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16. Abstract

Federal regulations and guidance define major investment studies (MIS) as a flexible framework that can be tailored to provide the information needed to make local decisions about transportation investments. It is intended to enhance the planning process by requiring consideration of a broad array of alternatives and higher levels of public participation early in the process. The consideration of mobility and accessibility improvements, and operating efficiencies in the development and evaluation of alternatives is encouraged, but no particular approach or level of detail is required concerning traffic demand analysis.

This project examines 13 completed MISs to identify the state-of-the-practice of traffic demand analysis employed in Texas and around the country. An examination of the methods identified was compiled in a range of analysis alternatives from planning-level down to microscopic analysis of freeway flow. Guidelines are included to help agencies conduct an MIS that adequately addresses traffic demand.

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TRAFFIC DEMAND ANALYSIS
IN MAJOR INVESTMENT STUDIES

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge was John C. Brunk, P.E. #77316.

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IMPLEMENTATION RECOMMENDATIONS

This project was intended to provide guidance concerning the application of traffic demand analysis for roadway alternatives in major investment studies (MIS) by examining case studies from Texas and around the country. Although the passage of TEA-21 will eliminate MISs as a separate study requirement, it is anticipated that corridor and subarea studies will be integrated into the regional planning process to ensure that a broad range of alternatives and greater public involvement continue to be included in the planning process. Effective demand analysis helps to ensure that alternatives will effectively serve future traffic volumes and that the best solution is chosen for the study area. Study managers responsible for performing a corridor or subarea analysis should consider the following guidance when conducting their study:

- Include engineers with traffic operations experience on the study team.

- When multiple MISs are being conducted in the same region, consider developing a joint technical analysis manual that specifies how traffic demand will be measured and evaluated.

- Include as much detail as possible about the level of effort that will be needed for the demand analysis — data collection, analysis methods, and measures of effectiveness in the work plan and initial study scope.

- Allocate sufficient resources to the identification of existing traffic problems; consider developing short-term solutions to address problems that can be remedied inexpensively.

- Focus sufficient attention on the development of alternatives to be reasonably certain that they can be built and operated efficiently. Complex design elements such as freeway-to-freeway interchanges, reversible facilities, and multimodal facilities in the same right-of-way require more detailed development and evaluation of traffic demands.

- Check the travel forecasting model's transportation networks and land use assumptions for the study corridor, and when possible, obtain direct assignments of peak hour volumes.

- Consider the following findings: Travel forecasting models are the backbone of the transportation analysis process and provide volume data that serves as an input to all other analysis. Origin-destination studies are helpful in defining the character of traffic in the study area and in validating the forecasting model. Highway Capacity Manual procedures and traffic simulation models are generally more data intensive, but are useful in examining specific problem areas. The System Plan Method and Path Flow Method are easy to apply in planning applications and can provide a useful check on how effectively the defined alternatives match traffic demand.

The guidelines should serve as a supplement to existing MIS guidelines and provide direction to MIS participants in the area of traffic demand analysis. To maximize this report's effectiveness, it should be distributed to personnel responsible for MISs in TxDOT districts and Metropolitan Planning Organizations (MPOs).

I. INTRODUCTION

PURPOSE OF THE RESEARCH

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) created new regulations for transportation officials for determining how and where to dedicate resources for transportation investments. The regulations require a major investment study (MIS) to aid in project prioritization, planning, and resource allocation. By identifying and addressing critical issues such as community, environmental, and transportation concerns in detail through the MIS process, decision making at the local level is becoming a much more rational and justifiable process. And, although the MIS process may be a value-added process for decision making, the level of detail of the analysis conducted for the MIS has been left largely up to the local planning agencies. Of particular concern is an absence of guidance regarding traffic demand or operational analysis of alternative roadway solutions.

The traditional four-step planning analysis may be sufficient in determining the general number of lanes required for major freeway reconstruction projects, and is necessary for estimating future demand, but this process may fall short when future traffic flow is considered. For example, bottleneck research has identified geometric features that inherently result in bottlenecks as demand approaches capacity. A certain level of operational analysis is required to identify potential bottlenecks and other shortfalls in the alternatives. Of particular concern is that greater capacity not be planned or constructed than can be adequately utilized due to these constraints.

The objective of this research will be to identify and provide guidance regarding the different levels of traffic demand analysis that should be performed for roadway alternatives as part of an MIS. The authors studied MISs in Texas and around the country to identify analysis methods that have been used. In some cases, a broad planning-level analysis will be sufficient, while other cases may warrant several levels of operational analysis. This research provides guidelines to help MIS practitioners determine the level of analysis needed for a particular project.

WORK PLAN

The research consisted of three primary tasks: literature review, development of case studies, and evaluation of traffic demand methods and development of guidelines for use in MISs. Each task is described in more detail in the following sections.

Task 1: Literature Review

The first task of this research was to perform a review of related literature. Although ISTEA was approved in 1991, MIS regulations and guidelines were not released until 1994. Consequently, the first MISs were not being completed until 1996. The result is that problems with major investment studies are just now being recognized based on first-hand experience. Therefore, the literature review provides an opportunity to identify areas in the operational analysis portion of the MIS process where some guidance may be useful.

The literature review also aids the research team in identifying and assessing the merits of different analytical methods. The focus of this portion of the literature review will be to cover the range of analysis tools from the four-step planning process to microscopic analysis of freeway flow. The literature review helps broaden the knowledge base regarding analysis tools. And, while there are a myriad of planning, simulation, and analysis tools that could be researched, this review is not intended to serve as a software guide. Therefore, the focus is on types of analysis tools available.

The literature review on the whole forms the foundation for the research. The first portion of the review discusses the MIS process, with emphasis placed on lessons learned, changes needed in the process, and analytical techniques that have been used. The literature review then details the range of analytical tools available during the MIS process.

Task 2: Case Studies and Surveys

A series of case studies of MISs in Texas and around the country made up the data collection portion of this research. The researchers used state and national contacts to identify a set of recently completed MISs to be considered candidates for the case studies. They also developed a telephone survey to obtain general information about each MIS, as well as specific information about the types of traffic demand analysis that were being undertaken.

The research team contacted study managers for the lead agency and/or the consulting firm that worked on the study to conduct the phone survey. The study managers were uniformly open about sharing their experiences in working on the subject case study and sent MIS reports to help answer specific questions about their study. The result of the case studies was to broaden the understanding of the MIS process as it is being practiced around the country for comparison with experiences in Texas. The researchers placed particular emphasis on identifying any innovative traffic demand analysis approaches that were being employed.

Task 3: Case Study Analysis and Development of Guidelines

Once the research team completed the literature review and case studies, the researchers compiled and analyzed the information gathered with the intent of identifying any trends that relate the scope or type of an MIS project to the level of detail undertaken in the traffic demand analysis. The final task before preparation of the guidelines was to identify those methods of analysis that proved successful in the MISs completed to date. Again, the types of analysis typically range from planning level analysis to microscopic examination of freeway flow.

The product of this research is a set of guidelines for traffic demand analysis for MISs. The research team developed guidelines using the case study analysis prepared in this task as well as researcher experience and the literature. These guidelines will be an information source for local MIS policy makers and study managers to help them determine, based on the type of project being planned, what level of analysis might be conducted and what methods are available. The guidelines will also describe the advantages and disadvantages of using a particular method. The guidelines stress the importance of choosing the appropriate analysis tools to reduce the potential for problem areas (e.g., bottlenecks) being designed into the preferred alternative, or for more capacity to be planned than can be effectively utilized.

LITERATURE REVIEW

Federal Regulations Requiring Major Investment Studies

Federal regulations defining the final rules for MISs were adopted in November, 1993 and are set forth in 23 CFR Part 450.318 (*1*). This section of the Federal Register contains the rules for "Statewide Planning" and "Metropolitan Planning," and specifically creates the requirement to conduct an MIS wherever a need for a major transportation investment is identified and Federal funds are likely to be involved. The purpose of the MIS is to develop or refine the plan for a subarea or corridor such that the MPO, in cooperation with other agencies, can make informed decisions on the design and scope of the investment for inclusion in the regional plan and transportation improvement program (TIP). Ideally, the MIS encourages decision makers to consider a broader array of options earlier in the planning process.

"Design and scope" is a term defined in EPA's air quality conformity regulation that refers to the type of facility to be implemented and the design aspects that will affect regional emissions. These design aspects include number of lanes or tracks, length, signalization, access control, approximate number and location of interchanges, and preferential treatment of high occupancy vehicles (HOVs).

The regulations also stipulate that at the beginning of the MIS a meeting will be convened to determine the extent of the analysis and agency roles in the study. This cooperative process is to include the MPO, the state department of transportation, public transit operators, environmental agencies, resource and permit agencies, local officials, FHWA, FTA, and any other groups or agencies that may be affected by the proposed scope of analysis, as well as the public. Working through this cooperative process, the participants are to establish the range of alternatives to be studied and the level of analysis that will be needed to reach a decision that supports local, state, and national goals. The regulations specifically identify general alignment, number of lanes, and operating characteristics among the range of alternatives to be considered. In addition to costs, the analysis of the alternatives is to examine mobility improvements and operating efficiencies, as well as other social, environmental, and economic factors.

Although the MIS is clearly a part of the planning process, it was intended to develop information that would support the project's development and funding. In particular, the MISs are intended to improve the linkage between the planning process and the environmental review process by documenting the consideration given to alternatives and their impacts.

MIS Guidance

Federal, state, and local sources have published documents to provide guidance in conducting MISs. The first was released by FHWA and FTA in August 1994, and consisted of a series of questions and answers designed to serve as initial guidance on MISs (*2*). This document does not address traffic demand analysis. It does touch on the appropriate level of detail for an MIS (*2, page 10*):

> "The level of detail should reflect the decision at hand, i.e., the selection of the design concept and scope of the investment...The level of analysis should be sufficient in accuracy and detail to identify and evaluate all of the significant differences among the alternatives under consideration...The level of detail should also reflect the complexity and type of the alternatives associated with the investment. In cases where some of the alternatives would cost several hundreds of millions of dollars, a more comprehensive study would normally be appropriate than in cases where the alternatives are likely to cost far less."

The researchers examined three other guides that have been produced to facilitate MISs. They were the USDOT's publication, "A Guide to Metropolitan Transportation Planning Under ISTEA" (*3*), TxDOT's report, "The Texas MIS Process Guidelines" (*4*), and the North Cental Texas Council of Government's paper, "Performing Transportation Major Investment Studies" (*5*). The guidance provided by these documents leaves the MIS process open to the performing agencies as a flexible, collaborative process designed to aid in the planning of future mobility enhancements. They do not address traffic demand analysis any more specifically than the metropolitan planning regulations.

National Transit Institute Training Program and Desk Reference

The *Desk Reference* is the most comprehensive document developed to guide the MIS process (*6*). It was prepared in conjunction with an MIS course manual by the National Transit Institute through a grant from the FTA (*7*). Several sections in the *Desk Reference* touch on the issues related to traffic demand analysis in MISs:

- Level of Detail—The appropriate level of technical analysis is established through a collaborative process that includes all the participating agencies. In general, as the study progresses, the number of alternatives decreases and the level of detail for the alternatives under consideration increases.

- Effectiveness—There are several considerations in the selection of evaluation measures related to the effectiveness of alternatives. The measures should address all stated objectives of the study, quantify impacts rather than express subjective judgments, and give a proper perspective on the magnitude of the impact. The evaluation methodology should be a high priority item early in the process.

- Ongoing Refinement of Alternatives—Each alternative should be refined to optimize its performance in the corridor; however, each alternative should be significantly different from other alternatives. Since the purpose of an MIS is to support decisions on the overall concept and scope of a transportation improvement, there is no need to take alternatives to a level of design ready for implementation.

Measures of Effectiveness

Most literature regarding MISs simply documents the lessons learned, provides opinions on policy issues relating to MISs, and shows how MISs fit into the planning process (*8-20*). Since the purpose of the MIS is as a planning tool, little has been written on the traffic demand, or operational analysis of alternatives. Turner conducted one study that does relate to traffic demand analysis regarding measures of effectiveness (MOE) for use in MISs (*21*). In particular, the study developed guidelines to help in the selection of appropriate MOEs for comparison of multimodal alternatives. Based on criteria of applicability, ease of measure, accuracy of results, and ease of interpretation, the authors were able to evaluate 58 candidate MOE under the five broad categories of transportation performance, financial/economic performance, social impacts, land use/economic development impacts, and environmental impacts. The preferred MOEs for transportation performance were:

- average travel time (minutes),
- average travel rate (minutes per mile),
- total delay (vehicle-hours or person-hours),
- person-miles of travel (PMT),
- person-hours of travel (PHT),
- person movement (persons per hour),
- person movement speed (person-miles per hour), and
- accident reduction (number per person-mile of travel).

Summary

Federal law and guidance define MISs as a flexible framework that can be tailored to provide the information needed by the public and decision makers. It is intended to enhance the planning process by requiring consideration of a broad array of alternatives and higher levels of public participation early in the process. The outcome of the MIS is a locally preferred alternative that is incorporated into the regional transportation plan and that simplifies the alternatives analysis portion of the environmental review process. The consideration of mobility and accessibility improvements, and operating efficiencies in the development and evaluation of alternatives is encouraged, but no particular approach or level of detail is required.

This research is not intended to alter the MIS process as it has been outlined by USDOT or TxDOT. However, as described above, the guidelines do provide limited direction in determining the level of detail needed for alternative analysis in an MIS. These decisions are made as a part of the MIS process itself. The results of this research provide a set of case studies showing how the MISs have addressed the issue of traffic demand analysis in a variety of contexts. It also provides a framework of analysis options available for examining freeway alternatives.

II. TRAVEL DEMAND ANALYSIS TOOLS

TRAVEL FORECASTING MODELS

Travel forecasting models are used to estimate future travel demands for expected land use developments over a transportation network. The state or local MPO as part of the statewide or metropolitan transportation planning processes make travel forecasts. Most travel forecasts are made with a four-step process that consists of trip generation, trip distribution, mode choice, and trip assignment. The primary products of the travel forecasts are the expected 24-hour volumes and speeds along the major roadways. The model sometimes directly assigns peak period or peak hour travel demands, or travel forecasters can calculate peak volumes using the 24-hour volumes and the expected percentage of traffic in the peak hour (K factor) and the directional split (D factors).

The travel forecast is the primary tool needed to analyze transportation improvements. Transportation planners and engineers use the results of the travel forecast to size facilities and estimate capital costs, to determine operating policies and estimate operating costs, to forecast fares and toll revenues, and to examine impacts ranging from region wide air quality to congestion on individual highway links. For the MIS, forecasts must address both highway volumes and speeds to support accurate estimates of pollutant emissions. The forecasting tools must be able to project the potential effectiveness of changes not only to the transportation system but also of strategies to modify overall travel demand. The forecasts must include measures that support the comparison of benefits across alternatives that include improvements focused on several different modes of travel.

ORIGIN DESTINATION STUDIES

Origin and destination (O-D) studies provide information on the origin and destination of all trips in a region or through a specific corridor. Planners use regional O-D studies as inputs to planning models and for calibrating traffic forecasts. The information provided by the O-D studies at the corridor level shows the existing demand and travel patterns on or through a facility. Planners make most O-D studies through detailed surveys of a representative sample of trips in a region or on a corridor. The surveys ask for specific trip information such as when and where the trip starts and ends, purpose of the trip, and the route and mode chosen for the trip. On a smaller scale, license plate recording at exits during the morning peak period, or matching of license plates at entrances and exits can be used to give basic origin and destination data, such as travel patterns through a facility.

TRAFFIC SIMULATIONS — FRESIM

FRESIM is a microscopic freeway simulation model that is part of a larger package of simulation models called CORSIM *(22)*. FRESIM models each vehicle as a separate entity. The behavior of each vehicle is represented through interaction with freeway geometry and with other vehicles.

FRESIM can simulate most freeway geometries, and the model provides a fairly realistic simulation of operational features. Transportation engineers can use FRESIM to evaluate alternative geometric designs, traffic management systems, and the effects of traffic incidents. While FRESIM is a much improved version of its predecessor INTRAS, previous work has shown that it does not always produce reliable results when modeling highly congested freeway sections *(23)*.

The model requires the user to specify many detailed inputs. The minimum inputs needed to define the roadway geometry include the number of lanes, the location of entrance and exit ramps, free flow speed, and pavement conditions. The minimum traffic characteristics include traffic flow rates, and entering and exiting volumes in the modeled system. Other characteristics that may be changed include driver sensitivity and vehicle performance factors, location of warning signs, grade, superelevation, radius of curvature, truck restrictions, incidents and incident detection, truck restrictions, ramp metering, and O-D data. FRESIM produces a detailed output file of predicted operational and environmental measures of effectiveness for the modeled system. The MOEs include average vehicle speed, stops, vehicle delay, vehicle hours of travel (VHT), vehicle miles of travel (VMT), fuel consumption, and pollutant emissions.

HIGHWAY CAPACITY MANUAL (HCM) PROCEDURES

Link level-of-service (LOS) and expected average speed are the most straight forward application of the procedures presented in the *Highway Capacity Manual* (*24*). The objective of planning analysis with the HCM procedures is to determine the number of lanes needed for a desired LOS or to determine the LOS given the number of lanes and a forecast design hour volume (DHV). The HCM uses density of the traffic stream to define LOS for basic freeway sections. LOS A through LOS D represent levels of traffic with increasing density. LOS E describes the condition when the density of the traffic stream has reached capacity at free flow speeds, and LOS F represents traffic which is congested or in failure.

The HCM also provides procedures for analyzing weaving areas and ramp junctions. The HCM directly relates LOS in weaving areas to the average speeds of the weaving and nonweaving vehicles. The primary measure of LOS for ramp junctions is density in the influence area of the ramp. The HCM describes how to use the basic freeway segment, weaving area, and ramp junction analysis tools together for a complete freeway capacity analysis, and a good understanding of system effects. However, these procedures tend to be more approximate and less precise than those applied to specific freeway elements.

SYSTEM PLAN METHOD

The System Plan Method (SPM) was developed jointly by the Texas Department of Transportation (TxDOT), North Central Texas Council of Governments (NCTCOG), Dallas Area Rapid Transit (DART), and Texas Transportation Institute (TTI) to provide a transportation analysis tool that would help bridge the gap between regional mobility planning and detailed corridor analysis *(25)*.

Since the transportation plans developed by different agencies tended to reflect the initial assumptions and priorities of those agencies, there was also a need to develop a tool that would help to provide system compatibility as the planned projects moved towards implementation. In other words, it was the intent of the SPM to ensure that the various elements of the transportation system worked together such that the capacity available in each segment could be utilized to its maximum. In order to achieve these basic objectives, the SPM is an iterative approach that evaluates alternatives for each corridor, then looks at how the best alternatives in each corridor fit together to form a system.

The corridor analysis begins with the collection of required data input items including travel data (existing and design year 24-hour volumes for freeways, HOV lanes, bus systems, and transit systems; percent of 24-hour traffic in the peak hour, peak hour directional splits, and peak hour truck percentages), roadway data (existing lanes, right-of-way limits, roadway structures, and buildings adjacent to the corridor), and information on planned projects in the region. These data are input into the SPM spreadsheets to evaluate a variety of cross section alternatives for a corridor. Cross sections can include a mix of facility types, such as general purpose lanes, HOV lanes, and express lanes. Given a particular volume of peak hour person trips, the spreadsheets determine the critical lane volumes for each facility type based on known relationships and capacity constraints that recognize that people will change their travel behavior when given the opportunity to avoid congestion. Finally, the SPM calculates a total net present cost to rank the performance of the various alternatives in the corridor. The original SPM considered capital costs (rehabilitation, construction, and right-of-way), operating and maintenance costs, and congestion delay as costs. Subsequent refinements to the methodology have added other costs (e.g., environmental and congestion from incidents) into the evaluation. The alternative with the lowest net present cost is considered to be the best alternative for that corridor and is used as the initial input into the system analysis.

The system analysis looks at the results of the corridor analysis to determine if the best alternatives for each corridor will operate efficiently as a transportation system. If there are lane balance or continuity problems between adjoining or intersecting corridors, then lower ranking alternatives for a particular corridor may be considered to ensure system compatibility.

TTI developed the original SPM in conjunction with the NCTCOG Mobility 2010 Plan Update in 1992. TTI made refinements to the methodology as part of three research studies (*26*-*28*). These studies modified the spreadsheets to include additional HOV data and extended the public cost model to include environmental costs (fuel consumption, air quality, noise, and visual impacts), congestion delay costs associated with incidents (nonrecurrent congestion), costs associated with commercial vehicles, and the effect of tolls. The final report of the latest research study (*28*) includes an expanded users manual for use of the SPM, which is in a Microsoft Excel spreadsheet format.

The SPM allows for the rapid assessment and refinement of roadway alternatives using lowest total public cost as the primary criteria. The SPM can handle alternatives with combinations of general purpose, express, toll, HOV, and high occupancy toll (HOT) lanes. HOT lanes are, in general, HOV lanes that allow single occupant vehicles (SOVs) access for a toll. HOT lanes are also known as managed HOV lanes. The SPM spreadsheet is easy to use, and it provides flexibility in defining input parameters.

PATH FLOW METHOD

The Path Flow Method is a planning level analysis tool to assess the capacity of freeway elements based on projected traffic demand for major movements through interchanges. TTI developed the Path Flow Method described here to analyze the proposed changes in the Canyon and Mixmaster (I-30 and I-35E interchange) of the Trinity River Corridor MIS. The method is useful where there are multiple paths, such as complex interchanges with collector-distributor roads, freeways that merge and then separate downstream, and combinations of general purpose and special use lanes at interchanges. The method helps to check that the capacity provided for each path is consistent with the traffic demand and allows refinement where the capacity is in excess or shortfall. It is more detailed than link analysis alone because the demands for each movement, such as weaving volumes, are identified within each link.

The first step of the method is to quantify the desired peak hour origins and destinations through the interchange. There are up to twelve possible movements through a common interchange of two freeways. More movements and potential paths will occur if there are additional interchanging freeways, if special use lanes are provided, or if ramps to or from local streets are proposed in the interchange. Good estimates or forecasts of future peak hour movement demands are essential to this path flow analysis. The analyzer should use existing movement demands to derive the future volumes if peak hour travel forecasts are not available. The path flow analysis done for the Trinity River Corridor MIS used a peak hour travel forecast for the year 2020.

The second step of the method is to check link capacities against demand volumes. The link analysis methods described in the HCM can be used to measure the expected LOS of the ramp connection, collector-distributor road, or mainlane section, etc. If any link or freeway element is over capacity, a check is made to see if capacity is available on alternate paths; the volume demands are adjusted and link capacities are rechecked. Once the volumes are adjusted, merge and diverge problems and high weaving volumes are readily identified, and the number of lanes or the position of ramps can be changed to meet the demand and overcome weaving problems.

The value of this relatively straight forward volume-to-capacity assessment at the planning stage cannot be overstated. It is at this point that the MIS team can easily make minor changes in the conceptual design that will allow major cost savings in construction and in future freeway operations.

III. MIS CASE STUDIES

The data collection phase of this research involved the identification of completed MISs in Texas and around the country. Researchers attempted to identify as many potential MIS case studies as possible at the beginning of the research by making agency contacts with FHWA and state DOTs, as well as searching for Internet web pages that had been set up to support the public participation efforts for some of the studies. The research team identified more than 30 potential studies. In order to work with a manageable number of locations, a screening process was used to narrow the list to 10 to 15 case studies. In general, there was an effort made to choose MISs that would satisfy the following factors:

- the studies should focus on corridors with existing roadway facilities or new corridors where roadway facilities are given strong consideration;
- about one-third of the studies should come from Texas with the remaining locations being distributed around the country;
- most locations should be identified as urban or suburban areas;
- there should be a mix of radial and circumferential facilities;
- the lead agency should include a combination of state departments of transportation and metropolitan planning organizations;
- some of the studies should have been completed by consultants and some by "in house" staff of the lead agency; and
- there should be a mix of sequential studies where the MIS proceeds prior to beginning the National Environmental Policy Act (NEPA) process (Option 1) and concurrent studies where the NEPA process begins as the MIS is being done (Option 2).

The researchers expected that adherence to this list would provide a set of MISs that would provide a wide range of approaches and experiences as they relate to traffic demand analysis. As can be seen in Table 1, which lists the case study locations, the first five factors are well represented. The last two factors could not be met because all of the MISs were sequential (Option 1) MIS studies, and used a consultant to manage the study and conduct technical analysis.

Table 1. Case Study Locations and Selection Factors.

Case Study	Existing Facility	State	Urban, Suburban, or Rural	Radial or Circumferential	Lead Agency	Consultant or Lead Agency	MIS Type
US50 Corridor	Freeway/LRT	CA	Urban/Suburban	Radial	MPO	Consultant	Sequential
Central County Corridor	Freeway/Rail	CA	Urban	Radial	MPO	Consultant	Sequential
East, Southeast, and West Corridors[1]	Freeway	CO	Urban	Radial	MPO, State DOT, Transit	Consultant	Sequential
I-4 Corridor	Freeway/LRT	FL	Suburban/Rural	Radial	State DOT	Consultant	Sequential
US78 Corridor	Freeway/ Arterial	GA	Urban/Suburban	Radial	MPO	Consultant	Sequential
Ohio River	Freeway	KY	Urban	Radial	MPO	Consultant	Sequential
US301 Corridor	Arterial	MD	Suburban/Rural	Radial	State DOT	Consultant	Sequential
I-435 Corridor	Freeway	MO	Urban/Suburban	Circumferential	State DOT	Consultant	Sequential
Trinity River Corridor	Freeway	TX	Urban	Radial	State DOT	Consultant	Sequential
I-635 (LBJ Freeway) Corridor	Freeway	TX	Urban/Suburban	Circumferential	State DOT	Consultant	Sequential
I-10 (Katy Freeway) Corridor	Freeway	TX	Urban/Suburban	Radial	State DOT	Consultant	Sequential
Capital Beltway Corridor	Freeway	VA	Suburban	Circumferential	State DOT	Consultant	Sequential
SR-16 / Tacoma Narrows	Freeway	WA	Urban/Suburban	Radial	State DOT	Consultant	Sequential

[1]This case study examines three MISs that were conducted concurrently in Denver, each with a different lead agency.

US50 CORRIDOR MIS

Location:	Sacramento, California
Lead Agency:	Sacramento Area Council of Governments (SACOG)
Completed:	December 1997

Description

US50 is a radial freeway corridor on the eastside of Sacramento running from the urban area of the downtown Sacramento central business district (CBD) to suburban areas in western El Dorado County (*29,30*). It is approximately 26 miles in length and lies mostly in Sacramento County. Significant job growth is occurring in suburban activity centers along the corridor, and residential development is occurring primarily in the eastern end of the corridor. Travel patterns reflect the recent suburbanization of jobs and are showing an increase in reverse commuting.

The eastern end of US50 has only four lanes, but it expands to six lanes and then eight lanes as it approaches the central business district. Major parallel arterials are Folsom Boulevard and White Rock Road. A light-rail line extends from downtown Sacramento out approximately one-quarter of the distance of the corridor. Several transportation improvements were in the works during the MIS including a light-rail transit (LRT) extension, interchange improvements on US50, and intelligent transportation system (ITS) improvements in the corridor.

A policy advisory committee composed of elected officials, a technical advisory committee of transportation officials, and a public outreach program made up the public involvement efforts of the MIS. The purpose and need for the MIS focused on the mobility concerns for the corridor (*29, page ii*):

> "The US50 transportation corridor in Sacramento County is rapidly becoming overwhelmed by travelers, as shown by current and future congestion levels, particularly during commute periods. Several reasons for considering major investments for this corridor are to maintain mobility in the face of this large increase in travel, to provide travel options for those who can't or don't want to use personal vehicles, and to provide incentives to carpool or use transit."

The outreach program included open public meetings to present the alternatives and later to discuss the analysis, open committee meetings, presentations to local government agencies in the corridor, and a general mailing list to 2000 people and groups located in the corridor. The only major controversy came from environmentalists who did not want HOV lanes added in the corridor.

Range of Alternatives

The policies adopted as a part of the Sacramento regional transportation plan played an important role in shaping the alternatives considered in the US50 MIS. In part, these policies stressed that all major projects or facilities be planned as multimodal including transit use, carpooling, walking, and bicycling, as well as single occupant vehicles (SOVs). The range of alternatives considered fall into four approaches with the addition of a base case scenario that includes all transportation improvements already approved and funded in the corridor. The four approaches were:

- Approaches A and B provide two bi-directional HOV lanes from the CBD to the eastern end of the study area at El Dorado Hills. Approach A includes an extension of the existing LRT line to Gold River, at about the midpoint of the corridor, while Approach B extends the LRT several miles further to Iron Point.

- Approach C focuses on lower cost systems by proposing conversion of a general purpose lane in each direction to an HOV lane between the CBD and Hazel, and allowing for an SOV "buy in" policy.

- Approach D extends the existing LRT line to Gold River and adds commuter-rail service to Folsom. Like approaches A and B, it includes the addition of two HOV lanes throughout the corridor.

The study team considered several strategies at the beginning of the MIS process for US50 that were excluded from the final set of alternatives:

- general purpose lanes,
- single direction or reversible HOV lanes,
- land use alternatives, and
- transit only alternatives.

The study team did not pursue further consideration of single direction or reversible HOV lanes for two reasons. A previous study determined that the cost of providing one additional median HOV lane in the US50 corridor would cost between 70 and 80 percent of the cost of building bi-directional lanes. In addition, there was an expectation that travel demand in the corridor would continue to trend toward a balanced directional split during the peak period.

Traffic Demand Analysis

SACOG's regional forecasting model (SACMET) was the primary tool used to evaluate travel demand for the US50 corridor. One of the first tasks in this MIS was for the consultant to study existing HOV lanes in Santa Clara County and to use the resulting data to refine the SACMET so that it could more effectively predict HOV usage. In addition to this enhancement, the model is flexible in that it can produce direct traffic assignments for a three-hour peak period and three-hour nonpeak (midday) period, as well as a 24-hour assignment.

Its first application in the MIS was to provide an assessment of existing traffic conditions and future conditions assuming the base case scenario. Conditions estimated were the percent of lane miles congested during peak hours, peak period levels of service, peak period delay, mode choice for work trips, and morning peak hour travel times. A survey of trucking companies also showed that congestion was an increasing problem. The 2015 assessment under the base case helped define the extent of the problem:

- 24-hour traffic volumes will grow 30 to 50 percent in the western half of the corridor and about 70 percent in the eastern end.

- Traffic growth will occur disproportionately on the arterial roadways in the corridor because of congestion on the freeway.

- Over 80 percent of US50 will operate at LOS F for at least one hour during each peak period of the day; 40 to 50 percent will experience LOS F for two to three hours during each peak period.

- Vehicle hours of delay will increase by about 300 percent.

- Travel time from El Dorado Hills at the eastern end to the central business district will increase from 43 minutes to 59 minutes.

The study team used the SACOG model to generate forecasts for each of the alternatives using time horizons of 2005, 2010, and 2015. The different time horizons provided information that would be helpful in phasing construction of the project. From the forecast, the study team estimated several MOEs including 24-hour and peak hour throughput and transit ridership, peak hour LOS for SOVs and HOVs, 24-hour and peak hour travel time savings, and peak hour vehicle occupancy. The study team studied various transportation management and land use measures to understand their effectiveness in reducing morning peak hour SOV trips separately and in combination. The study team coded specific HOV entrance/exit scenarios into the model's network to provide data to evaluate their effectiveness and impacts on the arterial street system.

Recommended Alternative

The final report recommended a combination of HOV, rail, and transportation management strategies that most closely matches Approach D among the alternatives: add two bi-directional HOV lanes in the median of US50, extend LRT service as far as Sunrise Boulevard, and pursue an LRT or commuter-rail connection between Sunrise and Folsom.

CENTRAL COUNTY CORRIDOR MIS

Location:	Orange County, California
Lead Agency:	Orange County Transportation Authority (OCTA)
Completed:	June 1997

Description

The central part of Orange County included in this MIS extends 28 miles from the Fullerton Transportation Center south to the Irvine Transportation Center and is about 6 miles wide (*31*). No longer a bedroom community, this area has high employment and population densities, and is home to more than 20 major activity centers including Disneyland, John Wayne Airport, and the Irvine Spectrum.

Although referred to simply as "The Corridor" in this study, it is more of a subarea than a linear corridor. A multimodal transportation system already serves the corridor by including:

- freeways (I-5, I-405, SR-57, SR-55, SR-22, SR-91, and SR-73),
- grid of major arterial streets,
- extensive bus transit network, and
- Metrolink commuter rail.

OCTA developed a public involvement program that was comprehensive and used different outreach strategies for different phases of the MIS. The strategies included direct mailings with surveys, open houses, presentations to targeted audiences, extensive consultations with five advisory committees, extensive media efforts, a comment hotline, interviews with community leaders, presentations to five city councils, newsletters, interactive kiosk at five activity centers, a web page, and a transit riders intercept survey.

Range of Alternatives

The study team developed at the beginning of the MIS process a wide range of possible transportation ideas. In order to identify the best solutions for the corridor, OCTA identified a three-step process that would provide a methodology to screen candidate alternatives from a large group of possible ideas, to approximately 10 reasonable alternatives, and finally, to a set of viable alternatives for further analysis. At each level the study team used the same four major criteria for the evaluation: mobility impacts, environmental impacts, public policy support, and cost effectiveness.

The six alternatives selected for detailed technical analysis were focused on distinct modes rather than different mixes of several modes:

- No Build or Do-Nothing Alternative. This alternative maintains transit service at 1995 levels and adds only freeway/roadway elements that are already planned, funded, and/or environmentally cleared. It is a baseline for evaluating other alternatives.

- Transportation System Management (TSM). The TSM improvements include signalization enhancements, increased bus service, introduction of business class commuter express bus routes, and additional commuter-rail seats.

- Enhanced Bus Alternative. This option includes all the elements of the TSM alternative and adds more comprehensive bus system improvements.

- Freeway/Roadway HOV Alternative. A system of two lane bi-directional HOV lanes would be added to five roadways in conjunction with a set of supporting TSM actions. An option would be available to convert the HOV lanes to HOT lanes in the future.

- Rail System Alternatives. The study team defined two LRT alternatives on different alignments to connect the Fullerton and Irvine Transportation Centers. Both systems would include supporting feeder bus systems.

- Freeway/Roadway Mixed-Flow Alternative. The freeway/roadway option includes the same lane additions as identified for the HOV option except that they would be open to all traffic.

Traffic Demand Analysis

The Central Corridor MIS used system level MOEs derived from the regional travel model as the primary tool for defining travel problems in the corridor and evaluating the differences between the alternatives.

Despite the baseline improvements included in the no-build alternative, growth trends in the county indicated that freeway and arterial congestion will worsen by the year 2015 as shown by the following projections:

- corridor travel will increase 40 percent to 6.6 million daily trips,
- transit reliant population — elderly, students, disabled, and low income — is expected to double,
- freeway congestion will increase — 73 percent of the system will operate at 30 mph or less during peak hours representing a 43 percent increase in congestion since 1990, and
- arterial congestion will increase — the number of major intersections operating at level of service F will increase from 4 percent in 1990 to 27 percent in 2015.

Evaluation criteria for mobility impacts used in the selection of the locally preferred strategy (LPS) included travel time savings, transit person trips, carpool person trips, and the percentage of freeway and uncongested arterial lane miles. Once the study team chose the LPS for this MIS, the study team developed a preliminary assessment of environmental impacts and conceptual mitigation measures. Some of the measures used to compare the LPS with the baseline condition were:

- daily auto trips and VMT,
- daily HOV vehicle and person trips,
- HOV and SOV travel times between selected origins and destinations,
- system-wide freeway and arterial congestion (volume to capacity ratios and level of service),
- screenline analysis of 24-hour roadway traffic volumes,
- selected arterial v/c ratios, and
- total intersection demand.

Each of these measures can be derived from the regional travel forecast model.

Recommended Alternative

The locally preferred strategy includes expanded bus service, transit related capacity improvements, 1000 new seats on Metrolink, and a fixed guideway rail system from the Fullerton Transit Center to the Irvine Transit Center. The freeway system improvements that were analyzed as a part of the MIS process will continue to be pursued although they are not formally part of the LPS.

EAST, SOUTHEAST, AND WEST CORRIDORS MIS

Location:	Denver, Colorado
Lead Agency:	Colorado Department of Transportation (CDOT) Denver Regional Council of Governments (DRCOG) Regional Transportation District (RTD)
Completed:	July 1997

Description

The Denver Regional Council of Governments (DRCOG), the Colorado Department of Transportation (CDOT), and the Regional Transportation District (RTD) conducted concurrent studies on three corridors in the Denver area *(32-37)*:

- The East Corridor is about 25 miles in length and provides the critical link along I-70 between the central business district and the new Denver International Airport.

- The Southeast Corridor connects the two largest employment centers in the region along I-25 from Denver's central business district to the south I-25 business area.

- The West Corridor connects predominantly residential communities along Sixth Avenue (US6) and West Colfax Avenue (US40) to Denver's central business district.

To ensure that each study followed the same technical process, the three agency partners and their consultants developed a "Guidance Manual for Technical Analysis." A high degree of consistency was desired so that the public would not be confused by three different processes and decision makers would be able to make direct comparisons among the studies. The guidelines require each study to follow the same basic four-phase technical process *(32)*:

- define the purpose and need for a major transportation investment;
- identify potential solutions at a conceptual level and determine those that are deemed most promising;
- define the short list of alternatives in detail and conduct a detailed technical evaluation, thereby providing a solid technical basis for decision making; and
- develop a consensus on the preferred mix of improvement strategies to be implemented based on a pro-active community involvement process.

The first three steps require some level of traffic demand analysis as defined in the *Guidance Manual*. Rather than describe the Denver MISs, this section will examine the types of traffic demand analysis identified by the *Guidance Manual* for all three studies.

Purpose and Need

The manual provides minimal guidance with regard to establishing the purpose and need for each MIS. The objective of this phase is to clearly define the corridor mobility deficiencies that the study is intended to address. At a minimum, it should identify goals and policies, provide a synopsis of any past studies, and examine existing and future traffic conditions. This should include roadway operational deficiencies such as weaving problems, bottlenecks, inadequate interchanges, and traffic movements not being served.

Conceptual Level Evaluation

The conceptual level evaluation is the first of a two-level screening process. At this level all ideas are compiled from prior studies, technical staff, and the public participation process. At this point the ideas are described simply by mode and general alignment. The study team does a pre-screening to eliminate suggestions that have fatal flaws. Fatal flaws might include inconsistency with regional goals and policies, unacceptable cost, unsolvable environmental impact or community/agency opposition, or unproven technology. The study team does not consider mobility analysis at this stage of the analysis.

Once the pre-screening is completed, the study team defines the remaining alternatives in somewhat more detail. Additional information might include general descriptions of location, horizontal alignment, vertical profile, typical cross section, as well as other features. Sketches on aerial photographs would be appropriate at this level. The criteria used to screen these criteria are the same as the pre-screening with the addition of some mobility measures.

The study team can only address traffic demand analysis in general at this stage. The focus of the analysis is on the relative performance of different alternatives. The guidelines specify that DRCOG will provide a baseline travel forecast assignment for 2015; individual assignments for different corridor, mode, or alignment alternatives will not be done. Study teams are instructed to rely on previous studies and model runs, and professional judgment to develop relative mode/alignment results. The two criteria identified to measure mobility effects are utilization of transit modes and travel time between selected key origins and destinations.

Detailed Level Evaluation

The detailed level evaluation provides the technical basis for decision making within each corridor. Each study team advances the no-build and TSM alternatives into the detailed analysis. The study teams will individually examine at this level the other alternatives that have passed the conceptual level screening; however, there is an understanding that at some point the study teams will need to give some consideration to mixing and matching alternatives to achieve a consensus.

The guidelines provide support information such as a general description, typical sections, design standards, and operating characteristics for each of the common modes: freeway lane additions, bus/HOV lanes, LRT, commuter-rail, and electric trolley bus. The guidelines also describe the measures that the study teams should use to evaluate the effectiveness of any given alternative to address the capacity constraints in a corridor, and to reduce congestion and delay. A definition and methodology to calculate each measure is included. The basis for the detailed evaluation for each MIS was the 2020 regional transportation model, which projects average weekday conditions. The measures are listed below:

- person-carrying capacity provided per hour in the peak direction,
- potential person-carrying capacity provided per hour in the peak direction,
- maximum link utilization,
- number of users per day,
- regional system utilization — total daily VMT,
- corridor congestion using peak hour v/c ratios across screenlines,
- travel times between select O-D pairs,
- person-hours of delay,
- travel time reliability, and
- impact to goods movement.

I-4 MIS

Location: Orlando, Florida
Lead Agency: Florida Department of Transportation (FDOT)
Completed: May 1996

Description

This MIS is part of the I-4 Multi-Modal Master Plan (MMMP), which is to serve as a blueprint for corridor improvements through the year 2020 (*38*,*39*). The study team intends that corridor improvements address increasing travel demand by maximizing the people moving capacity and providing travel choices. The study team derived the specific goals and objectives of the I-4 MMMP from FDOT's *Interstate Highway Policy* to guide the development and evaluation of alternatives. The *Interstate Highway Policy* defines the limits of highway expansion and should provide statewide environmental benefits, growth management benefits, economic benefits, increased capacity, reliability, and should be affordable. In addition to FDOT, the study team involved several agencies in the MIS process: the Central Florida Regional Transportation Authority (known as LYNX), Votran, FHWA, FTA, and the Orlando and Volusia Metropolitan Planning Organizations.

The part of I-4 under study is a 75-mile corridor that runs north and south of the Orlando CBD in Central Florida. The I-4 corridor has parts that can be described as urban, suburban, and rural. It also goes through a large tourist area that includes Walt Disney World. The corridor is primarily residential with pockets of commercial and industrial areas, with several activity centers along the corridor.

The MIS incorporated an extensive public involvement program. The study team established a project office to coordinate public involvement. The project office provided newsletters and press releases on a regular basis, and made numerous presentations to public groups. Also, a project advisory group met frequently.

Range of Alternatives

In Florida, according to FDOT's *Interstate Highway Policy*, in urban areas no more than 10 lanes may be constructed with six lanes for general use and four lanes for special use with an accommodation for a fixed guideway where appropriate. The study team considered nine alternatives ranging from retrofitting HOV lanes to a combination of SOV, HOV, and LRT improvements. All alternatives have some form of special use lane and TSM improvements. Special use lanes are for HOVs or SOVs and trucks traveling through the corridor without stopping. However, the study team limited single-lane special use lanes to HOVs. Transit improvements consisted of either express bus or LRT. Provision for intercity high speed rail through the corridor is also made for each alternative.

Traffic Demand Analysis

The study team established existing traffic characteristics to provide a basis for future conditions and to identify existing problems. The study team derived morning and evening peak hour properties from 1992 FDOT traffic counts, and traffic counts performed for the I-4 project's external O-D study. FDOT provided historical average 24-hour traffic counts from count stations. The study team used LOS from HCM procedures to provide an overview of existing operations on I-4 and arterial streets providing access to I-4. The study team obtained transit ridership from area transit agencies and transit providers.

The study team presented coordinated travel demand forecasts in the I-4 Bridge Study. The bridge study combined transit and highway regional travel demand forecasts to meet both FHWA and FTA requirements for coordinated highway and transit analysis using multi-modal travel demand modeling procedures for 2020. The bridge study described future conditions for the I-4 corridor as a function of regional population and employment growth, activity center development, land use patterns, travel demand, and transportation networks. The study team expects much of the future growth and travel demand to be focused on 12 activity centers. The study team expects daily person trips to double in the next 30-year period, and 50 percent of all expected trip attractions to be to an activity center.

The study team assessed five evaluation criteria with one or more MOEs. Traffic MOEs used were VMT, LOS on general and special use lanes based on the v/c ratio, hourly person trip capacity, and the increase in non-SOV trips.

Recommended Alternative

The MIS resulted in a recommended design concept for the I-4 corridor consisting of six general use lanes separated by a buffer and/or barrier from two bi-directional HOV lanes and an LRT system. The study team found this concept to have the best increase of vehicle occupancy rates without adversely impacting light-rail performance. The LRT system provides capacity, mobility options during highway construction, and an incentive for private participation in station development.

US78 CORRIDOR MIS

Location:	Atlanta, Georgia
Lead Agency:	Atlanta Regional Commission (ARC)
Completed:	March 1996

Description

The US78 MIS examines a major east-west radial route that begins at the I-285 loop and extends about 20 miles out into the fast growing northeast suburban areas of Atlanta *(40)*. The US78 study corridor is about 20 miles in length, and transitions from a six-lane freeway at its western end in DeKalb County to a four-lane arterial with two reversible lanes, then finally to a four-lane arterial with a two-way center left-turn lane.

High suburban growth rates produce severe congestion, safety problems, and other operational concerns along US78. Growth has been increasing daily traffic steadily in the corridor; counts range from 70,000 to 104,000 in the freeway section to 18,000 to 75,000 in the arterial sections. The corridor has a directional split as high as 80/20 approaching Atlanta.

The stated goal of the study as defined by the Corridor Resource Group (CRG), a study committee consisting of technical staff, elected officials, and interested citizens, was "to develop and define the most beneficial and cost effective transportation solutions that address local and regional issues in the corridor, and be consistent with local, regional, and state objectives and federal regulations" *(40, page I-3)*. The CRG identified the following transportation issues and objectives:

Issues

- operational issues (reversible lanes and signs),
- impact of US78 traffic on DeKalb County,
- traffic congestion in Snellville and need for a bypass,
- problems at the US78 and SR-124 intersection,
- additional traffic created by population growth, and
- safe and efficient traffic flow.

Objectives

- preserve and use existing transportation facilities efficiently and effectively,
- relieve and prevent future congestion on US78 and other roadways,
- provide for access to other transportation modes,
- provide for regional connectivity of transportation facilities,
- provide for compatibility between the existing and projected land use and transportation improvements,
- preserve the right-of-way for future transportation facilities,

- provide transportation solutions that have minimal impacts on the natural and human environment,
- provide for efficient freight movement, and
- provide for vehicular and pedestrian safety.

The study team were provided several opportunities for public participation. The study team held a public forum after Phase 1 of the alternative analysis to present the results and to review the proposed alternatives. The study team preceded the public forum by newspaper ads with a brief survey attached. The study team distributed a longer survey at the public forum. The study team held a second public forum to present the results of the Phase 2 analysis and to obtain additional public comment. The study team also asked attendees to complete a survey.

Range of Alternatives

The evaluation process consisted of two phases: Phase 1 identified and screened a broad range of alternatives, which included no-build, conventional highway improvements, new location for highway, highway with express or HOV lanes, transit, and land use/demand management strategies. The study team further refined and evaluated those concepts that survived a critical flaw analysis in the first phase in Phase 2. These alternatives included no-build, southern route, northern bypass, shorter southern bypass, express lanes along US78, express lanes with northern bypass, and express bus service on express lanes.

Traffic Demand Analysis

Traffic growth has been steadily increasing the average daily traffic along US78, and other routes in the corridor have also had large increases in traffic growth. The study team determined capacity deficiencies of the existing US78 by computing v/c ratios with the existing average daily traffic. The study team found the existing accident rate on US78 to be comparable to the statewide average.

The study team did no traffic demand analysis in Phase 1 of the study. However, Phase 1 surveys did identify addressing traffic demand as the most important factor to consider in planning solutions. In Phase 2, the study team evaluated the selected alternatives in more detail. The year 2010 served as the planning horizon year for the MIS. The ARC forecasted the 24-hour travel demand for the US78 corridor including scheduled improvements. The technical staff used reduction in congestion (v/c ratio) and effectiveness (number of users) as their quantitative MOEs for transportation service and based their analysis on the 24-hour traffic assignments. The study team also conducted a system level performance evaluation by calculating reductions in daily VMT and daily VHT using the 2010 travel forecast. The results, shown in Table 2, indicate that all the alternatives provide improvement as compared to the no-build, but the difference between the alternatives does not stand out.

Table 2. US78 Transportation System Performance Indicators.

Alternative	Reduction in VMT	Reduction in VHT
No-Build	0	0
Southern Route	129,000	89,500
Northern Bypass	121,000	116,000
Shorter Southern Bypass	158,200	79,700
Express Lanes along US78	131,300	97,900
Express Lanes with Northern Bypass	121,600	81,400

Recommended Alternative

The US78 MIS identified three recommended alternatives for further development and consideration in the environmental review process. All three recommendations included an upgrade of the existing freeway section of US78 from six to eight lanes.

- Expand the arterial sections to a four- or six-lane freeway with frontage roads, and provide a limited access bypass, without frontage roads, around the north side of Snellville.
- Add two reversible express lanes in the median of the arterial section west of Snellville, transition from the reversible express lanes to four-lane freeway on a bypass around the north side of Snellville, then provide a four-lane freeway with frontage roads east of Snellville.
- Add two reversible express lanes in the median of the arterial section west of Snellville, elevate the express lanes through Snellville, then transition to a four-lane freeway with frontage roads east of Snellville.

OHIO RIVER MIS

Location: Louisville, Kentucky
Lead Agency: Kentuckiana Regional Planning & Development Agency (KIPDA)
Completed: April 1997

Description

The purpose of the Ohio River MIS (ORMIS) was to address the problem of current and future travel mobility across the Ohio River between Kentucky and Indiana in the Louisville region (*41*). Locations to cross the Ohio River are limited and congested. I-64 and I-65 each cross the river, and a third bridge carries US31 across the river. All three bridges have narrow lanes and no shoulders. Three radial interstates (I-64, I-65, and I-71) converge near downtown Louisville, and the interchange of the interstates is known as “Spaghetti Junction.”

There is a need to reduce congestion and increase capacity across the river. The Kennedy Bridge (I-65) has four northbound lanes and three southbound lanes. Existing demand on the bridge is near capacity. The main source of congestion is in the nearby interstate interchange. The Minton Bridge (I-64) has three lanes in each direction, and has little delay except during incidents. The Clark Bridge (US31) is a four-lane undivided arterial and demand is limited by signals in downtown Louisville.

A major public involvement and information program included public work sessions, 19 committee meetings open to the public, meetings with the Regional Mobility Task Force (RMTF) and other special interest groups, resource center and hotline, fact sheets, resource papers, newsletters, and public service announcements.

Range of Alternatives

The ORMIS process was a two-phase process. The first phase of the process narrowed a list of more than 130 solution ideas into seven “Level 1” alternatives, some of which had options for different alignments. The second phase of the study, called “Level 2,” narrowed the number of alternatives to four: the first three included new bridges across the river and a partial, or full, reconstruction of “Spaghetti Junction,” and the last one consisted of a new LRT line crossing the river.

Traffic Demand Analysis

The study team made capacity analysis of the existing river crossings using HCM procedures to identify the specific source of congestion problems. In addition to traffic counts, truck counts, and travel time runs, two O-D studies conducted for other studies were available for the analysis of existing conditions.

The study team used the same evaluation criteria for Level 1 and Level 2 analysis; however, the study team made a greater level of effort in generating data for the Level 2 analysis. For example, the study team utilized the mode choice component of the model to provide a better analysis of the HOV and transit effects on the highway volumes and levels of service. Since the travel forecasting model applied by the KIPDA for the year 2020 generates only 24-hour assignments and system level MOEs, the study team used these measures to compare alternatives. The study team generated peak hour volumes using estimated K and D factors to check the effectiveness of the design concepts for "Spaghetti Junction." The study team also used the model to generate unconstrained traffic assignments to demonstrate the level of traffic demand at the river crossings if there were no congestion.

Recommended Alternative

The preferred investment strategy included two new bridges and a full rebuild of "Spaghetti Junction," as well as some bus-oriented transit improvements and short-term traffic operations improvements. In spite of the higher level of analysis given the "Spaghetti Junction" design, the study team recommended and made it clear that the environmental review will complete the analysis of all interchange options.

US301 MIS

Location: Prince George's and Charles Counties, Maryland
Lead Agency: Maryland Department of Transportation (MDOT)
Completed: November 1996

Description

US301 stretches 50 miles from US50 to the Potomac River, and is experiencing heavy congestion and increasing accidents due to fast growth in the region east of Washington, D.C. (*42*). The US301 corridor has a mix of suburban and rural characteristics, but mostly suburban with residential and commercial development. US301 is a four- to six-lane arterial street with at-grade intersections and signals. About 90 percent of its trips are local.

MDOT initiated the MIS to meet mobility needs and to maintain environmental quality and neighborhood character. In the late 1980s, MDOT proposed that the corridor be a full freeway bypass for Washington, D.C., but it was met with intense community opposition. MDOT organized a 75 member task force to conduct the MIS. Due to opposition toward the previous freeway proposal, the task force designed a comprehensive public involvement program to educate the public about the process. The committee of education and information, one of four standing committees of the task force, oversaw the public involvement effort, which included public hearings and workshops, a speakers bureau, and media contacts (news releases, media interviews, etc.).

Range of Alternatives

The range of alternatives considered in this study included a series of land use alternatives in addition to six transportation study packages. The six transportation packages represent different modal options that the study team distilled from an initial set of nearly 150 proposals:

- Base Case: existing and planned transportation improvements expected to be in place by 2020;
- Transportation Systems Management: minor construction and operational improvements to improve safety and operating efficiency without major capital expenditures;
- Transportation Demand Management: voluntary and pricing programs designed to increase vehicle occupancy, shift travel time, or eliminate trips;
- Rail Transit: light rail and commuter rail transit with feeder bus service to rail transit stations;
- HOV/Bus: high occupancy vehicle lanes reserved for use by carpools, vanpools, and buses; and
- Fully Controlled Access Highway: access provided only at interchanges.

In order to fully assess the effectiveness of the transportation options, the study team went a step further in identifying eight land use scenarios that could result from market driven forces or land use policies. Part of this analysis included shifting 40,000 to 80,000 jobs from Washington, D.C., to the US301 study area depending on the transportation scenario.

Traffic Demand Analysis

The study team defined existing conditions in the US301 corridor using vehicle counts, an O-D survey, and vehicle classification counts. A level of service analysis using HCM procedures found that 6 to 7 of 23 intersections in the corridor operate at LOS F where the average vehicle is stopped for greater than 60 seconds.

The study team used traffic forecasts for the year 2020 as the key analysis tools to analyze the transportation study packages in combination with the land use alternatives. Once the study team evaluated the alternatives separately, the study team established a project committee to examine combinations and to develop an alternative that integrated the best of each mode. The decision making criteria for the study included the following transportation concerns:

- congestion (travel speed and time),
- accident projections,
- access to and potential use of transit, and
- and transit ridership and travel time.

Recommended Alternative

The locally preferred alternative included a mix of freeway, arterial, HOV, and bus service elements. It also included recommendations for MDOT to begin to buy access rights along the roadway and for local jurisdictions to develop land use policies that would focus development at future interchanges to avoid strip development.

I-435 MIS

Location: Kansas City, Missouri
Lead Agency: Missouri Department of Transportation (MoDOT)
Completed: August 1997

Description

The purpose of this MIS was to address transportation problems in the I-435 corridor on the eastern side of Kansas City by determining the best type of improvements to meet the area's future travel demands *(43)*. The I-435 corridor is about 25 miles long extending from the US71 and I-470 interchange north to the I-35 interchange. The six-lane freeway serves several activity centers and frequently operates over capacity.

The I-435 study had an extensive public involvement program including formation of a stakeholders group, three public meetings, media advertising, phone hot line, newsletters, informational webpage, and an e-mail address.

Range of Alternatives

MoDOT and the study team considered a full-range of multimodal options in the initial set of conceptual strategies, including no-build, roadway improvements, transit improvements (bus and rail), HOV, transportation demand management (TDM), and ITS. The study team evaluated these options individually and it was determined that some combination of strategies would best serve the corridor's needs. The study team identified five combination alternatives for detailed evaluation:

- No-Build: roadway improvements that already have funding commitments, continued maintenance of the I-435 pavement, and implementation of an ITS strategy;
- Roadway Improvement: widening of the existing pavement to eight lanes and an ITS strategy;
- Bus Transit: roadway improvement and ITS elements plus improved bus service and park-and-ride lots;
- HOV lanes: roadway, ITS, and bus improvements plus two concurrent flow HOV lanes in the median of the freeway; and
- Demand Management: combination of ITS, bus improvements, and strategies to reduce travel demand.

Traffic Demand Analysis

The study team developed traffic projections for the study area using the Mid-America Regional Council (MARC) transportation model for the year 2020. The study team estimated peak hour volumes using estimates of K and D factors based on existing traffic data.

The I-435 study team put significant effort into developing and refining alternatives. The study team made a strong connection between the sizing of the link capacity and the interchanges that feed it. An examination of forecast volumes from the initial screening indicated that an eight-lane roadway section would be sufficient to serve future traffic needs. The study team evaluated each of the major interchanges to determine any deficiencies, then developed design alternatives representing different levels of investment. These could vary from complete reconstruction of the interchange (high-type improvement) to minor modifications to the existing interchange (low-type improvement). The study team then combined the interchange designs with the eight-lane cross sections to create a range of roadway improvements for evaluation.

The study team refined the specific roadway improvements through an iterative process that yielded recommendations that effectively served the anticipated traffic demand. The study team used FRESIM, a traffic simulation model, to simulate morning and evening peak hour conditions to determine the impact of recurring congestion. The study team used this model to assure that the full range of design options within the roadway improvements strategy provides the desired degree of operational benefits.

Once study team defined the roadway improvements through this process, the study team could complete the final evaluation of the five alternatives using more general MOEs.

Recommended Alternative

The preferred alternative was a combination of roadway improvements, ITS strategies, and bus service enhancements, including new express bus service and park-and-ride lots. The study team did not recommend the HOV lanes because it was felt that the HOV lanes would not provide sufficient travel time savings as a stand-alone HOV project. However, the recommended alternative reserved an envelope in the median to provide HOV in the future, provided that the Kansas City region develops a regional HOV system.

TRINITY RIVER CORRIDOR MIS

Location:	Dallas, Texas
Lead Agency:	Texas Department of Transportation (TxDOT)
Completed:	July 1997

Description

The Trinity Parkway Major Transportation Investment Study (MTIS) sought to solve the problem of traffic congestion at the intersection of I-30 and I-35E near downtown Dallas *(44)*. The study team analyzed current and future traffic requirements throughout the intersection, and developed strategies to improve the bottleneck. They also considered environmental concerns along the Trinity River floodway and its recreational and economic development opportunities.

Range of Alternatives

The study team started with a large number of alternatives. As the level of analysis became more detailed, the study team reduced the number of alternatives. The alternatives short listed for detailed evaluations included enhancements to the existing congestion management plans, incremental improvements to the Canyon and Mixmaster (I-30 and I-35E interchange), movement of employment to the south, increasing DART rail ridership, improvements to major city streets, two DART rail projects, and large scale roadway improvements consisting of a Trinity reliever route with various connections to the existing freeways.

Traffic Demand Analysis

The North Central Texas Council of Governments (NCTCOG) made 24-hour and peak hour travel forecasts so that the study team could fully evaluate the impacts of each alternative. The study team included several mobility effects in the evaluation criteria including:

- VMT,
- VHT,
- lane miles,
- average speed,
- traffic control delay,
- congestion delay,
- total vehicle delay,
- percent lane miles at level of service E and F, and
- vehicle emissions.

One element of the traffic demand analysis phase of the MIS that had a major influence in developing the recommended plan of action was the application of the path flow method to the analysis of the proposed freeway and HOV improvements to the Canyon (I-30), the Mixmaster (I-30 and I-35E interchange), and lower Stemmons (I-35E) within the study area. Using peak hour forecast data from NCTCOG and by identifying the desired vehicle paths through the facilities in question, TTI determined the optimum number of HOV lanes and the best location to end the HOV lanes. TTI reduced the projected cost of the HOV lanes by eliminating HOV lanes in locations where main lane demand was low enough to accommodate the HOV demand. TTI improved the forecast operations by optimizing the location of the HOV terminals, minimizing weaving impacts and ensuring that HOVs could access their destinations.

The application of the Path Flow Method also allowed for the identification of excess capacity on several proposed facilities and potential problems in several weaving and merging areas. TTI found the majority of the problems on the proposed collector-distributor and frontage road systems. The changes identified through this type of analysis will help avoid operational problems and reduce the proposed construction cost by about $50 million.

In response to community input, the study included an examination of the effect on peak travel patterns if future growth shifted additional employment to the southern part of Dallas. The study team reallocated about 24 percent of the job growth predicted to occur in the north to the south. While the test showed some benefits on a county-wide basis using system level measures, there was only a 1-2 percent reduction in demand through the corridor. Therefore, this alternative did not materially affect the capacity improvements recommended for the corridor.

Recommended Alternative

The recommended plan of action for the Trinity River corridor is made up of seven elements, which include measures to reduce work trips, bicycle and pedestrian facilities, enhanced ITS elements, improvements to the Canyon Mixmaster and Lower Stemmons, extension of Woodall Rodgers Freeway, a continuous HOV system through the Canyon Mixmaster and Lower Stemmons, and a parkway reliever route along the Trinity River.

I-635 (LBJ FREEWAY) MIS

Location:	Dallas, Texas
Lead Agency:	Texas Department of Transportation (TxDOT)
Completed:	December 1996

Description

The I-635 (LBJ Freeway) corridor is located in the Dallas-Fort Worth metropolitan area (*45*). The study corridor is approximately 21 miles long and runs along the northern and eastern sections of the LBJ Freeway extending from west of I-35E to US80. The corridor is bounded by Belt Line Road and Loop 12. Municipalities located along I-635 include the cities of Dallas, Farmers Branch, Garland, and Mesquite.

LBJ Freeway generally consists of eight general purpose lanes with two- to three-lane discontinuous one-way service roads. TxDOT added two bi-directional concurrent flow HOV lanes on an interim basis in the western part of the facility between US75 and I-35E. Right-of-way (ROW) width varies from 330 ft to 450 ft depending on the existence of service roads, interchange design, and drainage.

Due to organized opposition to an earlier TxDOT plan for the corridor, TxDOT created an extensive public involvement process for the study. TxDOT established an executive board with an appointed chairperson and broad community representation to guide the process. TxDOT also set up a series of committees with technical and community members to address particular issues.

Range of Alternatives

The I-635 MIS used a two-phase screening process to evaluate alternatives and choose a locally preferred alternative (LPA). In addition to a baseline alternative (do only projects already planned) and a congestion management alternative (do system management and demand management strategies in addition to planned projects), the first set of concepts included 11 "build" alternatives that incorporated different mixes of general purpose, express, HOV, and service road lanes. The first screening eliminated four of these alternatives because they provided insufficient capacity and left the remaining concepts for detailed evaluation.

Traffic Demand Analysis

One of the tasks undertaken to build a rapport with the community was to evaluate existing traffic problems in an effort to identify low cost improvements that could be undertaken in a 2-5 year time frame to provide some congestion relief. This analysis utilized Passer III, a program for optimizing diamond intersection operations, to evaluate 18 cross street intersections. The recommended improvements included adding right-turn and left-turn lanes on approaches, closing or modifying median openings, adding additional lanes on cross street bridges or underpasses, and adding u-turn lanes between service roads. The study team also identified locations where TxDOT could add auxiliary lanes between ramps and where TxDOT could modify or add ramps to improve operations.

The study team used FRESIM, a traffic simulation model, to conduct a more detailed evaluation of weaving problems on westbound LBJ Freeway between the Dallas North Tollway and Midway Road. A combination of high entering volumes from multiple ramps and a high exiting volume at Midway caused extensive traffic congestion during both peak hours. The study team calibrated FRESIM using existing roadway geometries and traffic volumes and then used the model to examine the effect of alternative ramping designs. This analysis suggested improvements that TxDOT could implement as an immediate action project and helped identify strategies that the study team could incorporate into the LPA.

The study team used the System Plan Method to evaluate different general purpose and HOV lane combinations east of US75. At the time of the analysis, the study team was leaning toward a recommendation of 10 general purpose and four bi-directional HOV lanes. Application of the SPM showed that there was sufficient capacity in the off-peak direction to handle both the SOV and HOV traffic volume resulting in a reduction in the number of HOV lanes from four lanes to two reversible lanes. This refinement had a significant impact in reducing ROW and construction costs.

Recommended Alternative

The LPA includes the addition of six HOT lanes west of US75, and continuous service roads with bypass lanes at major cross streets where feasible. East of US75, the plan calls for the addition of two general purpose lanes and four bi-directional HOV lanes transitioning to two reversible HOV lanes with continuous service roads.

I-10 (KATY FREEWAY) CORRIDOR MIS

Location: Houston, Texas
Lead Agency: Texas Department of Transportation (TxDOT)
Completed: October 1997

Description

The Katy Freeway MIS is a comprehensive study of the 40-mile corridor of I-10 between the Houston CBD and the Brazos River (*46-48*). I-10 is a multi-lane limited access freeway with two and three-lane discontinuous frontage roads. There are 40 interchanges along the corridor, three of which are full freeway to freeway interchanges. The section of I-10 between the CBD and I-610 has 10 general purpose lanes. From I-610 to Brookshire there are six lanes, and from I-610 to SH-6 there is one reversible HOV lane. From Brookshire to the Brazos River there are four lanes.

The MIS public involvement program provided opportunities for the public and various interest groups to be involved throughout the planning process and to participate in an on-going exchange of information. As part of the program, the study team held 14 public meetings in which nearly 1,400 individuals participated. Goals established for the study include:

- improve corridor mobility and safety in a cost effective manner;
- provide a transportation system that has minimal negative impact on aesthetics, environment, and community;
- provide a balanced and coordinated transportation system; and
- provide a transportation system that serves the regional land use and development patterns now and in the future.

Range of Alternatives

The study team developed seven refined alternatives from a range of conceptual alternatives developed to meet the needs of the I-10 corridor through the year 2020:

- no-build alternative (to which all other alternatives were compared),
- TSM/TDM alternative,
- moderate transit (HOV) / moderate SOV alternative,
- moderate transit (HOV) / high SOV alternative,
- high transit (HOV-special use lane) / moderate SOV alternative,
- high transit (fixed guideway) / low SOV alternative, and
- high transit (HOV-special use lane) / high SOV alternative.

Traffic Demand Analysis

TxDOT used traffic data collected in 1994, which included 24-hour and peak hour volumes, speeds, directional distributions, and peaking characteristics to establish existing conditions and historical trends. TxDOT also observed volumes and speeds on arterial streets parallel and perpendicular to I-10. The Houston-Galveston Area Council, the local MPO, provided the year 2020 travel demand forecast for the corridor. They made traffic projections for 24-hour conditions and the three-hour morning and afternoon peak periods.

The transportation criteria the study team selected for use in evaluating the refined alternatives and comparing them against the no-build alternative were:

- corridor person trips by purpose;
- corridor person trips by mode;
- change in VHT;
- change in VMT;
- volume-to-capacity ratios and levels of service;
- average roadway, corridor, and regional speeds; and
- average travel times between major origins and destinations.

The study team used screenlines to summarize v/c ratios, levels of service, and speeds during the peak period.

Recommended Alternative

The study team chose the high transit (HOV-special use lanes)/moderate SOV alternative as the recommended alternative. It provides two special use lanes in both directions between I-610 and SH-6, and the addition of one general purpose lane in each direction between I-610 and Katy; the alternative includes auxiliary lanes to provide lane balance at major interchanges.

CAPITAL BELTWAY MIS

Location: Fairfax County, Virginia
Lead Agency: Virginia Department of Transportation (VDOT)
Completed: January 1997

Description

The Capital Beltway MIS reviewed 20 potential strategies for the Virginia portion of the Beltway to determine which would be most effective in managing congestion, improving traffic flow and safety, and eliminating or reducing areas of conflicting movement (*49*). The Capital Beltway encircles Washington, D.C., and was originally a bypass. The Beltway is heavily congested, and the congestion is expected to increase in the future. The region has developed several suburban activity and employment centers along the Beltway. A project management team (PMT) made up of representatives from public agencies developed study goals and provided a link to the Beltway MIS in Maryland.

The portion of the Beltway included in this MIS is about 22 miles in length and intersects with 14 radial routes going into D.C. including I-66 and I-95/I-395. Many of the 14 interchanges do not meet current design standards. The Beltway is a freeway with four to five through lanes in each direction in various locations. The Woodrow Wilson bridge at the south end of the corridor, however, has only three lanes in each direction.

The public participation program used advertising to identify stakeholders. The PMT distributed a questionnaire to learn each respondent's perceptions about problems they encounter in using the Beltway, locations of problems, and suggested solutions. The program also included briefings to consultation groups, public officials and organizations, public information meetings, and information on VDOT's website on the Internet.

Range of Alternatives

The MIS started with 20 potential strategies for the Beltway. These strategies ranged from doing nothing to double decking the Beltway. After a screening process, the PMT advanced 12 strategies to the detailed evaluation process. The 12 strategies included an enhancement package, ITS improvements, TCM/TDM measures, rail and bus transit improvements along the Beltway, additional general purpose lanes, HOV options, express or local lane separations, double decking in Tysons Corner area, and interchange renovations, which included adding and removing ramps.

Traffic Demand Analysis

Defining the operational and physical transportation problems, as well as how the Beltway functions in the region was a critical step in the MIS process. The PMT identified existing traffic characteristics with traffic counts, an O-D study, and a trip length study made in 1990. The O-D study showed that a major portion of the trips on the Beltway are short and only occur between a few interchanges. The PMT used the region's constrained long range plan for 24-hour traffic demand projections for the year 2020. The PMT also estimated traffic demands assuming no capacity limitations or financial constraints to give an idea of the latent demand for trips in the Beltway corridor.

The PMT divided the study of the Beltway into two analysis steps. The first step was a screening analysis to identify the most promising strategies. Of the initial strategies 12 were advanced to the second step of analysis. One of the initial findings was the recognition that possible strategies could vary from segment to segment due to different traffic conditions or needs. The second step of the analysis was a detailed evaluation of the advanced strategies to identify the best investment strategy. Criteria used for the detailed evaluation included the transportation performance measures of vehicle and person throughput, hours of congestion, and effects to safety and enforcement. The PMT assessed each strategy consistently for each criteria. They established a screenline along the corridor and determined both the theoretical maximum and projected peak hour throughput for persons and vehicles for each strategy. The unique element of this MIS is that the PMT performed only the necessary level of detail needed to make a traffic demand analysis for each strategy in a consistent and uniform manner, with the recognition that the PMT would perform a more detailed analysis in the environmental impact statement (EIS) phase of the Beltway study.

Recommended Alternative

The recommended strategy package included elements from all the 12 advanced strategies except additional general purpose lanes. The strategy package includes two main components: lane management strategies that support HOVs and bus transit and rail transit planning to support connectivity to radial rail lines. VDOT and other agencies will implement the MIS results through a series of individual improvement projects due to the size of the corridor and the need to maintain traffic flow during construction. The MIS identified three zones as priority areas for improvements: Woodrow Wilson Bridge to Telegraph Road, the Springfield Interchange (I-95, I-395, I-495), and Tysons Corner to I-66.

SR-16 TACOMA NARROWS CORRIDOR MIS

Location:	Tacoma, Washington
Lead Agency:	Washington State Department of Transportation (WSDOT)
Completed:	July 1997

Description

The SR-16 Tacoma Narrows corridor is the only fixed roadway link across Puget Sound (*50,51*). The Tacoma Narrows Bridge (TNB) currently operates beyond its designed capacity with congestion lasting three to four hours a day in each direction. The corridor provides a principal highway connection between the Seattle-Tacoma area and southern Kitsap County. SR-16 extends north and east from I-5, and it is a four-lane freeway. The key feature of the TNB corridor the is that it has four narrow lanes. The Kitsap and Pierce County line to the north and the Cedar Street overpass in Tacoma to the south define the corridor area. The purpose of the MIS was to identify potential traffic improvements within the SR-16 corridor and for the Tacoma Narrows crossing.

The public involvement process included the assembly of a 20-member stakeholders committee and a series of public meetings. The study team held six public meetings during stage one of the study and held five more meetings during stage three. The study had an extensive web site on the Internet, and an information office and study library. Awareness of the corridor problems were widespread, and the project team did not have to convince the community that there was a problem.

Range of Alternatives

The study team with input from the stakeholders committee and the public initiated a range of 22 alternatives for screening evaluation. The alternatives ranged from no action to various cross-sound bridges and highway realignment. The study team advanced nine action alternatives and the no-action alternative to the detailed evaluation stage. These included TSM and TDM alternatives, a second deck for the existing bridge, a second deck for bus and HOV traffic, a parallel bridge, a parallel bridge for bus and HOV traffic, capacity enhancements, capacity enhancements with express buses, capacity enhancements with no bridge improvements, and a transit intensive alternative.

Traffic Demand Analysis

The study's consultant conducted a motorist travel pattern and trip characteristic survey as a basis for estimating the potential usage of any of the wide range of proposed alternatives. To the study team, it was critically important to obtain the most current and up-to-date measure of travel patterns and characteristics of motorists who could potentially use the improved SR-16 corridor. The study team obtained vehicle classification counts on the SR-16 corridor and alternate routes, and ferry traffic and ridership data at the same time as the trip survey. The travel survey allowed the study team to determine monthly, 24-hour, and hourly variations in traffic flow. One of the primary findings of the travel survey was that the majority of weekday traffic on the TNB is local within

Pierce County. From the survey results, the study team could estimate traffic diversions based on travel time and distance, the nature of trips, and the cost of potential tolls.

The study team used transportation and operations performance criteria as one of five categories of evaluation measures to evaluate alternatives. The study team evaluated the performance criteria with modeled year 2020 travel demands for each of the final nine action alternatives. The traffic operations criteria included daily hours of congestion, peak hour corridor speed, daily VMT, daily VHT, person hours of travel, truck hours of travel, person miles traveled per vehicle hour, and bus and ferry ridership.

Recommended Alternative

The recommendations of the study team were to advance three alternatives to the EIS phase; the no-action alternative, a second deck for the existing bridge with corridor improvements, and a new parallel bridge with corridor improvements.

IV. FINDINGS AND GUIDELINES

The MIS process is, by design, a flexible process that provides a significant amount of local control over the scope and level of detail that is undertaken to reach a decision. Since the primary reason for doing a MIS is to solve a significant mobility problem, it is critical that activities related to traffic demand analysis be given careful consideration throughout the process.

With only minor variations, all of the case studies followed a specific pattern in conducting their MIS: study initiation, definition of the problem, identification of alternatives, evaluation of alternatives, and selection of locally preferred solution. The evaluation of alternatives is typically a two-stage process in which the study team initially screens all ideas using fairly general criteria, then they develop and evaluate the remaining alternatives to a higher level and in greater detail.

An examination of the case studies provides some guidance on the application of traffic demand analysis in MISs. This section summarizes this information in three ways: (1) guidance concerning the steps in the MIS process, (2) lessons learned from each case study, and (3) guidance on the application of traffic demand analysis tools in MISs.

GUIDANCE CONCERNING THE MIS PROCESS

Study Initiation

- The development of a detailed work plan is always important to the management of any planning study. It typically includes a detailed description of each task to be performed, the relationships between tasks, and the product of each task. The development of the work program is an excellent time to focus attention on the traffic demand analysis methods and the level of effort that will be needed. Some issues to consider would be:

    - range of alternatives expected,
    - known operational problems and their complexity,
    - amount of existing traffic data available and the need to collect new data,
    - need for an O-D study,
    - how the study team will measure effectiveness of alternatives, and
    - how the study team will obtain required data.

- A higher level of traffic demand analysis is typically needed when:

    - the corridor or subarea has complex travel patterns that are not generally understood and accepted by all the participants;
    - the existing roadway and/or potential solutions will involve complex designs, such as freeway-to-freeway interchanges, reversible facilities, or multimodal facilities in the same ROW;
    - physical constraints, such as limited ROW, will likely force trade-offs; or

- ○ the project is controversial resulting in high levels of public involvement and, potentially, organized opposition.

- When multiple MIS studies are being undertaken in the same region, there are definite benefits from coordinating the process at the beginning to simplify the public's understanding of the processes involved and to help decision makers compare the results. This coordination can go well beyond cooperation. As the Denver example shows, in addition to outlining a MIS process, the study teams can prepare a manual that defines the basic design, operating, and cost parameters of potential alternatives; identifies how traffic demand will be measured; and specifies certain measures of effectiveness for comparison.

Definition of the Problem

- Establishing the need and purpose for an MIS is an exercise in traffic demand analysis that provides the focus for the MIS. All study participants, including the public, should be given an opportunity to identify traffic capacity and safety issues based on their experiences traveling in the study corridor. The study team will identify most problems through this process, and the process will raise some questions. The study team will use technical analysis to document the problems and answer the questions. Typically the study team will use for this task traffic data in the form of volumes, speeds, accident records, and O-D studies.

- Sometimes the study team can evaluate capacity or safety issues for short-term remediation and include them in an immediate action program to improve traffic conditions in the corridor. This approach can help build credibility with the public.

Development and Evaluation of Alternatives

- Traffic demand analysis is as much about refining the alternatives as it is about evaluating and comparing the alternatives. In many MISs there is an orientation toward developing alternatives that allows them to be compared in relative terms. However, the value of the MIS process is maximized by refining the alternatives under consideration so that they match the traffic demands in the corridor as closely as possible, thereby minimizing their costs and avoiding unnecessary changes during the environmental review process. The System Plan Method and Path Flow Method are tools that the study team can use in the MIS process to refine alternatives. In some cases, it may be advantageous to conduct a final review of the alternative chosen as the LPA.

- Travel forecasting models are the backbone of the transportation planning process:

  - ○ The quality of the travel forecasts are dependent on the accuracy of the inputs. At a minimum, the study team should check the model's roadway network within the study area to ensure that it is a good representation of the existing roadway network and the proposed alternatives. It is also advisable to check population and employment estimates for high activity areas.

  - All traffic models do 24-hour traffic assignments. Transportation planners have modified some models to do peak hour or peak period assignments. The study team should use peak hour assignments wherever possible to help avoid gross assumptions about K and D factors that can have a significant impact on the effectiveness of different alternatives.

- Some of the guidance for MISs indicates that the configuration of a major freeway-to-freeway interchange is normally beyond the scope of an MIS. In practice, it is critical that the study team develop an interchange in sufficient detail to ensure that the roadway capacity it feeds can be fully utilized.

- Although most of the MISs document their analysis of alternatives through summary tables that utilize broad measures of effectiveness, there is a significant level of engineering experience and judgment that is brought to bear on the conceptual development of the alternatives. It is critical that the study team develop all of the alternatives to a level that provides a reasonable assurance that the responsible agencies can build *and* operate the locally preferred alternative . The study team must include engineers with traffic operations experience, as well as design engineers and planners.

Selection of Locally Preferred Alternative

- Although the MIS is charged with developing enough information to make an informed decision for a particular project, it cannot answer every question. It is important to explain the difference between planning and project development, and to emphasize that the study team will not work out many details until the project is further developed during the environmental review process. The public often needs to be reassured that they will continue to be involved after the study team completes the MIS.

LESSONS LEARNED FROM THE CASE STUDIES

Table 3 lists each of the case studies examined as a part of this research project and provides a brief summary of the key findings from that MIS regarding the application of traffic demand analysis.

APPLICATION OF TRAFFIC DEMAND ANALYSIS TOOLS

Table 4 provides a summary of the analysis tools that have application in MISs and provides some basic guidance on the advantages and disadvantages of each tool.

Table 3. Lessons Learned from MIS Case Studies.

Case Study	Lesson
US50 Corridor Sacramento, California	• Updated travel model using California data to better predict HOV traffic volumes. • In addition to 24-hour forecasts, travel model is capable of direct peak period and nonpeak period assignments. • Used time horizons of 2005, 2010, and 2015 to assess the impacts of staged construction. • Proposed HOV lanes unload directly to arterial streets at the CBD requiring analysis to ensure that the arterial streets would still function at acceptable levels.
Central County Corridor Orange County, California	• Complex subarea study relied on system level MOEs to assess the benefits of different alternatives. • Selection of locally preferred alternative relied more on community consensus than on technical information.
East, Southeast, & West Corridors Denver, Colorado	• Developed guidance manual to ensure common regional approach for three studies; defined evaluation measures and calculation methodologies for the final selection; and provided a common format for reporting results.
I-4 Corridor Central Florida	• Derived goals and objectives from statewide Interstate Highway Policy. • I-4 Bridge Study combined transit and highway regional travel demand forecasting to meet both FHWA and FTA requirements for coordinated highway and transit analysis. • Used five broad evaluation criteria each with associated traffic related measures of effectiveness to compare the alternative concepts.
US78 Corridor Atlanta, Georgia	• Used travel forecast model to evaluate the effectiveness of general purpose, express, and HOV combinations along different alignments. • Reported the differences using 24-hour traffic volumes and system level MOEs. Knowledge that existing directional splits were as high as 80/20 resulted in consideration of alternatives that had reversible express or HOV lanes.
Ohio River Louisville, Kentucky	• Developed alternatives for "Spaghetti Junction" where two interstate freeways come together for a short distance and then split apart to a higher level of detail than other alternatives to ensure that the proposals could be constructed. • Travel model only generates 24-hour traffic assignments; technical staff conducted only a cursory review of peak hour volumes using estimates of K and D factors. Used the peak hour estimates to check the design alternatives for "Spaghetti Junction," but used 24-hour volumes to compare alternatives. • Used Travel model to generate unconstrained assignments to show the magnitude of travel demand that would use the river crossings if it were not constrained.

Table 3 (continued). Lessons Learned from MIS Case Studies.

Case Study	Lesson
US301 Prince George's and Charles Counties, Maryland	• Used travel forecasting model to evaluate a set of eight defined land use scenarios in conjunction with six transportation improvement packages.
I-435 Kansas City, Missouri	• Significant effort made to develop alternative design treatments for interchanges and to match their capacity to the mainline link capacity • Used FRESIM to evaluate and refine the alternative designs.
Trinity River Corridor Dallas, Texas	• Used Path Flow Method to refine the recommended alternative for reconstructing the Canyon and Mixmaster where I-30 and I-35 meet at the Dallas CBD. • Used peak hour assignments to refine the proposed HOV system; resulted in adjustments to the limits and number of HOV lanes. • Modeled changes in employment level in the southern half of the city to test its effect on peak hour travel patterns.
I-635 (LBJ Freeway) Dallas, Texas	• Used FRESIM to simulate traffic flows on LBJ Freeway WB between the Dallas North Tollway and Midway to evaluate different ramping alternatives. • Used System Plan Method to evaluate the eastern section of LBJ and reduce the number of HOV lanes from four bi-directional lanes to two reversible lanes.
I-10 (Katy Freeway) Houston, Texas	• Travel model provided assignments for three-hour morning and evening peak periods, as well as 24-hour traffic volumes. • Used screenlines to summarize peak period v/c, level of service, and speeds for each alternative.
Capital Beltway Corridor Fairfax County, Virginia	• Used unconstrained traffic forecasts to demonstrate the level of latent travel demand in the corridor. • Minimized level of detail in development of alternatives and traffic demand analysis during the MIS with a recognition that this would be done in the environmental review process.
SR-16 Tacoma Narrows Corridor Tacoma, Washington	• Used a comprehensive O-D study to characterize travel patterns and as a basis for traffic demand analysis of alternatives.

Table 4. Application of Traffic Demand Analysis Tools.

Analysis Method	Guidance
Travel Forecasting Models	• Provides future traffic volumes that are an input for all other analysis tools. • Predominant approach is the modeling of 24-hour traffic volumes and then the estimation of peak hour volumes using existing and/or estimated Ks and Ds. • The MIS can use direct peak hour assignments, when available, as a check on future Ks and Ds. This may be especially important in rapidly developing areas where land use changes could have a substantial effect on the magnitude or direction of peak hour traffic volumes. • Provides substantial output data that the MIS must carefully summarize within a few measures of effectiveness to ensure that the public understands the results.
Origin-Destination (O-D) Studies	• Useful in helping to validate the travel forecasting model for the specific corridor being studied. • Data from O-D studies can be helpful early in the MIS process in helping to define the nature of the traffic problem and in defining appropriate alternatives. • Full O-D studies are expensive and time consuming; as an alternative, the travel forecasting model can be a valuable, yet inexpensive, source of "derived" O-D information.
Highway Capacity Manual (HCM) Procedures	• Useful in examining specific problem areas, i.e. weaving sections, merge and diverge areas, and intersection capacity. • Often beyond the scope of an MIS, but may be required to address specific problems and/or public concerns. • May help in identifying short-term operational improvements using existing data that the MIS can readily obtain at a high level of detail.
Traffic Simulation Models	• Useful for analyzing longer sections of a corridor, especially interchanges or complicated weaving areas that are unsuited to analysis using HCM procedures. • Good calibration to existing conditions is critical to obtaining results that the MIS can apply with confidence to future conditions. • Requires extensive data to calibrate the models, and can be expensive and time consuming to obtain quality results.
System Plan Method	• Allows for the rapid assessment and refinement of roadway alternatives using lowest total public cost as the primary criteria. Can handle combinations of general purpose, express, toll, HOV, and HOT lanes. • Easy to use; provides total flexibility in defining input parameters.
Path Flow Method	• Useful where there are multiple paths; such as collector distributor roads, freeways that merge and then separated downstream, and combinations of general purpose and special use lanes at interchanges. • Helps to check that the capacity provided for each path is consistent with the traffic demand and allows refinement where the capacity is in excess or shortfall. • More detailed than link analysis because the MIS can identify the demand for each movement within each link.

V. IMPLICATIONS OF NEW FEDERAL LEGISLATION: TEA-21

The Transportation Equity Act for the 21st Century (TEA-21) was passed by the House and Senate on May 22, 1998. Section 1308 of Title 1 — Federal-Aid Highways specifically requires the elimination of the major investment study and instructs the U.S. Department of Transportation (USDOT) to develop regulations that would integrate its principles into the metropolitan transportation planning processes and the review processes required under the National Environmental Policy Act (NEPA):

> SEC. 1308. MAJOR INVESTMENT STUDY INTEGRATION. The Secretary shall eliminate the major investment study set forth in section 450.318 of title 23, Code of Federal Regulations, as a separate requirement, and promulgate regulations to integrate such requirement, as appropriate, as part of the analysis required to be undertaken pursuant to the planning provisions of title 23, United States Code, and chapter 53 of title 49, United States Code, and the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) for Federal-aid highway and transit projects. The scope of the applicability of such regulations shall be no broader than the scope of such section.

Underlying this decision was a belief that the MIS was duplicative of many of the analyses already required by the planning and NEPA processes and therefore introduced inefficiencies that have lengthened the planning process unnecessarily. At the time that this report was being written, the USDOT had just begun to seek input from state DOTs, MPOs, other implementing agencies, and professional organizations to determine how they can effectively retain the strengths of the MIS process—substantive analysis of transportation alternatives and increased public involvement early in the process.

Discussions with transportation agencies at the federal, state, and local levels indicate that the elements of the MIS will become more tightly defined as a part of the regional transportation planning process. It is even likely that the MPO and implementing agencies would undertake corridor and/or subarea studies for significant highway and transit issues as an adjunct to their system planning processes. As with the MIS, the goal of these studies would be to identify a locally preferred alternative for inclusion in the regional transportation plan through the analysis of alternatives and public involvement processes. Under TEA-21 the locally preferred alternative is referred to as simply a preferred alternative. This approach would reduce the range of alternatives that the responsible agency would have to undertake once the environmental review process was ready to begin. This model tends to position the MIS process more firmly in the planning process rather than project development. However, most of the principles and guidelines offered by this research should still be applicable and ought to be considered whenever a corridor or subarea transportation study is undertaken.

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