Profiles	○	◎	○	◎	●	●
Incentive Programs for First-time Users	●	●	●	●	●	●
Individualized Marketing Programs	●	●	●	●	●	●
Live-near-work Marketing	◎	○	◎	○	◎	○
Shop-near-work Marketing	◎	○	◎	○	●	○
Parking Programs						
Advanced Parking Technologies	●	●	●	●	●	●
Occassional Parking Program	●	●	●	●	●	●
Paid Parking	●	●	●	●	◎	◎
Parking Cashout	◎	◎	◎	◎	◎	◎
Unbundle and Share Parking	●	●	●	●	●	●
Rideshare Programs						
Vanpool Program	◎	◎	◎	◎	●	●
Site-based carpool matching	○	◎	○	◎	●	●
Alternative Work Programs						
Compressed Work Weeks	◎	◎	◎	◎	◎	◎
Flexible Work Schedules	◎	◎	◎	◎	◎	◎
Telework Programs	●	●	●	●	●	●
Other Programs						
Car-share Program	●	●	◎	○	◎	○
Concierge Service	◎	◎	◎	◎	◎	◎
Guaranteed Ride Home	●	●	●	●	●	●

● High applicability ◎ Medium applicability ○ Low applicability

The ratings for the TDM strategies and programs in Tables 14 and 15 were developed from national research and implementation programs in comparable major cities. Two important sources of local information were the results of the *2008 TDM Annual Survey* administered by Valley Metro (Valley Metro Regional Public Transportation Authority 2008) as well as the *2005-2006 Travel Reduction Program Annual Report* compiled by the Pima Association of Governments (Pima Association of Governments 2006). These documents report the impact of TDM programs on travel behavior, particularly on the percentage of travelers who use alternatives to driving alone. Some of the highlights from these reports that were considered in rating the TDM strategies and programs in Tables 14 and 15 are summarized below.

- The Valley Metro *2008 TDM Annual Survey* reported:
    - Use of telework has increased noticeably since 2007, and as a mode of travel to work it is responsible for 8 percent of total trips (in other words, 8 percent of trips that would normally be drive-alone trips to work never occur because people are teleworking, mostly from their homes).
    - Carpooling represents 15 percent of the total trips to work. This places it as the leading transportation alternative to driving alone to work. In addition, 22 percent of the surveyed population said they would very likely consider carpooling if it were made easier for them, and an additional 31 percent said they would be somewhat likely to consider it. Twenty percent of survey respondents said they would be very likely to carpool with gas expenses paid, and 28 percent said they would be somewhat likely. All these responses placed an emphasis on carpooling and incentive strategies in Tables 14 and 15, particularly preferential parking and site-based, ride-matching TDM strategies.
    - The strongest influences on the use of transportation alternatives are, in order of priority, a desire for greater convenience, easier access to the workplace, and the ability to maintain the same schedule as the normal commute to work. These perspectives strongly point to delivering individualized marketing and commute profiling as TDM strategies in Tables 14 and 15.

- The Pima Association of Governments' 2005-2006 Travel Reduction Program Annual Report found:
    - The most common employer programs are providing information on alternative modes, offering bike racks and lockers, providing ride-developing services, developing promotional campaigns, providing guaranteed ride-home programs, and targeting new employees with information. Because these strategies are popular with the existing employers in the Travel Reduction Program, they are all included in Tables 14 and 15.
    - The least common employer programs included parking fees, incentives for employees to live close to work, preferential parking, rebates not to use parking (cash-out programs), and vanpool subsidies. These programs were

also considered as TDM strategies, and case examples are presented in Chapter 2 to explain how and why these programs have been successful in other areas.

Detailed explanations of the TDM strategies displayed in Tables 14 and 15 are contained in Appendix B.

FUNDING MECHANISMS FOR TDM

Securing dependable, long-term sources of TDM funding is an issue faced by any entity that implements programs or services. Today, many TDM programs rely heavily on government-controlled funds, such as the federal Congestion Mitigation and Air Quality Improvement (CMAQ) program, or city or county sources. But public funds alone cannot support the programs and activities recommended in this chapter. The agencies, employers, and other organizations that have operated successful TDM programs over the long term use a variety of funding sources to sustain their efforts.

While a variety of organizations can implement TDM programs, there are generally four sources of revenue:

- Public grants (federal, state, and local) and foundation grants.
- Fee-for-service initiatives.
- Property assessments (business improvement districts and community improvement districts).
- Parking districts.

The need is ongoing to identify and incorporate strategic funding for any organization implementing TDM programs. To maintain quality service delivery, these organizations need a variety of funding sources. If one funding source dissipates, additional funding sources should be available to keep the programs running. If one funding source has prescriptive requirements, another should provide more flexibility in program options, leading to more diverse program offerings.

As an example, transportation management associations (TMAs) are one type of organization that implements TDM programs. A 2003 survey (Hendricks and Pederson-Stahl 2004) of TMAs around the country found that TMA program budgets included the following revenue sources:

- Membership dues (56 percent).
- Federal grants (48 percent).
- Local grants (28 percent).
- State grants (27 percent).
- In-kind donations (25 percent).
- Service contracts (19 percent).

- Fees for services (16 percent).
- Developer contributions (9 percent).
- Business improvement districts (BIDs) (7 percent).

Federal Grants: CMAQ Funding

The primary purpose of the Congestion Mitigation and Air Quality Improvement (CMAQ) program is to fund projects and programs that reduce transportation-related emissions in air quality nonattainment and maintenance areas, such as the Phoenix and Tucson regions. The 2004 decision by the Resource Allocation Advisory Committee (RAAC) directs all CMAQ funds available to Arizona to the Maricopa Association of Governments (MAG) in Phoenix. The RAAC is an advisory body whose membership includes high-ranking representatives from Arizona DOT and several regional planning organizations. Eligible CMAQ projects should demonstrate a likely contribution to the attainment of national ambient air quality standards.

Currently, CMAQ funds are used to fund a variety of projects aimed at reducing congestion and improving air quality in Maricopa County. CMAQ funds can be used to support transportation control measures identified by Arizona DOT or MAG as alternative-mode incentive programs, transit improvements, bicycle and pedestrian programs, and ridesharing projects. Funds have been used to purchase vans and buses, to subsidize bus operations, and to develop and implement ridesharing programs. Currently, MAG considers the following TDM-related elements as CMAQ-eligible (Maricopa Association of Governments 2005):

- Bicycle and pedestrian facilities.
- Bus and light rail projects, including new services.
- High-occupancy vehicle facilities.
- Ozone education programs.
- Park-and-ride facilities.
- Ridesharing programs.
- Telework programs.
- Trip reduction programs.
- Vanpool vehicles.

State, County, and Local Governments

Since TDM programs can mitigate congestion in key activity centers, state, county, and local jurisdictions often set aside funds to support implementation. Both the Phoenix and Tucson areas have several TDM programs in place due in large part to the trip reduction programs in each area. In addition to funding and maintaining much of the alternative transportation infrastructure, local governments help fund such programs as telework assistance, ride-matching services, commute campaigns, and shuttle or circulator

services. Furthermore, some city and county governments are implementing new alternative-mode-friendly development requirements to assist in mitigating the traffic impacts of future developments. These funds can provide additional revenues for future TDM programs. The Telework Arizona program described earlier is operated by the Arizona Department of Administration, a state government agency.

Foundation Funding

Foundation funding, though rare, is at times available to fund specific TDM projects and programs. National and local foundation funding is typically offered through a competitive grant process. A successful grant application will typically meet a specific need tied to the organization's mission and reflect strong community partnerships. The links among land use, transportation, and health are becoming more and more evident in our communities, and, as a result, several foundations and organizations offer active transportation grants. These groups include:

- Active Living By Design (established by the Robert Wood Johnson Foundation).
- Active Transportation for America (established by the Rails-to-Trails Conservancy).

Fee-for-Service Initiatives

Some organizations generate income for their TDM programs from fee-for-service initiatives, in which the organization charges fees to private companies that participate in its programs or receive its services. This can be an important source of private funding. Examples of services could include conducting employee surveys, developing customized trip reduction plans, implementing a comprehensive telework program, and developing a parking management plan. A fee-for-service program typically involves a menu of TDM services, along with a list of fees or range of fees for these services.

Case Example: The Emery Go-Round Shuttle

An example of a fee-for-service initiative is the Emery Go-Round, a free shuttle service provided to local residents and workers by the Emeryville Transportation Management Association in California. The TMA was formed in 1998 to manage shuttle services for seven members, including the city of Emeryville (located at the eastern foot of the Oakland/San Francisco Bay Bridge). The city initially funded 50 percent of the shuttle's budget, and the remainder was funded by fees collected from large employers and developers in the shuttle's service area.

By 2001, a business improvement district was formed, and today this district continues to fund the shuttle operations. The shuttle has been a successful program, and the property owners renewed the district and their assessment in 2006 with a strong majority vote. The district is currently composed of over 400 members, and the 2007 cost of services was approximately $1.27 million (Silvani 2008).

City Business Improvement Districts

A city business improvement district (CBID) provides the opportunity for businesses to implement tailored TDM strategies provided either by the district directly or contracted to the city. CBIDs are eligible in Arizona as a form of "Municipal Improvement District" under Arizona State Statute § 48-501 to § 48-725. The main purpose of this statute is to enable cities and towns to levy assessments on private property or issue bonds to pay for city or town improvements and maintenance activities. These assessments are typically based on square footage of commercial development or the number of dwelling units or the building footprint in a residential development. These projects can serve a range of purposes, from building pedestrian malls and maintaining sidewalk streetscape improvements to utility projects, such as sewer line installation or stormwater management. For the purpose of managing travel demand, many downtown areas have used CBIDs to help pay for directional signs and maps, on- and off-street parking improvements, transit services, multiuse trails, and bicycle facilities.

A CBID is created by municipal approval of both a petition from a majority (over 50 percent) of eligible taxpayers in the proposed district as well as a plan of services or improvements to be provided. Eligible properties are defined as those that pay business or occupational taxes.

Case Example: Downtown Phoenix Business Improvement District, Phoenix

The Downtown Phoenix Partnership currently operates a CBID to support a 90-square-block area roughly bounded by Fillmore Street to south of Jackson Street and by Seventh Street to Third Avenue. The CBID, once known as Copper Square, but now referred to as simply downtown Phoenix, is an assessment on property owners that pays for enhanced services including security, marketing, economic development, transportation/parking coordination, streetscape/urban design, and streetscape maintenance services. Specific to TDM services, this CBID helps finance the following activities:

- Connects travelers with transportation information via a public outreach team of "ambassadors" to provide assistance on the phone, on the grounds of the CBID area, and through the Internet.
- Provides parking information and traffic and security alerts.
- Provides funding for the free DASH shuttle and the Downtown Evening Express (DEE).
- Coordinates DASH and other bus transit services with Metro Light Rail.

The Downtown Phoenix CBID could implement further TDM programs in the future. Given that this strong CBID exists in central Phoenix, staff and partners of the CBID should be consulted when planning demand management strategies and marketing light rail and transit services.

Case Example: Cumberland Community Improvement District, Cumberland, Georgia

In addition to business improvement districts, another type of improvement district that is popular in the southeastern United States is the community improvement district (CID). A CID is very similar to a CBID, and both are flexible in how funds that are raised from assessments or municipal bonds may be spent.

The Cumberland Community Improvement District located northwest of Atlanta, Georgia, is one of the oldest and most successful CIDs in the nation. This CID was formed in 1988 with the intention of improving access to the highways serving the northwest region, known as the Cumberland Galleria. The CID has evolved since its inception to include transit, sidewalk, streetscape, vanpool, and other commuter service funding. Most pertinent to TDM-related programs, the CID currently funds the Cumberland CID Commuter Club. Through support from the CID assessment, the commuter club provides the following services:

- Carpool and vanpool matching.
- Reduced vanpool subscription rates ($50 per month).
- A 30 percent discount on bus and rail transit passes.
- Assistance in establishing telework programs at businesses in the CID.

The CID has tracked its performance and found that through the last 10 years it has helped commuters reduce 37 million miles of single-occupant car travel, 75 tons of pollution, and $5 million in personal transportation costs. The Cumberland CID is also one of the only *districts* (as opposed to a specific workplace) to achieve the U.S. Environmental Protection Agency's Best Workplaces for Commuters designation.

The Commuter Club budget is approximately $2 million per year. One-third of this money is used to fund vanpool, carpool, and transit services. Another third funds the local match for the area's federal CMAQ grant, and the remaining third is dedicated to staff salaries and administration.

Parking Districts

Implementing a modest fee for parking could generate a large pool of funding for TDM programs and services. Cooperation from city officials and businesses is vital to the program's success. Parking meter fees can also assist with parking management problems. Many studies have found that inexpensive, widely available parking is an important determinant in mode choice.

Case Examples: Boulder, Colorado, and Ann Arbor, Michigan

Examples of cities that use parking revenues to supplement the implementation costs of TDM strategies are becoming more common throughout North America. In 1993 the city of Boulder, Colorado, mandated parking maximums for its downtown and worked with

area businesses to decrease parking demand (EPA 2006). Out of the partnership came a plan to use revenue from parking meters to provide transit passes to all 7,500 downtown employees. Within four years, changes in employees' travel behavior had reduced parking demand by 850 spaces.

The city of Ann Arbor, Michigan, gave control of its seven parking structures to a quasi-public agency that took on the responsibility of repairing and maintaining the structures. The agency used parking revenues to revitalize the facilities and implement TDM strategies that included distribution of universal transit passes allowing employees unlimited rides on buses for an annual fee of $5; a fare-free circulator bus service between the downtown and nearby university; and the getDowntown program, which promotes the use of sustainable modes of transportation (Brown and Fields 2008). More information about the Ann Arbor case is provided in Chapter 2 in the Parking Management section.

EVALUATING AND MONITORING TDM IMPACTS

This section presents several monitoring and reporting procedures that can be used to evaluate the effectiveness of TDM. The impact of TDM programs is already monitored through the trip and travel reduction programs in place in both Phoenix and Tucson. In Phoenix, Valley Metro conducts an annual TDM survey of employed residents between the ages of 18 and 55 to determine the impact of the Maricopa County trip reduction program as well as understand how TDM programs could be improved in the future. The Pima Association of Governments also monitors the impact of its travel reduction program by surveying employers.

Building upon an understanding of TDM survey techniques demonstrated by TDM professionals in both Maricopa and Pima counties, this section provides two elements to help improve these efforts in the future:

1. A vehicle count methodology that could complement annual TDM surveys.
2. An approach to survey question design that may uncover more qualitative information about transportation alternatives that could provide information on improving TDM services.

Vehicle Counts and Monitoring Vehicle Trip Reduction

Vehicle count data provides the most direct means of associating actual trip reduction with the goals set by the trip/travel reduction programs in both Phoenix and Tucson.

Typically, vehicle counts should be performed during the morning and evening peak periods at work sites subject to the reduction program to monitor compliance. If the peak periods are not known, then a 24-hour count or at least a normal workday morning and evening count should be performed at the work site. The location where cordon lines or personnel counting vehicles are placed should be carefully selected to ensure that only

the trips from a development that is subject to trip reduction requirements are being monitored.

In a case where parking is shared among multiple uses, such as a mixed-use development, it may be very difficult to monitor trips from specific land uses that are subject to a trip/travel reduction program and others that are not. The method of conducting counts in these circumstances will most likely be different given each case. A monitoring protocol should be agreed upon by the county and the property owner at specific locations. An example of monitoring shared parking at a mixed-use development using a parking permit validation system is provided below.

Example of Trip Monitoring at Mixed-Use Sites

In the case of mixed-use developments that share parking among multiple uses, some of which are subject to trip/travel reduction programs and others not, a trip monitoring process could be instituted using parking gates and a continuous monitoring system as described below:[1]

1. Office employees would be required to access the parking structure with a key card, electronic transponder, etc. This vehicle tracking device would need to be used upon entering and exiting the facility. Access to the device's records would provide the appropriate information regarding the time employees entered and exited the parking facility.
2. Visitors to the offices would obtain a time-stamped ticket upon entering the parking structure. Prior to leaving, they would need to have that ticket validated by the office building manager (or other designated person). Upon exiting, a visitor would pay at the ticket booth and give the ticket to the person in the booth, who would time-stamp it and sort it with all other office visitor tickets.
3. Hotel guests or those attending conferences at the hotel would follow a similar procedure to office visitors, except that the hotel manager or front desk would validate their tickets.
4. Retail employees and customers simply would receive a ticket upon entering, pay as they leave, and give their tickets to the person in the ticket booth.
5. Traditional vehicle counts would be performed at these shared parking facilities to verify that all trips were accounted for by the above methods.

The records from the office employees' vehicle tracking devices along with the validated/invalidated tickets would be processed and sorted to determine the number of vehicles that entered and exited, and how many trips occurred, during the morning and evening peak hours for each individual land use.

Survey Questionnaires: Improving TDM Programs and Services

[1] Methodology provided in personal communications with Amber Mikec of Wells and Associates, Inc., Wexford, Pennsylvania, on June 2, 2008.

Surveys produce data valuable to understanding how effective TDM strategies have been at a particular site and what might be improved in the future. Whereas vehicle counts determine how many vehicles are entering and exiting during one weekday peak hour, survey questionnaires typically provide a multiday average of the transportation modes people are using instead of driving alone, such as carpooling, transit, bicycling, and walking, and do not have to be constrained to the peak period. Surveys are also an opportunity to poll people on what future TDM strategies are likely to be most attractive or useful. These strategies should result in more vehicle trip reduction, which is particularly important if the vehicle counts show a site is not reaching the trip reduction goal.

Surveys should be conducted close to the time vehicle counts are taken. The first section of the survey should focus on the respondent's travel mode during a defined period of days during the peak hour (morning or evening) that is subject to vehicle trip reduction. Sample questions to pinpoint this period could be the following, but should change to reflect specific site characteristics:

1. During the past [X] days, did you travel to, from, or within [site name] between the hours of [peak period, which will be determined by vehicle counts if not already known]?
   - ❑ Yes
   - ❑ No

2. If you traveled during this period, what mode of travel did you use on the following days?

   (Respondents would answer by choosing the appropriate mode by day of the week in a table similar to the example below. Depending on the type of use or situation, it may be necessary to allow respondents to report multiple trips for each day.)

Mode	Day 1	Day 2	Day 3	Day 4	Day 5
Drove Alone					
Bus/Light Rail					
Carpooled					
Vanpooled					
Biked					
Walked					
Worked at Home					
Don't Remember					

3. Trip purpose (work, school, shopping, etc.) questions may also be asked to further understand trip behavior.

Asking these three questions can help property owners target the right types of trips and time periods that would be affected by the trip/travel reduction program. Question 3 is asked to test whether the majority of trips are the journey-to-work trip or other trips. If it is found that many trips are not work-related, this is important to note, as use of transportation alternatives can differ substantially between work trips and non-work trips. TDM strategies should be altered accordingly.

A series of other qualitative questions should be asked to monitor the effectiveness of the TDM strategies implemented at the site and what improvements or different approaches should be undertaken. For example, if a transit pass subsidy is provided at the site, the survey questionnaire should ask if the respondent uses the subsidy and how often. In addition, it can be advantageous to leave space for respondents to comment on potential program improvements. These comments should be summarized and the top issues detailed in the final report. Examples of qualitative questions include:

- Using the scale provided, how likely is it that the following incentives would encourage you to try transit, carpooling, vanpooling, or bicycling to work?

	Very unlikely	Unlikely	Somewhat unlikely	Somewhat likely	Likely	Very likely
A guaranteed ride home in an emergency	❑	❑	❑	❑	❑	❑
The ability to change your arrival and departure times	❑	❑	❑	❑	❑	❑
Cheaper transit fares	❑	❑	❑	❑	❑	❑
Assistance finding a carpool partner	❑	❑	❑	❑	❑	❑
Bicycle storage and shower facilities	❑	❑	❑	❑	❑	❑

- How willing are you to use the following modes of transportation to get to and from work?

	Very unwilling	Unwilling	Somewhat unwilling	Somewhat willing	Willing	Very willing
Bike	❑	❑	❑	❑	❑	❑
Carpool	❑	❑	❑	❑	❑	❑
Ride the bus/rail	❑	❑	❑	❑	❑	❑
Walk	❑	❑	❑	❑	❑	❑
Work from home (telework)	❑	❑	❑	❑	❑	❑

At a minimum, surveys should be accurate to between ±5 percent at the 95 percent confidence interval.

CHAPTER 5. CONCLUSIONS

This report offers examples of many demand management strategies that broaden the traditional definition of travel demand management. The TDM Toolbox explores the application of these strategies in depth. It offers guidance on application and performance measurement, as well as on how such strategies should be selected, monitored, and funded over the long term. Implementing these strategies and others like them may play an important role in improving the efficiency of the current transportation system, and may serve as a key part of longer-term transportation improvements and complementary land use planning.

Ultimately, the role of demand management strategies will continue to evolve and contribute to larger goals of reducing congestion and increasing the efficiency of the transportation system. The focus of these strategies will also continue to expand beyond traditional employer-related TDM programs. In order to affect the larger transportation system issues of the future, demand management programs and strategies may expand to focus on the movement of all travelers, goods, and information on all trips throughout the entire transportation system. This diversity of trip types and purposes would result in an increasingly diverse array of ideas and concepts to manage the demands placed on the transportation system. For this reason, periodic research is valuable to assess the impact of these efforts and to help decision-makers, TDM managers, and transportation planners understand the benefits of TDM, as well as the complexity of its application.

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APPENDIX A. LAND-USE ASSESSMENT WORKSHEETS

The following worksheets contain the questions and information needed to complete the land-use assessment. This review is Step 1 in the process of determining the types of TDM programs that should be chosen for a specific location.

POINT 1: LAND-USE MIX

The land-use mix score has two components: land-use mix diversity and the number of retail stores, services, or schools in the area. Both the Diversity and the Retail, Services, and Schools scores must be achieved for the development to pass the Land-Use Mix point.

1. **Diversity Score:** Land-use mix within a half-mile of the center of the location.
    a. Are there residential uses present within a half-mile radius of the location? ❑ Yes ❑ No

    b. Is there at least 100,000 square feet of office/commercial space within a half-mile radius of the location? ❑ Yes ❑ No

    If the answers to both questions above are "Yes," the location achieves the Diversity score. If one or both questions are answered with a "No," the location does not achieve the Diversity score.

    Does the location achieve the Diversity score? ❑ Yes ❑ No

2. **Retail, Services, and Schools Score:** Number of uses within a quarter-mile walk from the center of the location[2].
    a. Number of grocery/supermarket stores: _____
    b. Number of other neighborhood-scale retail stores, services, and/or schools[3]: _____

    If the location is a residential or mixed-use development, at least one grocery/supermarket store must be present and at least eight other retail stores, services, or schools must be present to achieve the Retail, Services, and Schools score. If the proposed development is commercial-only, at least eight other retail stores, services, or schools must be present. A grocery/supermarket store is not required to achieve the Retail, Services, and Schools score for commercial development.

[2] It is assumed that locations are accessible by pedestrians through provision of sidewalks, crosswalks, pedestrian traffic signals, etc. **If there are inconsistent or nonexistent pedestrian accommodations within a quarter-mile of these locations, leave this score blank.**

[3] Neighborhood-scale small stores and services include "Main Street"–type uses, such as restaurants, cafes, clothing stores, post offices, banks, dry cleaners, fast food outlets, bookstores, schools, etc. Large regional shopping centers with large parking lots fronting the store are not considered neighborhood-scale.

Does the proposed development achieve the Retail, Services, and Schools score?

❑ Yes ❑ No

Does the proposed development achieve the Land-Use Mix point? (Note that the development must answer both the Diversity score and Retail, Services, and Schools score in the affirmative to achieve the Land-Use Mix point.)

❑ Yes ❑ No

POINT 2: DENSITY

1. **Density Point:** Review the densities of the proposed development and any uses within or touching a half-mile radius from the center of the proposed development.

   Density is defined as the total population and/or housing units divided by the total land area (e.g., gross density).

   For any proposed development, only **one** of the three density option questions must be answered affirmatively for the development to pass the Density point:

   a. **Option 1: Housing Units.** Are there at least 15 housing units per acre?

      ❑ Yes ❑ No

      For example: If a proposed residential development has 650 housing units on 25 acres and the surrounding area has 1850 housing units on 100 acres, the gross housing unit density is 20 units per acre (2500 units divided by 125 acres).

   b. **Option 2: Residential Population.** Is the population density greater than or equal to 30 people per acre?

      ❑ Yes ❑ No

      For example: If a proposed residential tower houses 600 people on 10 acres and the surrounding area has 4400 people on 120 acres, the gross residential population density is 38.5 people per acre (5000 people divided by 130 acres).

   c. **Option 3: Employment Population.** Are there at least 50 workers per acre?

      ❑ Yes ❑ No

      For example: If a proposed commercial building has 800 workers on 15 acres and the surrounding area has 5000 workers on 100 acres, the gross worker density is 50.4 workers per acre (5800 workers divided by 115 acres).

Considering the answer to one of the questions above, does the proposed development achieve the Density point? (Only one of the option questions must be answered in the affirmative.)

❑ Yes ❑ No

POINT 3: PEDESTRIAN ACCESSIBILITY

1. **Quality Walking Environment:** Considering a quarter-mile radius from the center of the proposed development:
    a. Are paved sidewalks at least four feet wide present on both sides of the street?

    ❑ Yes ❑ No

    b. Is lighting adequate to provide visibility of the sidewalk surface?

    ❑ Yes ❑ No

    c. Is the slope of the terrain less than five degrees?

    ❑ Yes ❑ No

    d. If the proposed development is along roadways with two or more vehicle lanes in each direction and/or speed limits in excess of 30 miles per hour:

    Are there planted median strips, on-street parking, or street furniture between the street curb and sidewalk?

    ❑ Yes ❑ No

2. **Average Block Length:** Considering a quarter-mile radius from the center of the proposed development:

    a. Is the average block length less than 600 feet?

    ❑ Yes ❑ No

Responses to all five questions (all parts of Questions 1 and 2) must be in the affirmative to achieve the Pedestrian Accessibility point.

Does this development achieve the Pedestrian Accessibility point?

❑ Yes ❑ No

LAND-USE ASSESSMENT SUMMARY

Taking the results of the three scores assessed, summarize the results below:

Point 1: Land-Use Mix	❑ Yes	❑ No
Point 2: Density	❑ Yes	❑ No
Point 3: Pedestrian Accessibility	❑ Yes	❑ No

Based on the "Yes" or "No" answers to the questions above for each point, the next step is to determine the appropriate column to use with Tables 14 and 15.

The "High" columns in Tables 14 and 15 are used if:

- Point 2 is a "Yes" plus either Point 1 or Point 3
- All three points are "Yes"

The "Low" columns in Tables 14 and 15 are used if:

- Point 2 is a "No"
- Both Point 1 and Point 3 are "No"
- Point 2 and any other point are "No"
- All three points are "No"

APPENDIX B. TDM STRATEGY DESCRIPTIONS

BICYCLE AND PEDESTRIAN PROGRAMS

Bicycle Lockers
Bicycle lockers provide an enclosed and secure place where people can leave their bicycles. Bicycle lockers provide extra security and protection for bicycles compared with bicycle racks. Bicycle lockers should be placed near building entrances and in well-lit areas.

Bicycle Paths
Bicycle paths provide bicyclists with a paved surface that is separated from vehicle traffic.

Bicycle Racks
Bicycle racks provide a secure location where people can leave their bicycles. Bicycle racks should be designed to provide support at both a bicycle's wheel and frame. Bicycle racks should be placed near building entrances and in well-lit areas.

Bicycle Routes
Bicycle routes provide bicyclists with a paved surface that is integrated with vehicle traffic. Bicycle routes are on roadways and may or may not include a painted lane for bicyclists. Bicycle routes are designated to help bicyclists identify their safest travel options.

Pedestrian Facilities
Pedestrian facilities provide safe, paved, and visually interesting connections between land uses within and proximate to a site. Pedestrian facilities should be illuminated and provide pedestrians with a sense of security.

Shower Facilities
Shower facilities provide a clean area where individuals can shower and change clothes. Shower facilities can be part of a gym or stand alone. Besides appealing to bicyclists, the facilities also appeal to workers who like to take exercise breaks during their workdays.

TRANSIT PROGRAMS

Bus Benches
Bus benches provide comfortable seating and help designate and draw attention to bus stops. Stops should include trash cans and be well lit.

Bus Shelters
Bus shelters provide both comfortable seating and protection from the elements and help designate and draw attention to bus stops. Bus shelters should include trash cans and be well lit.

Free Transit Passes
Free transit passes allow individuals to ride public transportation for free. Depending on the needs of the recipients and the goals of the distributing organization, passes may allow people to ride transit for free for a day, week, month, or year. In both the Phoenix and Tucson regions, it is possible to provide pass recipients with preloaded cards that provide free transit rides equivalent to a certain dollar amount of fares.

Information Kiosks
Information kiosks provide information on bus routes and schedules. Kiosks are generally placed at bus stops and provide riders with information on all routes serving the stop. Kiosks should provide fare information, basic details on how to use transit, and a phone number people can call for additional information. Kiosk displays can range from simple posters to touch-screen computers.

Real-time Transit Information
Real-time transit information provides continually updated arrival times for en-route buses and trains at bus stops and rail station areas.

Reduced-cost Transit Passes
Reduced-cost transit passes allow individuals to ride transit at a reduced cost. These passes can be subsidized by third parties who buy them from transit service providers and then pass them on to transit riders at a reduced cost. Programs can allow passes to be ordered through a website, phone, or mail.

Shuttle/Circulator Services
Shuttles and circulator services connect major residential, commercial, and office locations to one another and to nearby transit stations. Shuttle services are often operated using small buses or vans and run with short headways of 5 to 15 minutes during peak hours. This service is meant to move people short distances, and rides are generally free or very inexpensive.

MARKETING PROGRAMS

Access Guides
Access guides are small maps that display information on alternative modes serving a specific area. Access guides generally show transit and bicycle routes and include information on carpooling, vanpooling, and other alternative transportation modes.

Brick-and-mortar Commuter Stores
Brick-and-mortar commuter stores provide information on transportation options and sell items such as transit passes, messenger bags, bike locks, umbrellas, and maps. Brick-and-mortar stores should provide computer kiosks that allow shoppers to register for carpool partners, access transit websites, and participate in reward programs. Some commuter stores also provide indoor bicycle parking.

General Marketing Materials
General marketing materials provide transportation information to residents, workers, and shoppers via brochures, posters, table tents, commercials, etc. Information is not individualized to specific users but, rather, applicable to a large number of travelers.

Incentive Programs
Incentive programs provide participants with cash and prizes for using alternative transportation modes. Participants generally earn points for every trip they make using alternative transportation options. Points are accumulated and then exchanged for cash or prizes. Typically, these programs are oriented toward those who do not currently use transportation alternatives.

Individualized Marketing Programs
Individualized marketing programs provide information on alternative transportation options that are customized for the recipient. Participants generally indicate interest in specific transportation modes and programs, and applicable information is provided to them electronically, by mail, or in person.

Live-near-work Marketing
Live-near-work marketing is applicable at residential locations that are within walking distance of major employment sites. This marketing encourages employees to purchase or lease housing that is close to their workplaces.

New Employee Information
New employee information is typically a packet of information distributed to employees on the first day of their employment. Similar to a health benefit package, this package would illustrate the transportation benefits available to employees (e.g., if the company supports a transit subsidy or a pretax transit benefit program). The packet would contain enrollment forms for available transportation programs.

Off-peak Travel Programs
Off-peak travel programs use incentives and marketing to encourage individuals to take vehicle trips outside of peak vehicle travel hours.

Online Commuter Stores
Online commuter stores offer similar services as brick-and-mortar commuter stores, but, instead, do so through a website. The websites should provide commuters with interactive transportation information, the ability to purchase transit passes, and information on commuter programs and rewards. Online commuter stores are not appropriate in settings where many commuters lack Internet access.

On-site Transportation Fairs
On-site transportation fairs are conducted by representatives of TDM programs and are held in central locations to provide residents and workers with information about their transportation options. Information is provided through marketing materials, direct

conversation, and other media. In many situations, representatives from transportation providers throughout the region will attend the fairs.

Shop-near-home Marketing
Shop-near-home marketing uses marketing, coupons, and other special offers to encourage residents to shop at, eat at, and visit businesses that are within walking distance of their homes.

Transportation Coordinator Networks
Transportation coordinator networks are led by representatives from businesses and residential units within a TDM program's service area. The representatives are generally referred to as transportation coordinators and are volunteers. The transportation coordinators assist with the distribution of marketing materials, answer transportation questions for fellow employees and residents, help develop TDM strategies and programs, and assist with the implementation of marketing campaigns and programs.

Websites
Websites provide online transportation information tailored to residents and workers. The website should serve as a portal to regional transportation providers and should have a look and feel that is specific to the area being served. Websites can be integrated with online commuter stores and can provide information on transportation programs and incentives such as pay-for-performance programs, guaranteed-ride-home programs, and ride-matching services.

PARKING PROGRAMS

All parking strategies that result in paid parking should allow individuals to pay for parking on a daily basis. This ensures that individuals who primarily use alternative modes can still drive and secure parking when necessary.

Advanced Parking Technologies
Advances in parking technology allow individuals to reserve parking spaces in advance, request carpool parking spaces using their phones or the Internet, and determine the availability of parking through message boards, cell phones, and computers.

Paid Parking
Paid parking requires drivers to pay for parking. Effective programs require people to pay for parking on a regular basis. Programs should not allow people to pay for parking in blocks of more than three months at a time.

Parking Cash-out
Parking cash-out programs are generally implemented at employment sites and allow employees to choose between a free parking space and a cash payment equal to the value of the space. These programs are ideal for locations where a paid parking program would not be well-received.

Reserved Parking
Reserved parking provides individuals who carpool and vanpool with designated parking spaces that are close to building entrances or have some other intrinsic value that make them desirable. Spaces should be marked with signs to ensure that they are not misused and to make drivers aware of the program.

Unbundled Parking
Unbundled parking policies separate lease and purchase costs from parking costs. Individuals and companies are allowed to lease or purchase office space and residential units without also leasing or purchasing parking spaces. This allows individuals and companies to purchase only the parking spaces they need and want. Drivers can then be charged for parking on a daily or monthly basis.

Vanpool-accessible Parking and Drop-off Points
All parking and drop-off points should be accessible to vanpools. Vanpools generally require minimum clearances of 7 feet, 2 inches.

RIDESHARING PROGRAMS

Site-based Ride-matching
Site-based ride-matching uses database programs to automatically match participants with carpool partners based on locations where their commutes start and end and on work hours. The Pima Association of Governments and Valley Metro in Phoenix currently maintain ride-matching tools that can be used by commuters throughout the Tucson and Phoenix regions at no cost to users.

Vanpool Programs
Vanpool programs use 7- to 15-passenger vans to move commuters between their homes and work. Riders register with a vanpool program and are then matched with other riders based on their home and work locations and work hours. The vans are generally owned or leased by the entity operating the vanpool program. The vanpool driver is a volunteer and may be eligible for a reduced fare or allowed to use the van for limited personal use. Riders pay a monthly fare that is often subsidized. Vanpools tend to be most effective when fare collection is coordinated by a business or regional agency, rather than by vanpool drivers.

ALTERNATIVE WORK SCHEDULE PROGRAMS

Business Centers
Business centers are typically part of a residential development and are centrally located, available to all residents, and offer a quiet location for working, printing, faxing, and accessing the Internet. They are meant to facilitate teleworking.

Compressed Workweeks
Compressed workweeks allow employees to work 40 hours in 4 days or 80 hours in 9 days. These programs allow employees to avoid work commutes once a week or once every two weeks.

Flexible Work Schedules
Flexible work schedules allow employees to "flex" the start and end times of their work shifts. The amount of time by which employees may adjust these times generally varies from 15 minutes to 2 hours. Flexible work schedules allow employees to adjust their work schedules to better match transit schedules, as well as to avoid periods of peak traffic volumes.

Telework Programs
Telework programs allow employees to work from home. Successful TDM programs assist workplaces with the design of telework programs by informing management on issues regarding liability, rules of participation, and technology issues.

OTHER PROGRAMS

Car-sharing Programs
Car-sharing programs allow individuals to rent vehicles on an hourly basis and at a reasonable price. Program participants generally register with companies such as ZipCar, which allow them to make vehicle reservations over the Internet. Cars are parked at central locations and participants use specialized cards to unlock vehicles and access the car keys. Individual companies and work sites can also operate programs. In such a scenario, the programs operate like private fleets.

Concierge Services
Concierge services provide workers and residents with errand services that enable them to avoid vehicle trips.

Guaranteed-ride-home Programs
Guaranteed-ride-home programs provide a taxi or rental car ride home in case of an emergency, illness, or need to work late for those commuters who use alternative transportation modes. The number of rides available to an individual commuter may be limited to a certain number per calendar year.

Program Managers
Program managers provide oversight, coordination, and management of a TDM program's daily operations, programs, budget, and marketing activities. The program manager is responsible for planning and implementation of TDM programs and services, as well as evaluation and monitoring.