

# Developing Transportation Demand Management Packages Using Transportation Surveys: Case Study

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The goal of most transportation demand management (TDM) programs is the reduction of single-occupant-vehicle (SOV) use. The selection and packaging of TDM measures are critical in devising and implementing an effective program. The basis for the selection process can come from specialized transportation surveys. One such survey administered at the U.S. Department of Transportation (DOT) headquarters in Washington, D.C., is reported. The survey was distributed to 11,568 DOT employees, with a response rate of 41 percent. Only 16 percent of respondents commute by SOV. The Washington, D.C., core average is nearly 31 percent. DOT has excellent rideshare participation, with an overall occupancy of 1.89 employees per automobile. Several attitudinal questions were asked to investigate possible mode shifts if the headquarters were relocated near Union Station. DOT employees consider discounted transit passes and increased parking costs strong incentives to change modes of travel. It is anticipated that a combination of transit subsidies, rideshare programs, and flexible work schedules will be considered for the possible consolidation of DOT.

A critical objective of transportation demand management (TDM) programs both locally and regionally is the reduction of single-occupant-vehicle (SOV) use. A shift in mode choice from SOVs and a reduction in peak-hour vehicle trips are the major goals of most TDM programs. It was recently reported that suburban centers with mandatory TDM programs had considerably higher ridesharing than similar centers without required programs (1,2). Research has found that SOV use could be as much as 10 percent lower in areas with transportation management ordinances (2,3). The critical issues in devising a TDM program for a specific area are the selection and packaging of various management measures. Data on travel characteristics must be assessed before a TDM program is implemented. Travel information can come from many sources, including transportation surveys. Special employee transportation surveys are a tool to analyze which TDM measures to include in an overall management program. One such survey was administered at the U.S. Department of Transportation (DOT) headquarters in Washington, D.C. DOT is currently evaluating the relocation of most of its headquarters employees to a consolidated site in Washington, D.C. The

employee transportation survey was distributed to existing DOT personnel to identify effective TDM measures.

DOT currently employs 11,568 persons in three separate locations in Washington, D.C. It is anticipated that 8,252 employees will be relocated to one building near Union Station. To fulfill the requirements of the study, an evaluation of future transportation, traffic, and parking conditions with the consolidation project is required. The consolidation alone would bring over 8,000 additional jobs to the Union Station area. To mitigate the potential traffic impacts of the proposed action, packages of TDM measures are being tested. A preferred package will be selected and implemented when the development project to consolidate DOT employees is complete. The transportation survey and its use in TDM development are reported here. The following information is included:

- Comparison of travel characteristics for DOT employees and average regional measures for metropolitan Washington, D.C.,
- Evaluation of potential travel characteristics of DOT employees, and
- Processes for formulating TDM packages using attitudinal and other questionnaire responses.

Few DOT employees currently travel to work in SOVs. Even with the strong ridesharing and mass transit use at the existing buildings, additional aggressive TDM programs will be needed to reduce the traffic and parking impacts of the proposed action.

The Consolidation Employee Transportation Survey was distributed in March 1991 to all 11 operating administrations in DOT. Completed surveys were returned by 4,735 of the 11,568 employees. This is a response rate of 41 percent. Only 11 percent of employees actually live within the District of Columbia. Most live in the suburban areas surrounding Washington, D.C.

Figure 1 indicates the location of residences of DOT employees. Many options are available to DOT employees for the work commute. These include personal automobile, Metrorail, commuter rail, Metrobus, suburban bus, paratransit, bicycles, and walking.

Ample opportunity for ridesharing exists for employees in their commute to the current and future DOT headquarters sites. TDM strategies must be developed to encourage mode shifts to effectively use existing and programmed modes of travel.

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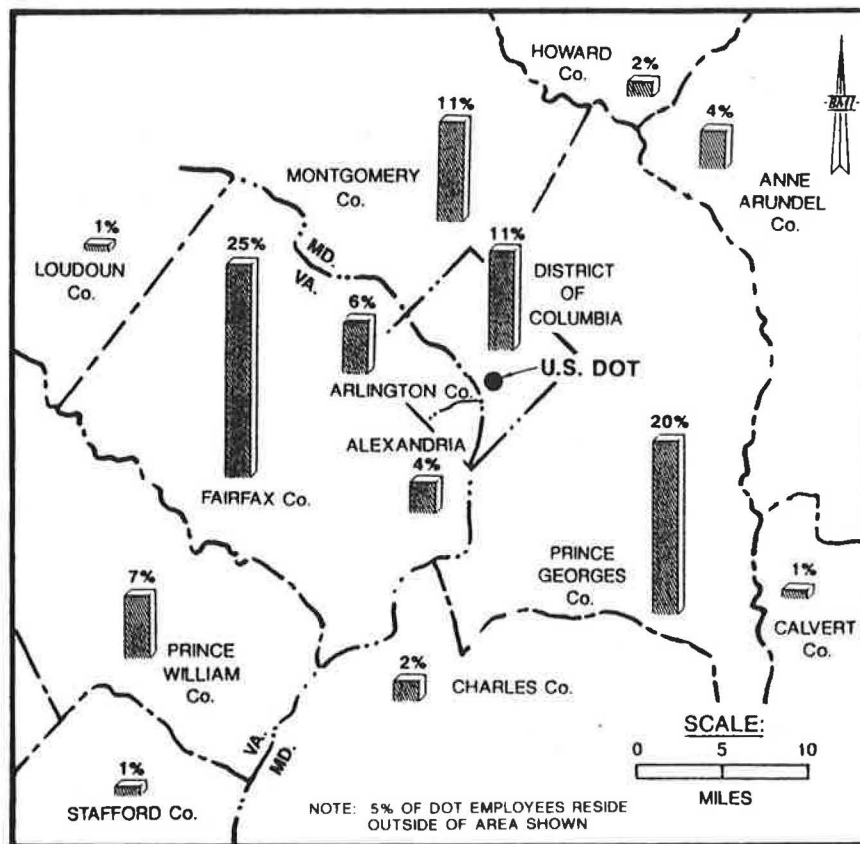


FIGURE 1 Residence of DOT employees.

As part of a study of such a consolidation, an employee survey was used to formulate the effectiveness of TDM strategies. The general goals of the TDM program are to reduce vehicular traffic and parking demand at the consolidation site.

### EXISTING TRAVEL CHARACTERISTICS

Before strategies for reducing personal automobile trips could be established, an understanding of existing travel characteristics was needed. These characteristics were defined through the responses to the employee transportation survey. The average one-way commute distance to work for DOT employees was found to be 21 mi for all travel modes. The average one-way commute time was approximately 45 min. The reported minimum and maximum commute distances and times were 1 and 170 mi and 5 and 180 min, respectively. Table 1 indicates the one-way commute times and distances for DOT employee trips to and from work. The employee-commute times and distances are slightly greater than the metropolitan area average. These will be checked with networks and employee locations through traffic assignment procedures.

The primary mode of travel to work for employees is indicated in Figure 2. Over 50 percent of respondents listed carpool and vanpool as the primary mode of travel. Public bus and rail were used by 28 percent of respondents. Only 16 percent travel to work by SOV. In addition, the occupancy of personal automobiles was calculated to be 1.89 employees

TABLE 1 COMMUTE TIMES AND DISTANCES FOR DOT EMPLOYEES

| Commute Time         |                     |                      | Commute Distance         |                     |                      |
|----------------------|---------------------|----------------------|--------------------------|---------------------|----------------------|
| One-Way Commute Time | Number of Responses | Percent of Responses | One-Way Commute Distance | Number of Responses | Percent of Responses |
| 1-10 minutes         | 100                 | 2.1%                 | 1-5 miles                | 358                 | 7.6%                 |
| 11-20 minutes        | 443                 | 9.4%                 | 6-10 miles               | 736                 | 15.5%                |
| 21-30 minutes        | 840                 | 17.7%                | 11-15 miles              | 754                 | 15.9%                |
| 31-40 minutes        | 790                 | 16.7%                | 16-20 miles              | 723                 | 15.3%                |
| 41-50 minutes        | 1,148               | 24.2%                | 21-25 miles              | 483                 | 10.2%                |
| 51-60 minutes        | 755                 | 15.9%                | 26-30 miles              | 457                 | 9.6%                 |
| 61-70 minutes        | 197                 | 4.2%                 | 31-40 miles              | 481                 | 10.2%                |
| 71-80 minutes        | 254                 | 5.4%                 | 41-50 miles              | 164                 | 3.5%                 |
| 81-90 minutes        | 133                 | 2.8%                 | 51-60 miles              | 68                  | 1.4%                 |
| 91+ minutes          | 75                  | 1.6%                 | 61+ miles                | 86                  | 1.8%                 |
| No Response          | 0                   | 0.0%                 | No Response              | 425                 | 9.0%                 |
| Total                | 4,735               | 100%                 | Total                    | 4,735               | 100%                 |

Source: March-April, 1991 survey conducted by DOT of its Washington, D.C. employees.

per vehicle. The peak period of trips was from 6:30 to 8:30 a.m., when 86 percent of employees arrive at work.

The regional travel characteristics for 1985 were compiled by the Metropolitan Washington Council of Governments (4). The data indicate that approximately 40 percent of trips to the Washington, D.C., core area are by transit. DOT employees use transit less than the regional average. The regional automobile occupancy to the core area is approximately 1.41

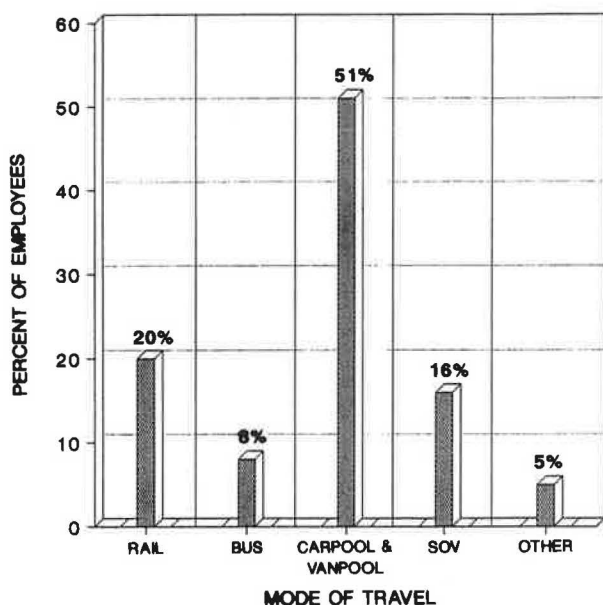


FIGURE 2 Existing mode choice of DOT employees.

persons per vehicle (6). The automobile occupancy for DOT is 1.89 employees per vehicle. Preferred parking in DOT garages is reserved for carpool and vanpool vehicles only.

Apparently the preferred parking incentive greatly influences the employee mode choice. Other mode-choice comparisons were sought. Data for numerous suburban activity centers have been reported in recent publications. Mode-choice attributes of office centers in California with TDM ordinances and office centers in various states without TDM requirements were reported (1,2). The research pointed to the effectiveness of TDM ordinances through a comparison of these centers. It was reported that the Silver Spring, Maryland, Metro Center (SSMC), located on a rail line with excellent mass transit opportunities, had a strong TDM program. The program includes discounted transit fare, flex time policies, and parking controls (6). Table 2 gives a comparison of the DOT; Washington, D.C., core; SSMC; and other recently reported mode-choice characteristics. As indicated, the DOT headquarters currently has excellent rideshare participation. The TDM program being developed for the planned relocation should aug-

ment the already effective trip reduction strategies in place at DOT.

### FUTURE TRAVEL CHARACTERISTICS

The environmental studies associated with the proposed DOT consolidation are focusing on sites near Union Station. Union Station is several blocks north of the U.S. Capitol near the intersection of Massachusetts Avenue and North Capitol Street. Union Station is a multimodal hub with the following public transportation opportunities:

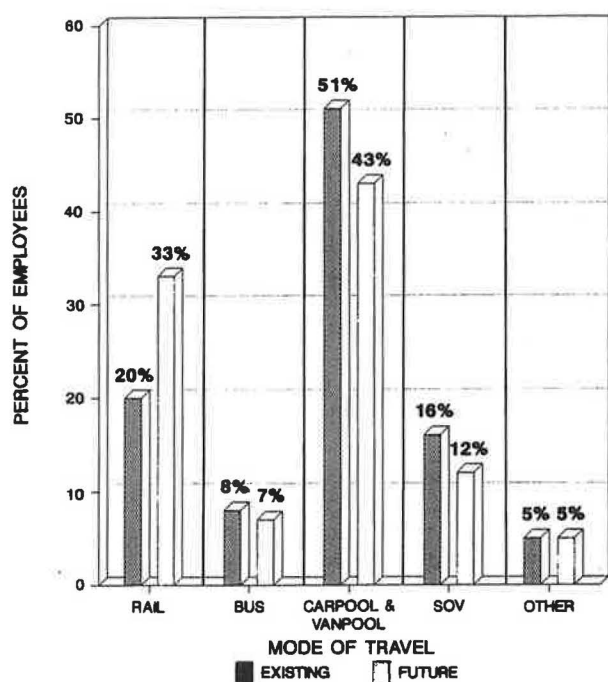
- Amtrak—heavy rail service along the eastern seaboard;
- MARC—commuter rail service to and from Baltimore, Maryland, and Harpers Ferry, West Virginia;
- Virginia Railway Express—commuter rail service to and from Fredericksburg and Manassas, Virginia;
- Metrorail—Washington, D.C., metropolitan subway system;
- Metrobus—regional service feeding Metrorail and providing sole service in other areas;
- Commuter bus—several carriers providing service from suburban Maryland; and
- Bicycle and pedestrian access.

If the consolidation takes place at Union Station, changes in employee mode choice are expected. In the transportation survey, employees were asked to anticipate their mode choice if the proposed action occurs. A map of the Union Station area was provided with the survey, and it was assumed that the respondents were aware of the mode-choice opportunities available. Figure 3 gives a comparison of existing and anticipated mode choice of DOT employees. Significant increases in rail use are expected. The mode shift to rail transit was from personal automobile use. The anticipated reduction in carpool or vanpool participation will reduce the overall automobile occupancy rates. The reported future automobile occupancy was calculated to be approximately 1.75 employees per vehicle, which is still 25 percent higher than the core average. The responses for future mode choice were without knowledge or consideration of TDM programs beyond the existing conditions. It is anticipated that transit and rideshare use could be even higher than reported because additional TDM measures will be implemented. TDM measures related

TABLE 2 DOT MODE-CHOICE COMPARISON WITH OTHER LOCATIONS

| Mode of Travel | California Suburban Office Centers With TDM (1) | Suburban Office Centers Without TDM (1) | Silver Spring Metro Center (SSMC) (5) | Washington D.C. Core Average (3) | U.S. DOT Headquarters |
|----------------|---|---|---------------------------------------|----------------------------------|-----------------------|
| Drive Alone    | 83%   | 92%                                     | 28%                                   | 31%                              | 16%                   |
| Car/Vanpool    | 11%   | 7%                                      | 28%                                   | 29%                              | 51%                   |
| Metrorail      | na  | na                                      | 11%                                   | 27%                              | 17%                   |
| Commuter Rail  | na  | na                                      | 10%                                   | 1%                               | 3%                    |
| All Transit    | 4%  | 1%                                      | 39%                                   | 40%                              | 28%                   |
| Other          | 2%  | na                                      | 5%                                    | na                               | 5%                    |
| Auto Occupancy | na  | na                                      | 1.41                                  | 1.41                             | 1.89                  |

na - not available



**FIGURE 3** Existing and future mode choice of DOT employees.

to parking management may serve as incentives to an increased number of persons per vehicle. Parking supply and pricing policies would offer other incentives.

### ATTITUDINAL RESPONSES

The responses to several attitudinal questions were used to screen TDM measures and help identify those measures that would further reduce SOVs. DOT employees responded "very likely," "somewhat likely," or "not at all likely" to the following questions:

- "If you presently drive alone, carpool, or vanpool, how likely would you be to take public transportation to DOT given the following incentives?"

- "If you presently drive alone, how likely would you be to join a carpool or vanpool to DOT given the following incentives?"

The incentives and responses are summarized in Table 3.

The discounted sale of transit passes was considered to be a strong incentive for changing modes. Whereas it was not possible to test actual dollar amounts of discount, it is reasonable to assume that the respondents would expect discounts of 25 to 50 percent in total fare cost. These discount rates have been effectively applied in the SSMC project (6). It was found that most employees at DOT are older, have been employed longer, and did not respond to enhanced day-care services as an incentive to change modes. This incentive is typically mentioned by younger workers as improving their likelihood to rideshare. Approximately 50 percent of respondents said that they would be very likely or somewhat likely

**TABLE 3** SUMMARY OF ATTITUDINAL QUESTIONS

| Question 1. If you presently drive alone, carpool or vanpool, how likely would you be to take public transportation to DOT given the following incentives? |             |                 |                   |                 |
|--|-------------|-----------------|-------------------|-----------------|
| Incentive  | Very Likely | Somewhat likely | Not at all likely | Total Responses |
| a. Discount bus or rail passes sold in your building.  | 26%         | 36%             | 38%               | 3,057           |
| b. Shifting work hours to better coincide with transit schedules.  | 18%         | 26%             | 56%               | 3,014           |
| c. Enhanced day care services provided.  | 6%          | 6%              | 88%               | 2,925           |
| d. Emergency ride home services.   | 22%         | 28%             | 50%               | 3,000           |
| e. Parking prices at commercial parking garage rates.  | 20%         | 27%             | 53%               | 2,977           |
| f. Convenient information on available public transportation.  | 12%         | 28%             | 60%               | 2,987           |
| Question 2. If you presently drive alone, how likely would you be to join a carpool or vanpool to DOT given the following incentives?                      |             |                 |                   |                 |
| Incentive  | Very likely | Somewhat likely | Not at all likely | Total Responses |
| a. An improved Ridematch service with personalized assistance and identified pick-up locations.  | 18%         | 30%             | 52%               | 727             |
| b. Shifting work hours to meet the schedule of a convenient carpool or vanpool.  | 20%         | 26%             | 54%               | 719             |
| c. Enhanced day care services.   | 7%          | 6%              | 87%               | 690             |
| d. Emergency ride home services.   | 19%         | 25%             | 56%               | 713             |
| e. Parking prices at commercial parking garage rates.  | 17%         | 27%             | 56%               | 711             |

to change modes of travel if a guaranteed ride home was available for emergency situations. Surprisingly, however, 12 percent of respondents who currently drive reported that they would change to transit if convenient information on public transportation was available. Approximately 17 percent of SOV respondents reported that they would rideshare if the charge for parking was at commercial garage rates. Presumably many of these employees currently find on-street parking. Another promising incentive was the ability to shift work schedules to accommodate ridesharing arrangements. Approximately 46 percent of persons using SOVs reported that they would be very or somewhat likely to shift modes if their work schedules were more flexible.

It is important to recognize that these responses are strictly attitudes and do not reflect actual mode shifts. Research has been conducted on the subject of behavioral intent and actual behavior. In the survey presented here, respondents provided behavioral intent. It is up to researchers and engineers to evaluate the reasonableness of the responses concerning future mode choice and the influences of TDM programs. Previous research has suggested that predictions of future behavior are more successful when the respondents to a survey have had experience directly related to the proposed action (7). It was also found that if a respondent currently uses a form of public transit, the response to a future transit ridership inquiry will likely be accurate. This research also found that the responses to questions about the demand for a particular mode of transit with which the respondent has had experience should be more reliable than the responses for a new mode (8). The DOT employees currently use mass transit to a great extent and are familiar with the regional transit system. No



TABLE 4 DESCRIPTION OF TDM ACTION GROUPS

| TDM Action Group                          | General Description  |
|---|--|
| 1. Increase Transit                       | Includes numerous programs and strategies for increasing transit usage; therefore, reducing reliance on personal autos.  |
| 2. Increase Carpool                       | Includes numerous elements which strive to increase ridesharing of current SOV users.  |
| 3. Increase Walk and Bicycle              | Includes enhancements to ped/bike networks and adds convenience facilities for potential users.  |
| 4. Improve Paratransit and Goods Movement | Includes measures to better link major transit facilities with the ultimate destinations. Includes measures to regulate, control, and improve the movement of goods through an area. |
| 5. Restricted Traffic                     | Includes partial or full restrictions of SOVs or autos in specified regions or corridors.  |
| 6. Pricing Measures                       | Includes programs which use the pricing of various travel elements to encourage or discourage the use of certain modes.  |
| 7. Parking Management                     | Includes the control of parking supply and fares to influence the selection of travel modes.   |

new modes of transit are expected in the future; therefore, DOT employees were responding on the basis of existing transit systems that will be available at the new headquarters site. The responses to future mode-choice and attitudinal questions are reasonable in light of the behavioral research cited.

#### FORMULATION OF TDM PACKAGES

Because of the large employee population and multimodal nature of the proposed site, a broad range of TDM measures was identified. Table 4 provides general descriptions of major TDM action groups identified for the DOT project.

While packages of TDM measures were being developed, evaluations of the interrelationships between individual measures and groups of measures were conducted. An example of this initial screening process is provided in Figure 4. This represents an extension of earlier work conducted for FHWA and UMTA by Bellomo. Each measure is screened to determine which TDM measures assist, which are independent, and which are counterproductive when packaged together.

This discussion provides, as examples, several interpretations of the interrelationships between the TDM measures specified in Figure 4. Increased carpooling is listed as independent of increased walking and bicycling. The potential market areas for each of these modes occur at vastly different travel distances from the destination. Carpooling becomes desirable at distances greater than 15 mi; walking and bicycling occur within distances of less than 5 mi. Another interrelationship example is the use of automobile-restricted zones (ARZs), which tend to increase transit use because cars are prohibited. However, ARZs are counterproductive in encouraging the formation of car or vanpools. Finally, parking management by limiting supply, time-restricted access, vehicle-restricted access, and pricing measures tends to increase the use of transit and ridesharing. Controls on parking are structured to discourage the use of SOVs.

In the process of evaluating TDM measures and formulating packages, the following concerns must be considered:

- What is the overall effectiveness of the measures or packages in reducing SOV travel and increasing ridesharing, bicycling, and walking?

- What departmental, legal, and financial obstacles must be addressed and what problems might arise from obtaining federal and local policy changes to implement the TDM package?

- Will employees and the public accept the TDM packages that might include changes in life-style, travel behavior, and commuting costs?

An overall goal for the TDM should be established. The measure of effectiveness (MOE) for the DOT headquarters project is likely to be one or more of the following:

- Reduced single-occupant vehicle trips,
- Reduced parking space requirements,
- Reduced vehicle trips,
- Increased vehicle occupancy, or
- Reduced peak-hour vehicle trips.

The TDM will have general objectives of reducing parking demand, limiting traffic impacts, and minimizing noise impacts on the adjacent residential communities. A transportation coordinator and staff will be assigned to implement the TDM programs. The TDM packages are still being developed, but the following programs and measures are likely to be recommended for the DOT project:

- Transit subsidy program to promote Metrorail, commuter rail, and bus use;
- Bulletin board and transportation and commuter office to disseminate rideshare information;
- Computerized carpool and vanpool matchlist data base;
- Parking controls in DOT garage to encourage high-occupancy vehicles (HOV) and discourage violation of occupancy requirements;
- Telecommuting and flexible hour work schedule programs; and

| ACTION GROUPS                            |                    |                           |  |                      |                    |                      |
|--|--------------------|---------------------------|--|----------------------|--------------------|----------------------|
|  | 2.Increase Carpool | 3.Increase Walk & Bicycle | 4.Improve Paratransit and Goods Movement | 5.Restricted Traffic | 6.Pricing Measures | 7.Parking Management |
| 1.Increase Transit                       | C                  | A                         | A  | A                    | A                  | A                    |
| 2.Increase Carpool                       |                    | I                         | I  | C                    | A                  | A                    |
| 3.Increase Walk & Bicycle                |                    |                           | I  | A                    | I                  | I                    |
| 4.Improve Paratransit and Goods Movement |                    |                           |  | C                    | I                  | I                    |
| 5.Restricted Traffic                     |                    |                           |  |                      | C                  | C                    |
| 6.Pricing Measures                       |                    |                           |  |                      |                    | A                    |

Legend:

A - Action Groups assist each other in reducing vehicle trips.

I - Action Groups are independent of each other in reducing vehicle trips.

C - Action Groups are counterproductive to each other in reducing vehicle trips.

FIGURE 4 Interrelationships between TDM measures.

- Provision or extension, or both, of HOV lanes for peak traffic periods.

DOT headquarters is in a central business district with a wealth of ridesharing opportunities. No one TDM measure would be sufficient to satisfy the vehicle trip reduction goals. In complex transportation situations, packages of TDM measures are needed to achieve the specified goals. DOT employees at the future headquarters location will decide between heavy and light rail, bus, paratransit, and various personal automobile arrangements for the commute trips. DOT employees currently reside in the metropolitan Washington, D.C., region with access to different transportation systems. Discouraging SOV travel requires an integrated program, including incentives and disincentives.

Besides the traffic, transportation, and parking issues addressed by the TDM programs, other factors will be considered. The MOEs must be broadened to include visual quality, pedestrian orientation, relationship to cultural activities, environmental concerns, and socioeconomic effects.

## SUMMARY

Formulation and testing of TDM actions require innovative work. Transportation surveys of employees can be quite useful in developing TDM packages and in evaluating their potential effectiveness.

A transportation survey that was distributed to 11,568 DOT employees in Washington, D.C., is reported. The survey was needed to obtain mode-choice, travel characteristics, and socioeconomic and other information to assist in the environmental studies and TDM programming of the proposed

relocation and consolidation of the DOT headquarters. A response rate of 41 percent was achieved, with 4,735 completed surveys returned. It was found that only 16 percent of the respondents currently arrive by SOV to DOT headquarters compared with a Washington, D.C., core average of 31 percent (4). The average personal automobile occupancy was calculated to be 1.89 employees per vehicle, which is higher than the Washington, D.C., core average of approximately 1.41 (5). Nearly 28 percent of employees currently use a form of public transportation to travel to work. On the basis of the survey, public transportation use would increase to 40 percent of employees if a DOT relocation near Union Station takes place. DOT employees consider the sale of discounted transit passes and increased parking costs as strong incentives to changing modes of travel.

The preferred TDM measures will be packaged and evaluated by qualitative and quantitative MOEs. A range of transportation, socioeconomic, and environmental objectives must be considered in establishing a TDM program. The interrelationships between measures must be understood and accounted for to ensure that an effective TDM package is developed. It is expected that a combination of transit subsidies, carpool and vanpool programs, and flexible work schedules will be instituted for the DOT consolidation.

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