Appendix C:
State of the Practice

Mobility Management Monitoring and Evaluation in the United States

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Prepared by:

Eric N. Schreffler
ESTC
Member, MOST Scientific Board
San Diego, CA, USA

I. Overview

This brief summary of the "State of the Practice" of Monitoring and Evaluation is intended to provide a flavor for the range of techniques used in the U.S. to evaluate the impact of Mobility Management (MM) or Transportation Demand Management (TDM) projects. This summary has been developed as part of MOST Deliverable D3 of Work Package 3: Monitoring and Evaluation. This deliverable includes an inventory of methods currently used to evaluate MM projects.

At the outset, two issues should be clarified.

1. <u>Ex Post Evaluation</u> – the methods used to monitor and evaluation MM projects are focused on measuring actual results of projects that have been or are being implemented, *not* to predict or estimate the potential impacts of a planned or hypothetical project. As such, this summary focuses on *ex post* evaluation methods, not *a priori* estimation techniques.
2. <u>Single Project/Program Evaluations</u> – most of the evaluation experience in the U.S. is based on the evaluation of individual pilot project that focus on a single MM measure (such as a new vanpool or public transport user subsidy) or on individual employer sites. As such, the population of users and potential users is well-defined. Broader evaluation results are obtained from cross-sectional comparison of a given MM measures as implemented at multiple project sites. Other evaluation efforts in the U.S. involve estimating the impact of regional ridesharing programs. In contrast, many of the MOST demonstrators and case study sites are intended to implement a variety of measures across a region, area or center.

The rest of this State of the Practice summary is organized as follows:

Section II discusses *why* MM evaluation is becoming more important in the U.S.

Section III provides an outline of the evaluation process used for most comprehensive evaluations

Section IV enumerates some of the Measures of Effectiveness used

Section V outlines monitoring and data collection techniques employed

Section VI discusses various evaluation approaches used to measure results

Section VII provides some "lessons learned" from experience in the U.S. over the past 25 years in the form of monitoring and evaluation "tips."

II. Why Evaluate?

Mobility Management monitoring and evaluation has witnessed a sort of renaissance in the U.S. in the past few years.

Mobility Management became widely accepted in the U.S. during the oil embargoes of the 1970's. The federal government allowed local and state government to use federal highway monies to fund "ridesharing" programs to help alleviate mobility constraints during these energy crises. The federal government also sponsored several large scale demonstration projects during that time, under the National

Ridesharing Demonstration Program. Comprehensive evaluations were an integral part of these projects and some of the evaluation techniques and measures of effectiveness from these projects are still used today (e.g., the “placement rate” or percent of commuters requesting rideshare matching information that are actually “placed: into a carpool, vanpool, or public transport vehicle.

In the 1980’s and early 1990’s, as TDM programs evolved and became less dependent on federal assistance, evaluation waned somewhat. The exception to this may have been the Employee Commute Options (ECO) provisions of Clean Air regulations. A tremendous amount of data was collected at regulated employer sites on employee travel behavior. Unfortunately, the ECO provisions were rescinded before the results of any objective evaluation could shed light on the cost effectiveness of these programs. During this period, various TDM evaluation approaches were debated by the TDM community [i, ii]

Over the past few years, monitoring and evaluation has been more and more important for several reasons. These reasons help answer the question “Why evaluate MM programs and projects?”

1. Local policy makers are **demanding accountability** for public funds spent on MM. They want to know what benefit the area is getting for the dollars spent. *(An example of this is the performance audit conducted on TDM projects funded by bridge toll revenue in San Diego[iii])*

2. New federal funding, in the form of the Congestion Mitigation Air Quality (CMAQ) requires that recipients both project the potential emission reductions from projects and **measure the actual results** at the end of the funding period. These emission calculations require estimation and measurement of vehicle trip and vehicle mile of travel reduced.[iv]

3. Many regions in the U.S. are still **claiming air quality emission reduction credits** from MM projects as an approved Transportation Control Measures (TCMs). This process requires ongoing evaluation to determine whether estimated emission reductions are being realized as a result of the MM projects. *(An example of this is the evaluation process used in Washington D.C. to measure the impacts of the Transportation Emission Reduction Measures program[v])*

4. Finally MM program managers are usng the results of evaluations to **better manage and improve their programs**. This often involves an assessment of how well the program and its implementing agent is fulfilling the objectives set forth for the project. Program managers see evaluation as a good management practice. *(An example of this is the program evaluation conducted for the Coronado Transportation Management Association in San Diego[vi])*

III. Overall Evaluation Process

Several comprehensive evaluation programs have been undertaken over the past several years, primarily tied to large-scale MM funding programs. For example, in California, standardized evaluation processes were developed for measuring and reporting the impacts of projects funded with CMAQ monies, with state vehicle registration surcharge funds (so-called AB 2766) and with county sales tax funds set aside for transportation (such as the Immediate Action Program that funded 110 TDM demonstration projects in Los Angeles County). Some of these evaluation programs were carried out by independent "third-party" evaluators and others involved self-evaluations using the prescribed methods and common reporting formats.

The overall evaluation process established for these comprehensive efforts included the following steps, as exemplified by the Los Angeles County program:

Step 1 Develop Evaluation Framework

An overall evaluation framework was developed that included: 1) the objectives for the evaluation and the intended use of the end products, 2) a description of the types of TDM projects to be evaluated, 3) a standardized method for calculating impacts, 4) guidance on comparing results across project types, 5) guidance on data collection and research design, and 6) a common format for reporting results.[vii] This evaluation framework formed the basis for a training workshop for all TDM project managers.

Step 2 Develop Individual Evaluation Plans

For each TDM project that was to receive an in-depth evaluation, a unique evaluation plan was prepared. This plan included: 1) the specific project objectives, 2) measures of effectiveness tied to these objectives, 3) data collection methods and instruments, 4) analysis techniques, 5) reporting requirements, 6) activities necessary to assure consistency with other evaluations, 7) a schedule of evaluation activities, and 8) a project evaluation budget. These evaluation plans were developed in cooperation with the implementing organization. The evaluations, however, were conducted by independent consultants.

Step 3 Collect Data

Data was collected with user surveys using consistent core questions and using secondary data provided by the project manager on program activities and utilization.

Step 4 Analyze Results and Calculate Impacts

Primary (surveys) and secondary data were analyzed to assess the impact of the program in fulfilling individual project objectives and in reducing traffic and emissions. To calculate these latter impacts, a standardized method (from Step 1) was used to convert participation in various TDM programs (such as new vanpoolers) to vehicle trip reduction using common factors (such as occupancy and prior mode). Average trip length was used to calculate vehicle miles of travel reduced. Average automobile emission factors were then used to convert trip and mileage reduction to emission reductions.

Step 5 Reporting and Refinement

The results of the various TDM projects were reported in individual reports, but were also summarized by project type in an overall final report.[viii] This report compared the effectiveness and cost effectiveness of each project and each category of projects. The results were used to make future TDM program funding decisions and to provide guidance to others on the most cost effective TDM strategies for meeting certain objectives.

In California, the results of several of these evaluation programs were used to make a comparison of 65 TDM projects.[ix] All the individual projects were evaluated using one basic, standardized methodology that used consistent assumptions and calculation factors.

Obviously, the evaluations of individual MM projects, that are not part of these comprehensive evaluation programs, vary in their planning, rigor, and execution. Many TDM programs in the U.S. perform some level of evaluation for reporting purposes. However, most are self-evaluations that are performed used activity-based reporting data (e.g., # of carpools formed) rather than on user surveys or before/after studies.

IV. Measures of Effectiveness

Measures of effectiveness (MOEs) should be tied to the objectives set for the MM project by the implementing agent (e.g., increase awareness of and ridership on a new tourist shuttle) and by the funder (e.g., reduce automobile trips and emissions in the tourist area). MM MOEs have evolved over the past 10 years or so and a unique set of measures has emerged.[x]

While not an exhaustive list for all types of MM projects, here are some of the most common MOES used in the U.S.

- **Awareness** – the percent of potential users that are aware of a new program or service. *(For example, 75% of residents in the San Francisco Bay Area were aware of the Spare the Air program that requested a reduction in automobile use during ozone alert days).*
- **Participation** – the number of people that register for a MM program or request information. *(For example, 2,700 commuters are registered in the Kansas City area's ridematching database).*
- **Utilization** – the number of people using alternative modes or riding a specific new service or sharing a ride. This is often expressed as <u>new</u> riders so as to account for the incremental impact of a new service or program. *(For example, 189 commuters started bicycling to work as a result of an employee bicycle loan program in Fullerton, California).*
- **Mode Split** – the proportion of travelers using each mode. *(For example, the mode split for the City of Pasadena's Pro-motion program was 58% drive alone, 27% carpool, 7% transit, 2% vanpool and 6% bike/walk/other after implementation of incentives and disincentives in 1990).*
- **Mode Shift** - a change in the use of non-drive alone mode shares. *(Using the same example from Pasadena, the carpool share increased from 12% to 27% after introduction of the parking fees and rideshare subsidies).*
- **Composite Measures** – several composite MOEs have been developed that represent a ratio or proportion. One common MOE is Average Vehicle Occupancy (AVO) or the average number of persons in each automobile and is an indication of carpooling and vanpooling. Average Vehicle Ridership (AVR) is a variant of AVO that accounts for transit and

non-motorized modes. Alternative Mode Utilization (AMU) represents the combined non-drive alone mode split. *(For example, the trip reduction regulations in southern California called for a target AVR of 1.5. In the Tucson region, participant employers have achieved an AMU of 29%).*

- **Vehicle Trip Reduction** – the number or percentage of automobiles removed from the road, or peak hour, or from a specific area (i.e., center city). One measure that is becoming more popular is the Vehicle Trip Rate (VTR). This is the average number of automobiles required per employee or per traveler and is the reciprocal of AVR. *(For example, the Pasadena Pro-motion program resulted in an VTR of 0.689 in 1990 as compared to 0.874 before implementation of the incentives and disincentives. This resulted in a vehicle trip reduction of 21.2%).*
- **Vehicle Miles of Travel (VMT) Reduced** – VMT reduction is important if the objective is to reduce the amount of travel or emissions. VMT reduction is most often calculated by multiplying the number of vehicle trips reduced by the average trip length (in miles) for the given trip purpose. *(For example, the Coronado TMA removed 995 vehicle trips from the bridge and 37,466 miles of travel from the region per day in 1998).*
- **Emission Reduction** – federal and state regulations called for the achievement of ambient air quality standards for various pollutants, including Volatile Organic Compounds (VOC), Reactive Organic Gases (ROG), Carbon Monoxide (CO), Oxides of Nitrogen (NOx), and Particulate Matter (PM). In California, average automobile emission factors have been calculated for each important pollutant for each year. Thus, trip- end and mileage factors are applied to Vehicle Trip and VMT Reduction numbers to calculate emission reductions for each pollutant and for the combined set of pollutants. *(For example, the Coronado TMA reduced 658 pounds of combined pollutants each day).*
- **Energy Reduction** – a left-over measure from the early days of TDM in the U.S. is energy savings, namely reduction in gasoline consumed as a result of mode shift. This measure has taken on a renewed importance given the recent popular outcry over fuel prices. Energy reduction is calculated by multiplying VMT reduction by average fuel cost per mile. *(For example, the 1997 evaluation of the Washington D.C. TDM program estimated that the 308 daily trips and 8,890 miles reduced resulted in a savings of 412 gallons of gasoline per day.)*
- **Cost per Unit of Reduction** – cost effectiveness measures are becoming more popular as program accountability and comparative cost effectiveness with other mobility strategies becomes more widespread. The most common cost effectiveness MOEs are: cost per vehicle trip reduced, cost per mile reduced, and cost per pound of pollutants reduced. Annual program costs are divided by annual reductions to derive these measures. *(For example, the Coronado TMA reduced each vehicle trip for US$2.03, each mile for US$0.05 and each pound of pollution for US$3.07. These number were then compared to the evaluation of California 65 projects as a benchmark).*
- **Commuter Cost Savings** – finally, many TDM programs also report user savings in the form of annual cost savings per ridesharer (in terms of reduced fuel, maintenance and insurance costs) or total daily commuter cost savings (the total savings for all ridesharers). *(For example,*

Washington, D.C. commuters who rideshare save US$912 per year and total commuting cost is reduced by US$1,711 per day for all commuters who are ridesharing as a result of the TDM program.

Vehicle Trip Reduction and VMT Reduction are the most common MOEs used in the U.S. for program evaluation. Cost effectiveness (cost per unit of reduction) is growing in popularity. These measures are focused on quantification of impacts on the transportation system. This is of greatest interest to policy-makers, planners, and funders. However, MM program managers may have other program-specific objectives that need to be evaluated. *(For example, a monitoring and evaluation process established for Transportation Management Associations in Florida includes several program and process related MOEs, including: level of corporate involvement, mix of public and private funding, degree of client satisfaction, degree of external visibility, etc.*[xi]*)* These MOEs are just as important to TMA managers as vehicle trip reduction.[xii]

V. Monitoring and Data Collection Techniques

Monitoring of MM programs involves the tracking of program activities, documentation of program utilization, and the collection of data on users and non-users of MM services. This can also be characterized as primary and secondary data for use in evaluation. It is useful to discuss secondary data, or monitoring, since it is more readily available.

Monitoring

Secondary data most often involve the tracking of program activities and participation on an on-going basis. These activities, which are fairly common in the U.S., can include:

- **Documenting Inquiries** – many MM programs, that provide information and advice on commute or travel alternatives, track the number of inquiries or requests for information. This could include telephone calls, web site hits, walk-in customers, etc.
- **Tracking Program Registrants** – most ridesharing organizations in the U.S. track the number of people that register with the program for purposes of ride-matching or receiving information on commute alternatives. Interested travelers either complete ride- matching forms, register over the phone or on-line, or become registrants if they request information as part of a travel survey.
- **Track Utilization** – some MM programs can track the number of actual users of various travel alternatives. For example, many employers offer preferential parking for carpools and vanpools or offer specific subsidies for vanpool or transit riders. Those participating for these specific services can be tracked via parking space allocation or subsidy reimbursement systems.
- **Document Activities and Services –** the most common form of monitoring is the documentation of program activities and new services. This can involve the number of employers contacted, the number of promotional events sponsored, the number of shuttle buses operating, number of vans leased for vanpooling, etc. While the number of activities is not directly correlated with program

effectiveness, it is useful to know the nature of alternatives offered and the level of new services.

Data Collection

Most MM evaluations require original data collection to assess change in travel behavior and reasons behind the shift in behavior observed. Data collection ranges from direct observation to sophisticated survey efforts.

- **User Counts** – similar to ongoing utilization records, user counts involve periodic counts of the number of users in various alternative modes. This could involve counting carpools and vanpools in preferential spaces, counting the number of transit pass recipients, counting bicycles parked at a given site, or counting teleworkers working from home over a certain period. Sometimes counts are problematic given the number of people who use alternatives on an occasional basis and the fact that some alternative mode use occurs outside of the formal program.
- **Parking Lot Counts** - some programs that are confined to a single site can use parking lot counts to document the mode split or the vehicle trip rate. Counters are stationed at parking lot and building entrances and count the number of vehicles and people entering the site. Given the proper circumstances, this method can be quite effective. Unfortunately, many MM programs are not confined to a single site. Counts also preclude the ability to ask users questions about why and how they changed their travel behavior.
- **Employee Tracking Forms and Timesheets** – some employer-based TDM programs use timesheets or special tracking form to allow employees to document their daily travel behavior. Sometimes these forms are used to provide subsidies for employees that use commute alternatives some minimum number of days per week or month. This also allows supervisors to provide some quality control over the information provided. One disadvantage of this method is the fact that only regular users of commute alternatives are motivated to complete the forms.
- **User Surveys** – the first type of survey used to collect information on MM program are user surveys, conducted among riders, teleworkers, walkers, bicyclists, etc. Surveys are given to, for example, new vanpool riders to collect data on their origin, the mode they previously used, and the mode they now use to get to the vanpool. On-board public transport rider surveys are also a common example. One unique user survey common in the U.S. is the “placement survey.” Registrants in the ride-matching database are periodically surveyed to assess whether they began ridesharing as a result of the information received. The proportion of registrants that begin sharing a ride a result of the service is referred to as the “placement rate.”
- **General Population Surveys** – surveys of all travelers, or the general driving population, are commonly implemented to either establish a baseline of travel behavior (e.g., the State of the Commute survey in the Los Angeles region) or to gauge general awareness about travel alternatives or specific promotional efforts (e.g., ozone alert program awareness surveys). Very rarely are general population surveys used

to measure the impact of a MM program, given the difficulty posed by the relatively low incidence of behavior change among the entire population. However, sometimes these surveys “screen” respondents for familiarity with a certain program.

- **Employee Surveys** – the most common form of MM survey in the U.S. is the employee survey. These surveys aim to establish the mode split among all employees at a work site and to assess changes in aggregate travel behavior over time. These surveys are seldom random and generally produce a response rate between 20-70%. This calls into question the representativeness of the sample and certain inherent biases. Sometimes, these surveys are combined with the ride-matching application form.
- **Employer Surveys** – some regions in the U.S. conduct surveys of transportation coordinators at employer sites to assess the current MM programs strategies being implemented. These surveys are more likely to be a stratified random sample to assure a representative mix of employer type, size, location, and TDM program focus are included.
- **Panel Surveys** – occasionally, surveys are conducted over time using the same group of travelers or panel. These panel surveys track changes in travel behavior over time among a finite and representative sample of travelers. Such surveys have been used, for example, to evaluate the use of and attitudes toward congestion pricing programs.
- **Focus Groups** – while focus groups are not generally suitable to measure changes in travel behavior or calculate impacts, they can provide valuable contextual information on the factors that influence travel behavior changes. They are most often used for program development and market research purposes, but are occasionally used to provide information on why certain travelers changed their travel behavior.

Often the monitoring and data collection activities undertaken by a MM program are not based on a specific evaluation plan, but are undertaken for prescribed reporting requirements. Comprehensive evaluation planning and subsequent data collection activities are far more common with demonstration projects. Even in the case of a pilot project, evaluation planning and budgeting are often not undertaken until the project is well underway. This often precludes the gathering of baseline or before data, the ability to consistently track the entire project, and need to adequately fund evaluation and data collection activities. This will compromise the rigor, objectivity and thoroughness of the evaluation.

VI. Evaluation Methods and Approaches

The approaches and methods to document results and measure impacts vary considerably. The primary difference comes down to the method for determine change in behavior or reduction of trips and the assumptions used. Most (but by no means all) evaluation methods in the U.S. convert program statistics to vehicle trip, VMT and emission reduction. Others simply track utilization, ridership or awareness. The following provides a brief description and example of various evaluation approaches and methods used in the U.S.

- **Annual Program Statistics** – some TDM program report annual awareness or utilization statistics as the number of people aware of the program, making inquiries about services, or utilizing travel alternatives. The most common means to evaluate impacts is to assume all program participants have shifted from driving alone to a travel alternative and equating the number of participants to the number of vehicle trips reduced. Research indicates, however, that many travelers switch from one alternative mode to another – such as from transit to carpooling. *(For example, it is common for ozone alert programs to measure increases in transit ridership on ozone days and equate each additional rider as a car removed from the road).*
- **Trend Analysis** – annual program statistics assessed over time can show trends in program awareness and utilization. Increases in utilization are considered to be "new" users and this equates to vehicle trip reduction as is assumed above. While it is important to only take credit for new users, this method still assumes all users of commute alternatives switched from driving alone. Research in California reveals that perhaps only 50% of new public transport and vanpool riders switch from driving alone, the rest coming from other modes. *(Again, this is common in analyzing public transport ridership trends or increases in ride-matching databases).*
- **Before/After Studies** – the first method that gets at quantifying change in travel behavior and mode shift is before/after studies. This rather common method from the social sciences requires mode split data be collected before the new program or service is implemented and then one or more surveys after the program is operational. Except for demonstration projects, true before data is hard to realize. More commonly, the first survey or count becomes the baseline and then each subsequent data set is compared to the baseline condition. This requires accurate count or survey data on mode split and not just information on those using travel alternatives. It also requires that the same survey instrument and method be used.

  The only other way to get at "before" travel behavior is to ask retrospective questions in an after survey as to prior travel behavior before the respondent switched modes. This approach, of course, can suffer from issues of respondent recall. Finally, before/after studies do not solve the issue of causality (did the program cause the mode shift or did exogenous factors cause the change?). *(The City of Pasadena Pro-motion program cited above is a good example of a before and after study where employee surveys were conducted before and after the imposition of financial subsidies for commute alternatives and parking fees).*[xiii]
- **Quasi-Experimental Design** – in order to address the issue of causality, evaluations have been conducted that employ treatment and control research designs. In this case, any "natural" or background changes in travel behavior are measured at a control site. The control might be an employer with a typical MM program or no program and the treatment site would be a pilot employer program being evaluated. The difficulty with "treatment/control" evaluations is finding a suitable match for a control and one that is willing to conduct surveys or collect data.[xiv] *(For example, the Los Angeles County TDM evaluation included two employer program that implemented parking charges for solo drivers and financial incentives for those using*

commute alternatives. The AVR at control sites was measured to increase 5%, whereas the treatment employers' AVR increased by 30%. Thus, the trip reduction results were "discounted" by 5% to account for natural increased in AVR resulting from the regional ridesharing mandate).

- **Project versus Regional Comparison** – a more imperfect means to determine the change in travel behavior, if before/after nor treatment/control data are not available, is to compare the mode split for a given site, program, or group of travelers to the regional ambient mode split. This implies that the MM program reduces trips as compared to the travel behavior to be expected in the absence of the program. Many researchers in the U.S. have questioned the accuracy of these comparisons. However, some TDM programs have been evaluated against a hypothetical base case that assumes 100% drive alone travelers and this is clearly not accurate. *(For example, an evaluation of 22 employer TDM programs throughout the U.S. used regional comparisons to estimate trip reduction for almost half of the sites. In suburban Washington D.C., the Nuclear Regulatory Commission was shown to have a Vehicle Trip Rate of 0.537 as compared to a VTR of 0.919 for the surrounding area. This resulted in a vehicle trip reduction of over 40%).*[xv]
- **Modeled Impacts** – when original data from travelers is impossible or impractical to collect, some evaluations have used modeled information. This is not the same as simply reporting the forecasted results of a project as the actual impacts (although many CMAQ-funded projects in the U.S. still do this). In the case of modeled impacts, the travel alternatives as implemented are used to model the impacts. Several predictive models have been developed in the U.S., including the FHWA TDM Evaluation Model, the CUTR_AVR Model, and the U.S. EPA COMMUTER Model. *(for example, to evaluate the impact of employer-based TDM programs in New Jersey, a survey of employers revealed the specific types of TDM strategies being implemented by different types of employers. These TDM strategies where then input into the FHWA TDM Model and expected employee travel behavior changes were estimated).*
- **Standardized Impact Calculation Methods** – once the number of travelers that have switched modes and the new mode split is established, the calculation of vehicle trip, VMT and emission reduction can be accomplished. Several standardized methods have been developed to convert changes in mode split or the number of new alternative mode travelers to these MOEs. To do so, several inputs or assumptions are needed, including:
    - ✓ prior mode,
    - ✓ the mode of access to the new alternative,
    - ✓ average vehicle occupancy of carpools and vanpools,
    - ✓ average trip length by trip purpose, and
    - ✓ average emission factors.

  These methods, and default assumptions or input factors, can been developed for several evaluations, including the AB2766 evaluation in southern California,[xvi] the Los Angeles County TDM evaluation discussed above, and a methodology developed by the California Air Resources Board for use in the Association for Commuter Transportation's employer TDM Tool Kit.[xvii]

The basic methodology involves four steps:

1. convert new participants or before/after mode split to vehicle trip reduction using a vehicle trip rate that accounts for prior mode,
2. convert vehicle trip reduction to VMT reduction by using average trip length (and sometimes discounting this VMT result to account for travelers who drive alone to a pick-up location),
3. convert vehicle trip and VMT reductions to emission reductions (sometimes adding back in the emissions generated by the higher occupancy vehicles), and
4. calculate the cost per vehicle trip, mile and pound of pollutants using annual program cost figures and annual reduction figures.

Many of these standardized calculation methods have been made into calculation software using simple spreadsheets or database managers.

- **Comparative Cost Effectiveness** – an emerging type of evaluation in the U.S. involves comparative cost effectiveness. Now that a growing set of evaluation results, using a consistent methodology and assumptions, are becoming available, the results from one project can be compared to peer projects from around the region, state or country (and someday around the world). These comparisons can reveal which types of MM projects are most cost effective or how one project compares to other within a category of projects. *(for example, the cost per trip, mile and pound of pollution reduced by the Coronado TMA's vanpool and transit subsidy programs were shown to be more cost effective than similar projects implemented throughout California).*

VII. Monitoring and Evaluation Tips from the U.S.

With almost 25 years of experience with MM monitoring and evaluation and with the emergence of standardized methods and MOEs, some lessons learned, in the form of "tips" can be offered that might help guide the monitoring and evaluation process for MOST.

TIP #1 Build Evaluation into Project Design Early

Evaluation planning should commerce in parallel with project planning. Once the MM concepts are defined and objectives set, an evaluation framework and/or evaluation plan should be prepared. Adequate staff and data collection resources should be built into the overall project budget.

TIP #2 Tie MOEs to Project Objectives

The measures of effectiveness used to measure project impacts should be directly tied to the objectives established for the MM demonstration project or ongoing program. MOEs may differ between funders and researchers (who want to measure travel impacts) and program implementers (who may wish to gauge awareness, acceptance and utilization of new services).

TIP #3 *The Primary MOEs in the U.S. Focus on Travel and Air Quality*

In the U.S., most evaluations focus on three core MOEs: vehicle trip reduction, VMT reduction and emission reduction. Trip reduction can be based on daily, peak hour or location-specific reductions. VMT reduction generally uses average trip length by trip purpose due to the significant inaccuracy of self-reported distances in surveys. Finally, many evaluations are calculating the cost per unit of reduction, and this requires careful tracking of annual operating, capital and other expenses.

TIP #4 *Impacts are Largely Based on Changes in Travel Behavior*

In order to calculate impacts, in the form of reductions, individual or aggregate changes in travel behavior need to be known or estimated. This means knowing the prior mode of those shifting modes. At an aggregate level, it means knowing mode split or travel behavior in a before/after study.

TIP #5 *Random Surveys can Avoid Certain Biases*

Random surveys of travelers or employees can be very difficult to administer, but can overcome several critical biases. Low response rates among surveys that are distributed to everyone in a given population can suffer from non-response bias. More importantly, alternative travel surveys tend to suffer from self-selection bias, whereby only those who change modes or are interested in the topic complete surveys. If mode split is needed to estimate change, then low response rates and self-selection can lead to significant over-estimation of impacts. Random surveys are better at ensuring the representativeness of the sample.

TIP #6 *Every Evaluation Should Not Become a PhD Dissertation*

Experience has shown that there may be a theoretical "best" approach to evaluating a certain MM project or program and a more practical evaluation approach. Few evaluation efforts have the time, money or expertise to carry out highly rigorous, scientific studies. It is more important to undertake an evaluation process that fits the character of the MM project, but is careful to not do anything to seriously call into question the limited results it produces. This requires careful consideration of data sources, calculation assumptions, and interpretation of results. This balance of rigor and practically has become the "art" of TDM evaluation in the U.S.

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