CONGESTION MITIGATION HANDBOOK

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Chicago Area Transportation Study

CONGESTION MANAGEMENT SYSTEM TASK FORCE

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CATS was formed in 1955 to develop the first comprehensive long-range transportation plan for the northeastern Illinois region. Since then the CATS Policy Committee has been designated by the governor of Illinois and northeastern Illinois local officials as the metropolitan planning organization (MPO) for the region. MPOs have been mandated by federal legislation to provide additional opportunities for public participation in transportation planning.

The preparation of this report was carried out by the Congestion Management System Task Force made up of CATS Work Program Committee (WPC) members and citizen members representing environmental, public interest groups and business interests. The purpose of the Task Force is to prepare a range of recommendations to the WPC on issues involved in the development of required processes and measurements employed in the specification, implementation and performance of the northeastern Illinois component of the congestion management system for the state of Illinois.

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Congestion Mitigation Handbook

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1. INTRODUCTION

This Congestion Mitigation Handbook is one element of the Congestion Management System (CMS) for Northeastern Illinois. The CMS is defined as "a systematic process for managing congestion that provides information on transportation system performance and on alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs (CFR 500.109)." As such, the CMS is a decision support tool designed to assist CATS and the region's other transportation agencies in evaluating and implementing strategies to reduce congestion and to improve the movement of people and goods.

A required component of the CMS is the "identification and evaluation of the anticipated performance and expected benefits of appropriate traditional and nontraditional congestion management strategies that will contribute to the more efficient use of the existing and future transportation system (CFR 500.109 (b)(4)." In this regard, the CMS regulations mandate that consideration be given to strategies that reduce single occupancy vehicle travel.

1.1 PURPOSE

It is recognized that transportation agencies in the Chicago area already engage in activities to develop and administer programs and projects that improve transportation systems. It is also recognized that a motivating factor for these projects is often increased roadway congestion. The purpose of the CMS and this Handbook is not to replace existing activities, but to provide for a more systematic approach and to provide guidance. This Handbook is intended to be a resource or reference guide used by project planners who are considering alternative strategies, and to help them meet the following requirements set forth in the CMS regulations:

- *that consideration be given to traditional and nontraditional strategies, specifically those that reduce single-occupant-vehicle travel* -

  Increasingly, building new roads or adding lanes to existing facilities is becoming less feasible due to a combination of budget and environmental constraints. Many alternative strategies to new construction are available that may successfully address congestion problems without the resource cost of new construction. The challenge for agency staff is to successfully identify, screen, and analyze potential alternative strategies that may be appropriate for a particular area and a specific problem. The Congestion Mitigation Handbook identifies and describes forty strategies, broken into twelve strategy classes, for addressing the region's congestion and mobility problems. The

Handbook also describes how, when, and where these strategies may be implemented to be most effective.

- *that all reasonable alternatives be appropriately analyzed before a project involving the addition of general purpose lanes to an existing roadway or the construction of a new roadway can be advanced for federal funding -*

While the strategies described in the Handbook are by no means new, experience in evaluating these different strategies can vary significantly between agencies and individuals. The Congestion Mitigation Handbook describes methods and techniques that may be used to evaluate the potential impacts of various strategies.

- *that where the addition of general purpose lanes is deemed most appropriate, the project must incorporate all reasonable and appropriate operational and demand management elements to ensure that the facility may be effectively managed in the future. In addition, other travel demand reduction and operational management strategies appropriate for the corridor, but not appropriate for incorporation into the facility itself, shall also be identified through the CMS -*

The Handbook describes the Travel Demand Reduction (TDR) program being undertaken by CATS to review all add-lanes projects submitted by IDOT and identify those TDR measures that may be incorporated into the proposed project.

- *that the CMS include a process for evaluating the effectiveness of implemented strategies -*

The Handbook provides guidelines for when and how post-implementation effectiveness evaluation studies should be conducted.

It is important to recognize, however, that the benefits of a logical and careful strategy evaluation process go far beyond simply meeting the letter or intent of the federal legislation. Implementation of new strategies should result in more cost-effective multimodal solutions and ultimately an improved transportation system. State and local agencies all have their own experience with transportation improvement strategies, but there are always new findings and ideas from other places. Strategies like traffic operations improvements or incident management systems can significantly reduce congestion, but must be applied in the right places. Even more benefit can be achieved by using multiple strategies (e.g., HOV facilities and ridesharing programs), but the challenge lies in knowing how, where, and when to package these strategies. The key to an effective strategy screening and evaluation program is to follow a logical and thoughtful process that uses all available information.

1.2 STRUCTURE OF THIS HANDBOOK

This handbook consists of six chapters including this introduction. Chapter 2 introduces a range of strategies that may be used to reduce congestion and improve mobility. A total of forty-six (46) strategies, grouped into twelve (12) classes, are identified. In Chapter 3, the strategy classes and the individual strategies are discussed in some detail. A one-page summary description is provided for each strategy. These strategy summaries provide information regarding current policies and applications, typical benefits and impacts, and application principles. This information is intended to be used by the reader to help identify and screen alternative strategies. The summaries also include guidance regarding the tools and methodologies that may be used for more detailed study of specific strategies. These are designed as a starting point for analyzing strategies; additional tools or techniques may be available.

Chapter 4 of the Handbook provides an overview of the strategies described in the previous chapter. Through the use of a series of tables, the general impacts and characteristics of the various strategies are summarized. A discussion of strategy "packaging", with a look at how creative strategy packaging can create synergies and cost-efficiencies, is also provided in this chapter. Project planners should familiarize themselves with the benefits and limitations of each strategy class.

Chapter 5 addresses the specific issue of defining complementary strategies for general purpose capacity expansion or "add-lanes" projects. This chapter describes CATS' current Travel Demand Reduction (TDR) program or process. Chapter 6 describes some approaches for evaluating the effectiveness of strategies or projects after they are implemented. These evaluations are commonly referred to as "before-and-after" studies. Appendix A provides a listing of key acronyms and terms that the reader should be familiar with when using this handbook, while Appendix B contains a brief description of the analysis models or software packages identified in Chapter 3.

1.3 USING THIS HANDBOOK

This handbook is designed primarily to provide an introductory-level tool for the identification and evaluation of strategies. Its goals are to help broaden the reader's knowledge and to assist the reader in the strategy consideration step of the planning process. The information in Chapters 2, 3 and 4 can help the reader identify and screen potential strategies that may address the particular needs and objectives of a given situation. Guidance is also given in Chapter 3 on the tools and methodologies that may be used to evaluate those strategies that may be most appropriate. If general purpose capacity expansion ("add-lanes") is determined to be the most feasible solution, Chapter 5 defines for the reader those procedures that are taken to identify complementary TDM/TSM actions that may be implemented in conjunction with the add-lanes project. Finally, Chapter 6 can be used to help determine when and how to conduct before-and-after studies. Where applicable, additional references are offered for a more intensive review of strategies.

It is important to recognize that although this handbook is comprehensive, it is not intended to be the only resource for identifying and evaluating alternative strategies. There may be strategies or improvement measures that are not fully recognized in this handbook, and there are, undoubtedly, alternative approaches to defining and classifying the strategies. Likewise, the analysis techniques presented in this handbook are not the only credible methods available for analysis of congestion problems. CATS, through the CMS Task Force and the CMS consultant team, has worked to define a set of reasonable analysis approaches, as well as alternative approaches where identifiable, as a primer on congestion relief measures. Advanced users and experienced practitioners may have other preferred techniques for analysis of these strategies.

1.4 UPDATES

The Congestion Mitigation Handbook is intended to be an evolving document. Ideally it will reflect current policies and analysis methodologies related to the strategies described herein. Furthermore, the strategies themselves should be representative of those measures most commonly and currently applied when addressing congestion problems. To achieve these objectives, this handbook will be updated on a periodic basis by CATS through the CMS Task Force. As appropriate, these updates may include only selected chapters or sections of the handbook. In addition to these formal updates, users of the handbook are encouraged to add their own notes.

2. OVERVIEW OF STRATEGIES

This chapter provides an overview of a number of strategies that may be used to reduce congestion and increase mobility in northeastern Illinois. This information is intended to help the analyst or project planner in the early task of identifying potential strategies that may warrant further consideration. This is done by first identifying the range of potential congestion mitigation and mobility enhancement strategies. More detailed information on the individual strategies is provided in the following chapter.

2.1 STRATEGY FRAMEWORK

Depending on one's perspective, there is virtually a limitless number of transportation improvement strategies that can be defined. A key task in the development of the Handbook was structuring the range of improvement strategies into a manageable set of strategies for discussion in this document. For this Handbook, a three-tiered framework has been defined that consists of:

- **Strategy Classes** - Strategy classes represent broad groupings of individual strategies and improvement measures. The strategies in this Handbook have been broken into the following twelve classes, as identified in the *Interim Final Rule* for the CMS:

    1. transportation demand management (TDM) measures
    2. traffic operational improvements
    3. measures to encourage high occupancy vehicle (HOV) use
    4. transit capital improvements
    5. transit operational improvements
    6. measures to encourage the use of non-motorized modes
    7. congestion pricing
    8. growth management
    9. access management
    10. incident management
    11. Intelligent Transportation Systems (ITS)
    12. general purpose capacity expansion

- **Strategies** - Within each class, a set of relatively distinct strategies have been defined. The goal in defining the set of strategies for this Handbook was to provide sufficient detail so that alternative strategies could be clearly differentiated, while minimizing the number to avoid becoming excessive and unwieldy. The strategies defined at this level are the basis for subsequent discussion within this Handbook.

- **Representative Measures** - To help illustrate or describe each strategy, a number of representative measures or actions have been identified. It should be noted that in some cases, improvement measures may be included in more than one class or strategy. For example, park-and-ride lots are appropriate as a measure promoting HOV use, and as transit capital improvements.

Table 1 lists the strategies identified for each class, and some representative improvement measures for each strategy. In reviewing this list, it is important for the analyst to recognize that the CMS does not require that every one of these strategies be analyzed for every project. Only those that could potentially meet the project's needs and objectives in a reasonable manner should be analyzed. This list is simply intended to ensure that the analyst is introduced to the range of alternatives.

Table 1
Strategy Class Summary

CLASS/STRATEGY		REPRESENTATIVE MEASURES	
TDM Measures			
1	Ridesharing Programs	Rideshare Matching Marketing and Promotion	Vanpool Operation
2	ShareCarGo Car Sharing Program		
3	Alternative Work Arrangements	Telecommuting Flex-Time	Compressed Work Weeks Staggered Work Hours
4	Transit/Carpool Incentives	Employer-paid Transit Passes Subsidized Vanpool Service	Carpool/Vanpool Parking Discounts
5	Parking Management	Preferred Carpool/Vanpool Parking Carpool/Vanpool Parking Discounts	Increased Parking Fees
6	Guaranteed Ride Home Programs		
Traffic Operational Improvements			
7	Traffic Signal Improvements	Signal Retiming Demand Responsive Systems	Coordinated Systems
8	Roadway Geometric Improvements	Turn Lanes Acceleration/Deceleration Lanes Lane Widening Grade Separation	Roadway Channelization Bus Turnouts One-way Couplets
9	Time-of-Day Restrictions	Turning Restrictions Truck Restrictions	Parking Restrictions
10	Ramp Metering	Localized Ramp Metering Demand Responsive Ramp Metering	Coordinated Ramp Metering HOV Bypass Ramp Metering
11	Commercial Vehicle Improvements	Commercial Vehicle Facilities Geometric Improvements	Intermodal Facilities Truck Routes
12	Construction Management	Management Plans Detours	Signing Advance Information
HOV Measures			
13	HOV Priority Systems	HOV Priority Lane HOV Ramps	HOV Ramp Bypass Transit Signal Priority
14	HOV Support Services	Park-and-Ride Facilities Casual Carpool Facilities	HOV Toll Savings
Transit Capital Improvements			
15	Exclusive Right-of-Way Facilities	Commuter Rail Rapid Transit Light Rail Busways	Bus Lanes Bus Bypass Ramps
16	Fleet Improvements	Fleet Expansion Vehicle Replacement/Upgrades	Transit Vehicle Management Systems Vehicle Type Changes
17	Transit Support Facilities	Park-and-Ride Facilities Transit Centers	Improved Station/Stop Facilities
Transit Operational Improvements			
18	Transit Service Improvements	Increased Frequency Additional Stop Locations Modify Operating Hours	Express Routes Route Modifications Route Expansion
19	Transit Marketing/Information	Marketing Programs Agency Coordination	Transit Information Systems
20	Fare Incentives	Fare Reductions	Fare Packages
21	Traffic Operations for Transit	Traffic Signal Priority Signal Coordination	Bus Turnouts Rail Crossing Coordination

Table 1 (continued)
Strategy Class Summary

CLASS/STRATEGY	REPRESENTATIVE MEASURES	
Non-Motorized Modes Measures		
22 Bike/Ped Infrastructure Improvements	Bike Lanes Bike/Pedestrian Paths	Bike Route Marking Sidewalks
23 Bike/Ped Support Services	Bike Racks/Lockers Transit Vehicle Bike Carriers Employer Showers	Bike/Pedestrian Planning Bike Route Maps Promotional Campaigns
Congestion Pricing		
24 Road User Fees	Increased Tolls Time of Day Pricing	HOV Facility Fees for SOVs
25 Parking Fees	Surcharges	Time of Day Pricing
Growth Management		
26 Compact Development	Density Standards	
27 Redevelopment and Infill Development	Site Reclamation and Reuse	Incentives to develop in areas with existing infrastructure
28 Location Efficient Mortgage		
29 Mixed Use Development	Zoning Regulations	
30 Jobs/Housing Balance	Zoning Regulations	
31 Transit-Oriented Development	Density Standards Bicycle/Pedestrian Access	Design Requirements
32 Corridor Land Use and Transportation Coordination	Intergovernmental Agreements	
Access Management		
33 Driveway Management	Policies & Standards Sidestreet/Alley Access	Shared Access/Common Driveways
34 Median Management	Policies & Standards Bi-Directional Turn Lanes	Establishing Medians
35 Frontage Roads		
Incident Management		
36 Incident Detection/Verification	Emergency Traffic Patrols Emergency Monitoring	Roadway Detectors/Surveillance
37 Incident Response	Emergency Vehicle Priority Emergency Traffic Patrols	Communication Systems/Protocol
38 Incident Clearance	Emergency Response Teams	Service Patrols
39 Incident Information/Routing	Highway Advisory Radio Alternative Route Planning	Variable Message Signs

Table 1 (continued)
Strategy Class Summary

Intelligent Transportation Systems			
40	Advanced Traffic Management Systems	Freeway Management Traffic Signal Control	Emergency Management Electronic Toll Collection
41	Advanced Traveler Information Systems	Multimodal Regional Traveler Information	
42	Advanced Public Transportation Systems	Vehicle Management Systems Electronic Fare Payment	Automated Vehicle Location System
43	Commercial Vehicle Operations	Weigh-in-Motion System	Electronic Credential Checking
44	Advanced Vehicle Control Systems	Collision Avoidance System	Vehicle Guidance System
General Purpose Capacity Expansion			
45	Expressway Lanes	Add Lanes to Existing Facilities	Construct New Facilities
46	Arterial Lanes	Add Lanes to Existing Facilities	Construct New Facilities

3. INDIVIDUAL STRATEGY DISCUSSIONS

Any of the strategies from the previous section can be an effective means of addressing transportation system deficiencies. For a specific situation, however, not all will be appropriate. The specific problem and the performance requirements must be considered on a project-by-project basis to assess the viability of each strategy. Also, the regional setting will affect which strategies can be successfully implemented in a given area. Policy directives may dictate which strategies are appropriate for the region, and existing corridor-wide transportation strategies (or the lack thereof) may make some facility-specific improvements ineffective.

This section provides information useful for the identification, screening, and analysis of individual strategies. Where appropriate, this information is tailored to the Chicago area. These detailed descriptions of strategy classes and individual strategies are presented as a means of suggesting where different strategies may be used to address deficiencies.

The remainder of this section is organized by strategy class. For each class, a general description is provided, followed by detailed discussions for selected strategies within that class. The discussion of individual strategies uses the following format:

- **Description**: An overview of the strategy, highlighting measures or improvements typical of the strategy.
- **General System Benefits and Impacts**: A brief description of how the strategy works, how it benefits system performance, and some of its potential limitations or negative impacts.
- **Regional Policies and Actions**: A summary of current policies and activities related to a strategy in the Chicago area recognizing that this may dictate when and where a strategy may be applied.
- **Application Principles:** General guidelines identifying the circumstances when a particular strategy may be an effective and reasonable alternative. Some strategies are more appropriate for specific projects, while others can only be implemented on a corridor or areawide basis.
- **Analysis Guidelines:** Information on the tools and performance measures that are available for measuring the potential impact of the strategy in question. Included in these guidelines are references to a number of analysis packages and models. A brief description of these models is provided in Appendix B.

- **Key Contacts:** Titles and telephone numbers for people who may be able to provide more information or assistance with analyzing a particular strategy.

The description and summary of impacts of the strategy discussions are designed to inform project planners about the types of strategies that are available and to assist them in identifying potential solutions. The information on regional policies and application guidelines may then be used to screen the strategies and determine which may be most appropriate and reasonable for a given situation. The analysis guidelines are intended to provide project planners with direction on how to evaluate the selected alternatives. It is important to recognize that these are suggested methodologies, and do not reflect a required approach nor, perhaps, the only approach. The key contacts provide the project planner with a resource for obtaining further guidance and information.

Throughout the strategy descriptions, a number of relevant documents are referenced. A complete listing of these documents is provided in Section 3.13 - References at the end of this chapter. In addition, a brief description of the analysis packages and models identified in this chapter is provided in Appendix B.

3.1 TRANSPORTATION DEMAND MANAGEMENT (TDM) MEASURES

TDM measures are aimed at affecting travel demand by reducing the need for travel, increasing vehicle occupancy or the use of alternative modes, or shifting the timing of trips to periods outside of the peak. In short, TDM strategies can improve system performance by reducing and/or re-distributing the demand for SOV trips. These strategies are intended to change the relative benefits of the transportation choices available to each traveler, thereby modifying trip-making behavior. TDM measures are generally targeted for peak periods, especially by reducing either the number of total work trips or the number of SOV work trips taken during the most congested travel periods.

TDM measures are typically implemented on a regional scale, although some strategies may be implemented directly by individual employers or by local jurisdictions. TDM covers a wide range of potential activities from employer-based ridesharing programs to areawide parking management. However, most TDM strategies have the following factors in common:

- most TDM strategies involve an activity or emphasis at the origin or destination of a trip;
- there is usually need for public/private sector coordination; and
- the emphasis is primarily on work trips because other trip types are more difficult to affect.

The keys to TDM success in reducing congestion lie primarily in finding ways to make alternative modes or travel behavior more convenient and economical. The convenience of personal freedom of movement can be difficult to overcome. To be most effective, TDM strategies should be implemented in conjunction with other strategies such as measures to encourage HOV travel. It becomes easier to persuade people to carpool if there is a travel time advantage in doing so.

***For Details, See Individual Strategy Sheets**:*

1. *Ridesharing Programs*
2. *ShareCarGo^tm Car Sharing Program*
3. *Alternative Work Arrangements*
4. *Transit/Carpool Incentives*
5. *Parking Management*
6. *Guaranteed Ride Home Programs*

Strategy #1 Class: TDM Measures

Ridesharing Programs

DESCRIPTION

Ridesharing measures include a variety of actions to support the formation and maintenance of carpools and vanpools. Carpools use private vehicles, typically operate a minimum of 3 days/week, and generally include regular riders using a shared-cost arrangement. Vanpools are more structured, typically operate 5 days/week, and are usually used for longer distance commutes. They may be company-sponsored, third-party or owner-operated. Measures to support ridesharing include promotion and marketing programs, ridematching services (services that match potential riders with drivers), and vanpool operation. These measures may be taken by public agencies and/or private entities such as an employer, developer or Transportation Management Association. Related measures include incentives for ridesharing (see Strategy #4), preferential parking (Strategy #5), and GRH programs (Strategy #6).

BENEFITS & IMPACTS

Ridesharing can reduce congestion by **reducing the number of vehicle trips**, in turn leading to reductions in VMT, **air pollution** and **energy consumption**. For participants, ridesharing can **reduce commute costs**. For companies, the most visible benefit is the **reduced need for parking** and the associated cost savings. Like most TDM measures, the effectiveness of ridesharing programs is dependent on the location and type of program. Studies have shown that TDM programs can lead to parking reductions of up to 30%, while Chicago area firms have achieved rideshare levels of 20 to 40% (Ref. 1A).

REGIONAL POLICIES

A variety of ridesharing programs have been implemented in the Chicago region. Public-sponsored activities include **CATS' Rideshare Services** and **Pace's VIP Service**. CATS Rideshare Services program offers ridematching services to the general public, and a variety of services to employers such as help in setting up local programs, promotional assistance, and coordinator training. CATS encourages employers to offer programs with basic (preferred parking, GRH) and value-added (benefits, financial support) benefits. Pace's VIP Service offers vanpool program assistance including providing the vehicle, management assistance, market research, and a GRH service.

Other public ridesharing initiatives include an evaluation of carpool park-and-ride lots and implementation of kiosk-based ridematching (CARAVAN). In addition, many **employers and groups of individuals** have established their own carpool or vanpool programs. The 2020 RTP recommends that CATS Rideshare Services pursue methods to increase rideshare participation and voluntary employer-based programs. The RTP also supports the expansion of the region's vanpool programs.

APPLICATION PRINCIPLES

Ridesharing is most prevalent for longer distance trips and requires that participants share a common origin and destination. As such, this strategy is typically applied where there is a **high concentration of trips**, such as a larger employer or activity center. However, measures such as ridematching and promotion can be implemented on a regionwide basis. This strategy is most effective where there is a **benefit to the participants** such as direct incentives, reduced costs, or reduced travel times. Factors that may contribute to the effectiveness of ridesharing include the **presence of HOV priority lanes**, and **high parking costs.** Vanpool programs may also be appropriate where traditional transit service is not applicable or efficient. **Strong employer or management support** is also critical to program success. Ridesharing may be supported by other TDM strategies and by HOV strategies.

ANALYSIS GUIDELINES

The effect of this strategy is generally measured by the **reduction in vehicle trips**. CATS Rideshare Services maintains the FHWA **TDM Model** for evaluating TDM and rideshare potential, plus a **sketch-planning spreadsheet analysis** to determine environmental impacts of a program. A good start is to look at the results from similar programs in other areas.

KEY CONTACTS

CATS Director of Transportation Management - (312) 793-5554

Pace VIP - (847) 364-PACE Ext. 4500

Strategy #2 Class: TDM Measures

ShareCarGo ^{tm} Car Sharing Program

DESCRIPTION

The ***ShareCarGo*** ^{tm} Car Sharing Program is an innovative new program that will create a private sector corporation, structured either as a non-profit or for-profit organization, that would provide its participating members with access to a variety of motor vehicles that would be stored locally and made available for short-term rental through a call-in reservation service. The goal of ***ShareCarGo*** ^{tm} is to enable people to use vehicles whenever they need them, but to preclude the need to own them. Car sharing is very popular in Germany, Switzerland, and Belgium; car sharing programs have also been created in Canada and in Portland, OR. Members pay a refundable security deposit, call to make a reservation, use the vehicle, and pay a monthly user fee based on the total time and mileage accumulated during the preceding month. Members do not own the vehicles, and therefore aren't responsible for fuel, service, maintenance, insurance, or other conventional transportation costs.

BENEFITS & IMPACTS

In Europe, car sharing reduces VMT per person by enabling more people to use fewer vehicles. In Germany, car-sharing programs have demonstrated that one car-sharing vehicle can replace 5 to 10 cars depending on location and intensity of use. Specifically, in the first year of operation 21% of the members sold their vehicles; 37% used car-sharing as an alternative to buying a car; and 35% had no intention of buying a car. In Europe, where energy costs are greater than in the United States, car-sharing members found that they could save as much as $2,500 per year in motor vehicle travel costs. European car-sharers also found that they reduced their VMT by 6,000 miles per year; U. S. reductions could be greater because of the tendency to travel more. In Chicago, the ***ShareCarGo*** ^{tm} program will enable members to have ready access to a wide variety of vehicles for short-term and local travel. For example, a car sharing fleet might include small, high-efficiency urban vehicles, minivans, pickups and intermediate sedans, as well as experimental vehicles using alternate fuels, zero emissions systems, or other advanced technologies. Because ***ShareCarGo*** ^{tm} members are likely to be able to walk or bike to vehicle storage spots, they will be able to substitute ***ShareCarGo*** ^{tm} vehicles for their current cars while saving hundreds of dollars per month on vehicle ownership and operating costs.

REGIONAL POLICIES

ShareCarGo ^{tm} is consistent with and advances a variety of congestion mitigation and air quality improvement goals of regional agencies. It is envisioned as a companion program to the Location Efficient Mortgage (LEM - Strategy #28) because LEM borrowers are likely to live in areas where ***ShareCarGo*** ^{tm} pick-up and drop-off spots will be located and because ***ShareCarGo*** ^{tm} services will reinforce the ability of LEM borrowers to live conveniently without owning a vehicle.

APPLICATION PRINCIPLES

ShareCarGo ^{tm} is a private sector program that will require the assistance of public agencies for start-up research/development funding. Once it is under way, it will be funded through the user fees collected from its participating members. Additional public policy support will be needed from City departments to enable cars to be stationed in convenient and safe locations.

ANALYSIS GUIDELINES

ShareCarGo ^{tm} members become a community of vehicle users that can be readily surveyed for impact analysis either through periodic service evaluation queries or through the analysis of the billing records of their rental activities. As presently envisioned, the ***ShareCarGo*** ^{tm} program would compile impact data and model it for insights into how well it helps reduce congestion, trips, VMTs, and vehicle purchases. Emissions reductions will be calculated on the basis of compiled usage data.

KEY CONTACTS

Center for Neighborhood Technology ***ShareCarGo*** ^{tm} Program Director - (773) 278-4800, ext. 115

Strategy #3 Class: TDM Measures

Alternative Work Arrangements

DESCRIPTION

Alternative work arrangements include a variety of programs that allow employees to deviate from the standard 8-hour, 5-day work week. Alternative work arrangements fall into two categories: **modified hours** (e.g., compressed work weeks, flex-time, and staggered work hours) and **modified work places** (e.g., telecommuting and regional work centers).

With compressed work weeks, employees work their regularly-scheduled hours in fewer days per week. Flex-time arrangements are similar, but allow employees to select the hours they work each week. Staggered work hours are arranged so that employees work 8-hour shifts, but starting and ending times vary. With telecommuting, employees perform their regular work duties at home rather than commuting to work, either full-time or part-time. Regional work centers are suburban locations where workers from the same or different offices can work at a location closer to their home (instead of a downtown office).

BENEFITS & IMPACTS

This strategy may reduce congestion in different ways depending on the measure implemented. This strategy may lead to **reduced vehicle trips** (compressed work week, telecommuting), **reduced peak period travel** (staggered work hours, flex-time), or **reduced VMT** or trip length (regional work centers). By reducing the number of total or peak period trips, this strategy can help lessen the spreading of the peak travel period. By spreading demand over a longer period or to other areas (e.g. away from downtown to an outlying work center), the transportation system may handle more commuters without additional peak capacity.

These programs are **generally inexpensive to implement**, and generally receive a positive reaction from employees. Some programs (e.g., telecommuting and flex-time) may meet with some resistance from employers.

REGIONAL POLICIES

This strategy falls largely under the **domain of individual employers**, thus the public agency response has been one of supporting the concept rather than specific action**.** It is recognized that alternative work arrangements support TDM objectives and can be used to encourage use of alternative modes. As such, this strategy is promoted by CATS Rideshare Services for **consideration during the development of employer TDM programs**.

APPLICATION PRINCIPLES

Alternative work arrangements are generally applied on a **site-specific basis.** They are most effective where there is a single **large employer** or strong **business group**. Because these arrangements are **implemented by the individual employers**, the public role is primarily one of **educating and assisting employers**.

Unlike other TDM strategies, supporting strategies are not important for alternative work arrangements, and this strategy may even counter some of the benefits of strategies like ridesharing programs and transit/carpool incentives by disrupting the common work schedules of employees who rideshare.

ANALYSIS GUIDELINES

The effect of this strategy is generally measured by the **reduction in vehicle trips during the peak periods**. CATS Rideshare Services maintains the FHWA **TDM Model** for evaluating the potential of various TDM measures, plus a **sketch-planning spreadsheet analysis** to determine environmental impacts. In general, sketch-planning analysis can suggest the approximate impacts of a program by considering the number of employees expected to participate and the current mode choices of these individuals. Results from similar programs in other areas may also be used to estimate the impacts of future applications.

KEY CONTACTS

CATS Director of Transportation Management - (312) 793-5554

Strategy #4 Class: TDM Measures

Transit/Carpool Incentives

DESCRIPTION

Transit, vanpool and carpool subsidies are **economic incentives** for using these modes, and they are usually provided by individual employers or through regional programs. There are a number of ways to structure these incentives. One direct way is to provide a **free or subsidized vanpool service** (the vehicle and/or the organization of the service). Another way is to provide **free or reduced parking** for carpools and vanpools. Other incentives for using carpools and vanpools can be free gasoline, prizes and recognition, and compensatory time off.

Employees who use transit can be provided with **free or reduced-price transit fares**, or may be able to "cash out" the value of the parking that they do not use. **Tax advantages** can be provided for employers who offer subsidies for employees using alternative forms of transportation. From the users' perspective, free ridematching (Strategy #1) and GRH programs (Strategy #6) are also incentives for using transit or carpool modes.

BENEFITS & IMPACTS

Incentive-based measures generally encourage HOV (transit, carpool, vanpool) use by **reducing the costs incurred by travelers**. The overall impact may be measured through a **reduction in SOV vehicle trips**, and an **increase in carpool or transit mode share**. Experience in New York/New Jersey indicates that participants in a transit subsidy program were able to increase transit use by approximately 15% (Ref. 4A). There are no real negative impacts for these programs, as long as there are employers willing to participate.

REGIONAL POLICIES

In accordance with federal rules, RTA administers a regional **Transit Check program**. Under this program employers can purchase tax-free vouchers for their employees. The vouchers may then be used to purchase fares or passes on the RTA system. As of 1996, more than 1,000 companies had participated in the Transit Check program. Beyond this program, the implementation of incentive measures varies from employer to employer, and by transit provider. The 2020 RTP supports efforts to expand participation in the transit check program, including increased marketing and investigation of a tax benefit program at the state level.

APPLICATION PRINCIPLES

Incentives are generally given by **individual employers**, and are most typically available through large employers. They are most effective in areas where transit service is available but underutilized, where the parking supply is limited, or for employers with large numbers of employees who have **long commute trips**. Transit subsidies might also be provided on a regional basis, as a promotion or as an ongoing program to boost transit ridership along a particular corridor. Incentives may be used as a complementary strategy for other rideshare and transit improvements.

ANALYSIS GUIDELINES

The effect of this strategy is generally measured by the **reduction in vehicle trips** and/or **shifts in employee mode choice**. CATS Rideshare Services maintains the FHWA **TDM Model** for evaluating the potential of various TDM measures, plus a **sketch-planning spreadsheet analysis** to determine environmental impacts of a program.

The impact of these programs can also be estimated through **peer group comparisons** with other programs where information about transit and/or carpool participation (either increased transit utilization, carpool formation or better rideshare retention) is known. This information can then be used to calculate the potential increase in carpool share or transit utilization rates at the study location. After implementation, **surveys** of employees can be used to measure actual mode shifts.

KEY CONTACTS

CATS Director of Transportation Management - (312) 793-5554

RTA Transit Check Sales and Marketing Representative - (800) 531-2828

Strategy #5 Class: TDM Measures

Parking Management

DESCRIPTION

Parking Management basically refers to any plan by which parking space is provided, controlled, regulated, or restricted. With respect to congestion management, this strategy typically involves **limiting the amount of parking** available or **increasing the cost**. Actions to limit parking can include removing existing parking spaces, applying restrictions (e.g. time of day, duration, type of use or vehicle), and controlling the amount of parking supplied for new developments through zoning code and ordinances.

Related measures include **providing preferential or discounted parking for HOVs**, instituting an **areawide parking cap** that limits the overall supply of parking, and **promoting fringe parking** (park-and-ride lots) away from congested areas. Most cost-related actions, such as increasing fees or rates, are covered under Strategy #25, however this strategy does include **eliminating employer-paid parking** (parking subsidies). More detailed discussion of this strategy is provided in Reference 5A.

BENEFITS & IMPACTS

The primary intent of parking management is to discourage driving by making it more difficult or more expensive to park. The higher cost and/or additional time needed to park may make alternate modes more attractive. Thus, this strategy will **reduce vehicle trips** and **encourage the use of non-auto modes**. The impact is typically greatest on peak period work trips, when parking supply is most critical. Preferential parking for HOVs will lead directly to **increased HOV travel**. This strategy may lead to **reduced development costs** due to reduced parking requirements, but may lead to **higher driver costs**, and may **discourage development or customers** in areas where parking is limited or costly.

REGIONAL POLICIES

On-street parking restrictions are common throughout Chicago, and some communities have adopted **travel demand reduction (TDR) programs** involving parking management. A limited parking supply in many parts of the region effectively reduces demand for SOV travel. The 2020 RTP recommends that CATS develop and distribute informational material, and provide technical support to encourage parking management programs. The plan also supports a regional study of parking management techniques and encourages local implementation.

APPLICATION PRINCIPLES

This strategy is most often implemented on a local level (at specific sites or streets) but can also be effective across a larger area. Parking management measures may be applied in a variety of settings. Characteristics that contribute to the effectiveness of this strategy include the **availability of alternative transportation options** (such as public transit, non-motorized mode facilities, and rideshare services) and a **high parking occupancy rate**. It should be noted that it is generally recognized that most suburban areas oversupply parking, so reducing parking spaces in these areas may have minimal impact. Generally, parking management has its greatest impact in areas where parking is already in short supply, and support measures such as ridematching and preferential parking are provided by the employer.

ANALYSIS GUIDELINES

The effect of this strategy is generally measured by the **reduction in vehicle trips** and/or **shifts in mode choice**. CATS Rideshare Services maintains the FHWA **TDM Model** for evaluating the potential of various TDM measures, plus a **sketch-planning spreadsheet analysis** to determine environmental impacts of a program. **Elasticities** can be used to estimate the impact of parking supply on pricing and the impact of parking pricing on mode choice, but the available data are somewhat limited. Another resource is the ITE ***Parking Generation*** **manual** (Ref. 5B) which can be used to determine the number of parking spaces required for a particular development or mix of developments.

KEY CONTACTS

CATS Director of Transportation Management - (312) 793-5554

NIPC - (312) 454-0400

Strategy #6 Class: TDM Measures

Guaranteed Ride Home (GRH) Programs

DESCRIPTION	GRH programs provide **alternate transportation** under special circumstances to people that carpool, vanpool, use transit, walk, or bicycle. When there is an emergency or other circumstances (e.g., working late) that result in these people missing their regular transportation, they are taken home via a **company-owned or leased vehicle** or given **taxi fare**. GRH programs can be provided by individual companies or throughout a larger area.
BENEFITS & IMPACTS	The primary benefit of GRH programs is that of adding to the sense of **personal security** for those people using non-SOV modes. The GRH program provides assurance that a person can get home safely and quickly when needed. In turn, this strategy can help **encourage the use of alternative modes**. Research has suggested that a GRH program can **reduce SOV trips** by 1-3% for employees of a company (Ref. 6A), when it is used in combination with other TDM measures.
REGIONAL POLICIES	At present, GRH programs have been implemented on a limited basis throughout the region. Pace provides this service to all participants in its **VIP Vanpool program**. The number and nature of GRH programs offered by private sector entities (e.g. employers) is not known. CATS is examining the potential for a **regional GRH program** for participating carpoolers. Immediate activities include the preparation of a policy paper on this topic and initial implementation on a demonstration corridor basis.
APPLICATION PRINCIPLES	A GRH program supports the effectiveness of other TDM measures that encourage the use of transit and ridesharing. It has little benefit by itself, but can be **critical to the success of other strategies**. The strategy can be implemented on a local scale (for individual companies) or an areawide program can be developed.
ANALYSIS GUIDELINES	GRH programs **should not be analyzed individually** for trip reduction. The analysis techniques for other TDM measures can be adjusted slightly if GRH programs are (or are not) available.
KEY CONTACTS	CATS Director of Transportation Management - (312) 793-5554 Pace VIP - (847) 364-PACE Ext. 4500

3.2 TRAFFIC OPERATIONS IMPROVEMENTS/TRANSPORTATION SYSTEMS MANAGEMENT (TSM)

Traffic operations improvements are designed to allow more effective management of the supply and use of existing roadway facilities. These improvements can increase effective capacity by optimizing traffic operations without the addition of general purpose lanes. TSM strategies tend to be low cost, to require minimal right-of-way, and to be rapidly implementable compared to new construction. Typical strategies include signal re-timing, signal coordination, and geometric improvements. These traffic operations improvements are implemented at a site-specific or facility level. However, this class of strategies also includes measures such as ramp metering and traffic control centers. Strategies of this type are best applied at the corridor and regional levels. Traffic operations improvements are effective for eliminating bottlenecks and improving safety.

Keys to the success of these strategies are a thorough engineering study to identify the appropriate strategy, and the application of appropriate engineering criteria in the design of the improvements. To ensure on-going benefit, another important factor is adequate maintenance of traffic signals and loops. While TSM strategies can effectively address congestion problems as stand-alone improvements, opportunities for packaging with other strategies should also be explored. For example, as part of a signal system upgrade consideration may be given to transit vehicle priority. Similarly, a ramp metering plan may include priority for HOVs. An obvious packaging of strategies is the inclusion of appropriate TSM strategies within a plan to add new lanes or construct a new roadway. This type of packaging, and the requirements for doing so, are discussed in more detail within Chapter 4.

For Details, See Individual Strategy Sheets:

7. Traffic Signal Improvements
8. Roadway Geometric Improvements
9. Time-of-Day Restrictions
10. Ramp Metering
11. Commercial Vehicle Improvements
12. Construction Management

Strategy #7 Class: Traffic Operations Improvements

Traffic Signal Improvements

DESCRIPTION

Traffic signal improvements refer to a host of actions related to traffic signal equipment and operation. These actions range from **improved maintenance practices** that reduce 'down time' to the installation of **centralized traffic signal control systems**. Typical improvements include **installing new signals**, **updating equipment**, **re-timing signals**, **adding signal phases** (e.g. left turn phase), **converting from fixed-time to actuated operation**, and **improving coordination between adjacent signals**. Less common improvements include accommodating **bus and/or emergency vehicle preemption** and implementing all-red clearances. For the purposes of this handbook, network-wide control systems are discussed as part of Strategy #40 - ATMS.

BENEFITS & IMPACTS

Traffic signal improvements are aimed at **improving operations and vehicle flow.** Most of these measures can be implemented within the existing right of way, cause minimal disruption to existing residents and businesses, and can be accomplished at a relatively low cost and in a short time. Improved traffic operations result in **higher overall travel speeds**, **reduced delay, improved safety**, and **better air quality**.

Projects implemented under IDOT's Signal Coordination and Timing (SCAT) Program have been shown to produce significant reductions in vehicular emissions, delay, and fuel consumption. A review of several locations revealed a 41% reduction in overall peak period delay. The duration of positive impacts from signal improvements is usually short term (five years or less). The effectiveness of the system needs to be maintained and timing changes made to ensure benefits are realized.

REGIONAL POLICIES

Traffic signal improvement strategies are among the highest priority urban traffic improvements implemented in northeastern Illinois. IDOT's **SCAT Program** is a separately funded program element designed to facilitate implementation of computerized, coordinated signal systems. The SCAT Program provides state funding assistance for the traditionally local share of such projects. In addition, local governments in northeastern Illinois, ranging from the City of Chicago to suburban counties, have implemented comprehensive **traffic signal improvement programs**. A significant number of signal improvements were funded from the region-wide CMAQ program implemented through CATS.

APPLICATION PRINCIPLES

Traffic signal improvements are applicable at the individual intersection, facility, corridor or subarea levels. Candidate locations for signal installation or modification include intersections in areas that have experienced **growth** or **shifting land use patterns**. These characteristics may lead to corresponding increases in traffic volumes and/or changes in traffic patterns. The need for improvements may be identified through such performance measures as **total delay, average travel speed, and travel time**. **Accident rates** may also help identify locations where traffic signal improvements may be warranted. Larger scale traffic signal improvements (arterial coordination, traffic signal control centers, etc.) are most applicable where **signals are closely spaced**. Where possible, traffic signal improvements, especially those involving new signal equipment, should be coordinated with proposed roadway construction projects.

ANALYSIS GUIDELINES

Potential impacts of traffic signal improvements are typically measured by **assessing changes in travel times, speeds and delays**. For isolated intersections and simple arterial segments, the ***Highway Capacity Manual*** (Ref. 7A) methodology and related software package may be used. For more complex situations, a number of **traffic simulation packages** (e.g. SYNCHRO, CORSIM, PASSER II, and TRANSYT-7F) are available. These packages can provide local and network estimates of changes in total delay and travel time.

KEY CONTACTS

IDOT Central Office Traffic Operations Section - (217) 782-2076

IDOT Central Office Bureau of Statewide Program Planning - (217) 782-2755

IDOT District 1 Bureau of Traffic - (847) 705-4141

IDOT District 1 Bureau of Programming - (847) 705-4393

IDOT District 1 Bureau of Local Roads and Streets - (847) 705-4201

CDOT Bureau of Traffic - (312) 744-4686

Strategy #8 Class: Traffic Operations Improvements

Roadway Geometric Improvements

DESCRIPTION

Geometric improvements refer to **physical improvements** that may involve adjustment to the number or arrangement of travel lanes at intersections or on **limited segments** of a roadway. Intersection measures include **restriping, channelization, adding turn lanes, installing traffic islands, modifying the intersection angle, and improving corner radii**. Segment improvements may include expressway **auxiliary lanes, passing lanes, truck climbing lanes, bus turnout lanes, widened shoulders, one-way couplets, and reversible lanes**.

BENEFITS & IMPACTS

These strategies are designed to **improve traffic flow** by increasing the effective capacity of the affected intersection or roadway segment. This is achieved primarily by providing separate lanes for various maneuvers (e.g., turning, passing, merging). In doing so, geometric improvement strategies may also provide significant **safety benefits**.

Geometric improvements typically are low-cost and highly **cost-effective**, require minimal right-of-way, and can be implemented in a relatively short timeframe, although these characteristics may vary. Social and environmental impacts are generally minimal, but may include land acquisition, reduced sidewalk widths, and bringing traffic lanes closer to property lines and buildings.

REGIONAL POLICIES

These types of strategies are commonly implemented throughout northeastern Illinois and the rest of the U.S. CATS and IDOT support the implementation of these strategies where appropriate.

APPLICATION PRINCIPLES

These strategies are appropriate for use where **localized congestion** exists (bottlenecks), generally for individual facilities. It is important, however, that the result is not one of simply moving the bottleneck from one location to another. Careful study is required to identify the appropriate type of improvement. Depending on the proposed improvement, the availability of ROW may be an issue.

There are a wide variety of circumstances that may dictate where geometric improvements could be effective. Intersection improvements may be applicable in locations with a **high volume of turns** (restriping, channelization, addition of turn lanes) or where intersection **geometry is substandard** (intersection realignment, increasing turn radii). Intersections with high **accident rates** may be good candidates for geometric improvements Segment improvements may be applicable on facilities with a **high percentage of trucks** combined with **steep grades** or where congestion is caused by **weaving, merging, or diverging**.

Reversible lanes may be considered on facilities with a significant peaking pattern; where the percentage of traffic in the peak direction is much greater than fifty percent in the peak period. Bus turnouts are appropriate along major bus routes and should be implemented in consultation with the appropriate transit provider.

ANALYSIS GUIDELINES

Field inspections by a qualified traffic engineer can often determine where this type of strategy is appropriate. The operating impacts of these strategies can be assessed using the methodologies described in the ***Highway Capacity Manual*** (Ref. 7A) and related software package. Most other **level of service analysis and simulation packages** (e.g., TRANSYT, NETSIM, FREQ) can also be used. Turning movement counts, current geometrics and signal timing are necessary for a thorough analysis. Future traffic volumes should also be considered.

KEY CONTACTS

IDOT District 1 Bureau of Programming - (847) 705-4393

IDOT District 1 Bureau of Local Roads and Streets - (847) 705-4201

CDOT Bureau of Traffic - (312) 744-4686

Strategy #9 Class: Traffic Operations Improvements

Time-of-Day Restrictions

DESCRIPTION

Time-of-day restrictions refer to the **prohibition of parking and/or turning movements.** This strategy also includes **truck restrictions**, such as limiting access to a facility during specific times and prohibitions on truck loading in congested areas. These measures may be applied at individual intersections, on specific roadway sections, or throughout a defined area (i.e., CBD). While these restrictions may apply at all times, they typically are in effect only for peak periods.

BENEFITS & IMPACTS

These restrictions are designed to **maximize operational efficiency** of the existing system by eliminating turning or parking conflicts, reducing the impacts of trucks, or freeing up roadway capacity. For example, parking restrictions during peak hours allow the curb lane to be used as an additional through or right turn lane. On roadways with no separate left turn lanes, turn restrictions eliminate queues and conflicts thus **reducing delays** and **improving travel speeds** by eliminating conflicts. An important advantage of this strategy is that increased operational efficiency is achieved at a relatively **low cost** and **without the need for construction or additional ROW**.

A potential disbenefit of parking restrictions is the **economic impact** to businesses related to **reduced parking.** For turn restrictions, a potential disbenefit is **increased VMT** as vehicles circumvent restricted areas or avoid prohibited movements.

REGIONAL POLICIES

Time-of-day restrictions, especially left turn prohibitions during peak hours, are used throughout northeastern Illinois. They are more common on arterials in Chicago that have restricted right of way.

APPLICATION PRINCIPLES

Generally, Time-of-Day Restrictions are a **localized strategy**, but they may be applied along an entire facility or throughout a subarea. They are typically applied in locations where **ROW constraints** prohibit the addition of turn or additional through lanes.

Because this is a restrictive strategy, the potential disbenefits should be carefully considered. Ideally, Time-of-Day Restrictions should be used where **other strategies are not available**, and where the **demand for the restricted action is limited** or where **alternatives to the restricted movement exist**. For example, parking restrictions are most acceptable in areas of low parking demand or where sufficient off-street parking is available. Turn restrictions at certain locations are best if nearby intersections can accommodate these turning movement demands. Truck restrictions are applicable in congested areas where commercial vehicles contribute significantly to the congestion problem and where alternate routes exist. Truck restrictions may also be appropriate on facilities with narrow lanes or poor turning radii.

Often critical to the success of these measures is the implementation of complementary measures such as the improvement of adjacent intersections, addition of ancillary parking, and coordination with businesses and trucking companies.

ANALYSIS GUIDELINES

The application of Time-of-day restrictions can be evaluated using the methodologies in the ***Highway Capacity Manual*** (Ref. 7A) and/or **arterial simulation packages** like TRANSYT 7F. Data typically required for this analysis includes turning movement counts, lane configurations, signal phasing and timing, and travel speed. Because turn prohibitions force drivers to use alternate routes, consideration should be given to the **additional VMT** generated. Turn restrictions are not recommended if they force detours greater than 0.5 mile.

KEY CONTACTS

IDOT Central Office Bureau of Statewide Program Planning - (217) 782-2755

IDOT District 1 Bureau of Traffic - (847) 705-4141

IDOT District 1 Bureau of Programming - (847) 705-4393

CDOT Bureau of Traffic - (312) 744-4686

Strategy #10 Class: Traffic Operations Improvements

Ramp Metering

DESCRIPTION

Ramp metering is used to **manage the rate at which vehicles enter a controlled access highway**. It is most often used to control vehicles entering at ramps, but can also be used at mainline locations, at expressway-to-expressway interchanges, and at gateways (e.g., bridges or tunnels). Metering is usually **controlled using traffic signals**, but can also be accomplished using **changeable message signs or gates**. Metering can be set at or below demand rates, and can be varied by time-of-day. Demand responsive metering can help to manage fluctuations in traffic volumes, and to prevent queues from becoming too long.

BENEFITS & IMPACTS

Ramp metering has proven to be one of the most **cost-effective** techniques for **improving traffic flow** on expressways. By spacing or limiting the number of vehicles entering the highway, **merge conflicts are reduced** and mainline **speeds can be increased**. A survey by FHWA of seven ramp metering systems in the U.S. and Canada revealed that average speeds increased 29% (Ref. 10A). In addition, **increased volume throughput** and **reduced accident rates** have been observed. Studies in the Chicago area have shown benefit-cost ratios of 7.1 to 1, with reductions in peak period congestion, up to 60%, and accidents, up to 18% (Ref. 10B).

Potential disbenefits of metering include **increased wait times on ramps**, **queue spillover** onto local streets, and **diversion** to alternative routes. Allowing HOV vehicles to bypass ramp meter queues can **encourage ridesharing** and reduce person travel-time.

REGIONAL POLICIES

Ramp metering has been used in many locations throughout Illinois, including current installations on the Eisenhower, Kennedy, Edens and Dan Ryan Expressways.

APPLICATION PRINCIPLES

Ramp metering is often applied where traffic volumes are near capacity for large portions of a highway. The strategy is most effective where there are only **short periods of oversaturation.** It is generally ineffective in situations where oversaturated conditions last throughout a peak period or for several hours. In many locations, congestion cannot be significantly reduced without causing **large queues on ramps**, which can result in backups to surface streets. The success of ramp metering strategies is often dependent on supporting strategies like operational (e.g., signal timing) or geometric (e.g., ramp reconstruction) improvements.

These controls are typically only employed during congested periods where highway congestion is caused by a **high concentration of vehicles merging into the traffic flow**. Ramp metering can also be effective where a traffic signal periodically causes a surge of vehicles onto a ramp. It can only be used in areas where there is **sufficient storage area on ramps** to avoid traffic backing up local streets. Ramp meters can also be used to close on-ramps during incident conditions.

Equity issues are important in planning ramp metering, because there may be significant delays to vehicles entering the highway in communities in congested areas, while drivers making longer trips may enjoy shorter trip times.

ANALYSIS GUIDELINES

Ramp metering is often analyzed using **macro- or micro-simulation models**; FREQ is the most commonly used tool. It is important to use techniques and data that support a fine level of analysis. While a difference of 50 vehicles per hour may be insignificant for expressway operations, a similar error on a ramp may be the difference between an effective strategy and an unsatisfactory queue spillback. For simple situations, spreadsheet analysis can be used.

KEY CONTACTS

IDOT District 1 Bureau of Traffic - Expressway Operations Engineer - (847) 705-4157

Strategy #11 Class: Traffic Operations Improvements

Commercial Vehicle Improvements

DESCRIPTION

Commercial vehicle improvements are a group of actions designed to facilitate the flow of commercial vehicles (trucks) and/or minimize their contribution to peak period congestion. Measures to facilitate truck movement focus on removing operational and physical constraints. Such measures include **modifying signal operations** to accommodate the deceleration/acceleration characteristics of trucks, **increasing turn radii**, **widening lanes, signing for vertical clearance**, and **removing vertical obstacles**.

Other measures that can help minimize the impact of large vehicles on congested facilities include **designating truck routes**, **restricting the use of selected lanes**, **modifying delivery schedules**, and **enhancing loading facilities**. Related measures include those under strategies #7 - Signal Improvements, #8 - Geometric Improvements, and #43 - Commercial Vehicle Operations (CVO).

BENEFITS & IMPACTS

Commercial vehicle improvements are intended to **increase the capacity or operational efficiency** of roadways by helping trucks move through the network more easily or by removing commercial traffic from congested routes. Enhancing truck movements will **increase speeds** for all vehicles and may have **economic and safety benefits**. Truck route designation can be an important strategy if the designated routes have the capacity, geometry, operational characteristics and physical condition to absorb increased commercial traffic.

Restrictions on truck movements and delivery times can **increase roadway capacity and passenger vehicle speeds** by removing low-performing trucks from the vehicle mix. However, restrictive measures may have **negative economic impacts** for truck operators and the shippers or receivers of goods.

REGIONAL POLICIES

The truck route classification scheme developed by IDOT helps direct through commercial traffic to routes that can handle large vehicles. IDOT also utilizes truck lane restrictions on some Chicago expressways. Within northeastern Illinois, many communities have through-truck restrictions.

APPLICATION PRINCIPLES

Commercial vehicle improvements are most applicable in locations with **significant commercial vehicle volumes or activity** (e.g. truck VMT exceeds 20% of total), and along roads that provide **connections to key truck facilities**. The type of improvement will depend upon the individual circumstances. Design and operational improvements are appropriate where **constraints to truck movement** exist. For situations where truck activity **impedes vehicle flows**, restrictive measures, increased enforcement or improved loading facilities may be appropriate. Identification of truck routes should be considered only if the designated facility can handle the increased commercial traffic. The truck route should have adequate clearances and lane widths, through capacity, turning radii and be maintained in proper condition.

Application of any commercial vehicle improvement must be accompanied by adequate enforcement and education to ensure success. Complementary strategies include CVO and roadway operational or design improvements.

ANALYSIS GUIDELINES

Evaluation of the potential benefit from implementing commercial vehicle improvements can be estimated by **calculating total delay** on various links by modifying truck volumes. Typical analysis tools include the truck adjustment impact tables in the *Highway Capacity Manual* (Ref. 7A). By calculating total delay with existing and modified truck volumes, the analyst can determine potential ideal applications.

KEY CONTACTS

IDOT District 1 Bureau of Traffic - (847) 705-4141

IDOT District 1 Bureau of Programming - (847) 705-4393

Strategy #12 Class: Traffic Operations Improvements

Construction Management

DESCRIPTION

One of the more frequently occurring disruptions to traffic flow on major roadways is that caused by required maintenance and construction operations. These activities can result in roadway or lane closures and can reduce the capacity of those lanes remaining open (per-lane capacities through construction zones are typically in the range of 1200-1500 vph versus 1800-2000 vph in non-construction areas). Construction management activities can be categorized into two areas: construction enhancement activities and traffic mitigation activities.

Construction enhancement activities include: limiting work activities to the lower volume, off-peak hours; phasing work activities to minimize traffic impacts on a daily, weekly, or seasonal basis; utilizing construction materials (e.g., high early-strength concrete) to open the highway to pre-construction conditions as early as feasible.

Traffic mitigation measures include: maintaining a given number of open lanes; eliminating on-street parking to allow an additional travel lane; promoting ridesharing or transit use; identifying and improving alternative routes; conducting advance public information programs; and re-timing signals.

BENEFITS & IMPACTS

The principal benefit of construction management is that of **minimizing the duration and/or magnitude of traffic disruption**. Mitigation measures can improve the efficiency of traffic flow and increase available capacity during construction, particularly in peak periods. While they may be unavoidable, **vehicle delays and speed reductions can be minimized**. The congestion-related benefits of certain measures (e.g., night-time construction) need to be balanced against the **safety and cost considerations**.

REGIONAL POLICIES

IDOT and local transportation agencies maintain **policies on construction periods and procedures**. Additional procedures may be written into construction contracts. Methods to minimize traffic disruption during construction are promoted. IDOT has used **public information and alternative route improvement techniques** with a high degree of success. Extensive public information programs have been implemented to support expressway reconstruction projects. The **GCM Corridor Internet home page** (http://www.gcm.travelinfo.org) includes a map of current construction activities. The Council of Mayors publishes an **annual map of local construction activity** for each coming year.

APPLICATION PRINCIPLES

The strategy to implement construction management activities along a highway system can be applicable on a **spot location** basis (e.g., bridge repair) or on a **corridor** basis (e.g., lane widening along an arterial). The strategy may **apply to all highway functional classification** types, i.e., expressway, arterial, and collector routes.

The key to successful implementation of this strategy is **effective and thorough planning** and public education. Supporting strategies include TDM measures, transit improvements, and TSM actions.

ANALYSIS GUIDELINES

The analysis approach for construction management strategies is similar to the approach for incident management. However, the approach may require adjustment of traffic volumes to account for the type of construction management technique employed. There are several tools available to assist with the analysis of a construction management program. These include several **simulation models**, such as FREQ and NETSIM, both of which are capable of simulating construction effects through assumed capacity reductions. The spreadsheet-based tool, QUEWZ, provides a sketch-planning level approach to estimating construction-induced delays on an expressway.

KEY CONTACTS

IDOT Central Office - Office of Public Affairs - (217) 782-6953

IDOT District 1 Bureau of Construction - (847) 705-4300

IDOT District 1 Public Information Section - (847) 705-4079

IDOT District 1 Bureau of Programming - (847) 705-4393

3.3 MEASURES TO ENCOURAGE HIGH OCCUPANCY VEHICLE (HOV) USE

High occupancy vehicle (HOV) measures are intended to provide travelers with an incentive to use high-occupancy modes of travel. In doing so, these strategies address congestion by increasing the average number of people per vehicle and reducing the number of vehicle trips. This goal is achieved primarily by providing preferential treatment to HOVs which results in travel time savings and can encourage mode shifts away from SOV travel. HOV priority treatments range from dedicated HOV lanes along a corridor to HOV signal priority at an intersection or ramp meter. This class also includes support strategies that improve the convenience or reduce the cost of HOV use. Such measures include the construction of park-and-ride lots and providing HOV toll savings. Even though most HOV priority measures are applied to specific facilities, strategies to support HOV use must occur throughout a transportation corridor to be effective.

HOV measures are gaining widespread attention and application throughout the U.S. In order for HOV strategies to be effective, there must be enough travelers going between a common set of origins and destinations to form enough HOVs to merit the creation of HOV facilities. For HOV priority systems, notably HOV lanes, right-of-way (ROW) requirements is a key factor. The conversion of mixed-flow facilities to HOV use is possible, but not typically supported. Naturally, HOV support measures are most effective in those corridors that also contain priority systems. Many of the strategies described in other classes may be packaged with and contribute to the effectiveness of HOV strategies. These include most of the TDM measures, including all of the ridesharing programs, carpool/vanpool incentives, parking management, and guaranteed ride home programs; preferential ramp metering for HOVs; developing bus routes that would take advantage of new HOV lanes (transit service improvements); and land use policies that support dense and pedestrian friendly employment centers.

For Details, See Individual Strategy Sheets:

13. HOV Priority Systems (HOV lanes, HOV ramps or ramp by-pass, HOV signal priority)

14. HOV Support Services (HOV toll savings, Park-and-ride facilities, casual carpool facilities)

Strategy #13 Class: HOV Measures

HOV Priority Systems

DESCRIPTION

HOV priority systems are roadway facilities reserved for the exclusive use of carpools, vanpools, buses, and (sometimes) motorcycles. They are most commonly **exclusive HOV lanes** on expressways, but can also include **ramp bypasses**, where HOVs can avoid queues at ramp meters, **special ramps** for entering directly to an HOV lane, **arterial lanes**, or even turning lanes at signals. HOV facilities can be restricted vehicles with at least two or three passengers, or for transit vehicles only. HOV restrictions can be in place for the entire day, but they are most commonly implemented for the peak period and direction only.

There are several configurations for HOV lanes, but the most important parameters are whether or not there is a barrier between the HOV and mixed-flow lanes and whether the HOV lane is in both directions or is a reversible facility. When introducing a new HOV system, it can either be an added lane, or the modification ("take-away") of an existing lane.

BENEFITS & IMPACTS

From a system perspective, the primary purpose of HOV systems is to **increase person capacity** or throughput. Experience in northern Virginia, Seattle and San Francisco shows that HOV lanes can lead to increased person throughput by achieving an AVO of around 7, compared 1.25 typically found in general purpose lanes (Ref. 13A). For users of an HOV system, the primary benefit is **faster travel speeds**. In turn, HOV systems can **encourage HOV use**, and thereby reducing the number of vehicles and VMT. In some instances, the shift to carpools and vanpools may come at the expense of transit ridership. Depending on the configuration of the HOV system, **cost and ROW requirements** may be significant.

REGIONAL POLICIES

At present, there are no HOV facilities in the region. Past policy has focused on reserving ROW along expressways for rail transit. However, the 2020 RTP does include recommendations for the construction of **HOV lanes along the Eisenhower Expressway** and for a **feasibility study of HOV ramp meter bypass** lanes. Many metropolitan areas throughout the country (e.g. Houston, Seattle, San Francisco, Los Angeles, and Virginia) have extensive HOV priority systems and may serve as examples for this region.

APPLICATION PRINCIPLES

This strategy is generally applicable at the **corridor level** and used on facilities with **severe and recurring congestion**. It may be considered on highways where the peak hour speed is less than 30 mph. HOV lanes are also appropriate where **traffic congestion significantly reduces the speed of bus trips**, or where rail service is absent or over-capacity.

In addition to the physical requirements, an important consideration in the development of an HOV is the **minimum carpool occupancy requirement**. Allowing too small of a minimum occupancy can create excess demand for the facility, thus negating any time savings and incentives. Complementary measures to this strategy include **TDM measures** that promote carpooling and **transit operational improvements** that take advantage of the HOV facilities.

ANALYSIS GUIDELINES

When analyzing HOV facilities, there are two key issues to be addressed: will the volume of HOVs on the new facility be greater than its capacity, and will the **travel time savings** for HOVs be enough to justify the new facility? V/C ratios on the HOV facility should be less than the mixed-flow facility, and time savings on the order of **one minute per mile** of HOV lane during the peak may be used as a benchmark to justify HOV lane construction.

There are a variety of analysis methodologies for HOV facilities, but a **modeling effort** is generally required. To screen potential strategies, a sketch-planning analysis may be used, but ultimately a more detailed **simulation model** (e.g., FREQ) and/or **travel demand model** is appropriate.

KEY CONTACTS

IDOT District 1 Bureau of Programming - (847) 705-4393

Strategy #14 | Class: HOV Measures

HOV Support Services

DESCRIPTION

An HOV facility requires supporting services to ensure that drivers and riders have the conveniences and incentives to use it. One set of services are facilities where carpools can form; these are most commonly **park-and-ride facilities** where drivers can leave their vehicles to form carpools with others. **Casual carpool areas** (which may be formal or informal) allow drivers to pick up individual riders to fill out their carpools. These are typically curbside areas where potential passengers wait for the next available vehicle. To encourage casual carpooling, these areas may be identified through signing and/or pavement marking. HOVs may be given **reduced or free tolls**, which may be a travel time incentive as well as an economic one.

Other strategies to support HOV facilities include many of the TDM strategies (e.g., ridesharing, transit/carpool incentives, parking management, and guaranteed ride home programs) that are described in previous summaries.

BENEFITS & IMPACTS

HOV support services are intended to make HOV travel **more convenient** and/or **less costly**. In turn, they help to achieve the **reduction in SOV travel** that is the goal of HOV priority systems. These support services may have little impact by themselves, but can help to ensure the success of an HOV system.

REGIONAL POLICIES

Consistent with the absence of an HOV priority system in the region, very little has been done to date with respect to HOV support measures. At this time, HOV toll preferences are not provided on the region's tollways. However, the region's **first park-and-pool lot** recently opened. The 2020 RTP promotes development of a **regional park-and-pool network**. IDOT policy is to review park-and-pool market needs as part of roadway construction projects. **Preferred HOV parking** has been implemented in a few places around the Chicago area.

APPLICATION PRINCIPLES

These support strategies should be implemented in combination with an HOV facility, and should be focused on the corridor that includes the HOV facility. Park-and-ride lots should be located at points near the facility that are closest to housing (i.e., farthest from employment centers). Other strategies should be focused on residents or employees in the corridor.

ANALYSIS GUIDELINES

Supporting strategies should be analyzed in terms of their support for the HOV facility, and specifically in terms of the number of HOVs who use the facility. Park-and-ride lots should be designed to be close to or at capacity during the day, either for current or future demand. These supporting strategies are typically analyzed at a **sketch planning** level.

KEY CONTACTS

IDOT District 1 Bureau of Programming - (847) 705-4393

CATS Director of Transportation Management - (312) 793-5554

3.4 PUBLIC TRANSIT CAPITAL IMPROVEMENTS

Transit capital improvements include physical improvements for transit service only, exclusive of carpools and vanpools, and are intended to increase ridership by improving transit infrastructure or vehicles. The congestion-related benefit of these strategies is a reduction in the number of automobile trips. Possible improvements include extending rail lines, replacing or upgrading transit vehicles, and building transit transfer centers or stations. While specific improvements may be of a local scale (e.g. a transit station), they should be viewed as part of a regional or corridor approach. Planned or proposed improvements for the region are identified in the capital or strategic plans for the individual transit operators in the region.

Transit capital improvements are typically most effective in major corridors where a high level of travel and congestion suggest a significant market for transit. A major obstacle to implementing most public transit capital improvement strategies is the cost. The keys to winning support and funding for these strategies are a demand for additional transit services (especially in areas with particularly bad roadway congestion) and the success of existing transit services. If the public is satisfied with existing service, it will often support funding new transit facilities and capital improvements to existing services.

Public transit capital improvements may be packaged with several of the other strategies described in this handbook. Most TDM measures can be designed to encourage transit ridership, thus making transit capital improvements more effective. Naturally, transit capital and operational improvements also complement one another. Pedestrian improvements are a good strategy to consider for the areas around new transit line stops. Growth management strategies can also support transit service, especially fixed guideway or rail systems. Transit capital improvements may also complement ITS strategies such as APTS and ATIS. Strategies that tend to conflict most with these improvements are those that enhance automobile travel such as roadway capacity expansion and traffic operational improvements.

For Details, See Individual Strategy Sheets:

15. Exclusive Right-of-Way Facilities
16. Fleet Improvements (expansion, vehicle replacement/ upgrades)
17. Transit Support Services (Park-and-ride lots, transit centers, etc.)

Strategy #15 Class: Transit Capital Improvements

Exclusive Right-of-Way Facilities

DESCRIPTION

Exclusive ROW facilities include commuter rail lines, light rail lines, busways, bus lanes and bus bypass ramps. These are facilities that allow transit vehicles to operate unimpeded by mixed-flow traffic. Typically, commuter **rail lines**, light rail lines, and **busways** involve infrastructure that is separated from the road network. **Bus lanes** refer to lanes within a roadway designated for exclusive use by buses. Bus lanes may vary in length and may be combined with more generalized HOV lanes. **Bypass ramps** are separate ramps or lanes used by buses to avoid queues at ramp meters. Improvements may include the rehabilitation of existing facilities, extension of existing facilities, or the construction of new facilities.

BENEFITS & IMPACTS

Free of roadway congestion and vehicular incidents, the primary advantage of exclusive right-of-way facilities is that they provide **more consistent and lower transit travel times**. As such, this strategy can result in significant **transit ridership increases** that, in turn, leads to reduced congestion and improved air quality. These benefits must be weighed against the **ROW requirements** and significant costs associated with these facilities.

REGIONAL POLICIES

Agencies in the Chicago region actively support transit capital improvements. Recent improvements include the **North Central Line** service and the **rehabilitation of the Green Line**. The 1997-2001 capital programs for CTA, Metra and Pace (Ref. 15A, 15B, 15C) focus on the rehabilitation of existing track and structures. The 2020 RTP includes **six major extensions or new transit facilities** for the region including North Central service enhancements, the Outer Circumferential commuter rail corridor, the Mid-City Transitway, Orange Line extension, Red Line extension, and South Suburban commuter rail corridor.

The 2020 RTP also includes the designation of a **Strategic Regional Transit (SRT) System**. The SRT System is an integrated network of high-capacity transit facilities and services. Planning studies will be conducted for each designated SRT System facility or service to identify both short-range and long-range enhancements or improvements.

APPLICATION PRINCIPLES

In general, exclusive right-of-way facilities are most effective in **heavily-traveled corridors** or subareas. The appropriate setting for application of these facilities, however, varies according to the type of facility. Commuter rail and busways, with limited frequency and stops, are most effective when serving a **major activity center,** although the residential end may be of low density for these services. Light rail is also most effective when serving major activity centers, but may also effectively serve larger, medium-density areas.

Smaller-scale improvements, such as bus bypass ramps, depend more on local conditions. Bypass ramps may be most effective at locations that are metered and therefore offer bus vehicle priority in ramp queues.

ANALYSIS GUIDELINES

Rail and busway projects should be examined at the corridor or regional level. The guidelines for a Major Investment Study (MIS) should be consulted. The principal tools for conducting this analysis are **CATS' regional travel demand model** and **RTA's transit travel demand model**. The regional model can be used to estimate mode shifts and impacts on the roadway network. Various **sketch planning techniques** are also available for estimating potential ridership.

Bus lanes and bypass ramps may be analyzed through sketch planning techniques based on the HCM (Ref. 7A), although large-scale bus lane improvements may warrant use of the regional travel demand model. A simple process would be to assume a reduction in bus travel time equal to the average time spent in the queue for all other traffic. **Simulation programs** such as FRESIM may be adapted to model the operation of bus bypass treatments.

KEY CONTACTS

RTA System Planning - (312) 917-0700

CTA Manager of Traffic Engineering - (312) 733-7000 ext. 6790

Pace Manager of Capital Planning and Construction - (847) 228-4260

Metra - (312) 322 - 6900

Strategy #16 Class: Transit Capital Improvements

Fleet Improvements

DESCRIPTION

Fleet improvements include measures such as fleet expansion, and vehicle replacements or upgrades. **Fleet expansion** typically occurs in conjunction with operational improvements, in which case it should be considered as part of the operational improvement strategy. Fleet expansion, in the context of this strategy, involves the addition of new vehicles to existing trains with no change in frequency or other service attributes. **Vehicle replacement or upgrade** can involve the replacement in-kind of older vehicles or the introduction of a new type of vehicle providing increased capacity or level of customer convenience and comfort. Other vehicle upgrades include alternative fuel systems, such as electric buses. Vehicle management systems involving ITS technologies are covered under Strategy #42 - APTS.

BENEFITS & IMPACTS

Fleet improvements are intended to increase the attractiveness of transit service through a combination of improved **comfort and convenience**, improved **reliability**, and increased **capacity**. More attractive transit service can then lead to **increased ridership** resulting in reduced vehicle trips and congestion levels. Experience in New York City revealed that ridership increased on new or renovated vehicles (Ref. 16A).

Fleet improvements can also **reduce maintenance costs, reduce emissions, and improve fuel efficiency**. They can also help improve the fleet mix so that the appropriate size vehicle is being operated to accommodate ridership or the area served. Because this strategy does not directly involve the construction of new facilities, it does not require additional land nor create construction-related environmental impacts, but often requires **considerable capital investment**.

REGIONAL POLICIES

There is a strong commitment within the region to the maintenance and upgrade of the transit fleet. The region's transit service boards are continuously undertaking programs to upgrade their current fleets. The 1997-2001 capital programs for the region's transit service boards include expenditures for the **rehabilitation of vehicles,** the purchase of **replacement vehicles,** the purchase of **new vanpool and paratransit vehicles,** and the **upgrading of fare control and communication systems**. As part of this, Metra is purchasing new accessible train cars to better serve disabled people.

APPLICATION PRINCIPLES

Fleet expansion as part of this strategy is most appropriate for rail services that are **operating at or near capacity**. In this situation, expansion of the rail fleet will result in increased train capacity. Fleet expansion may also be considered as a method to improve operational flexibility.

Vehicle replacement should be considered when existing **vehicles have reached the end of their useful life**. Although vehicle rehabilitation can extend their useful life, consideration must be given to vehicle reliability (frequency of breakdowns and repairs) and associated maintenance costs. Vehicle upgrades should be considered whenever vehicles are replaced, and when current vehicle characteristics do not meet the preferences or expectations of riders.

ANALYSIS GUIDELINES

While it is generally acknowledged that improvements in the reliability, attractiveness and comfort of transit services will have a positive impact on ridership, very little has been done to quantify those impacts. In the absence of a formal approach, **empirical data** from local experience supplemented by analysis of passenger surveys can be used to estimate the likely impacts of such improvements. Alternatively, available **sketch planning** techniques may be adapted for this purpose. A number of these techniques are described in Reference 16B. RTA's **Capital SM Model** may be used to forecast capital replacement needs, however it is not capable of forecasting the ridership impacts associated with vehicle replacement.

KEY CONTACTS

Pace Manager of Capital Planning and Construction - (847) 228-4260

CTA General Manager of Service Planning - (312) 733-7000 ext. 6730

Metra - (312) 322 - 6900

RTA System Planning - (312) 917-0700

Strategy #17 Class: Transit Capital Improvements

Transit Support Facilities

DESCRIPTION

This strategy includes the construction of new facilities or improvements to existing facilities that serve as access points to transit services. Making transit service and facilities more convenient, safer and pleasurable to use are important parts of a program to attract and keep riders. These facilities include **park-and-ride lots**, rail stations, **bus shelters or stops**, transit centers, and **rail yards or maintenance facilities**. A **transit center** is a facility where multiple modes or services are physically integrated. **Rail stations** that provide connections to other services may be considered intermodal stations. Typical improvements include constructing new facilities, adding capacity to existing facilities, and improving the amenities at existing facilities.

BENEFITS & IMPACTS

The construction of new facilities directly increases the **accessibility** of transit services. Thus, new markets may be captured and **transit ridership increased**. Improvements to existing facilities make them and transit service more attractive by improving comfort, safety or amenities. This, in turn, may induce more travelers to use transit. As a result, this strategy can **reduce vehicular trips** and/or trip lengths. With the exception of bus shelters, however, these facilities often require additional public property.

REGIONAL POLICIES

Park-and-ride lots have been built throughout the region at rapid transit and commuter rail stations. Many CTA lots also support bus service. Pace has constructed bus **transit centers** and park-and-ride lots to support express service. Metra and CTA have recently made **improvements to stations** throughout their systems. Examples include those at Metra's Highland Park, Kensington, Worth and Winfield stations, and at CTA's Lake Transfer, Washington/State, and Roosevelt/State stations.

The 2020 RTP includes designation of a **Strategic Regional Transit (SRT) System**. The SRT System is an integrated network of high-capacity transit facilities and services. Planning studies will be conducted for each designated SRT System facility or service to identify both short-range and long-range enhancements or improvements. Such enhancements may include both capital and operational improvements.

APPLICATION PRINCIPLES

The effective application of this strategy **varies** according to the type of facility. **Park-and-ride lots** can be effective in both **suburban areas** with lower densities that are difficult to serve by traditional transit, and in congested **urban areas**. Lots should be located near major roads for easy access. Station and bus shelter improvements may be implemented along existing routes, and a standard should be developed for shelters and benches so that they are placed at appropriate bus stops.

Transit intermodal centers are appropriate where **multiple modes** or services connect. They are most effective when placed in areas that can attract ridership from pedestrians, kiss-and-ride, and park-and-ride passengers. Services connecting at the transit center must be integrated or coordinated, but this integration should not be forced.

ANALYSIS GUIDELINES

The analysis techniques for evaluating the impacts of implementing transit support facilities vary by the type of facility or improvement. The evaluation of major multimodal centers or new rail stations will likely require use of the **regional travel demand forecasting model**. The implementation of park-and-ride lots and minor transit centers may be evaluated with **sketch planning techniques** such as those described in Reference 17A. RTA's **Capital SM Model** may be used to forecast capital replacement needs, however it is not capable of forecasting the ridership impacts associated with facility replacement.

KEY CONTACTS

CTA Manager of Traffic Engineering - (312) 733-7000 ext. 6790

Pace Manager of Capital Planning and Construction - (847) 228-4260

Metra - (312) 322 - 6900

RTA System Planning - (312) 917-0700

3.5 PUBLIC TRANSIT OPERATIONAL IMPROVEMENTS

Transit operational improvements are intended to make transit more attractive and/or accessible. These improvements can increase the use of transit, which reduces the number of vehicles and, in turn, the level of congestion. Some improvements, such as service expansion, also enhance the general level of mobility and accessibility. Typical improvements include changes in service frequency or routing, improved coordination, fare programs, and transit-related roadway improvements. The strategies and measures in this class can be applied at the site, route, corridor, or regional levels.

The circumstances under which transit operational improvements are appropriate or effective can vary significantly. Many of the improvements are directed at growth areas where new or expanded service is appropriate. Other improvements, such as fare programs and improved coordination, are applicable to existing services. The key is in identifying the reason that potential riders are not using the system; whether it be due to lack of service, cost, lack of information, or time. While operational measures do not have the ROW requirements of capital improvements, the cost to implement these measures may still be an issue.

Transit operational improvements may be supported or complemented by a variety of other strategies including TDM measures, transit capital improvements, HOV measures, bicycle and pedestrian improvements, and growth management. It should be recognized, however, that in some instances these same strategies may conflict with transit improvements. For example, some TDM and HOV measures may encourage a shift from public transit to other HOV modes (carpool, vanpool). Conversely, strategies such as roadway capacity expansion and TSM improvements that typically conflict with the goal of increasing transit ridership, may have a positive impact on bus transit operations either indirectly, through improvements in general purpose traffic flow, or directly, through measures such as construction of bus pullouts and transit signal priority.

For Details, See Individual Strategy Sheets*:*

18. Transit Service Improvements (frequency, operating hours, routing)

19. Transit Marktering/Information (transfers, information systems, marketing)

20. Fare Incentives (fare reductions, fare packages)

21. Traffic Operations for Transit (signal priority, coordination)

Strategy #18 Class: Transit Operational Improvements

Transit Service Improvements

DESCRIPTION

This strategy encompasses a variety of measures including **route modifications** (e.g. realignment, expansion, new express or regular routes), **schedule modifications** (e.g. increased frequency, changes in operating hour, schedule coordination, timed transfers), and **additional bus stops**. These improvements affect the distribution and level of service. This strategy also includes measures that primarily affect the comfort, reliability and safety of transit service. Such measures include changes in **vehicle types** and **increased security**. Finally, this strategy includes changes in the **type of service** provided (fixed-route, express, demand responsive). These improvements may be implemented by both public and private providers.

BENEFITS & IMPACTS

Transit service improvements can increase transit ridership by serving new markets or **increasing access** (route modification or expansion), **reducing passenger travel times** (increased frequency, express routes), or **increasing attractiveness** through improved comfort, reliability and safety (vehicle upgrades, security). Depending on the measure, cost impacts will vary. While route expansion will undoubtedly increase operating costs, route modification may result in no change or even a decrease. By increasing transit use and reducing vehicle trips, transit operational measures can have a positive environmental impact.

REGIONAL POLICIES

CTA, Pace and Metra are continuously identifying and implementing service improvements. Recent improvements include increased service on Metra's North Central and Milwaukee District North lines, increased service on CTA's Orange line, and the expansion of Pace's express bus service. A key consideration for these modifications is the requirement that the service meet a **minimum farebox recovery ratio**. This requirement is used to assess the feasibility of proposed service expansions, as well as to identify the need for the modification or elimination of low-performing routes.

The 2020 RTP includes designation of a **Strategic Regional Transit (SRT) System**. The SRT System is an integrated network of high-capacity transit facilities and services. Planning studies will be conducted for each designated SRT System facility or service to identify both short-range and long-range enhancements or improvements. Such enhancements may include both capital and operational improvements.

APPLICATION PRINCIPLES

Transit operational improvements may be implemented under a variety of circumstances. Individual needs or objectives will determine the type of improvement implemented. Many factors can influence the need for and effectiveness of transit service improvements. Naturally, **current operating characteristics** (e.g. frequency, passenger load factors, safety problems, schedule adherence, transfers possibilities) are an important consideration. **Land use and density conditions** should also be considered when establishing the level and type of service. Supporting or complementary strategies include transit capital improvements, HOV measures, TDM, growth management, and transit-oriented TSM improvements.

ANALYSIS GUIDELINES

There are a number of tools or techniques that can be used to evaluate the impacts of transit operational improvements. The appropriateness of specific techniques depends on the nature of the service improvement and the data that is available. If the proposed improvements are of a large scale, the **CATS' regional travel demand model** or **RTA's transit travel demand model** may be used. RTA also has a **TCM model** for analyzing smaller-scale projects. Pace uses its **GIS** to help identify service needs and analyze potential impacts. Several **sketch planning techniques** are described in Reference 16B. The most common of these techniques involves the use of **demand elasticity factors**.

KEY CONTACTS

RTA Manager of Regional Services - (312) 917-0700

CTA Manager of Bus and Rail Service Planning - (312) 733-7000 ext. 6750

Pace Manager of Operations Planning - (847) 228-4234

Metra - (312) 322 - 6900

Strategy #19 Class: Transit Operational Improvements

Transit Marketing/Information

DESCRIPTION

This strategy includes measures to increase the awareness or understanding of transit services. Typical measures include marketing programs, service coordination, and information systems. **Marketing programs** generally tell potential users about the service and reasons for using it, while information systems tell them how to use the service. Thus, marketing and information dissemination measures are often closely linked. Marketing may include advertising campaigns or special promotions. Passenger information actions can range significantly from transit route maps and schedules to advanced **transit information systems**.

Agency coordination involves cooperation in the delivery of transit services. Common transit coordination actions include fare coordination, schedule coordination, coordinated customer information, and facility/stop signage coordination.

BENEFITS & IMPACTS

By increasing awareness and ease of use, transit marketing and information measures can **attract new riders**. The implementation of transit coordination measures will help improve service quality which in turn will increase transit ridership. These measures marginally reduce congestion levels by encouraging more travelers to use transit and reducing the number of vehicle trips.

Implementation of a "typical" package of marketing and information actions can result in a 0.50 percent increase in transit ridership (Ref. 19A), although comprehensive marketing programs combined with other actions such as route or schedule changes, fare reductions, and special fare programs, have been credited with ridership increases ranging from 20 to 25 percent (Ref. 19B and 19C). Impacts of these measures are limited to costs of implementation; there are no environmental impacts.

REGIONAL POLICIES

RTA, CTA, Metra and Pace all have on-going marketing and information programs. These programs range from paid advertisements in various media to posters and signs on vehicles and in stations. RTA operates the **Travel Information Center (TIC)** which provides information on routes and schedules to callers via a toll-free number. Metra and Pace offer **ticket-by-mail programs**. Although there is no universal ticket program covering all three of the region's transit services, Pace and CTA passes are valid on either system, and Metra offers a **"Link-Up" program** for its monthly passholders that provides for unlimited use of CTA and Pace services at an additional charge.

APPLICATION PRINCIPLES

This strategy is typically applied on a regional level, but may be targeted to specific subareas or locations. For example, marketing and information measures may be targeted to areas experiencing **new development or changes in service**. Similarly, schedule coordination measures are applicable where different **services connect**. This strategy is most effective when combined with other strategies such as transit service improvements.

ANALYSIS GUIDELINES

As a rule, effects from marketing, enhanced information dissemination and coordination **are too small to be effectively modeled**, even with sketch planning techniques. However, these strategies offer **synergistic effects** that may enhance the effectiveness of other strategies. In these instances, it would be appropriate to rely on impact estimates that are in the high end of the range of potential effects.

KEY CONTACTS

CTA Vice President, Communications - (312) 664-7200 ext. 4020

Pace Manager of Marketing and Communications - (847) 228-4261

RTA Manager of Regional Services - (312) 917-0700

Metra - (312) 322 - 6900

Strategy #20 Class: Transit Operational Improvements

Fare Incentives

DESCRIPTION

Fare incentives for transit service include **fare reductions**, specialized fare packages, or reduced rates of fare increase. Typical **fare packages** or programs include lower off-peak fares, and discounted fares associated with prepaid tickets or certain markets (e.g. seniors, students). This strategy covers measures that may be undertaken by transit providers. Fare incentives provided by an employer to its employees, such as providing transit passes, are discussed under the TDM class of strategies (see Strategy #4: Transit/Carpool Incentives).

BENEFITS & IMPACTS

The application of fare-related measures are intended to **reduce the cost** associated with transit travel, and provide the incentive for **increased transit ridership**. The increase in ridership will help reduce vehicle trips and VMT as a result of the diversion from auto to transit. In turn, congestion levels and vehicle emissions can be reduced. The potential cost of this strategy is a loss of revenue from lower fares.

REGIONAL POLICIES

The region's transit service boards (CTA, Metra and Pace) offer a variety of fare programs, including **reduced fare programs** for targeted groups (e.g. students, people with disabilities, senior citizens), and **monthly passes**. Pace and CTA offer an electronic **transit card** that is valid on either system and provides fare discounts. Metra offers a **"Link-Up" program** for its passholders that provides for unlimited use of CTA and Pace services at an additional charge. Metra also offers a discounted **10-ride ticket** program.

Although fare incentive measures are being applied, it must be recognized that the region is **required by law to recover fifty percent (50%)** of its transit operating costs through farebox revenue. This requirement is a critical factor for assessing the feasibility of additional fare incentives.

APPLICATION PRINCIPLES

This strategy is generally applied at a **regional level**, but may be applied to a specific subarea (e.g. a free downtown shuttle). Fare incentives should only be used where or when extra transit capacity is available. The ability to implement this strategy may be constrained by the mandatory farebox recovery ratio.

ANALYSIS GUIDELINES

The impact of fare strategies on person-trips by mode may be estimated using the demand **elasticity factor methodology**. Generalized elasticity factors such as those provided in Reference 15B may be used; although it is preferable to develop local factors. CTA uses a **FARES model** to examine changes in fare prices and the fare mix. CATS' **regional travel demand model** or RTA's **transit travel demand model** may also be used to estimate mode shifts related to transit fare incentives. A more in-depth discussion of evaluation methodologies for this strategy is provided in Reference 20A.

KEY CONTACTS

CTA Senior Vice President, Finance and Capital Management - (312) 664-7200 ext. 4680

Pace Manager of Marketing and Development - (847) 228-2467

Metra - (312) 322 - 6900

RTA Manager of Regional Services - (312) 917-0700

Strategy #21 Class: Transit Operational Improvements

Traffic Operations for Transit

DESCRIPTION

Traffic operational improvements for transit include measures designed to improve the movement of transit vehicles in mixed-flow situations. Possible measures include traffic **signal priority** for transit vehicles, bus **turnouts**, **off-street bus turnarounds**, modifications to the **location or frequency of bus stops**, and rail crossing coordination. Signal priority may be used to activate or extend green times to accommodate transit vehicles in through or turn lanes. General traffic operational improvements, such as signal coordination or geometric improvements, may also be used to improve transit operations.

BENEFITS & IMPACTS

Generally, these measures are intended to **reduce transit travel times** or, at least, minimize the variability of these times, and **improve schedule reliability**. Individual measures may also **improve transit convenience and safety**. The result is an **increase in transit ridership** leading to a reduction in vehicle trips and VMT. Bus turnouts and turnarounds eliminate buses from occupying road space thus **improving vehicle flow**. Turnarounds also provide safer turn movements and can reduce operating costs. However, bus turnouts and turnarounds may require additional ROW, and may result in transit vehicles having difficulty re-entering the traffic stream leading to increased transit travel time. Costs include those for any physical modification or improvement to the roadway and signal systems. A potential disbenefit of signal priority is an increase in average delay for non-transit vehicles.

REGIONAL POLICIES

The accommodation of transit vehicles on the region's roadways has gained increased importance in recent years. For example, the consideration of **physical transit treatments** is an important element in the development of **SRA** plans. Such improvements have been made as part of several roadway construction projects. IDOT District 1 coordinates with transit agencies on every major highway construction project. Operational improvements, such as traffic **signal priority**, have also been implemented. These include projects on Cermak Avenue and Martin Luther King Drive.

The 2020 RTP includes designation of a **Strategic Regional Transit (SRT) System**. The SRT System is an integrated network of high-capacity transit facilities and services. Planning studies will be conducted for each designated SRT System facility or service to identify both short-range and long-range enhancements or improvements. Such enhancements may include both capital and operational improvements.

APPLICATION PRINCIPLES

Transit-related traffic improvements can be implemented at **individual locations or along a facility**. While the improvements are typically made by the operator of the roadway network (state or municipal agency), they should be made in coordination and cooperation with affected transit agencies. Signal priority may be implemented on arterials without exclusive bus lanes; however, this action is most effective when implemented on arterials with bus lanes.

ANALYSIS GUIDELINES

Evaluation of this strategy requires first that any travel time savings be determined. This may be done using the proposed priority plans or field measurements. **Arterial analysis packages** such as HCS or TRANSYT may be useful for this task. These savings may then be used to determine changes in ridership using **sketch planning techniques** or the **regional travel demand model**.

This analysis should also **examine the impacts to mixed-flow traffic** caused by the combination of a reduction in volume (reduced number of vehicles as travelers shift to transit) and reduced green times for certain movements (in the case of transit vehicle signal priority). The NETSIM model incorporates a bus priority feature and can analyze the impact of reductions in bus dwell time on arterial streets. Measures that primarily affect convenience and safety are more difficult to quantify.

KEY CONTACTS

CTA Senior Vice President, Planning and Development - (312) 664-7200 ext. 6760

Pace Transportation Engineer - (847) 228-4287

3.6 MEASURES TO ENCOURAGE THE USE OF NON-MOTORIZED MODES

Measures in this class are intended to make bicycle and pedestrian travel more convenient, efficient and safer. By encouraging the use of these modes, these strategies can address congestion by reducing the number of vehicle trips. These strategies must also be recognized for their recreational and accessibility benefits. Specific measures include bicycle paths or lanes, sidewalks, pedestrian signals, bicycle racks, and aesthetic improvements. These measures may be applied at the facility or corridor levels. In addition to physical improvements, this class of strategies may include policy-oriented measures such as a requirement that new or reconstructed roads include sidewalks. These measures would be applied on an areawide basis.

Certainly, climate and terrain have a significant impact on the level of bike and ped travel. Another major determinant is the proximity of trip ends, as bike and ped trips tend to be shorter in length. Thus, from a practical perspective, these modes are most likely to be used where trip origins and destinations are located close to one another (the average bicycle work trip is 2.1 miles, and the average walking trip is less than one mile). In considering this factor, it is important to recognize that bike or ped travel may form only a portion of the trip, such as between the home and a rail station. In these situations, bike and ped measures can be effective in encouraging multimodal (transit and bicycle or walk), non-auto trips.

As the factors contributing to the effectiveness of these measures suggest, there is a strong relationship between this class of strategies and both land use and transit strategies. Land use strategies can lead to development patterns that facilitate shorter trip lengths and, in turn, make bike and ped travel more viable. Non-motorized mode use is facilitated by mixed use development and a good jobs/housing balance. Meanwhile, providing non-auto infrastructure and support systems near rail stations and bus stops can support the use of public transportation. Design standards may be used to ensure that the appropriate infrastructure is built within developments to complete the bike and ped networks. With respect to implementation, bike and ped improvements may be tied to roadway construction projects.

***For Details, See Individual Strategy Sheets**:*

22. Bike/Ped Infrastructure Improvements (paths, sidewalks, paths)

23. Bike/Ped Support Services (bike racks, lockers, showers, planning)

Strategy #22 Class: Non-Motorized Modes

Bike/Ped Infrastructure Improvements

DESCRIPTION

Bicycle and pedestrian facilities serve as transportation links for bicyclists and walkers. Bicycle facilities can include **bike lanes** on surface streets, bicycle **route marking** on the street network, bicycle **paths** (which may be shared with pedestrians), and bicycle system improvements (e.g., bicycle loop detectors). Pedestrian facilities include **sidewalks**, paths, tunnels, bridges, and crosswalks.

BENEFITS & IMPACTS

Bicycle and pedestrian improvements increase the potential for non-motorized trips to replace motorized trips. This reduces vehicle trip demand and traffic congestion, albeit marginally in most situations. The impact is generally measured as a **reduction in vehicle person-trips**, but may also be expressed in vehicle miles traveled.

REGIONAL POLICIES

This strategy is strongly supported at many levels in the region. Northeastern Illinois has an extensive system of **designated bicycle routes**. Bikeway and bike **path projects** are common, and improvements to pedestrian facilities occur frequently. Bike and pedestrian improvements have received considerable financial support under both the CMAQ and Transportation Enhancement programs that were part of the federal ISTEA legislation. The 2020 RTP reiterates this commitment to non-motorized modes and recommends that the region maintain a high level of funding for bicycle and pedestrian projects.

The *Northeastern Illinois Regional Greenways Plan* (Ref. 22A) adopted by NIPC in 1992, has been an effective framework for the development of local and regional bicycle and pedestrian trail networks. The *Year 2000 Regional Greenways and Trails Implementation Program* (Ref. 22B), an update of the greenways plan, was developed in conjunction with the 2020 RTP to identify existing and potential linkages between local bikeway systems and the regional trail system.

APPLICATION PRINCIPLES

This strategy is generally targeted toward **facility-level improvements**. Projects may be developed to overcome specific problem areas or to generally promote bicycle and pedestrian travel. While there is merit in providing appropriate bike and ped facilities in all areas, there are several factors that contribute to the potential need for and use of these facilities. These factors include: **terrain**, climate, **recreational opportunities**, **density of activity and mix of uses** (suggest potential for short trips), and the presence of a **transit center or station**.

Existing bicycle and pedestrian activity should be used as an indicator of the possible benefit of improvements. Bicycle and pedestrian facilities can be implemented with lower cost and a shorter timeframe than highway facilities. Both pedestrian and bicycle system users will only use a non-motorized mode if their trips are convenient, safe, and enjoyable.

ANALYSIS GUIDELINES

Analysis of pedestrian and bicycle facilities is usually conducted at the level of individual trips, because the likelihood of a bicycle or pedestrian trip is directly dependent upon the origin, destination, and length of each trip. A fraction of the trips along a corridor or facility can be expected to bicycle or walk; the percentage depends upon factors such as the availability of bicycle and pedestrian facilities, trip length, trip purpose, weather, and socioeconomic characteristics of the travelers. A **mode choice model** (either a formal model or sketch-level analysis) is appropriate for this type of analysis.

KEY CONTACTS

IDOT Central Office Bicycle and Pedestrian Coordinator - (217) 785-2148

IDOT District 1 Bureau of Programming - (847) 705-4393

IDOT District 1 Bureau of Local Roads and Streets - (847) 705-4201

NIPC Director of Planning Services - (312) 454-0400

City of Chicago Bicycle Program Coordinator - (312) 744-8093

Chicagoland Bicycle Federation - (312) 427-3325

CATS Council of Mayors - Director of Community Liaison - (312) 793-3472

CATS Director of Plan Development - (312) 793-0380

Strategy #23 | Class: Non-Motorized Modes

Bike/Ped Support Services

DESCRIPTION

Support services for non-motorized modes include a variety of strategies to make the use of bicycle and pedestrian facilities more convenient, safe, and enjoyable. Public bicycle storage systems (e.g., **lockers**) provide a safe and secure place for bicycle storage. Adding **bicycle racks** to transit vehicles may encourage bicycle use. Employers can provide bicycles, shower facilities, or bicycle parking. Also, **monetary incentives** may be used to support bicycle or pedestrian trips; these are generally provided by individual employers.

On a regional basis, bicycle and pedestrian **planning programs** can help to develop a network of non-motorized facilities. Once these networks are developed, distributing bike route maps is an effective way to increase bike facility use. Other **marketing efforts**, promoting the health, environmental, pleasure, or convenience aspects of non-motorized modes, can be used to support bicycle and pedestrian travel.

BENEFITS & IMPACTS

Bicycle and pedestrian support services are only effective in conjunction with bicycle and pedestrian facilities, but are important to insure or improve the benefits described in Strategy #22. These support services will make a difference to some travelers in choosing a non-motorized mode, and will be reflected in the number of **motorized person-trips** and VMT.

REGIONAL POLICIES

Support for this strategy is reflected by numerous actions and efforts undertaken by agencies at various levels in the region. For example, Pace and Metra have installed **bicycle racks** at rail stations and transit centers. CTA and the City of Chicago have also implemented aggressive bike rack programs. Many agencies have **designated staff** responsible for bicycle and pedestrian planning. The *Northeastern Illinois Regional Greenways Plan* (Ref. 22A), the *Year 2000 Regional Greenways and Trails Implementation Program* (Ref. 22B), and numerous subregional plans have resulted from this commitment of staff resources. **Bicycle maps and brochures on commuting and safety** are available to the public. Bike and pedestrian improvements have received considerable financial support from both the CMAQ and Enhancement programs.

At this time, there is no formal policy related to allowing bicycles on transit vehicles. This decision is being left to the individual transit providers.

APPLICATION PRINCIPLES

Support services should be applied in conjunction with existing bicycle and pedestrian facilities to help promote the use of these facilities. They can be focused on individual facilities, but are more often **regionally based**, to encourage bicycling and walking throughout a city or region.

ANALYSIS GUIDELINES

Supporting strategies should be analyzed in terms of their support for the bicycle and pedestrian facilities, and specifically in terms of the number of people who use these modes. Supporting strategies are typically analyzed at a **sketch planning level**.

KEY CONTACTS

IDOT Central Office Bicycle and Pedestrian Coordinator - (217) 785-2148

IDOT District 1 Bureau of Programming - (847) 705-4393

IDOT District 1 Bureau of Local Roads and Streets - (847) 705-4201

City of Chicago Bicycle Program Coordinator - (312) 744-8093

Chicagoland Bicycle Federation - (312) 427-3325

CATS Director of Plan Development - (312) 793-0380

CATS Council of Mayors - Director of Community Liaison - (312) 793-3472

3.7 CONGESTION PRICING

Congestion pricing involves charging fees to motorists to discourage vehicle travel, particularly during peak or congested periods. This class of strategies is intended to reduce congestion by shifting trips to other time periods or modes. This may be done directly through road user fees or indirectly through parking fees. Within this context, congestion pricing differs from the current toll system in that fees are charged at a time-differentiated rate to discourage use during congested periods. Strategies may be applied at a corridor level (time-of-day pricing similar to current toll systems) or areawide (permit systems, perimeter-type toll systems, parking fees). There has been limited practice of congestion pricing in the U.S., but this strategy may be implemented more often pending the outcome of several demonstration projects that are underway.

A major criteria for the implementation of congestion pricing is the level of political and public support. Such support may be difficult to gather until there is evidence of a successful program elsewhere in the U.S. From a practical perspective, congestion pricing may be most effective in locations where there is a high level of congestion, there are limited alternative routes but are alternative modes, and the road system is well-suited to pricing or toll operation (there are chokepoints or other locations where fees could be charged).

Complementary strategies include improvements to other modes including HOV, transit capital and operational improvements, and non-motorized modes strategies. A direct complementary measure would be the extension of discounts or fee waivers for transit vehicles and/or carpools. TDM programs that promote knowledge and use of alternatives may also contribute to the effectiveness of congestion pricing. ITS technologies, notably electronic toll collection, also contribute to the cost-effectiveness of this strategy. The expansion of non-fee facilities would naturally reduce the effectiveness of this strategy.

For Details, See Individual Strategy Sheets:

24. Road User Fees (graduated fares, fees for use of HOV facilities by SOVs)

25. Parking Fees (surcharges. taxes)

Strategy #24 Class: Congestion Pricing

Road User Fees

DESCRIPTION

As a congestion mitigation strategy, road user fees are used to redistribute or eliminate trips. Pricing schemes are usually divided up into **facility-based approaches**, which charge for access to a toll road, toll lanes, bridge, or tunnel; and **area-wide schemes**, which use permits or blanket fees to charge for entry to an area like a city center, airport ground access system or other activity centers. Other proposals include implementing road user fees through higher fuel taxes, auto parts (e.g., tires) taxes, excise taxes, or registration fees. Yet another variation on this theme is a VMT fee, which would be assessed on a periodic basis depending upon utilization of certain classes of vehicles.

BENEFITS & IMPACTS

Road user fees have several different potential impacts, depending upon the approach selected. Fees associated with a particular facility, in addition to providing a consistent **revenue stream**, can result in diversion from that facility to parallel routes on which no fee is charged. Alternatively, time-of-day fees can result in **shifting demand** into different time periods. Finally, if a fee is charged for non-HOV vehicles to use the excess capacity on an HOV facility, the result may be more economic use of capacity while maintaining relatively high levels of service. Area pricing schemes can result in **mode shifts**, as travelers to an activity center choose to park at the periphery, or make their entire trip by an alternative mode, rather than pay an access fee.

Any of these approaches can result in reduced environmental impacts, resulting from lower VMT and fewer vehicular trips. However, it is crucial that mobility alternatives exist which will provide access for those who choose not to pay the road fees.

REGIONAL POLICIES

As reflected by the existing 230-mile **tollway system**, the region has supported the use of road user fees (tolls) as a means of constructing and maintaining major roadway facilities. At this time, however, tolls **do not vary by time of day** and many toll facilities experience considerable congestion in the peak periods. Thus, the current tollway system does not truly represent congestion pricing.

APPLICATION PRINCIPLES

Facility-based road user fees are best suited to facilities with a high level of **access control**, and where **few or no alternate routes are present**. If a goal of this strategy is to encourage alternate mode usage, then other policies must be in place to assure the **availability of alternative modes**. In general, these strategies are difficult to implement, especially on existing facilities. In addition, questions of **equity** often arise, particularly with schemes which impose a price hurdle that may be difficult to pass for lower income drivers, but which may seem relatively inexpensive to higher income drivers.

ANALYSIS GUIDELINES

In general, **travel demand models** perform well in assessing potential impacts from road user fees. Some sketch planning approaches are available to model the impacts of areawide access fees for smaller activity centers.

KEY CONTACTS

FHWA Washington D.C. Office - Office of Policy Development, Transportation Studies Division - (202) 366-9242

CATS Director of Operations Analysis - (312) 793-0360

Parking Fees

DESCRIPTION

Parking fees are a market-based strategy designed to modify mode choice by imposing **higher out-of-pocket costs for parking** private automobiles. Municipalities may impose parking fees through **surcharge or taxes** on off-street parking or on-street **parking meters**. Private sector providers may adjust parking rates based on demand or time of day. Employers may impose parking fees, often as part of a policy of "cashing out" the free parking fringe benefit, to manage limited parking space. This strategy is closely related to the parking management and transit/HOV support strategies.

BENEFITS & IMPACTS

The impacts of parking fees will depend upon the scale of implementation, but they will generally result in changes in **overall trip making, time of day for travel, and mode choice** (use of high-occupancy modes and bicycle/ pedestrian access). Appropriate measures for the success of parking pricing techniques include changes in VMT and mode choice.

REGIONAL POLICIES

There is currently no regional policy governing parking fees; these decisions are the domain of individual jurisdictions. Many jurisdictions have **implemented metered parking** in downtown areas and activity centers. The City of Chicago currently applies a fee to parking in the downtown area. Beyond this, parking rates are largely established by private operators and market forces. Some operators currently vary rates by time of day, but not for congestion relief purposes. Both CATS and RTA encourage **parking "cash-out" measures** as part of employer TDM programs. As part of the RTP development process, CATS examined the impacts of this strategy, although no specific recommendations were made.

APPLICATION PRINCIPLES

Parking fees are **applicable at several levels**, from imposition of fees at a single facility, to fees or surcharges at the activity center level, up to area-wide policies to address regional congestion or environmental issues. From a practical standpoint, this strategy is most likely to succeed at the activity center level, although regional coordination may still be needed to prevent jobs and commerce from migrating "across the border" to avoid parking fees. As a rule, market-based measures such as parking fees are most applicable in **highly congested areas** where most of the supply-side solutions that are readily available have been exhausted.

The **political issues** surrounding market-based measures may make parking pricing difficult to implement. One technique to make this strategy more palatable is the **decision about how parking revenues would be used**. Public support for transportation user fees is generally greatest when funds generated by the charges are devoted explicitly to transportation improvements. To the extent that parking fees, surcharges or taxes are dedicated to projects which have the potential to reduce congestion, the fees themselves are more palatable. This factor is an important consideration in the overall design of any market-based measure.

ANALYSIS GUIDELINES

Strategy impacts can be estimated directly through the **regional travel demand model**, by modifying the cost of parking as one element of the out-of-pocket costs for travel. The mode choice model itself within the regional travel demand model can be used directly to report changes in travel mode. As an alternative, a **sketch-planning approach** may be used. This approach involves the use of **price elasticity assumptions** to determine how many trips are eliminated; how many are shifted to other modes; and how many travelers shifted onto parallel facilities. One study of parking fees cited a range of elasticities from -0.08 to -0.23, for an average of -0.15 (Ref. 25A). If information is available about the cross-elasticities of other modes, it may be possible to determine mode shift, trip elimination, and diversion impacts.

KEY CONTACTS

FHWA Washington D.C. Office - Office of Policy Development, Transportation Studies Division - (202) 366-9242

CATS Director of Operations Analysis - (312) 793-0360

RTA Manager of Market Development - (312) 916-7000

3.8 GROWTH MANAGEMENT

A key factor influencing the purpose, number, and length of trips is land use. Growth management and land use strategies seek to achieve concurrency between transportation infrastructure and land development. The goal of these strategies is to create environments that are conducive to the use of modes other than driving and to shorter trip lengths. Strategies or concepts that fall into this strategy class include locating higher density residential or commercial development near transit stations or along transit corridors, promoting mixed-use development, maintaining a jobs/housing balance, density management for new developments, and providing economic incentives for redevelopment of areas with existing infrastructure and/or those that are contiguous with current development. These strategies are generally implemented through land use plans, policies, incentives, regulations and ordinances. By law in Illinois, land use regulations are implemented at the county or municipal level. However, growth management concepts and impacts may be best viewed at the regional level.

The primary positive impacts of growth management strategies are the elimination of vehicle trips and the reduction in VMT. These impacts are sometimes not immediately realized because of the length of time it may take to implement these strategies and then realize their benefits. However, the benefits are well-known and there is considerable support for many growth management measures. Results of surveys done at recent regionwide workshops on growth issues in northeastern Illinois indicate that there is strong support for incentive-based strategies for managing regional growth patterns. Educating officials and the public about the transportation and other benefits of growth management may be the key to successfully implementing this strategy. Complementary strategies are those that support alternative modes, including TDM measures, transit capital and operational improvements, and non-motorized modes strategies.

For Details, See Individual Strategy Sheets:

26. *Compact Development*
27. *Redevelopment and Infill Development*
28. *Location Efficient Mortgage[sm]*
29. *Mixed Use Development*
30. *Jobs/Housing Balance*
31. *Transit-Oriented Development*
32. *Corridor Land Use and Transportation Coordination*

Strategy #26 Class: Growth Management

Compact Development

DESCRIPTION

A principal cause of the massive amount of daily travel in most metropolitan areas is the low density of residential settlements. Because housing is spread over a large area, people have to drive long distances to commute and perform other daily tasks. A compact development strategy encourages development and redevelopment at a greater average density than that of the metropolitan area as a whole. Skillful design techniques can achieve fairly significant increases in density that are almost indiscernible to the average viewer.

BENEFITS & IMPACTS

More compact development can reduce travel distances, thus reducing VMT and increasing the potential for walk or bicycle travel. It can also be more effectively served by public transit, leading to increased transit use and further reductions in vehicle trips and VMT. A San Francisco Bay Area study has shown that doubling residential density from a suburban level to a level equal to that in the city of San Francisco neighborhoods reduces per capita VMT by 25 to 30 percent.

REGIONAL POLICIES

NIPC has adopted the *Strategic Plan for Land Resource Management* (Ref. 26A) which contains polices and specific action recommendations for the study of developing and redeveloping at higher densities through the use of “Diversified Regional Centers”. NIPC has also published a guide for public officials entitled *Local Non-Auto Techniques to Promote Clean Air* (Ref. 26B). This guide contains a study on the effects of density on VMT in two suburban northeastern Illinois centers.

APPLICATION PRINCIPLES

While implementation of this strategy is through the local zoning and development approval processes, compact development requires regional cooperation to successfully address congestion problems.

ANALYSIS GUIDELINES

A primary method for analyzing the impact of land use strategies on the performance of the transportation network is to use the **regional transportation model**, combined with regional land use models. NIPC and CATS have used these models to evaluate different regional growth pattern scenarios. These scenarios included the testing of more compact development and the impacts on such measures as transit usage, water quality, and regional growth dispersion.

KEY CONTACTS

NIPC Director of Planning Services - (312) 454-0400

Strategy #27 Class: Growth Management

Redevelopment and Infill Development

DESCRIPTION

Redevelopment and infill activities are part of the Regional Growth Strategy in northeastern Illinois where (1) renewed growth and investment occurs in those areas which have experienced population and/or employment losses in recent decades and (2) growth and investment continues in those built-up areas in which growth is leveling off and which could face future losses. A redevelopment and infill strategy includes actions such as reclamation and reuse of abandoned or contaminated property for employment and residential use, maintenance and improvement of the transportation system, financial assistance for infrastructure targeted to support redevelopment and infill projects, improved transportation between existing housing and job centers, and attainment of high levels of educational quality and public safety.

BENEFITS & IMPACTS

The goal of redevelopment and infill strategies is to create the most efficient pattern of regional land development that is possible. Redevelopment and infill strategies produce (1) cost savings through the use of existing infrastructure and avoidance of costly new infrastructure improvements, and (2) travel savings by taking advantage of compact and mixed use development patterns instead of the more inefficient patterns of new development seen on the fringes of metropolitan areas. Studies have shown that positive impacts result from redevelopment and infill activities in terms of increased transit ridership, reduced VMT because of shorter trips, and increased walking and bicycling.

REGIONAL POLICIES

NIPC has adopted the *Strategic Plan for Land Resource Management* (Ref. 26A) and a *Policy on Regional Growth Strategy* (Ref. 27A) both of which strongly support redevelopment and infill strategies. The City of Chicago and the state of Illinois have incentive programs to encourage “brownfields” redevelopment, and transportation programming occurs both at the municipal, subregional and state levels. These kinds of programs will continue to evolve but they also could be enhanced or pursued more aggressively. NIPC is currently exploring ways to achieve enhancement of these redevelopment and infill tools through a regional Growth Strategy program.

APPLICATION PRINCIPLES

The kinds of actions cited above under “Description” can occur through a variety of implementing authorities, including local, regional and state governments, as well as the private development sector. While markets and local zoning regulations generally identify those areas of new development, it is often necessary to provide incentives to achieve development of disinvested areas.

ANALYSIS GUIDELINES

A primary method for analyzing the impact of land use strategies on the performance of the transportation network is to use the **regional transportation model**, combined with regional land use models. NIPC and CATS have used these models to evaluate different regional growth pattern scenarios. These scenarios included the testing of infill and redevelopment strategies and their impacts on such measures as transit usage, water quality and regional growth dispersion.

KEY CONTACTS

NIPC Director of Planning Services - (312) 454-0400

Strategy #28 Class: Growth Management

Location Efficient Mortgage ^{sm}

DESCRIPTION	The ***Location Efficient Mortgage*** ^{sm} (LEM) is a new mortgage product that will be offered by local mortgage lenders to borrowers who are interested in purchasing homes in more densely populated, urban neighborhoods that are pedestrian and bicycle-friendly environments, which offer ready access to local amenities and services, and which are served by public transit. These sorts of neighborhoods are considered "Location Efficient" because they enable residents to own fewer vehicles than is typical in less efficient neighborhoods. LEM borrowers will be encouraged to avoid the purchase and operation of vehicles because as part of their mortgage payment they will be paying for a "go anywhere/anytime," discounted CTA transit pass that will enable them to "live locally" and use public transit. The transportation-related savings achieved by the LEM borrower (by not owning a vehicle) is taken into account as additional income as part of the LEM's qualifying ratios.
BENEFITS & IMPACTS	The LEM will enable an estimated 3,700 households to qualify for mortgages in the City of Chicago and 11 adjacent communities served by the Chicago Transit Authority (CTA). If the estimated 3,700 LEMs are originated there will be both socio-economic and transportation impacts. When LEM borrowers purchase homes in proximity to transit-oriented and infill development projects, they expand the customer base of merchants and services that make commitments to commercial business development. If a significant portion of the LEM borrowers choose to live in the City of Chicago and closer to work, the LEM will also help reduce commuting time and expressway congestion. Each household is likely to avoid the use of one vehicle and will become a regular transit rider. This permanent change in transportation habits will reduce vehicle trips, reduce VMTs, reduce highway congestion and air pollutant emissions, and increase public transit ridership.
REGIONAL POLICIES	The LEM is consistent with NIPC's *Strategic Plan for Land Use Management* (Ref. 26A) and NIPC's specific recommendations and land development policy actions. The LEM reinforces a variety of regional public policies that encourage in-fill development in built communities. It also reinforces the policies incorporated into the 2020 Regional Transportation Plan.
APPLICATION PRINCIPLES	The LEM is a private-sector initiative that is funded through normal conduits of mortgage investment. The market test of the LEM is sponsored by Fannie Mae, the nation's largest supplier of home mortgage capital, in cooperation with local mortgage lenders. Participating in the program are the American Planning Association, Bethel New Life, Inc., the Chicago Association of Realtors, the Chicago Public Schools, the Chicago Transit Authority, Hispanic Housing, Inc., Lawrence Avenue Development Corporation, Neighborhood Housing Services of Chicago, and NIPC.
ANALYSIS GUIDELINES	As part of the LEM market test protocol, LEM borrowers will be interviewed annually to determine the effect the LEM has had on traffic congestion-related factors such as vehicle ownership and use, VMT per year for the household, commuting habits, and transit use. Estimates will be made of the trip reduction, VMT, and air emissions impacts that the LEM has had.
KEY CONTACTS	Center for Neighborhood Technology LEM Program Director - (773) 278-4800, ext. 115.

Strategy #29 Class: Growth Management

Mixed Use Development

DESCRIPTION

The goal of mixed use development is to localize as many shopping, recreation, work, and school trips as possible, keeping them off the regional road network. If trips are short enough, many of these trips may be made by walking or bicycling. Mixed use development works by providing employment and shopping opportunities within residential neighborhoods and incorporating into employment centers many of the activities known to be linked to work and shopping.

BENEFITS & IMPACTS

The advantage of mixed use development is the ability to shift and shorten some trips that would otherwise end up on regional roads, and to encourage walking and bicycling to destinations. Studies have shown that commercial centers with even a narrow range of uses can eliminate 25 percent of the trips consumers would have made going to separate destinations. At business parks, on-site services and shopping can eliminate 20 percent of the VMT by office workers. Hillsborough County, Florida has established minimum requirements for clustering on-site jobs and shopping for some new residential developments that can effectively keep up to 24 percent of all trips on-site.

REGIONAL POLICIES

NIPC has adopted the *Strategic Plan for Land Resource Management* (Ref. 26A) which contains polices and specific action recommendations for mixed use development through the use of "Diversified Regional Centers" as a way to mitigate local traffic congestion, and mixed use development is encouraged in NIPC's *Regional Growth Strategy* (Ref. 27A). NIPC is also producing a source book titled *Site Design for Transportation and Air Quality Benefits* (Ref.29A) that promotes and provides examples of mixed use development.

APPLICATION PRINCIPLES

Implementation of this strategy is through the local zoning and development approval process. Limitations in traditional zoning regulations that do not allow for mixed use development at the scale that is most effective at reducing VMTs, can be overcome through the use of innovative techniques such as Planned Unit Developments (PUD).

ANALYSIS GUIDELINES

A primary method for analyzing the impact of land use strategies on the performance of the transportation network is to use the **regional transportation model**, combined with regional land use models. The extent of mixed use development can be analyzed using *The Regional Land Use Inventory,* a NIPC analysis of land uses for the Northeastern Illinois Region.

KEY CONTACTS

NIPC Director of Planning Services - (312) 454-0400

Strategy #30 Class: Growth Management

Jobs/Housing Balance

DESCRIPTION	The goal of this strategy is to reduce congestion by balancing, in each subregion, the number of jobs with the number households and to balance the style and cost of the housing with the wage level of the jobs. The basic concept is to make it possible for people to live closer to where they work, thereby shortening average commuting journeys. Under most circumstances, long commuting journeys generate more traffic congestion than shorter ones. In Northeastern Illinois, a good target ratio for job/housing balance in a subregional area is 1.47 jobs per household, the ratio for the region as a whole.
BENEFITS & IMPACTS	Any development that helps to bring jobs and housing into better balance has the potential for reducing average commute lengths, thereby reducing VMT. This strategy may also eliminate much of the traffic congestion imposed by commuters traversing other communities on their way to work. The Southern California Association of Governments has adopted a policy of shifting 12 percent of new jobs away from areas of job surplus and shifting six percent of new housing away from areas of housing surplus. This policy was adopted as an alternative to adding roadway capacity because the region faces a large projected increase in congestion.
REGIONAL POLICIES	NIPC has adopted the *Strategic Plan for Land Resource Management* (Ref. 26A) which contains polices and specific action recommendations in support of balanced employment and housing development. Balanced development is also encouraged in NIPC's *Regional Growth Strategy* (Ref. 27A).
APPLICATION PRINCIPLES	While implementation of this strategy is through the local zoning and development approval processes, jobs/housing balance requires regional cooperation to successfully address issues and design solutions for congestion problems. The best practice emphasizes jobs/housing balance in the larger subregion of which a given development is a part, rather than striving for balance within each and every project. A community or groups of communities should strive for a jobs/housing balance within a three-to-five mile area around a development site.
ANALYSIS GUIDELINES	A primary method for analyzing the impact of land use strategies on the performance of the transportation network is to use the **regional transportation model**, combined with regional land use models. The Census Transportation Planning Package contains subarea information on employment, household, and commuting patterns that can be used to identify areas with jobs/housing imbalances.
KEY CONTACTS	NIPC Director of Planning Services - (312) 454-0400

Strategy #31 Class: Growth Management

Transit-Oriented Development

DESCRIPTION

Transit-Oriented Development is a strategy that promotes land development patterns that maximize the use of the public transportation system and to help achieve cost-effective land use patterns at the same time. This strategy promotes urban design features including a mix of land uses (residential, retail, offices), a centrally located commercial core with compact development patterns, a well-connected grid street networks, and ease of pedestrian and bicycle access.

BENEFITS & IMPACTS

The goal of transit-oriented development is to take advantage of rail stations by locating high density residential developments near the stations allowing pedestrians easy access, or by locating employment or retail near a station so that rail riders can have easy access to those destinations. It promotes transit usage and eliminates the need to travel by automobile. This in turn reduces auto emissions and the resulting air pollution. A study by NIPC (Ref. 26B) has shown that, for two new apartment buildings near a commuter rail station, nearly 500,000 vehicle miles traveled were saved by the transit-oriented development. This translated into a reduction of about 2,000 pounds of hydrocarbons annually.

REGIONAL POLICIES

Transit-oriented development, while new to many areas of the country, is a concept that helped shape early development patterns in northeastern Illinois, and continues to be a major policy strategy among many agencies in the region. NIPC has adopted a *Strategic Plan for Land Resource Management* (Ref. 26A) and a *Regional Growth Strategy* (Ref. 27A), both of which strongly support transit-oriented development strategies. NIPC is also producing a source book titled "*Site Design for Transportation and Air Quality Benefits*" (Ref. 29A). Pace, Metra and the CTA have each developed **guidelines for transit-oriented and transit-supportive development** (Ref. 31A, 31B, 31C). RTA has initiated a grant program to provide transit-oriented design planning assistance and has produced a number of related documents (Ref. 31D,31E, 31F, 31G).

The 2020 RTP includes objectives that "promote the planning and design of employment centers, commercial facilities, and multi-use centers that allow for convenient and safe transit, bicycle, pedestrian, automobile, and freight access and distribution." The 2020 RTP also includes the designation of a **Strategic Regional Transit (SRT) System**. Planning studies will be conducted for each designated SRT System facility or service. A proposed objective for these studies is that of coordinating and encouraging transit-oriented development and design with SRT system improvement.

APPLICATION PRINCIPLES

Implementation of this strategy is through the local zoning and development approval process, requiring coordinated efforts among municipal officials, developers, transportation and urban design planners, and members of the community. Although this approval process is **generally established by individual counties and municipalities,** it is possible that this strategy could be adopted and promoted at a wider scale through groups such as Transportation Management Associations (TMAs) and Corridor Planning Councils (CPCs). Programs are available through the RTA, Metra, CTA and NIPC to assist communities with transit-oriented development.

As a practical matter, this strategy is most effective when combined with other land use policies, TDM strategies such as carpool/vanpool programs and transit incentives, or bicycle and pedestrian improvements within public ROW. Reference 31H describes various packaging issues.

ANALYSIS GUIDELINES

Analysis of transit-oriented design standards can best be accomplished through **case studies**. Before-and-after analysis techniques have been applied to actual projects encompassing a variety of site design and related measures. A report has been prepared by NIPC (Ref. 26B) showing that these techniques can have considerable positive impacts reducing VMT and reducing air pollutants. At a more localized level, a **sketch planning methodology** may be applied. Based on the empirical results from the case studies, analysts may reduce the vehicle trip generation rates and boost transit and HOV rates proportionally for zones or developments where design standards are in force. Transit-oriented development has also been tested using the regional transportation and land use models of CATS and NIPC.

KEY CONTACTS

RTA Transit-oriented Development Clearinghouse - (312) 917-0700

NIPC Director of Planning Services - (312) 454-0400

Pace Transportation Engineer - (847) 228-4287

Metra Real Estate and Planning Department - (312) 322-6972

CTA - (312) 733-7000

Strategy #32 Class: Growth Management

Corridor Land Use and Transportation Coordination

DESCRIPTION

Corridor land use and transportation coordination is a tool for cooperation among local governments designed to promote transportation and land use solutions aimed at congestion management goals. This tool allows for joint planning among corridor-wide communities for land use and transportation and for the assessment of cumulative impacts resulting from corridor-wide growth. Coordination of this type is achieved when the governments in a transportation corridor enter into formal intergovernmental agreements specifying a process for planning an program implementation.

BENEFITS & IMPACTS

This tool can be helpful when congestion management projects call for a regional or subregional approach such as access management, corridor-wide land use design practices, transit access, or jobs/housing balance. Five “Corridor Planning Councils” (CPC) are currently coordinating land use and transportation planning in northeastern Illinois. Through these CPC processes, it has been found that the cumulative effects of plans in a corridor, if pursued independently, will exceed adopted growth forecasts by a factor of five. This coordinated intergovernmental process allows for the examination and implementation of land use and transportation solutions to realistic growth forecasts and to avoid unwanted consequences of growth, such as congestion.

REGIONAL POLICIES

NIPC has adopted the *Strategic Plan for Land Resource Management* (Ref. 26A) which contains polices and specific action recommendations in support of coordinated, corridor-wide, intergovernmental planning for any new major expressway or rail project. Model intergovernmental agreements are available from NIPC for the formation of corridor planning councils.

APPLICATION PRINCIPLES

Implementation of this strategy is done through intergovernmental agreements as organized under the *Intergovernmental Cooperation Act* and the *Local Land Resource Management Planning Act* which enable units of local government to enter into intergovernmental agreements, perform joint land resource and transportation planning, and pursue implementation strategies.

ANALYSIS GUIDELINES

A model has been developed by NIPC to measure the impact of joint land use plans in transportation corridors. This model has been used for the five corridor planning councils mentioned above.

KEY CONTACTS

NIPC Director of Planning Services - (312) 454-0400

3.9 ACCESS MANAGEMENT

Access management strategies are designed to improve traffic flow and safety by reducing the friction associated with vehicles entering or exiting the roadway. This is done by controlling access to and egress from arterial roadways. Controlling access can increase the effective capacity of a roadway, thereby reducing congestion. Representative actions include limiting the number of driveways, consolidating existing driveways, eliminating median breaks, adding a bi-directional center turn lane, and constructing a frontage road. In addition to these physical actions, access management strategies are implemented through guidelines and ordinances that govern road design and driveway access. These guidelines are typically applied during the development review process. In general, these measures are appropriate for application on individual facilities.

Access management can be effective where an arterial facility is in or is serving a growing area that has a high percentage of through trips and possesses a high potential for development. These strategies may also be applied along already developed corridors where congestion and safety problems may be attributed to uncontrolled access. In such cases, the support of the local government and community is needed to facilitate solutions acceptable to property owners. Supporting strategies for access management include traffic operations improvements (e.g., traffic signal improvements and roadway geometric improvements) and land use policies and regulations (growth management strategies). The most cost-efficient way to implement the physical elements of access management are as part of roadway expansion or reconstruction projects.

***For Details, See Individual Strategy Sheets**:*

33. Driveway Management
34. Median Management
35. Frontage Roads

Strategy #33 Class: Access Management

Driveway Management

DESCRIPTION

This strategy involves controlling the number and/or location of driveways along a roadway. Driveway Management includes both **regulatory** and **engineering** elements. The first element includes **regulations or polices to control the placement of driveways** as part of new developments, the reuse of existing sites, and the reconstruction of existing roadways. The engineering element includes the actual **construction or reconstruction of driveways**, as well as techniques for reducing the number of driveways while maintaining access. These techniques include creating **shared-access driveways** that serve multiple properties and providing **access from sidestreets or alleys**. Providing cross-access between properties can also reduce driveway-related impacts. This strategy is closely related to land use and zoning measures.

BENEFITS & IMPACTS

Vehicles leaving or entering a roadway from adjacent properties naturally conflict with through vehicles causing them to slow down. This, in turn, leads directly to delays and is a principal cause of congestion safety concerns on roadways with no access control. Reduction of driveway movements decreases side friction, effectively **increasing roadway capacity**. Through vehicles experience **improved travel speeds**, fewer speed reductions, and reduced conflicts. Driveway management may also result in **lower accident rates**. Potential disbenefits are increased travel distances and times for those accessing adjacent properties and reduced accessibility to these properties.

REGIONAL POLICIES

State law **requires that access be provided** between public roads and private properties. There is no specific regional policy related to this strategy, although the concept of access management is supported. Driveway management standards and regulations are the **responsibility of the agency with jurisdiction** over the affected roadway. Many agencies have **established uniform policies** for application throughout their jurisdictions. For example, IDOT has established standards for state highways in the region as part of its SRA program (Ref. 33A). In addition, NIPC is developing a **model ordinance** for access management (Ref. 33B). New or revised access management policies are sometimes accompanied by changes in legislation at the state level.

APPLICATION PRINCIPLES

This strategy is appropriate for roadways in developed areas that experience access-related congestion, as well as for roadways in developing areas as a means of avoiding such problems. For developing areas, effective driveway management is secured through a combination of **transportation agency standards** for driveway location, size, and frequency (including uniform application and enforcement), standardized state and local **permitting procedures**, and local planning/ zoning **regulations and approvals**.

Driveway management in developed areas can be difficult to implement, especially when prevailing conditions suggest the need for stricter control of access. For sites undergoing redevelopment, driveway management can be implemented through **application of standards** in the same way as for new development. In many areas, however, driveway management has not been tightly regulated, and making changes in access policies, driveway standards, permitting and zoning that affect existing entrances is often politically challenging. For other currently developed areas, it is necessary to gain the **support of affected property owners**. In this case, alternative access arrangements may need to be implemented.

This strategy is most effective where a roadway has **too many driveways** in proximity, **large curb cuts** (which do not channelize vehicle movements), **driveways close to intersections** (which interfere with intersection operation), and **driveways across the roadway from each other** that lead to turning conflicts. Agencies with successful access management policies may use the programming of capital improvements along a facility as an opportunity to implement changes in driveway placement.

ANALYSIS GUIDELINES

Criteria for the application of driveway management measures include the number of conflict points, their proximity to each other and intersections, traffic volumes, driveway volume and development density. Utilizing **basic highway capacity concepts** and/or **simulation models** like CORSIM, the planner can generate analytical justification for implementing driveway management measures. For a long corridor or in a regional setting, impacts can be estimated using of a regional model.

KEY CONTACTS

IDOT District 1 Bureau of Traffic - (847) 705-4141
IDOT District 1 Bureau of Programming - (847) 705-4393
NIPC Director of Planning Services - (312) 454-0400

Strategy #34 Class: Access Management

Median Management

DESCRIPTION

Median management refers to actions that **limit and control median breaks** on arterial highways thus affecting vehicles turning left across the centerline to or from adjacent properties. As with driveway management, this strategy includes both regulatory and engineering elements. The regulatory element involves **establishing and enforcing standards** for median break location, frequency, and geometry. Engineering actions include **constructing medians**, **creating bi-directional left turn lanes**, and **eliminating existing median breaks**.

BENEFITS & IMPACTS

Managing access for vehicles to turn across centerlines reduces vehicle conflicts and traffic flow friction, therefore effectively increasing capacity and **improving safety**. Through vehicles experience **increased travel speed**, fewer deceleration incidents, and **less delay**. Turning vehicles benefit from improved safety, but may experience increased travel distances and times if alternative routing is necessary. The possibility of **reduced accessibility** to adjacent properties is also a concern.

REGIONAL POLICIES

There is no specific regional policy related to this strategy, although the concept of access management is supported. The implementation of median management measures is the **responsibility of the agency with jurisdiction** over the affected roadway. IDOT has a long-standing **policy of median** management, but usually does not make significant changes in median configuration unless in conjunction with a roadway improvement. In limited circumstances, businesses have successfully petitioned the agency for reestablishing a median cut, citing adverse conditions and access. In addition, NIPC is developing a **model ordinance** for access management (Ref. 33B).

APPLICATION PRINCIPLES

Median management is typically applied through regulatory action and therefore affects all roadways of one or more classifications within a jurisdiction. From an engineering perspective, median management actions can be applied to **undivided roadways** (when left turns into adjacent property occur at driveways), **divided roadways** (with too many/close median breaks), intersections where median breaks are located so close they interfere with operation, arterial sections with a bi-directional left turn lane at or approaching capacity, or roadways warranting a bi-directional left turn lane where none exists. Uncontrolled suburban strip development is a very common location for median management measures, often in concert with other access management strategies.

From a cost-efficiency perspective, median management measures, as well as other access management strategies, may be best implemented when a roadway undergoes a **capital improvement**. This also allows for uniform and simultaneous application of access standards.

ANALYSIS GUIDELINES

Planners can estimate the impact of median management measures by analyzing **basic traffic data**, including roadway configuration, driveway locations, turning movement counts, through vehicle counts, accident history and travel speed. **Basic highway capacity concepts** and/or **simulation models** like CORSIM may be used for this analysis. Over a long corridor or in a regional setting, estimation of impacts can be accomplished through use of a regional model. In some instances the implementation of median management measures requires drivers to use alternate routes or make detours to make their desired move. If this additional travel is significant, it can negate the positive impacts of median management measures.

KEY CONTACTS

IDOT District 1 Bureau of Traffic - (847) 705-4141

IDOT District 1 Bureau of Programming - (847) 705-4393

NIPC Director of Planning Services - (312) 454-0400

Strategy #35 Class: Access Management

Frontage Roads

DESCRIPTION

This strategy involves the **construction of a parallel roadway** directly adjacent to an arterial or highway facility. **Access to the arterial facility is then limited** to selected intersections (often with advanced signalization hardware). Vehicles desiring access to adjacent properties are directed to the low volume, low speed exclusive frontage (or back property) roadways that provide direct access without causing arterial delays. Frontage roads are the most effective of access management strategies, but also the most expensive due to construction and ROW costs.

Expressways, especially in urban areas, are often constructed with frontage roads. As congestion worsens on other facilities, however, frontage roads may be considered for application in congested arterial situations.

BENEFITS & IMPACTS

Implementation of frontage road strategies frees existing lanes for through movements, increasing capacity and separating slower traffic bound for adjacent property from the through traffic stream. This **increases travel speeds** and **reduces accident rates** for through vehicles by removing most centerline and driveway conflicts. Turning vehicles will also benefit from this improved safety.

REGIONAL POLICIES

There is no specific regional policy related to this strategy, although the concept of access management is supported. The implementation of frontage roads is the **responsibility of the agency with jurisdiction** over the affected roadway. IDOT works with local governments, land owners and developers to implement frontage roads on a very select basis. These improvements require expensive right of way, roadway construction, intersection modifications, traffic signal improvements and median alterations, along with changes in access control. They are only applied in dense development situations where adjacent property owners support such an improvement and needed right of way can be obtained. NIPC is developing a **model ordinance** for access management (Ref. 33B).

APPLICATION PRINCIPLES

Like other access management strategies, frontage roads can be applied to a **roadway segment** or on a **corridor** basis. This strategy is typically applied in situations similar to driveway control: **numerous driveways** in proximity to each other or intersections, **large curb cuts** (which do not channelize traffic), **misaligned driveways** across the street from one another.

Compared to driveway management, a key requirement of frontage roads is the **availability of sufficient ROW**. Frontage road applications are at a level higher than driveway control, reserved especially for clustered development along an overdeveloped strip on an already-congested arterial. The provision of frontage roads must take into consideration the secondary **traffic impacts to local streets**. If the frontage road system is inadequate, the negative impacts directly affect adjacent arterials and local streets.

ANALYSIS GUIDELINES

Frontage road actions reduce the number of conflict points, reduce deceleration requirements, and remove turning vehicles from through lanes. The analyst must define the proposed program and estimate speed changes due to contemplated frontage road improvements. Using basic ***Highway Capacity Manual*** **techniques** or **sophisticated modeling**, the comparison of speed change results with travel delay reductions is useful in a frontage road analysis.

KEY CONTACTS

IDOT District 1 Bureau of Programming - (847) 705-4393

NIPC Director of Planning Services - (312) 454-0400

3.10 INCIDENT MANAGEMENT

This class of strategies is used to deal with incident-related, non-recurring congestion. Incidents can include accidents, disabled vehicles, and special events. Nationally, highway incidents are estimated to account for approximately 50-60 percent of the expressway vehicle-hours lost to congestion. This congestion also has a secondary impact in that approximately 20 percent of expressway accidents are estimated to have been caused by previous incidents or secondary incidents. Non-recurring congestion results because there is a temporary reduction in effective capacity. Incident management strategies are intended to minimize the duration of this capacity reduction and the negative impacts of an incident. Incident management may be divided into three steps: detection/verification, response, and clearance. Measures addressing these steps can include roadway surveillance systems, computerized dispatch systems, inter-agency coordination agreements, and documented response procedures. Incident management may also include providing information and alternative routing to motorists impacted by the incident. Incident management measures can be applied to an individual facility or an entire system (e.g. the expressways). Some components, such as inter-agency agreements, may be developed and applied on an areawide basis.

To-date, the regional approach has been one of having a strong expressway incident management program. As part of this, IDOT, ISTHA, police, and emergency agencies have established notification protocols and response procedures to deal with expressway incidents. Arterial incident management programs have not been as strongly pursued; although a study examining the feasibility of an arterial incident management program was recently completed. The development of stronger arterial programs will require significant local involvement. Another area for improvement is that of expanding existing programs to include other transportation agencies such as transit providers. Current initiatives, such as the Gary-Chicago-Milwaukee (GCM) Corridor ITS project and the Central Transportation Information Center (CTIC), are intended, in part, to address this issue.

This strategy class may be applied to and effective for any location where incident-related congestion is a significant problem. The costs and benefits of alternative incident management actions should be carefully analyzed. While there are many technological advances that may support this strategy, some "low-tech" strategies like expressway service patrols and improved inter-agency coordination have proven to be effective at relatively lower cost. Incident management strategies can be packaged with (and may include) traffic operational (TSM) and ITS strategies.

For Details, See Individual Strategy Sheets*:*

36. Incident Detection/Verification. (video cameras, service patrols, motorist call boxes, cellular phone call-ins)

37. Incident Response. (multi-agency incident response teams; notification systems or protocols, computerized dispatch)

38. Incident Clearance. (service patrols, operating policies).

39. Incident Information/Routing - (information dissemination, variable message signs; dynamic signal/meter control, route guidance systems)

Strategy #36 Class: Incident Management

Incident Detection/Verification

DESCRIPTION

Incident detection and verification is the **initial phase** of the incident management process. It is defined as the activity required to determine or identify that an incident of some nature has occurred. Some of the more common means of incident detection used in the U.S. include: expressway **service patrols** along the highway, motorist cellular **phone call-ins**, CB radio call-ins, commercial traffic reporters, police patrols along the highway, **call boxes** stationed at regular intervals along the highway, automated incident detection (requires **highway surveillance** methods), and, along toll roads, input to toll operators by motorists.

BENEFITS & IMPACTS

The benefits of improved incident detection are derived through a reduction in the total time the incident blocks traffic or is left on the shoulder of the roadway. This, in turn, **reduces traffic delay** and **reduces the potential for secondary accidents**. Past research estimates that, under heavy traffic conditions, for every additional minute of delay in responding to and clearing an incident, from four to eight additional minutes of delay per vehicle in the queue may be expected.

REGIONAL POLICIES

The Chicago region has one of the longest-standing incident management programs in the U.S. The IDOT "**Minute Men**" and ISTHA **HELP** provide roving patrols on major Chicago expressways. The expressway **surveillance system** provides real-time expressway data and the ability to verify incidents from the control center. The future installation of closed circuit TV cameras at selected locations will enhance this capability. The **Communication Center** serves as a central point for data gathering and is responsible for the public call-in system (*999) that has become increasingly effective with the greatly increased use of cellular phones. As part of the **GCM Corridor project**, these current programs will be enhanced. A study examining the feasibility of an arterial incident management program was recently completed (Ref. 36A), but such a program has not been implemented.

APPLICATION PRINCIPLES

Incident detection and verification procedures are most commonly applied to **expressways**, primarily interstates and toll roads, but may be applied to **other major high-volume corridors** where a disruption to traffic can have a detrimental impact to traffic operations and safety for an extended period of time. Incident management usually requires the **cooperation and coordination** of numerous inter-agency and intra-agency parties.

While incident detection and verification represent key initial phases of an incident management program, other phases (response, clearance, and information/routing) represent key activities in the overall success of a regional incident management program.

ANALYSIS GUIDELINES

There are several tools available to assist with the analysis of an incident management program. These include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION, each of which is capable of simulating an incident. Another spreadsheet-based tool (DELAY) provides a sketch-planning level approach to estimating incident-induced delays on an expressway.

A key factor in the analytical framework for all these tools is estimating the current nature of incident duration and severity (number of lanes blocked for how long) and the potential reduction in incident duration that could be brought about through incident detection/verification strategies. Tables are available describing throughput reduction for various combinations of number of lanes and lanes blocked (Ref. 36B).

KEY CONTACTS

IDOT ITS Program Office - (847) 705-4800

IDOT District 1 Bureau of Traffic - Expressway Operations Engineer - (847) 705-4157

IDOT District 1 Bureau of Traffic - Emergency Traffic Patrol Manager - (773) 624-0470

IDOT District 1 Bureau of Electrical Operations - Communications Section Chief - (847) 705-4441

ISTHA Office of Public Relations - (630) 241-6800

CATS Director of Operations Analysis - (312) 793-0360

Strategy #37 — Class: Incident Management

Incident Response

DESCRIPTION

Incident response is the activation of a pre-planned **response strategy** to minimize the adverse impacts (delays, secondary accidents) of incidents. Feasible means to improve incident response may include: implementation of **service patrols**, development of incident **response plans**, development of incident responder lists (with telephone numbers) or flow charts by incident type and location, computerization of the response lists for quicker access, computerized phone or paging techniques to relay the response needs simultaneously, computer-aided dispatch systems (with "expert system" capability), AVI systems to monitor emergency vehicles and other key equipment operators, GIS technology to better organize available resources, contracting for additional response resources (e.g. tow operators and equipment), and implementation of emergency vehicle signal **priority** capabilities.

BENEFITS & IMPACTS

Incident response improvements can significantly reduce the impacts of highway incidents. Timely response can **reduce the probability of secondary accidents** and, in the case of accidents, **minimize the impact of injuries**. For the general traveling public, benefits from an incident management response program may include **reduced delays** and **decreased travel times**. Past research estimates that, under heavy traffic conditions, for every additional minute of delay in responding to and clearing an incident, from four to eight additional minutes of delay per vehicle in the queue may be expected.

REGIONAL POLICIES

The Chicago region has one of the longest-standing incident management programs in the U.S. The IDOT "**Minute Men**" and ISTHA **HELP** provide roving patrols on major Chicago expressways. As part of the expressway programs, contact lists, protocols, and response plans have been developed. Significant effort has been invested in inter-agency coordination and response plan development. The dispatch of appropriate response personnel is handled through the **Communication Center**. A study examining the feasibility of an arterial incident management program was recently completed (Ref. 36A), but such a program has not been implemented.

APPLICATION PRINCIPLES

Incident response procedures are most commonly applied to **expressways**, but may also be applied to **other major high-volume corridors**. Effective incident response requires the **cooperation and coordination** of numerous inter-agency and intra-agency parties. Assisting injured motorists and collecting accident data are typically higher priorities than restoring normal traffic conditions, so policies that can hasten these efforts can significantly reduce incident clearance times.

Incident response represents one phase of an incident management program; other phases, (detection & verification, clearance, and information & routing) are also critical to the overall success of a regional incident management program.

ANALYSIS GUIDELINES

Tools available to assist with the analysis of an incident management program include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION. Another spreadsheet-based tool (DELAY) provides a sketch-planning level approach to estimating incident-induced delays on an expressway.

A key factor in the analytical framework for all these tools is estimating the nature of incident duration and severity (number of lanes blocked for how long) and the potential reduction in incident duration that could be brought about through incident response strategies. Tables are available describing throughput reduction for various combinations of number of lanes and lanes blocked (Ref. 36B).

KEY CONTACTS

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Strategy #38 Class: Incident Management

Incident Clearance

DESCRIPTION

The objective of incident clearance in the incident management process is to safely and quickly **restore the roadway capacity** to its pre-incident condition. Implementing an effective incident clearance strategy will not only result in efficient and quicker removal of the incident (thereby reducing the impacts of delay and secondary accidents) but will assist in creating a team-oriented process (involving inter- and intra-agency groups) for the area that can carry over into other transportation and public actions.

An effective incident clearance plan will include both a means of **implementation** (such as the use of tow services and service patrols having push bumpers, procurement of special equipment) and the use of formally adopted **policies** (such as "quick clearance", abandoned vehicles, "hold harmless", use of flashing lights on emergency vehicles, drivers staying with incapacitated vehicles) to support the implementation efforts.

BENEFITS & IMPACTS

Benefits associated with incident clearance and removal activities include **reduced probability of secondary accidents** caused by queues forming behind the initial incident, **reduced delays** and **decreased travel times**. Past research estimates that, under heavy traffic conditions, for every additional minute of delay in responding to and clearing an incident, from four to eight additional minutes of delay per vehicle in the queue may be expected.

REGIONAL POLICIES

The Chicago region has one of the longest-standing incident management programs in the U.S. The IDOT "**Minute Men**" and ISTHA **HELP** programs provide roving patrols on the region's expressways. These programs include policies that allow the patrol operators to relocate vehicles to an off-site location or from a blocked lane to a shoulder, as well as special heavy-duty equipment to deal with spilled loads and overturned trucks. A study examining the feasibility of an arterial incident management program was recently completed (Ref. 36A), but such a program has not been implemented.

APPLICATION PRINCIPLES

Incident clearance procedures are typically applied to **major highway facilities**, such as interstates and toll roads, but may also be applied to **other major high-volume corridors** where a disruption to traffic can have a detrimental impact to traffic operations and safety for an extended period of time. Effective incident clearance usually requires the **cooperation and coordination** of numerous inter-agency and intra-agency parties.

Incident clearance procedures represent one phase of an incident management program; other phases (detection/verification, response, and information/routing) represent key activities in the overall success of a regional incident management program.

ANALYSIS GUIDELINES

There are several tools available to assist with the analysis of an incident management program. These include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION, each of which is capable of simulating an incident. Another spreadsheet-based tool (DELAY) provides a sketch-planning level approach to estimating incident-induced delays on an expressway.

A key factor in the analytical framework for all these tools is estimating the current nature of incident duration and severity (number of lanes blocked for how long) and the potential reduction in incident duration that could be brought about through incident clearance strategies. Tables are available describing throughput reduction for various combinations of number of lanes and lanes blocked (Ref. 36B).

KEY CONTACTS

IDOT ITS Program Office - (847) 705-4800

IDOT District 1 Bureau of Traffic - Expressway Operations Engineer - (847) 705-4157

IDOT District 1 Bureau of Traffic - Emergency Traffic Patrol Manager - (773) 624-0470

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Strategy #39 — Class: Incident Management

Incident Information/Routing

DESCRIPTION

The purpose of incident information and routing activities is to efficiently and effectively utilize the available transportation system in moving traffic through and around the incident area under incident conditions. In achieving this purpose, traffic management activities are intended to **inform and guide** (and possibly divert) motorists in the incident area, as well as those in areas away from the incident (but who may be impacted by the incident or add to worsening conditions). Providing **better and more timely information to motorists through various methods** (e.g., variable message signs, highway advisory radio, commercial radio, static "flip-down" signs) will greatly assist this effort.

BENEFITS & IMPACTS

Benefits associated with incident information/routing activities include: **minimizing vehicle delay** in and around the incident area; **reducing the potential for secondary incidents**; and providing **safety for incident response personnel**. Incident information may be used by motorists to adjust their trip time or route. Incident information/routing measures will result in more effective utilization of the region's transportation system, and can result in a significant lessening of potential delay and safety impacts in the incident area. However, transportation-related **impacts (delays, accidents) may result along the diversion routes**.

REGIONAL POLICIES

The Chicago region has one of the longest-standing incident management programs in the U.S. This includes a variety of activities to provide information to the traveling public. Congestion information produced by the expressway surveillance system is broadcast over a **highway advisory radio** system, as well as over **commercial radio stations**. The surveillance system automatically indicates the location and extent of congestion on various parts of the network. The **Communication Center** plays an important role in gathering and distributing the relevant information. **Variable message signs** have been installed in key locations to provide additional information. As part of the region’s Strategic Early Deployment (SEDP) activities, a screening study of possible **regional diversion routes** is being conducted.

APPLICATION PRINCIPLES

Traffic diversion/alternative routing plans are commonly developed as part of incident management programs for expressways, but may also be developed for major highway facilities. Corridors with good **alternate routes** are the most amenable to potential benefit from incident information/routing measures. While incident information/routing represents a key phase of an incident management program, other phases (detection/verification, response, and clearance) represent key activities in the overall success of a regional incident management program. Incident information activities are usually **tied to ATIS** (Strategy #41).

ANALYSIS GUIDELINES

There are several tools available to assist with the analysis of an incident management program. These include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION, each of which is capable of simulating an incident. Another spreadsheet-based tool (DELAY) provides a sketch-planning level approach to estimating incident-induced delays on an expressway.

The approach to analysis for incident information/routing differs from those incident management strategies that involve reducing incident duration. The analysis requires an estimate of the **amount of traffic diverted** and the potential delay savings of that diversion. The delay savings can be approximated using one or more of the above tools. Unfortunately, there are many combinations of origins and destinations, and the analyst will need to make a number of assumptions regarding how traffic may be redistributed.

KEY CONTACTS

IDOT ITS Program Office - (847) 705-4800

IDOT District 1 Bureau of Traffic - Expressway Operations Engineer - (847) 705-4157

IDOT District 1 Bureau of Traffic - Emergency Traffic Patrol Manager - (773) 624-0470

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3.11 INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Previously known as Intelligent Vehicle-Highway Systems (IVHS), ITS refers to a collection of strategies and techniques intended to improve transportation system efficiency and operation through technology. ITS strategies range from variable message signs along an expressway to fully automated vehicles. In between, ITS includes traffic surveillance systems, centralized signal control systems, automated vehicle identification, on-board traveler information, and weigh-in-motion systems. ITS can be applied throughout a region, along a transportation corridor, or on a specific facility.

For any strategy, the key to success may be in finding the right time and place for a first implementation. As ITS technologies are implemented throughout the U.S., they will be added piece by piece. Therefore, a solid base of successful applications (no matter how basic) will be critical to the success of larger systems.

For the most part, ITS strategies do not stand alone - they are largely technological extensions of other congestion management strategies. ITS technologies may be applied to and be a critical part of traffic operational improvements, transit operational improvements, congestion pricing, and incident management. These strategy classes all have components that can be more effective with the appropriate technology.

***For Details, See Individual Strategy Sheets*:**

40. Advanced Traffic Management Systems (ATMS)
41. Advanced Traveler Information Systems (ATIS)
42. Advanced Public Transportation Systems (APTS)
43. Commercial Vehicle Operations (CVO)
44. Advanced Vehicle Control Systems (AVCS)

Strategy #40 Class: Intelligent Transportation Systems

Advanced Traffic Management Systems (ATMS)

DESCRIPTION

ATMS includes a collection of techniques for improving traffic flow on expressways and surface street networks. Some of the techniques have already been referenced, including **ramp metering** and **traffic signal improvements**. ATMS also overlaps with **incident management**, including traffic surveillance methods, closed circuit TV, and route diversion strategies. In addition to these, some of the **advanced technologies** can include integrated expressway/arterial operation, computerized signal control systems, and advanced signal optimization programs. The focal point of an ATMS is usually a **traffic management center**, where information sources are brought together and traffic management decisions are made.

BENEFITS & IMPACTS

The benefits of ATMS primarily include **reductions in delay** for recurring and non-recurring congestion, and **reduction in accidents**. A number of studies have indicated that computerized signal systems can achieve as much as a 25 % increase in average speeds when compared against situations with older timing plans (Ref. 40A). One of the significant benefits of surface street ATMS is that it provides the capability to **interactively adjust timing plans** in response to unique conditions, such as incidents and special events. In addition, there may be internal management efficiencies for some systems, such as the benefits of **improved knowledge of maintenance problems** with controllers or detectors. Improved interagency coordination and decision-making is often a side benefit of such systems.

REGIONAL POLICIES

The Chicago region is a leader in ATMS, and regional policy supports continued growth in this area. The region's expressway surveillance and control system is operated through the **Traffic Systems Center** (TSC). This center has been in operation for over 35 years, and has been frequently expanded and updated. The TSC operates over 2200 loop detectors, 40 CCTV cameras, and 110 ramp meters. **Computerized control and closed loop systems** for arterials have been implemented by many agencies including IDOT, Naperville, and DuPage County. The City of Chicago has recently installed a **MIST signal control system** in the CBD and is beginning development of a closed loop system on a few major arterials.

Current planning activities that are exploring additional regional ATMS initiatives include the **GCM ITS Priority Corridor** Plan and the Northeastern Illinois **Strategic Early Deployment Plan** (Ref. 40B).

APPLICATION PRINCIPLES

ATMS measures may be applied to both expressways and surface streets. Ramp metering is most critical along **expressways with recurring congestion**. It is beneficial in these corridors to also have good arterial street systems to allow for diversion from the expressway, where warranted. Traffic signal control systems are most beneficial where the **density of traffic signals is high**, such as downtown grid street systems, but significant benefits can be achieved on suburban arterial systems as well. Application principles for other ATMS elements such as incident detection and information systems are contained under the Incident Management and ATIS categories. In all cases, the backbone of ATMS is the **communications system** that ties the various surveillance and control elements together. Communications systems are important in allowing these other systems to function.

ANALYSIS GUIDELINES

There are several tools available to assist with the analysis of ATMS. On the expressway side, these include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION. For surface streets, TRANSYT-7F and NETSIM can be used to estimate benefits, primarily the impact on vehicle delay. INTEGRATION allows for full interaction between expressway and arterial systems. Recently, FHWA has also provided an integrated version of FRESIM and NETSIM, called CORSIM, allowing for the analysis of expressway and arterial networks as a unit.

To conduct an evaluation, the analyst must select the appropriate tools and provide the inputs that will replicate the ATMS techniques to be employed. Some of the tools may not be able to directly accommodate some ATMS measures.

KEY CONTACTS

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Strategy #41 Class: Intelligent Transportation Systems

Advanced Traveler Information Systems (ATIS)

DESCRIPTION

ATIS is a class of ITS technology that **provides travelers with information** about travel options, times, delays and/or incidents. The information provided may be based on 'fixed' (e.g. transit schedules) or 'real-time' (e.g. monitored traffic speeds) inputs. An ATIS typically includes three elements: **data collection**, **data compilation and processing**, and **information dissemination**. The data collection element, particularly if it involves real-time data, is usually part of an ATMS or APTS. The second element involves converting inputs into a format useful for the traveler. This information is then delivered to travelers either pre-trip or en-route through any of various means. **Pre-trip methods** include information kiosks, traffic flow maps on the Internet or cable TV, and TV or radio reports. **En-route methods** include variable message signs, highway advisory radio, pager services, and commercial radio. This discussion of ATIS focuses on this last element.

BENEFITS & IMPACTS

The most significant benefit of ATIS is that it provides the traveler with the information needed to make **informed decisions**. Travel information can assist in the choice of the trip route, mode and timing. Much of the benefit of ATIS is derived in providing information during **incident conditions**, so that drivers can make adjustments to the normal route, mode or timing of their trip. The result, ideally, is **more efficient use** of the transportation system and **reduced delays** on congested facilities. For the traveler, an additional benefit is simply knowing the extent of delays.

REGIONAL POLICIES

The Chicago region already has multiple information delivery systems in place. Using data gathered from the expressway surveillance system, the **Communication Center** broadcasts traffic information over a **highway advisory radio** system. The surveillance system automatically indicates the location and extent of congestion. This same information is made available to the media for broadcast over their **commercial radio stations**. A **real-time traffic flow map** is available over the Internet. **Variable message signs** have been installed in key locations to provide additional information. Many agencies actively provide event and construction information to the media.

As part of the GCM Corridor project, a study is underway for a **"gateway" multimodal traveler information center** to collect, process and disseminate information. Dissemination methods being examined include many of those listed above plus kiosks and pagers. Transit ATIS initiatives include RTA's **automated itinerary system**, that may be incorporated into the "gateway" system, and a proposal for **real-time/active transit signs** at stations and other key locations. These ATIS components will rely on inputs from proposed APTS elements.

APPLICATION PRINCIPLES

ATIS can be applied at several levels, from information for a particular, narrowly defined geographic location, to extensive regional information. **Regional information** combines a wide range of sources together to provide information such as real-time traffic flows, transit delays, incidents, special events, and construction activities. **Spot or corridor information** can include specific congestion locations, incident location/severity, information on specific buses, and alternate routing of traffic.

ANALYSIS GUIDELINES

There are several tools available to assist with the analysis of traveler information systems for highways. These include several **simulation models**, such as FREQ, FREFLO, FRESIM, and INTEGRATION. The **regional travel demand model** is highly sophisticated and may also be used for ATIS strategy analysis. However, changes in mode share due to the availability of information are highly speculative, and difficult to project.

KEY CONTACTS

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Strategy #42 Class: Intelligent Transportation Systems

Advanced Public Transportation Systems (APTS)

DESCRIPTION

APTS encompasses a variety of technologies intended to increase the cost-effectiveness and usage of public transportation systems. Representative technologies include: **electronic fare management systems** (including "smart cards"), **AVI** systems, and **AVL** systems. **Advanced management systems** involve the implementation of multiple technologies such as AVI, AVL, and advanced communications. Information from these systems may be used as inputs to active transit signing and other transit ATIS components.

Surveillance technology may be used to increase security on transit vehicles and at transit stops. **Transit maintenance systems** use diagnostic technology to predict part failure and better schedule maintenance services. **Dynamic ridesharing** involves real-time matching of potential riders, drivers and vehicles to provide greater potential matching capability. A more thorough discussion of these systems is provided in Reference 42A. **Bus signal priority systems**, which typically rely on AVI or AVL systems, are discussed under Strategy #21.

BENEFITS & IMPACTS

The benefits of APTS vary depending upon the type of system implemented. Electronic fare payment **reduces boarding times** and **reduces cash management costs** and theft problems. Transit AVL can improve a transit agency's **ability to make real-time adjustments** in transit runs and to respond to maintenance and security problems. An integrated vehicle management system is useful for monitoring the transit system and **improving efficiency**.

Surveillance measures **reduce security problems** and perception of such problems. Vehicle maintenance systems help **identify maintenance needs more exactly**, reducing breakdowns and allowing for **more effective maintenance programs**. Dynamic ridesharing increases the potential for reducing vehicle trips and reducing transportation costs for travelers.

REGIONAL POLICIES

Regional policy is to pursue the use of technology to improve transit operations and service. Transit providers are pursuing a number of activities to implement APTS. CTA is pursuing **electronic fare, emergency communication**, **and advanced management systems**. Pace is moving forward with plans for its own advanced management system. Additional APTS policy and projects are being developed through the SEDP and GCM ITS Priority Corridor Project. These include upgrading RTA's **automated itinerary system**, implementing **active transit signs**, developing **guidelines for deployment of transit priority systems**.

APPLICATION PRINCIPLES

Most APTS technologies are implemented on a **system-wide basis**. The exception may be security surveillance which can be employed selectively in areas of specific concern, such as park-and-ride lots or on board the vehicles themselves. Circumstances for implementing APTS vary with the individual measures. Fare management systems are appropriate for improving cash management and reducing dwell times, particularly on routes with significant transit ridership. AVL systems are usually contemplated along with a broader **information system** for transit. Transit maintenance systems are an increasingly important part of all transit fleet management. Advanced management systems are appropriate when there are concerns about vehicle reliability, schedule adherence, and safety.

ANALYSIS GUIDELINES

Each type of APTS strategy would need to be analyzed differently. Transit maintenance, fare management, and security systems have benefits to internal efficiency and would need to be evaluated from a **cost-management** standpoint. Dynamic ridesharing, AVL, and fare management systems can be analyzed in terms of potential attraction of transit trips and reduction in delay. Benefits can be derived through simple **sketch-planning techniques**.

KEY CONTACTS

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FTA Region 5 - (312) 886-1616

CTA, General Manager, Communications/Power Control - (312) 664-7200 ext. 8001

Pace, Manager of Management Information Systems - (847) 228-2460

Strategy #43 Class: Intelligent Transportation Systems

Commercial Vehicle Operations (CVO)

DESCRIPTION

CVO describes a class of actions which would apply ITS technology to **goods movement**. Examples of CVO include **weigh-in-motion** systems, **automated paperwork** functions, **electronic credential checking**, **one-stop "shopping"** for permits, **pre-clearance** at weigh stations, **AVL or global positioning systems (GPS)** to locate vehicles**,** and pre-trip or on-board **information systems**. These information systems may include navigation or routing systems.

BENEFITS & IMPACTS

Weigh-in-motion and electronic credential checking can produce significant **delay reductions** for trucks that qualify. Such systems can also result in **reduced administrative costs** for agencies. AVL and GPS systems are used to **improve the efficiency** of individual truck operations. Information systems can reduce delay, primarily through optimizing route choice.

As a practical matter, CVO applications are likely to have only a **limited impact on peak period congestion** relief for a number of reasons. First, the percentage of trucks tends to be higher in the off-peak hours, therefore, the greatest potential for impact may be during the off-peak. Second, weigh stations are generally located outside the urban area or on the fringes, so that weigh-in-motion and electronic credential checking would result in little direct benefit to urban congestion relief. However, information systems can help trucks avoid, and therefore not contribute to, congested facilities and time periods. Furthermore, CVO applications could be considered as a strategy to **foster transportation and economic efficiency**.

REGIONAL POLICIES

Goods movement is an important industry in the Chicago region. Measures to promote mobility for goods are promoted in the RTP and other documents. As part of the GCM ITS Priority Corridor Project, **a number of CVO applications are being examined**. These include weigh-in-motion (IDOT), electronic credential checking (IDOT), automated height clearance checking (City of Chicago), GPS transponder/hazardous materials incident response system (Chicago), and truck platooning study (Indiana DOT).

FHWA's CVISN program is a multi-state, public/private effort to provide a mechanism for the exchange of safety, registration, fuel tax, HAZMAT, and license information to support inspection and pre-clearance activities.

APPLICATION PRINCIPLES

CVO measures may be applied at **various levels**, but often require considerable **inter-agency and private sector participation**. At one end, a weigh-in-motion station can be a spot application and involve only the regulatory agency. Electronic credential checking must be integrated over a long stretch of roadway (usually interstate) with multiple stations to be of significant benefit. One-stop shopping is also typically applied over a large, sometimes multi-state, area and can involve numerous public agencies. Information systems can benefit the trucking industry when implemented at both the regional level and for specific locations.

There are many decisions on CVO systems (e.g. equipping fleets with GPS systems) that are made solely by private industry for purposes of improving the efficiency of their operations.

ANALYSIS GUIDELINES

The analysis technique will depend on the specific CVO application being analyzed. Possible delay-reduction from weigh-in-motion and electronic credential checking can be estimated based on assumed penetration/eligibility levels and the volume of trucks at the specific locations. The analysis of delay savings due to information-based approaches can be analyzed using the same basic techniques as for ATIS. However, the analysis would focus on the CVO subset of all traffic. The benefits of vehicle location systems is mainly internal to the trucking industry and usually does not need to be analyzed within the public sector.

KEY CONTACTS

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Strategy #44 Class: Intelligent Transportation Systems

Advanced Vehicle Control Systems (AVCS)

DESCRIPTION

AVCS consist of a range of ITS activities covering **in-vehicle technologies** and making use of in- or on-roadway or other off-site information systems to assist in **informational, guidance, or navigational systems** for highway and transit vehicles. The AVCS activities may range from individual vehicle systems (e.g., "Mayday" systems or on-board safety monitoring systems) to systems comprising vehicle groups (as in several alternative concepts identified as the "Automated Highway Systems). Many additional concepts are in the research and development stage.

Example applications include: "Mayday" system, in-vehicle driver impairment sensors, in-vehicle headway sensor systems, in-vehicle operation monitoring systems, in-vehicle headway systems, in-vehicle route guidance, in-vehicle "probe" (surveillance), in-vehicle speed control, and fully automated highway system.

BENEFITS & IMPACTS

The benefits of AVCS vary depending upon the type of system being implemented. In general, these systems are proposed to **manage traffic demands and flows** along the transportation system and to **reduce the frequency or impacts of highway accidents**. In-vehicle headway, route guidance, and speed control systems, along with the automated highway systems are examples of measures intended to manage traffic flows. Safety-related applications include in-vehicle driver impairment, headway and collision avoidance systems. A “Mayday” system also provides safety benefits by aiding in emergency response. Operation monitoring systems may be used to improve vehicle maintenance and repair functions.

REGIONAL POLICIES

AVCS falls primarily in the **domain of the private sector**. Many AVCS elements will be implemented by vehicle manufacturers **as the technology becomes available and a market is created**. At present, several trucking companies have installed Mayday systems; some higher-end cars also come equipped with these systems.

A number of AVCS elements, particularly the more sophisticated elements that involve a transfer of vehicle control from the driver to automated systems, will **require increased public and political acceptance** before they are implemented. Regional policy should seek to accommodate those applications that will have a benefit for overall regional mobility and safety.

APPLICATION PRINCIPLES

The strategy to implement AVCS systems will **vary by specific application**. Most are initiatives that would be taken on by the vehicle manufacturing industry. They may be applicable to individual vehicles (e.g., on-board system monitoring), highways (e.g., "Mayday" system), or corridors/regions (e.g., Automated Highway Systems (AHS)). Many of these systems are **in development and under operational testing** (on a limited basis) and may be five to ten years away from regular application by an operable level of vehicles along a highway or corridor.

ANALYSIS GUIDELINES

Given the range of AVCS activities existing, planned and under development, the potential impacts associated with these activities are wide ranging. Proposed applications may be assessed on a highway segment, highway, corridor, or regional basis. The **approach to analysis varies widely, depending on the application**. Generally, analysis will be confined to those elements for which state and local governments may have responsibility.

KEY CONTACTS

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3.12 CAPACITY EXPANSION

Capacity expansion directly addresses congestion through an increase in roadway capacity. Capacity expansion includes the addition of general purpose lanes to an existing facility or the construction of a new facility. General purpose lanes are those that may be used by all vehicular traffic modes (e.g., SOVs, HOVs, transit, and trucks). This strategy class covers major roadway expansion projects; smaller scale additions (e.g., turn lanes) or those for specific purposes (e.g., passing lanes) are included under Traffic Operations Improvements (section 3.2). Capacity expansion strategies are applied to individual roadways.

Capacity expansion is appropriate in a variety of settings, but it is critical to analyze other strategies before concluding that capacity expansion is the right solution. Constraints to the application of this strategy include cost, availability of ROW, and environmental impacts. Where capacity expansion is deemed appropriate, it may be packaged with a variety of other strategies to increase the efficiency and effectiveness of the resulting facility. Such strategies include traffic operational improvements, transit-related roadway improvements, and access management measures.

A related coordination issue is that of cost-effectiveness. In many cases it may be cost-effective to incorporate components of other strategy classes into a capacity expansion project at the time of construction. Such components include HOV, bicycle and pedestrian, and ITS measures.

For Details, See Individual Strategy Sheets*:*

45. Expressway Lanes

46. Arterial Lanes

Strategy #45 Class: Capacity Expansion

Expressway Lanes

DESCRIPTION

This strategy includes **adding lanes** to or **extending** existing expressways, as well as **constructing new facilities**. For existing expressways, adding general purpose lanes can range from relatively limited improvements (e.g., to provide an auxiliary lane for merge and diverge movements between interchanges) to major improvements where additional lanes are constructed for several miles. Some expressway lane additions are characterized as "gap closures" that result in a balanced number of lanes in an area that previously suffered congestion from "lane drops."

BENEFITS & IMPACTS

Expressway general purpose lane additions are designed to **increase roadway capacity** and **reduce traffic congestion** (relief may be short-term as long-term relief is elusive). In some cases, **safety improvements** are included. Other benefits may include shorter peak periods for congested urban conditions, and considerable congestion relief on parallel arterials. Expressway lane additions are **high-cost**, typically require **additional right-of-way**, and consume years to plan, design and construct. The approval process can also be lengthy due to the potential impacts of expressway lane additions. These impacts can include relocation of people from adjacent homes and businesses, increases in noise and some air pollutants, destruction of habitats, and traffic congestion on local streets particularly at expressway interchanges.

REGIONAL POLICIES

IDOT and ISTHA **carefully study locations** in which the addition of expressway lanes can help address bottleneck and mobility concerns. These agencies have implemented several successful add lanes projects in situations where this type of improvement is the best fit. Because northeastern Illinois is a nonattainment area, alternatives must be appropriately analyzed before a recommendation for the significant addition of general purpose lanes is made.

The 2020 RTP has **identified several locations where expansion of the toll/expressway system is warranted**. Recommended improvements include extensions of IL 53, the Elgin-O'Hare and the O-Hare Bypass, as well as add lanes projects on I-55, I-94, I-90, I-88, I-294, I-80, I-57, and IL 394.

APPLICATION PRINCIPLES

Expressway lane additions may be appropriate for "pipeline" projects where substantial planning resources have been expended and where **sufficient public interest and support** exists to construct the project. Careful study is required to identify where the **new bottlenecks** will occur when the additional expressway lanes carry additional traffic downstream. New bottlenecks are often realized at the ends of expressway ramps to local streets and at junctions with other expressways.

Expressway lane additions may conflict with other congestion management strategies, particularly those intended to encourage the use of alternative modes of travel. Complementary strategies include operational improvements, access management and ITS measures. Expressway expansion may also be coordinated with the implementation of other infrastructure improvements (e.g. HOV, bike/ped) as a means of achieving cost-efficiencies.

ANALYSIS GUIDELINES

The urban-scale benefits of expressway lane additions can be assessed using the CATS **regional travel demand model**. The corridor-scale benefits and impacts of these strategies can be assessed using procedures described in the *Highway Capacity Manual (Ref. 7A)* and **simulation analysis packages** such as FREQ, CORFLO, and CORSIM.

KEY CONTACTS

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CATS Director of Plan Development - (312) 793-0380

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Strategy #46 — Class: Capacity Expansion

Arterial Lanes

DESCRIPTION

This strategy includes **adding lanes** to or **extending** existing arterials, as well as **constructing new facilities**. For existing arterials, this strategy involves construction of new through lanes over a long distance on surface streets. Minor improvements to specific locations are described in Strategy #8: Roadway Geometric Improvements.

BENEFITS & IMPACTS

Arterial lane additions are designed to **increase roadway capacity** and **reduce localized traffic congestion**. In some cases, safety improvements (e.g., median treatment) are included. As part of a system wide plan to improve travel times via arterials, this strategy can be more effective than widening a parallel expressway. Arterial lane additions can be **costly** if additional right-of-way is required in built-up areas. Planning and right-of-way preservation for the ultimate width at the time when adjacent land is being developed or redeveloped is recommended.

The widening of arterials **may adversely impact pedestrian travel** and **traffic operations**. Wide (i.e., six-lane) arterials are perceived by pedestrians as a barrier and will inhibit pedestrian travel. Wide arterials also increase the required pedestrian-crossing time at a signalized intersection resulting in more delay for vehicles. Wider arterials may also require multi-phase traffic signals which improve safety, but reduce efficiency due to longer clearance times between different conflicting turning movements. Conversely, arterial lane additions can provide an opportunity to implement **complementary strategies** (e.g., bike lanes, upgraded signal systems).

REGIONAL POLICIES

Development patterns in northeastern Illinois have helped magnify the need for additional arterial capacity in fast-growing areas. IDOT works closely with the regional councils in discussing major arterial “add-lanes” projects. Because of financial constraints, land use densities, and air quality issues, add-lanes arterial projects are generally focused on the **Strategic Regional Arterial** system. The SRAs were identified through a region wide planning effort with the goal being high capacity arterial facilities serving inter-regional traffic. The agency's SRA studies, financed through Operation GreenLight, have identified ultimate SRA configurations through an intensive public involvement process.

Because northeastern Illinois is a nonattainment area, alternatives must be appropriately analyzed before a recommendation for the significant addition of general purpose lanes is made. The 2020 RTP financial strategy includes funding for expansion of the SRA system, although specific improvements are not identified.

APPLICATION PRINCIPLES

Arterial lane additions may be appropriate for "pipeline" projects where substantial planning resources have been expended and where sufficient public interest and support exists to construct the project. Arterial lane additions may also be appropriate when proposed in conjunction with **complementary transportation improvements** such as bike lanes, median and driveway controls, or as an alternative to expressway widening

ANALYSIS GUIDELINES

The urban-scale benefits of arterial lane additions can be difficult to assess, but this is best done using the **regional travel demand model**. Corridor-scale benefits and impacts of these strategies can be assessed using procedures described in the *Highway Capacity Manual* (Ref. 7A) and **simulation analysis packages** such as TRANSYT, PASSER, SYNCHRO, NETFLO and NETSIM.

KEY CONTACTS

IDOT Central Office Bureau of Statewide Program Planning - (217) 782-2755

IDOT District 1 Bureau of Programming - (847) 705-4393

CATS Director of Plan Development - (312) 793-0380

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4. STRATEGY SUMMARY

This chapter summarizes the key impacts and characteristics of the strategies described in the previous chapter. The topics of institutional responsibility and the packaging of strategies are also discussed. This information is useful for developing a base understanding of the alternatives.

4.1 BENEFITS AND IMPACTS

This section contains two tables that summarize how the strategies described in this handbook may be expected to impact system performance and travel behavior. The information presented in these tables may be used to help identify the subset of strategies that appear most reasonable for meeting the needs, objectives and constraints of a particular project. The cells in each table are used to indicate whether a particular strategy is likely to have a positive or negative impact with respect to the specific parameter being addressed. When using these tables, it is important to remember that they indicate the typical or generalized impacts of the alternative strategies; exact impacts and characteristics are dependent upon the individual circumstances regarding where and how the strategies are implemented. In reviewing and using the information presented, it is important to keep the following items in mind:

1. **The tables are intended to highlight only those areas where a strategy has a specific or direct impact.** For example, HOV Priority Systems may be expected to have a direct impact on the number of HOV travelers and HOV travel times. An indirect impact may be an improvement in travel times for all vehicles due to the possible decease in the total number of vehicles on the road. These indirect impacts are more uncertain and are, therefore, not indicated in these tables.

2. **Mixed impacts may be attributed to a number of factors.** This may include cases where the impact varies according to the exact strategy measure or action that is implemented. For example, a Ridesharing Program may include an element that leads to increased transit ridership, or may include a vanpool program that results in a shift from transit. In other cases, a strategy may simply cause an improvement in some aspects of an impact area, but a worsening in others. For example, the addition of general purpose lanes can reduce congestion and associated emissions, but may result in increased vehicular travel.

3. **In some instances the changes or impacts may be of significant magnitude, but of limited geographic scope; whereas others are of smaller magnitude but regionwide.** For the purposes of this handbook, the tables do not differentiate between these cases.

Table 2 addresses the issue of how the strategies impact travel behavior, including the number of trips taken, mode choice and the timing of trips. This table also highlights the generalized impact the strategies may be expected to have on travel times, safety and the environment. The different types of impacts are as follows:

- *Reduce Total Vehicle Trips*: does strategy impact the number of motorized vehicle trips (positive benefit is a reduction in vehicle trips)
- *Increase HOV Trips*: does strategy impact the number of HOV trips (positive benefit is an increase in HOV trips)
- *Increase Non-Auto Trips*: does strategy impact the number of transit, bicycle or pedestrian trips (positive benefit is an increase in non-auto trips)
- *Improve Vehicle Travel Time*: does strategy impact the travel time for general purpose vehicles, including single-occupant vehicles, HOVs and transit vehicles (positive benefit is a decrease in vehicle travel times)
- *Improve HOV Travel Time*: does strategy impact the travel time for HOVs whether on HOV or mixed-flow facilities (positive benefit is a decrease in HOV travel times)
- *Improve Transit Travel Times*: does strategy impact the travel time of transit vehicles (positive benefit is a decrease in transit travel times)
- *Reduce VMT*: does strategy impact the number of vehicle miles traveled by all vehicles (positive benefit is a decrease in VMT)
- *Shift Trip Timing*: does strategy result in a shifting of trips away from (congested) peak periods (positive benefit is to shift trips away from the peak)
- *Safety*: does strategy reduce or increase the frequency and/or severity of vehicle crashes or crime (positive benefit is improved safety)
- *Air Quality*: does strategy impact air quality (positive benefit is a reduction in emissions)
- *Other Environmental/Socio-Economic Impacts*: does strategy have other significant impacts including property acquisition and relocation, socio-economic, visual, noise, and impacts to plants and animals (positive benefit is reduced or relatively limited impacts).

Table 2
General Transportation Impacts

KEY

- ◆ No impact
- ⇧ Likely Potential Benefit
- ⇩ Likely Potential Disbenefit
- ⇔ Mixed Impact

STRATEGY CLASS/STRATEGY	IMPACT: Reduce Total Vehicle Trips	Increase HOV Trips	Increase Non-Auto Trips	Improve Vehicular Travel Times	Improve HOV Travel Times	Improve Transit Travel Times	Reduce VMT	Shift Trip Timing	Safety	Air Quality	Other Environ./Socio-Economic
TDM Measures											
1 Ridesharing Programs	⇧	⇧	⇔	◆	◆	◆	⇧	⇔	◆	⇧	⇧
2 ShareCarGo Car Sharing Program	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	⇧
3 Alternative Work Arrangements	⇧	◆	◆	◆	◆	◆	⇧	⇧	◆	⇧	◆
4 Transit/Carpool Incentives	⇧	⇧	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆
5 Parking Management	⇧	⇧	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆
6 Guaranteed Ride Home Programs	⇧	⇧	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆
Traffic Operational Improvements											
7 Traffic Signal Improvements	◆	◆	◆	⇧	⇧	⇧	◆	◆	⇧	⇧	◆
8 Roadway Geometric Improvements	◆	◆	◆	⇧	⇧	⇧	◆	◆	⇧	⇧	⇩
9 Time-of-Day Restrictions	◆	◆	◆	⇔	⇔	⇧	⇔	⇧	⇧	◆	◆
10 Ramp Metering	◆	◆	◆	⇔	⇧	⇧	⇔	⇧	⇧	⇔	◆
11 Commercial Vehicle Improvements	◆	◆	◆	⇧	⇧	⇧	◆	◆	⇧	⇧	◆
12 Construction Management	◆	◆	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	◆
HOV Measures											
13 HOV Priority Systems	⇧	⇧	⇧	◆	⇧	⇧	⇧	◆	◆	⇧	⇩
14 HOV Support Services	⇧	⇧	⇧	◆	⇧	◆	⇧	◆	◆	⇧	◆
Transit Capital Improvements											
15 Exclusive Right-of-Way Facilities	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	⇧	⇩
16 Fleet Improvements	⇧	◆	⇧	◆	◆	◆	⇧	◆	⇧	⇧	◆
17 Transit Support Facilities	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆
Transit Operational Improvements											
18 Transit Service Improvements	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	⇧	◆
19 Transit Marketing/Information	⇧	◆	⇧	◆	◆	⇧	⇧	◆	◆	⇧	◆
20 Fare Incentives	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆
21 Traffic Operations for Transit	⇧	◆	⇧	⇔	◆	⇧	⇧	◆	⇧	⇔	◆
Non-Motorized Modes											
22 Bike/Ped Infrastructure Improvements	⇧	◆	⇧	◆	◆	◆	⇧	◆	⇧	⇧	⇧
23 Bike/Ped Support Services	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	◆

Table 2 (continued)
General Transportation Impacts

KEY
- ◆ No impact
- ⇧ Likely Potential Benefit
- ⇩ Likely Potential Disbenefit
- ⇔ Mixed Impact

STRATEGY CLASS/STRATEGY	IMPACT										
	Reduce Total Vehicle Trips	Increase HOV Trips	Increase Non-Auto Trips	Improve Vehicular Travel Times	Improve HOV Travel Times	Improve Transit Travel Times	Reduce VMT	Shift Trip Timing	Safety	Air Quality	Other Environ./Socio-Economic
Congestion Pricing											
24 Road User Fees	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆	⇧	◆
25 Parking Fees	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆	⇧	◆
Growth Management											
26 Compact Development	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	⇔
27 Redevelopment and Infill Development	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	⇔
28 Location Efficient Mortgage	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	⇧
29 Mixed Use Development	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	⇧	⇧
30 Jobs/Housing Balance	⇧	◆	◆	◆	◆	◆	⇧	◆	◆	⇧	◆
31 Transit-Oriented Development	⇧	◆	⇧	◆	◆	⇧	⇧	◆	◆	⇧	◆
32 Corridor Land Use & Transportation Coordination	⇧	◆	◆	⇧	⇧	◆	⇧	◆	⇧	⇧	◆
Access Management											
33 Driveway Management	◆	◆	◆	⇧	⇧	⇧	⇩	◆	⇧	⇔	⇔
34 Median Management	◆	◆	◆	⇧	⇧	⇧	⇩	◆	⇧	⇔	⇔
35 Frontage Roads	◆	◆	◆	⇧	⇧	⇧	⇩	◆	⇧	⇔	⇩
Incident Management											
36 Incident Detection/Verification	◆	◆	◆	⇧	⇧	⇧	⇧	◆	⇧	⇧	◆
37 Incident Response	◆	◆	◆	⇧	⇧	⇧	⇧	◆	⇧	⇧	⇧
38 Incident Clearance	◆	◆	◆	⇧	⇧	⇧	⇧	◆	⇧	⇧	⇧
39 Incident Information/Routing	◆	◆	◆	⇧	⇧	⇧	⇔	⇧	◆	⇧	◆
Intelligent Transportation Systems											
40 Advanced Traffic Management Systems	⇔	◆	⇔	⇧	⇧	⇧	◆	⇧	⇧	⇧	◆
41 Advanced Traveler Information Systems	⇧	◆	⇧	◆	◆	◆	⇧	⇧	◆	⇧	◆
42 Advanced Public Transportation Systems	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	⇧	⇧
43 Commercial Vehicle Operations	◆	◆	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	◆
44 Advanced Vehicle Control Systems	⇔	◆	⇩	⇧	⇧	⇧	⇔	◆	⇧	⇧	◆
Capacity Expansion											
45 Expressway Lanes	⇩	⇩	⇩	⇧	⇧	⇧	⇔	⇩	⇧	⇔	⇩
46 Arterial Lanes	⇩	⇩	⇩	⇧	⇧	⇧	⇔	⇩	⇧	⇔	⇩

Table 3 summarizes the expected impacts of the alternative strategies based on the established CMS Performance Monitoring measures. These measures are to be used within the CMS to monitor performance of the region's transportation system on an on-going basis. A thorough description of the CMS performance measures and the CMS Monitoring Program is provided in the *CMS Technical Supplement*. The CMS performance measures included in Table 3 are as follows:

- *Travel Time*: does strategy impact the expected trip travel times (for all or individual modes) through increased speeds, reduced delays, improved connections, reduced wait times, etc. (reduced travel time is a benefit)
- *Travel Speed*: does strategy directly impact the speed of private or transit vehicles on the affected link or segment through reduced friction from other vehicles, improved signal progression, etc. (increased travel speed is a benefit)
- *V/C Ratio*: does strategy impact the roadway V/C ratio by changing the number of vehicles on or capacity of the roadway segment (reduced V/C ratio is a benefit) - Note: this is a surrogate measure of roadway level-of-service (LOS); it is typically less sensitive than measures such as vehicle density and intersection LOS; it is included in the CMS because it may be readily calculated within the travel demand model
- *Expressway Vehicle Density* (measure of LOS on expressways): does strategy impact vehicle densities by changing the number or spacing of vehicles on an expressway segment (lower vehicle density is a benefit)
- *Arterial/Intersection LOS*: does strategy impact arterial LOS by reducing vehicle trips, improving signal progression, reducing conflicts, etc. (lower delay or better LOS is a benefit)
- *Duration of Congestion*: does strategy impact the time period for which congestion exists through increased capacity, reduced demand or reduced impacts from capacity-constraining events (shorter period is a benefit)
- *Person Throughput*: does strategy impact the total number of travelers that can pass a corridor screenline in a given time period through increased capacity or better utilization of the system (higher throughput is a benefit)
- *Average Vehicle Occupancy (AVO)*: does strategy impact the number of persons per vehicle (higher AVO is a benefit)
- *Modal Shares*: does strategy impact the percentage of trips by modes other than single-occupant-vehicles (higher percentage is a benefit)
- *Transit System Measures*: does strategy impact transit operational and financial performance
- *Incident Measures*: does strategy impact the frequency and/or severity of incidents.

This CMS Monitoring Program also includes three accessibility measures that reflect the percentage of households and employment with nearby access to key transportation facilities or services.

These measures are impacted primarily by strategies which affect the size of the transportation system, in terms of both infrastructure and services. The three accessibility measures included in the CMS and Table 3 are:

- *% of Hholds/Empl. Near Bus Stop*: does strategy impact the percentage of households/employment within a specified distance of a stop on a bus route (higher percentage is a benefit)
- *% of Hholds/Empl. Near Rail Station*: does strategy impact the percentage of households/employment within a specified distance of a rail station (higher percentage is a benefit)
- *% of Hholds/Empl. Near Expressway*: does strategy impact the percentage of households/employment within a specified distance of an expressway on- or off-ramp (higher percentage is a benefit)

In reviewing Table 3, it is important to recognize that the set of CMS performance measures is intended to capture many aspects of the transportation system. As a result, instances occur where a particular strategy may have no or little impact on a specific measure, or where a performance measure is not considered an appropriate indicator when assessing the impact of a particular strategy. Table 3 attempts to highlight only the direct impacts of each strategy in terms of those CMS performance measures that are most appropriate for assessing this impact.

As a secondary function to summarizing expected impacts, this table helps highlight those CMS performance measures that may be used by the project planner or sponsor to evaluate and monitor the different strategies. For example, travel times, speed, intersection LOS, and person throughput may be valuable measures for assessing the impacts of traffic signal improvements. The reader should keep in mind, however, that there may be other measures that are not part of the CMS Monitoring Program, but that may also be useful for assessing the potential impact of individual strategies.

It is also important to remember that this table attempts to illustrate the typical or generalized impacts of the alternative strategies. In many cases, the impact may vary according to the exact strategy measure or action that is implemented. For example, the impact of Strategy #9 - Time-of-Day Restrictions on performance measures such as travel time and V/C ratio is highly dependent on the type of restriction (parking, turn movement, truck) that is implemented.

Table 3
Potential Impacts Relative to CMS Performance Measures

KEY
- ◆ Not a Primary Measure
- ⇧ Likely Potential Benefit
- ⇩ Likely Potential Disbenefit
- ⇔ Mixed Impact

STRATEGY CLASS/STRATEGY	CMS PERFORMANCE MEASURE													
												Access		
	Travel Time	Travel Speed	V/C Ratio	Expressway Vehicle Density	Arterial/Intersection LOS	Duration of Congestion	Person Throughput	Vehicle Occupancy	Modal Shares	Transit System Measures	Incident Measures	% Near Bus Stop	% Near Rail Station	% Near Expressway
TDM Measures														
1 Ridesharing Programs	◆	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇔	◆	◆	◆	◆
2 ShareCarGo Car Sharing Program	◆	◆	◆	◆	◆	◆	◆	◆	⇧	⇧	◆	◆	◆	◆
3 Alternative Work Arrangements	◆	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆	◆	◆	◆	◆
4 Transit/Carpool Incentives	◆	◆	⇧	⇧	◆	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆
5 Parking Management	◆	◆	⇧	⇧	◆	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆
6 Guaranteed Ride Home Programs	◆	◆	⇧	⇧	◆	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆
Traffic Operational Improvements														
7 Traffic Signal Improvements	⇧	⇧	◆	◆	⇧	◆	⇧	◆	◆	⇧	⇧	◆	◆	◆
8 Roadway Geometric Improvements	⇧	⇧	⇧	◆	⇧	⇧	⇧	◆	◆	⇧	⇧	◆	◆	◆
9 Time-of-Day Restrictions	⇔	⇧	⇧	◆	⇧	⇧	◆	◆	◆	◆	⇧	◆	◆	◆
10 Ramp Metering	⇔	⇔	⇧	⇧	⇔	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆
11 Commercial Vehicle Improvements	⇧	⇧	◆	◆	⇧	◆	⇧	◆	◆	◆	⇧	◆	◆	◆
12 Construction Management	⇧	⇧	◆	◆	◆	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆
HOV Measures														
13 HOV Priority Systems	⇧	⇧	⇧	⇧	⇔	⇧	⇧	⇧	⇧	⇔	◆	◆	◆	◆
14 HOV Support Services	◆	◆	◆	⇧	⇧	◆	⇧	⇧	⇧	⇔	◆	◆	◆	◆
Transit Capital Improvements														
15 Exclusive Right-of-Way Facilities	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆
16 Fleet Improvements	◆	⇧	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆
17 Transit Support Facilities	◆	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇧	◆	⇧	⇧	◆
Transit Operational Improvements														
18 Transit Service Improvements	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆	⇧	◆	◆
19 Transit Marketing/Information	⇧	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇧	◆	◆	◆	◆
20 Fare Incentives	◆	◆	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇔	◆	◆	◆	◆
21 Traffic Operations for Transit	⇧	⇧	⇧	⇧	⇔	◆	⇧	⇧	◆	⇧	⇧	◆	◆	◆
Non-Motorized Modes														
22 Bike/Ped Infrastructure Improvements	◆	◆	◆	◆	◆	◆	⇧	◆	⇧	◆	⇧	◆	◆	◆
23 Bike/Ped Support Services	◆	◆	◆	◆	◆	◆	⇧	◆	⇧	◆	◆	◆	◆	◆

Table 3 (continued)
Potential Impacts Relative to CMS Performance Measures

KEY
- ◆ Not a Primary Measure
- ⇧ Likely Potential Benefit
- ⇩ Likely Potential Disbenefit
- ⇔ Mixed Impact

STRATEGY CLASS/STRATEGY	CMS PERFORMANCE MEASURE													
												Access		
	Travel Time	Travel Speed	V/C Ratio	Expressway Vehicle Density	Arterial/Intersection LOS	Duration of Congestion	Person Throughput	Vehicle Occupancy	Modal Shares	Transit System Measures	Incident Measures	% Near Bus Stop	% Near Rail Station	% Near Expressway
Congestion Pricing														
24 Road User Fees	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆	◆	◆	◆
25 Parking Fees	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	◆	◆	◆	◆
Growth Management														
26 Compact Development	⇧	◆	⇧	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	◆	◆
27 Redevelopment and Infill Development	⇧	◆	⇧	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	⇧	⇧
28 Location Efficient Mortgage	◆	◆	◆	◆	◆	◆	◆	◆	⇧	⇧	◆	⇧	⇧	⇧
29 Mixed Use Development	⇧	◆	⇧	⇧	◆	⇧	◆	◆	⇧	◆	◆	◆	◆	◆
30 Jobs/Housing Balance	⇧	◆	⇧	⇧	◆	⇧	◆	◆	⇧	⇧	◆	◆	◆	◆
31 Transit-Oriented Development	⇧	◆	⇧	⇧	◆	⇧	◆	◆	⇧	⇧	◆	⇧	⇧	⇧
32 Corridor Land Use & Transportation Coordination	⇧	⇧	⇧	◆	⇧	⇧	◆	◆	◆	◆	◆	⇧	⇧	⇧
Access Management														
33 Driveway Management	⇔	⇧	⇧	◆	⇔	◆	⇧	◆	◆	◆	⇧	◆	◆	◆
34 Median Management	⇔	⇧	⇧	◆	⇔	◆	⇧	◆	◆	◆	⇧	◆	◆	◆
35 Frontage Roads	⇧	⇧	⇧	⇧	⇔	◆	⇧	◆	◆	◆	⇧	◆	◆	◆
Incident Management														
36 Incident Detection/Verification	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆	◆	⇧	◆	◆	◆
37 Incident Response	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆	◆	⇧	◆	◆	◆
38 Incident Clearance	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆	◆	⇧	◆	◆	◆
39 Incident Information/Routing	⇧	⇧	◆	◆	◆	⇧	◆	◆	◆	◆	⇧	◆	◆	◆
Intelligent Transportation Systems														
40 Advanced Traffic Management Systems	⇧	⇧	⇧	⇧	⇧	◆	⇧	◆	⇩	⇔	⇧	◆	◆	◆
41 Advanced Traveler Information Systems	⇧	⇧	◆	◆	◆	⇧	◆	⇔	⇔	⇧	◆	◆	◆	◆
42 Advanced Public Transportation Systems	⇧	⇧	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇧	⇧	◆	◆	◆
43 Commercial Vehicle Operations	⇧	⇧	⇧	◆	⇧	◆	◆	◆	◆	◆	⇧	◆	◆	◆
44 Advanced Vehicle Control Systems	⇧	⇧	⇧	⇧	◆	◆	⇧	◆	◆	◆	⇧	◆	◆	◆
Capacity Expansion														
45 Expressway Lanes	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇩	⇩	⇩	⇧	◆	◆	⇧
46 Arterial Lanes	⇧	⇧	⇧	◆	⇧	⇧	⇧	⇩	⇩	⇩	⇧	◆	◆	◆

4.2 IMPLEMENTATION CHARACTERISTICS

Table 4 addresses a number of key characteristics that directly affect the implementation of strategies. For this table, the cells are used to indicate whether the defined characteristic typically applies to the strategy in question. The characteristics summarized in this table are:

- *Low Total Cost*: to construct and/or operate;
- *Cost Effective*: ratio of total benefit to total cost;
- *Short Implementation Timeline*: time to implement (shorter timeframe is considered positive);
- *Readily Available Technology*: indicates if the strategy can be implemented with current technology;
- *Political Acceptance*: indicates strong existing base of political support for adoption or implementation of strategy (higher is positive);
- *Regional Scale*: indicates that strategy is typically applied or may be applied at the regional level (this does not reflect an inherent advantage or disadvantage, it is simply intended to inform the reader); and
- *Local Scale*: indicates that strategy is typically applied or may be applied at the local level.

4.3 PLANNING AND IMPLEMENTATION RESPONSIBILITY

While the strategies presented in the Handbook may be applicable in a variety of circumstances and locations, the planning and implementation of some strategies may be limited to specific agencies. For example, most transit-related improvements are planned and implemented by the individual transit operators, and improvements to state highways are implemented by IDOT. However, this should not limit other agencies from identifying and evaluating potential improvements to these services and facilities in coordination with the responsible agency.

Table 5 identifies which agency (e.g., IDOT, CATS, etc.) has the most direct responsibility for planning, implementing or managing each CMS strategy. The table also highlights those strategies where the involvement of the private sector can be beneficial or critical. Note that in many cases the responsibility is shared among multiple agencies. This may reflect instances where a strategy involves the participation of multiple agencies, or where a strategy may be implemented on the system owned or operated by many different agencies.

Table 4
Strategy Implementation Characteristics

KEY
◆ Neutral/Uncertain
⇧ More Applicable
⇩ Less or Not Applicable
⇔ Mixed

STRATEGY CLASS/STRATEGY	Low Total Cost	Cost Effective	Short Implementation Timeframe	Technology Readily Available	Political Acceptance	Regional Scale	Local Scale
TDM Measures							
1 Ridesharing Programs	⇧	⇧	⇧	⇧	⇧	⇧	⇧
2 ShareCarGo Car Sharing Program	◆	◆	⇧	⇧	⇔	⇧	⇧
3 Alternative Work Arrangements	⇧	◆	⇧	⇧	⇧	◆	⇧
4 Transit/Carpool Incentives	⇩	⇧	⇧	⇧	⇩	⇧	⇧
5 Parking Management	⇧	⇧	⇧	⇧	⇩	⇧	⇧
6 Guaranteed Ride Home Programs	⇧	⇧	⇧	⇧	⇧	⇧	⇧
Traffic Operational Improvements							
7 Traffic Signal Improvements	⇧	⇧	⇧	⇧	⇧	⇧	⇧
8 Roadway Geometric Improvements	⇔	⇧	⇔	⇧	⇧	◆	⇧
9 Time-of-Day Restrictions	⇧	◆	⇧	⇧	⇔	◆	⇧
10 Ramp Metering	◆	◆	⇩	⇧	◆	⇧	◆
11 Commercial Vehicle Improvements	⇔	⇧	⇩	⇧	⇧	⇧	⇧
12 Construction Management	⇔	⇧	⇧	⇧	⇧	⇧	⇧
HOV Measures							
13 HOV Priority Systems	⇩	⇔	⇩	⇧	⇩	⇧	◆
14 HOV Support Services	⇧	⇧	⇧	⇧	⇧	⇧	⇧
Transit Capital Improvements							
15 Exclusive Right-of-Way Facilities	⇩	⇔	⇩	⇧	⇔	⇧	◆
16 Fleet Improvements	⇩	⇔	⇩	⇧	◆	⇧	◆
17 Transit Support Facilities	⇔	◆	⇔	⇧	◆	⇧	⇧
Transit Operational Improvements							
18 Transit Service Improvements	⇔	◆	⇔	⇧	⇧	⇧	⇧
19 Transit Marketing/Information	⇧	◆	⇔	⇧	⇧	⇧	⇧
20 Fare Incentives	⇔	◆	◆	⇧	⇔	⇧	◆
21 Traffic Operations for Transit	⇩	◆	⇩	⇧	◆	⇧	⇧
Non-Motorized Modes							
22 Bike/Ped Infrastructure Improvements	⇔	⇩	⇔	⇧	⇔	⇧	⇧
23 Bike/Ped Support Services	⇧	◆	⇧	⇧	◆	⇧	⇧

Table 4 (continued)
Strategy Implementation Characteristics

KEY
◆ Neutral/Uncertain
⇧ More Applicable
⇩ Less or Not Applicable
⇔ Mixed

STRATEGY CLASS/STRATEGY	Low Total Cost	Cost Effective	Short Implementation Timeframe	Technology Readily Available	Political Acceptance	Regional Scale	Local Scale
Congestion Pricing							
24 Road User Fees	⇔	⇧	⇩	⇔	⇔	⇧	◆
25 Parking Fees	⇧	⇧	◆	⇧	⇩	◆	⇧
Growth Management							
26 Compact Development	⇧	⇧	⇔	⇧	⇔	⇧	⇧
27 Redevelopment and Infill Development	⇧	⇧	⇔	⇧	⇧	⇧	⇧
28 Location Efficient Mortgage	⇧	⇧	⇧	⇧	⇧	⇧	⇧
29 Mixed Use Development	⇧	⇧	◆	⇧	⇧	⇧	⇧
30 Jobs/Housing Balance	⇧	◆	⇩	⇧	⇔	⇧	◆
31 Transit-Oriented Development	⇧	◆	⇔	⇧	⇔	⇧	⇧
32 Corridor Land Use & Transportation Coordination	⇧	⇧	◆	⇧	⇧	⇧	⇧
Access Management							
33 Driveway Management	⇧	⇧	⇧	⇧	⇔	◆	⇧
34 Median Management	⇧	⇧	⇧	⇧	⇔	◆	⇧
35 Frontage Roads	⇩	⇧	⇩	⇧	⇧	⇧	⇧
Incident Management							
36 Incident Detection/Verification	⇩	⇧	⇩	⇧	⇧	⇧	⇧
37 Incident Response	⇩	⇧	⇩	⇧	⇧	⇧	⇧
38 Incident Clearance	⇩	⇧	◆	⇧	⇧	⇧	⇧
39 Incident Information/Routing	⇩	⇧	⇩	⇧	⇧	⇧	⇧
Intelligent Transportation Systems							
40 Advanced Traffic Management Systems	⇩	⇧	⇩	⇔	⇧	⇧	⇧
41 Advanced Traveler Information Systems	⇩	⇔	⇩	⇔	⇧	⇧	◆
42 Advanced Public Transportation Systems	⇩	⇧	⇩	⇔	⇧	⇧	◆
43 Commercial Vehicle Operations	⇩	⇔	⇩	⇧	⇧	⇧	⇧
44 Advanced Vehicle Control Systems	⇩	⇧	⇩	⇩	⇩	◆	◆
Capacity Expansion							
45 Expressway Lanes	⇩	⇧	⇩	⇧	⇔	⇧	◆
46 Arterial Lanes	⇩	⇧	⇩	⇧	⇔	⇧	⇧

CHARACTERISTIC

Table 5
Institutional Responsibilities

KEY: ◆ Responsibility

STRATEGY CLASS/STRATEGY	IDOT	CATS	ISTHA/Chicago Skyway	RTA	Pace	CTA	Metra	NIPC	Local	Private
TDM Measures										
1 Ridesharing Programs		◆			◆					◆
2 ShareCarGo Car Sharing Program										◆
3 Alternative Work Arrangements		◆								◆
4 Transit/Carpool Incentives				◆						◆
5 Parking Management		◆			◆	◆	◆		◆	◆
6 Guaranteed Ride Home Programs		◆			◆					◆
Traffic Operational Improvements										
7 Traffic Signal Improvements	◆								◆	
8 Roadway Geometric Improvements	◆		◆						◆	
9 Time-of-Day Restrictions	◆								◆	
10 Ramp Metering	◆		◆						◆	
11 Commercial Vehicle Improvements	◆		◆						◆	
12 Construction Management	◆		◆						◆	
HOV Measures										
13 HOV Priority Systems	◆	◆	◆		◆	◆				
14 HOV Support Services	◆	◆			◆	◆				
Transit Capital Improvements										
15 Exclusive Right-of-Way Facilities	◆	◆		◆	◆	◆	◆		◆	
16 Fleet Improvements				◆	◆	◆	◆			
17 Transit Support Facilities	◆	◆		◆	◆	◆	◆		◆	
Transit Operational Improvements										
18 Transit Service Improvements	◆	◆		◆	◆	◆	◆		◆	
19 Transit Marketing/Information				◆	◆	◆	◆			
20 Fare Incentives				◆	◆	◆	◆			
21 Traffic Operations for Transit	◆	◆		◆	◆	◆	◆		◆	
Non-Motorized Modes										
22 Bike/Ped Infrastructure Improvements	◆							◆	◆	
23 Bike/Ped Support Services	◆							◆	◆	◆

Table 5 (continued)
Institutional Responsibilities

KEY: ◆ Responsibility

STRATEGY CLASS/STRATEGY	IDOT	CATS	ISTHA/Chicago Skyway	RTA	Pace	CTA	Metra	NIPC	Local	Private
Congestion Pricing										
24 Road User Fees	◆	◆	◆							
25 Parking Fees		◆			◆	◆	◆		◆	◆
Growth Management										
26 Compact Development								◆	◆	◆
27 Redevelopment and Infill Development								◆	◆	◆
28 Location Efficient Mortgage									◆	◆
29 Mixed Use Development								◆	◆	◆
30 Jobs/Housing Balance								◆	◆	◆
31 Transit-Oriented Development				◆	◆	◆	◆	◆	◆	◆
32 Corridor Land Use & Transportation Coordination	◆	◆	◆	◆	◆	◆	◆	◆	◆	
Access Management										
33 Driveway Management	◆							◆	◆	
34 Median Management	◆							◆	◆	
35 Frontage Roads	◆							◆	◆	
Incident Management										
36 Incident Detection/Verification	◆		◆						◆	
37 Incident Response	◆		◆						◆	
38 Incident Clearance	◆		◆						◆	
39 Incident Information/Routing	◆		◆						◆	
Intelligent Transportation Systems										
40 Advanced Traffic Management Systems	◆	◆	◆	◆					◆	◆
41 Advanced Traveler Information Systems	◆	◆	◆	◆	◆	◆	◆		◆	◆
42 Advanced Public Transportation Systems	◆	◆		◆	◆	◆	◆		◆	◆
43 Commercial Vehicle Operations	◆	◆	◆						◆	◆
44 Advanced Vehicle Control Systems	◆	◆	◆						◆	◆
Capacity Expansion										
45 Expressway Lanes	◆	◆	◆						◆	
46 Arterial Lanes	◆	◆							◆	

4.4 STRATEGY PACKAGING

While many of the strategies described in this handbook can be implemented as stand-alone projects, it is often prudent to examine combinations or packages of strategies. As a general rule, a strategy implemented in isolation only has a limited impact on congestion. The reason is that a given strategy generally addresses only one aspect of the complex mix of causes which generate traffic congestion. There are three primary reasons for packaging strategies:

1. to take advantage of potential synergies between strategies;
2. to take advantage of potential cost efficiencies during implementation; and
3. to fully address a need or deficiency.

Synergy - There are often interrelationships among strategies that can produce more robust and effective congestion mitigation approaches. An example of a synergy between strategies is the following set of three strategies: traffic signal progression, peak-period parking restrictions, and driveway management. While the implementation of any one of these programs may have a small, but measurable effect on traffic congestion, a coordinated program incorporating all of these strategies is likely to have a greater impact.

In the case of a project which adds general purpose capacity, the added capacity can be quickly consumed if the facility is not adequately managed. Traffic system management strategies, and programs to encourage transit use or higher vehicle occupancies can continue and expand on the efforts to provide and maintain capacity in the corridor.

Cost-Efficiencies - Multiple strategies or measures may be packaged to take advantage of cost efficiencies during implementation. This is most often the case with projects involving roadway construction. In this case, it may be cost-efficient to undertake improvements to bicycle and pedestrian infrastructure, minor geometric improvements, signal upgrades, and installation of bus turnouts.

Complex Needs - In some cases it may simply be necessary to combine strategies as a means of addressing a major or complex problem. This may occur because of constraints (e.g. physical, financial, political) that limit the ability of a single strategy to fully resolve a deficiency. For example, in a high demand corridor it may be necessary to expand both roadway and transit service capacity.

Experience in the region and elsewhere suggests the packaging of supportive or complementary strategies can lead to more effective and efficient approaches. Table 6 highlights those strategies that are typically considered to support one another and provide synergistic benefits. This table has been included in the Handbook as an aid in the selection of mutually reinforcing strategies. By assessing whether strategies are mutually supportive, the analyst will have some guidance about whether to increase the estimated potential impacts of selected strategies. It should be recognized that this table does not include all potentially beneficial combinations, but is intended only as a starting point.

In a similar vein, it is important to recognize that there may be times when strategies can conflict with one another. The reasons for the conflict vary, but can generally be classified into two groups: those which have conflicting objectives, and those which compete for the same market. An example of the first type of conflict may be between general purpose capacity expansion and land use strategies. These strategies can be diametrically opposed in terms of the objectives (accommodating additional vehicle travel versus deterring new vehicle trips). An example of strategies which compete for the same market are vanpool and express bus strategies. Transit and ridesharing tend to target the same set of commuters, and the effectiveness of expanded transit service can be reduced by "door-to-door" services which offer higher perceived levels of service to commuters. However, this does not mean that strategies that appear to conflict should not be pursued in parallel. In many cases, both strategies may be needed to meet demand and multiple objectives.

Determining the potential benefits of combining strategies can be problematic. Some studies have attempted to assess the potential synergies of different strategies, and to calculate how the effectiveness of other strategies can be diminished if conflicting strategies are introduced. However, the amount of information on how to estimate the benefits of strategies used in combination is extremely limited. The analyst is required to exercise considerable judgment and rely on empirical evidence to determine which strategies can reinforce one another, and which can limit or restrict the positive effects of other strategies.

One approach for determining the impacts of combined strategies would be to calculate the benefits of the second strategy using the results of the first strategy as a base. For example, if the first strategy reduced peak trips by five percent, the impacts of the second strategy would be evaluated based on the remaining 95 percent of the trips, not the original 100 percent. This approach is more accurate if the calculations are based on market segments or trip types, not total trips. For example, if the strategies focus exclusively on trips to work, the calculations should apply only to that trip type. Another approach is to consider one strategy as primary and the others as secondary. The secondary strategies are then assessed as to whether they are mutually reinforcing or contradictory with respect to the primary strategy. The estimated benefits of the primary strategy can then be enhanced or reduced by a marginal factor to reflect the synergistic or countervailing effects of the secondary strategies.

With either approach, the initially-calculated impacts may be under- or over-estimated. With experience, the analyst is likely to be able to identify the range within which the benefit derived from the application of multiple strategies will fall. The analyst may wish to make adjustments to account for any discrepancies or note that adjustments for additional synergistic or countervailing effects have not been made. The analyst should exercise caution to ensure that the net reductions after application of all strategies is still reasonable.

Table 6
Typical Strategy Packaging

Primary Strategy Being Considered	Supporting Strategy Offering Potential Synergy[1]	Strategy Offering Potential Cost-Efficiency when Implemented Concurrently
TDM Measures	• HOV Measures • Transit Capital Improvements • Transit Operational Improvements • Non-Motorized Mode Measures • Congestion Pricing • Growth Management	
Traffic Operational Improvements	• Traffic Operations for Transit • Access Management • Incident Management • ITS • Capacity Expansion	• Traffic Operations for Transit • Bike/Ped Infrastructure • Access Management • Incident Management • ITS • Capacity Expansion
HOV Measures	• TDM Measures • Transit Capital Improvements • Transit Operational Improvements	• Transit Capital Improvements
Transit Capital Improvements	• TDM Measures • HOV Measures • Transit Operational Improvements • Non-Motorized Mode Measures • Congestion Pricing • Growth Management • ATIS/APTS	• HOV Measures • Bike/Ped Infrastructure • ITS

NOTE:

1. This table does not expressly consider the issue of "directionality" of "supporting" synergistic strategies. As an illustration of this issue, consider the classes of traffic operational improvements and capacity expansion. It is logical to view traffic operational improvements as a supporting strategy for a capacity expansion project. However, it is less reasonable to view capacity expansion as a "supporting" strategy when considering traffic operational improvements.

Table 6 (continued)
Typical Strategy Packaging

Primary Strategy Being Considered	Supporting Strategy Offering Potential Synergy[1]	Strategy Offering Potential Cost-Efficiency when Implemented Concurrently
Transit Operational Improvements	• TDM Measures • Traffic Operational Improvements • HOV Measures • Transit Capital Improvements • Congestion Pricing • Growth Management • ATIS/APTS	• Geometric Improvements
Non-Motorized Mode Measures	• Parking Management • GRH Programs • Transit Capital Improvements • Transit Operational Improvements • Growth Management	• Geometric Improvements • Transit Support Facilities • Capacity Expansion
Congestion Pricing	• Transit Capital Improvements • Transit Operational Improvements • ATMS	• Geometric Improvements • ATMS • Capacity Expansion
Growth Management	• Parking Management/TDM • Transit Capital Improvements • Transit Operational Improvements • Non-Motorized Mode Measures • Access Management	

NOTE:
1. This table does not expressly consider the issue of "directionality" of "supporting" synergistic strategies. As an illustration of this issue, consider the classes of traffic operational improvements and capacity expansion. It is logical to view traffic operational improvements as a supporting strategy for a capacity expansion project. However, it is less reasonable to view capacity expansion as a "supporting" strategy when considering traffic operational improvements.

Table 6 (continued)
Typical Strategy Packaging

Primary Strategy Being Considered	Supporting Strategy Offering Potential Synergy[1]	Strategy Offering Potential Cost-Efficiency when Implemented Concurrently
Access Management	• Traffic Operational Improvements • Transit Operational Improvements • Growth Management • Incident Management • Capacity Expansion	• Traffic Operational Improvements • Capacity Expansion
Incident Management	• Traffic Operational Improvements • Access Management • ITS • Capacity Expansion	• Traffic Operational Improvements • ITS • Capacity Expansion
ITS	• Traffic Operational Improvements • Incident Management • Capacity Expansion	• Traffic Operational Improvements • Incident Management • Capacity Expansion
Capacity Expansion	• Traffic Operational Improvements • Access Management • Incident Management • ITS	• Traffic Operational Improvements • Access Management • Incident Management • ITS

NOTE:

1. This table does not expressly consider the issue of "directionality" of "supporting" synergistic strategies. As an illustration of this issue, consider the classes of traffic operational improvements and capacity expansion. It is logical to view traffic operational improvements as a supporting strategy for a capacity expansion project. However, it is less reasonable to view capacity expansion as a "supporting" strategy when considering traffic operational improvements.

5. COMPLEMENTARY STRATEGIES FOR GENERAL PURPOSE ADD-LANES PROJECTS

The federal CMS and Metropolitan Planning Regulations recognize that there are occasions when the addition of general purpose capacity is the most feasible and effective solution to transportation problems. It is also recognized, however, that the ability of the added capacity to relieve congestion can quickly be eroded by unmanaged use of the facility. Traffic management strategies, and programs to encourage transit use or higher vehicle occupancies can continue and expand on the efforts to provide and maintain capacity on the new facility. In response, the regulations (subsection 450.336 (b)(2)) require that, *If ...analysis demonstrates that additional SOV capacity is warranted, then all reasonable strategies to manage the facility effectively (or to facilitate its management in the future) shall be incorporated into the proposed facility. Other travel demand reduction and operational management strategies appropriate for the corridor, but not appropriate for incorporation into the SOV facility itself, must be committed to by the State and the MPO for implementation in a timely manner but no later than completion of construction of the SOV facility. If the area does not have a traffic management and carpool/vanpool program, the establishment of such programs must be part of the commitment.*

As a response to this requirement, CATS and IDOT developed a procedure for identifying and evaluating travel demand reduction (TDR) strategies for application with IDOT roadway add-lanes projects. This procedure has been formalized as the TDR Report program. A key element of this program is that the task of identifying potential complementary TDR strategies is performed by CATS rather than the project sponsor. A more detailed description of the TDR program is provided below.

5.1 TRAVEL DEMAND REDUCTION REPORT PROGRAM

Under this program, the Transportation Management Division of CATS performs reviews and site-screenings of add-lanes projects to identify opportunities for TDR strategy applications in project corridors. The resulting TDR reports are incorporated into the CMS or environmental assessment documents for the project.

CATS currently analyzes the TDR potential for those IDOT add-lanes projects that, through a screening process, have been identified as having rideshare or system management potential. CATS also conducts TDR analyses for local add-lanes projects on request. The screening process involves a review of corridors or areas to assess their potential for transportation management strategy implementation. The criteria used in this assessment include project length and location, density and nature of existing and future development, level of public transportation service, proximity to major roadways, level of traffic congestion, and the presence of a local transportation interest group or potential for the formation of a transportation management association.

For those project locations that pass the screening, the second step involves identifying specific transportation management strategies for implementation. The application of TDR strategies can potentially remove vehicles from the proposed roadway to extend the effective design life, and enhance the efficiency and effectiveness of the improvement in order to meet regional travel needs. TDR strategies that are considered include rideshare information signing, Transportation Management Association development, employer-oriented rideshare programs, expansion of bus and rail transit services and facilities, transportation system management, employee parking management programs, mixed-use development and on-site convenience services, improved pedestrian access, new resident packets containing information on commute alternatives, and interconnection of traffic signals. Long-term strategies recommended for implementation include subregional transportation studies to identify traffic patterns and future transportation infrastructure and service needs, transit service provision between residences and transit stations, and the monitoring and evaluation of commuter rail.

Under the TDR Program, CATS will perform these analyses on an on-going and as needed basis and will prepare reports for those corridors having high TDR potential. TDR strategy application will differ according to the characteristics of the project area and the existing transportation services and organizations in the target corridor. The responsibilities of the project implementor include requesting the preparation of a TDR report, reviewing the report recommendations, and incorporating the appropriate strategies into the project design.

The following are general guidelines CATS staff follow to perform corridor analyses and to recommend TDR activities for implementation in a corridor.

- Corridor Identification — Evaluate land use patterns and traffic information to develop a corridor boundary that includes travel patterns and employment centers most directly affected by the proposed improvement. For analysis purposes, boundaries should coincide with the traffic analysis zones defined by CATS.

- Corridor Screening — Following the identification of a corridor, conduct field inspections to collect data on travel patterns, major employment locations, land uses, transit locations, and pedestrian facilities. Evaluate traffic data, intersection design studies, aerial photographs, employer data, socio-economic forecasts, and schedules and maps of transit service to supplement the field data.
- Traffic Data — Collect traffic data for both the A.M. and P.M. peak for the affected roadway. Determine if the roadway is primarily serving regional or local traffic, or a combination of both. Analyze traffic data for the major traffic movements (through and turning) for both peaks.
- Land Use Development — Examine the current and proposed land uses in the corridor for activity centers.
- Corridor Growth — Examine the predicted future employment and population figures, developed by the Northeastern Illinois Planning Commission, for the corridor.
- Highway and Transit Access — Examine access to expressways and major arterials for traffic entering and leaving the corridor. Examine access to bus and rail transit for people within the corridor, including routes and scheduling.
- Pedestrian and Bicycle Access — This will be investigated by IDOT as part of Phase I engineering and design reports.
- Existing TDR Activities — Provide a discussion of existing programs in the corridor aimed at reducing travel demand. These programs could include activities such as Transportation Management Associations, employer activities, rideshare information signage, signal interconnection, and regional rideshare development programs.

6. POST-IMPLEMENTATION EFFECTIVENESS EVALUATION

Effectiveness evaluation involves assessing the benefits that have actually been achieved from implemented transportation strategies. These evaluations are typically called "before-and-after" studies. The Federal CMS regulations call for a "process of periodic assessment of the efficiency and effectiveness of implemented strategies in terms of the area's established performance measures."

Effectiveness evaluations can be useful in three primary ways:

- Provide an indication of effectiveness of various strategy types so that better planning decisions can be made.
- Provide information to fine-tune the operation of projects already implemented.
- Provide assistance in refining planning tools and models (such as the regional travel demand model), so that the relationships and traveler responses are properly reflected.

At present, only a small number of projects or improvements are subject to post-implementation effectiveness evaluations. These include projects implemented as part of selected programs, specifically those implemented under the CMAQ and SCAT programs. In addition to projects under these programs, a number of larger-scale and 'showcase' projects have been subject to post-implementation evaluation assessment.

The information derived from effectiveness evaluation assists in making better planning decisions in the future, as lessons are learned from those projects already in place. This information can be used to improve the estimation of impacts as part of subsequent studies and to provide guidance to decision-makers on the selection of effective strategies for future implementation. However, there are difficulties with effectiveness evaluation that limit its use. Effectiveness evaluation can be costly, and there can be a variety of complicating factors (e.g. changes taking place other than the transportation improvement itself) that make it difficult to isolate the impacts of the study improvement.

An important effectiveness evaluation element of the CMS for northeastern Illinois will be the CMS Monitoring Program. The CMS Monitoring Program will provide regularly updated performance information for selected elements of the region's multimodal transportation network. This performance assessment will be based on a variety of congestion, multimodal, and accessibility measures, and will rely primarily on existing data collection activities. The performance assessment results will be published in a periodic CMS Monitoring Report. CATS is responsible for compiling the necessary data, conducting the performance assessment, and producing the monitoring report. Where applicable, other agencies will be requested to work cooperatively and submit the pertinent data to CATS. A more detailed description of the CMS Monitoring Program is provided in *CMS Technical Supplement* report.

There may be instances, however, when a more detailed or focused evaluation of strategy effectiveness may be warranted. Thus, the purpose of this chapter is to provide guidance on when and how to conduct post-implementation evaluation studies beyond that provided by the CMS Monitoring Program. Section 6.1 defines criteria that may be used to determine when an effectiveness evaluation study may be warranted. Section 6.2 provides suggestions on performance measures to use and how to conduct a study based upon the type of strategy being examined. It is important to recognize that the material presented in this chapter does not represent hard-and-fast rules regarding effectiveness evaluation studies. Rather, this information is intended to help individual implementors reach their own decisions regarding when and how to conduct these studies. This information will also be used by the CMS Task Force to identify those occasions when CATS staff may take a lead or supporting role in conducting an effectiveness evaluation study.

6.1 STUDY CRITERIA - "WHEN" TO CONDUCT EFFECTIVENESS EVALUATIONS

It is recognized that it is neither warranted nor practical to conduct effectiveness evaluations for all projects or improvements. However, there may be some situations in which the evaluation of implemented transportation projects is worthwhile or necessary; they are:

- **Where there is little known about the actual benefits of the project.** Effectiveness evaluation could be used to determine whether the benefits are sufficient for it to be implemented elsewhere. For example, a survey might be conducted of a new type of trip-reduction initiative to determine how trip-making behavior actually changed.

- **Where there is a need to test the methodology used to evaluate the project.** For many strategies there are accepted analysis methodologies. In instances where this is not true, an effectiveness evaluation may be useful in testing the methodology that was used.

- **Where there is a significant community concern.** In some cases, for example, development agreements have included a requirement for monitoring to ensure that traffic levels have not been exceeded or that a promised trip reduction measure is actually working.

- **Where the information will help to improve and fine-tune on-going operations.** For example, a traffic management system typically has a built-in monitoring capability of traffic and of system hardware that allows operators to continuously evaluate and improve operations.

Several additional factors also need to be considered in determining the need to evaluate implemented projects. Many times, effectiveness evaluations can be expensive, and some are not practical at all. This would include conditions in which several improvements are being implemented together or where the changes in travel behavior are difficult to isolate. The cost and feasibility of evaluation is the primary reason why commitments to effectiveness evaluation must be limited. In addition, if few such improvements are contemplated in the future, or if the implemented project is highly unique, the transferability of the information is limited. Therefore, projects that are too unique and have limited potential for application elsewhere are also not good candidates for evaluation.

The above criteria may be used by individual agencies as an aid in determining whether it is beneficial or warranted to conduct an effectiveness evaluation study for a project they have implemented. In addition, these criteria will be used by the CMS Task Force to make an annual determination of which transportation projects, if any, should be given additional evaluation emphasis. Candidate projects will be rated against the above criteria.

6.2 STUDY GUIDELINES - "HOW" TO CONDUCT EFFECTIVENESS EVALUATIONS

While the CMS Monitoring Program will provide performance information for an extensive portion of the region's multimodal transportation network, it may not capture the impacts of individual projects or strategies. This may be due to the fact that the Monitoring Program does not provide the necessary level of detail, does not capture the proper locations, or does not include measures that best reflect the potential impacts of a particular strategy. Therefore, it is helpful to understand the geographic extent to which the impacts of individual strategies should be measured, as well as the level of detail needed. Furthermore, it is important to identify the data and measures that are most useful for evaluating the effectiveness of various strategies.

6.2.1 Effectiveness Evaluation Measures and Methodologies

Table 7 at the end of this chapter summarizes appropriate performance measures and data collection methods for effectiveness evaluation of implemented projects. Performance measures are tailored to the CMS strategies. The specific types of improvements within each strategy (i.e. the examples in Table 1) may require slightly different performance measures as well. The analyst should ensure that the measures are appropriate for the individual improvements being implemented. The measures listed are not the only possibilities, but are those typically used. The individual researcher should use this as a guide.

Most post-implementation evaluation methodologies would involve a "before-and-after" framework. The complexity of evaluation varies dramatically by strategy type. Strategies such as incident management and traveler information produce changes that are very difficult to trace in the field. Others are very straightforward and can be relatively inexpensive. Several sources provide additional information on study methodology. One of the most comprehensive is the "Manual of Traffic Engineering Studies," published by the Institute of Transportation Engineers. The Manual provides guidance on how to collect data for a wide range of study types.

6.2.2 Evaluation Principles

For those determining that an evaluation is needed, there are a number of principles to keep in mind to help make the evaluation successful:

- We learn from failures as well as the successes. Lessons learned in the failures should be documented so that the same mistakes are not made again.
- There are many factors that can cause problems in obtaining a valid evaluation. These include influences other than the implemented project (e.g. construction on nearby roadways), improperly designed data collection methods (e.g. poorly worded survey questions), inadequately trained data collection staff, insufficient sample sizes, or analysis errors. Pretesting some methods, especially surveys, can help avoid some of these errors.
- Check the reasonableness of data, from newly acquired field data to the results of the analysis itself.
- Plan far enough in advance, especially for the "before" period. The timing of data collection is important, and proper planning helps to preserve flexibility to select time periods that are least subject to outside influences.
- Collect data that are as directly tied to the underlying change as possible. For example, for a TDM program at a site, a survey of mode choice is probably the best instrument to identify whether transit use and ridesharing has increased as a result of the TDM program. Traffic counts and parking counts may not give an accurate answer, because employment may have increased or decreased at

the site between the before and after period. Traffic counts may only reflect the employment change, not the influence of the TDM program.

The study results need to be documented. In effectiveness evaluation reports, easily read summaries can be provided for a broader audience, with any backup technical details in an appendix or separate document. It is useful to keep a file of evaluation reports (including those from other areas of the country) so that they can be referenced when someone is contemplating the implementation a project of the same nature. This will ensure that the investment in evaluation will pay dividends for future planning.

6.2.3 Designing a Monitoring Program to Assist in Strategy Evaluation

As indicated earlier, the monitoring program can supply some of the data for effectiveness evaluation. For example, a traffic surveillance system can provide a wealth of information rather inexpensively, particularly in cases where multiple days of data are needed. Other examples also exist at a smaller scale:

- A device can be provided in a traffic signal controller cabinet to capture count data from loop detectors. This device could be required for signals near development projects as part of a monitoring/evaluation program for the development. This not only can be a part of ongoing traffic monitoring but can be used for special evaluation purposes (e.g. if a flex-time program were instituted in the development).

- Periodic vehicle occupancy counts can be taken on major roadways feeding activity centers. This would provide an ongoing basis for evaluating area-wide strategies that sought to increase transit and ridesharing mode shares.

- Counting locations can be established at strategic locations on freeways and their parallel arterials, allowing for diversion effects to be captured more easily than if the freeway and arterial sampling locations were not planned together.

The main point is that strategy evaluation should be a consideration in designing an ongoing monitoring program. This may permit evaluations to be conducted inexpensively, when evaluation may not have been possible otherwise.

Table 7
Effectiveness Evaluation Measures and Methods

STRATEGY		Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
TDM Measures				
1	Ridesharing Programs	Number of carpoolers/mode share (region, site) Number of new carpoolers placed by program AVO (region, site) Number of vehicle trips (site) Park-and-ride lot utilization	Work place surveys of mode choice Regional travel survey Parking counts at park-and-ride lots	Work place surveys are relatively inexpensive. Regional travel surveys are performed periodically and may provide program evaluation data.
2	ShareCarGo[tm] Car Sharing Program	Vehicle trips/VMT Person trips Mode share	Surveys of program participants Ridership counts for routes serving program areas	Surveys provide the most direct measurement of changes.
3	Alternative Work Arrangements	Vehicle trips (site) Person trips (site) Number of people working at home % of trips in peak hour	Work place surveys Traffic counts at site Employer records of telecommuting	Surveys are the most direct measurement technique. Traffic counts can quantify extent to which peak is spreading.
4	Transit/Carpool Incentives	Mode share/transit or carpool use (site) Number of trips being subsidized Number of vehicle trips (site)	Work place surveys Vehicle occupancy counts Employer records of subsidies	Records of subsidies provide relatively easy methods to determine approximate effect. However, one must ensure that subsidies are being used as intended.
5	Parking Management	Mode choice (area, site) Number of parking spaces used Number of vehicle trips (site)	Work place surveys Vehicle occupancy counts Parking facility counts	Surveys are the most direct measurement technique. Caution should be exercised on parking counts. Parkers may have merely moved to alternative facility.
6	Guaranteed Ride Home Programs	Mode share/transit or carpool use (site) Number of rides provided Number of vehicle trips (site)	Employer records on rides given Work place surveys	Effect is potentially much more significant than number of rides given. Surveys provide best data, but associating with GRH program may be difficult.
Traffic Operational Improvements				
7	Traffic Signal Improvements	Vehicle delay (intersection, segment) Average travel speed (arterial segment) Number of stops Accident rate (intersection)	Intersection delay study Moving car runs Accident rate analysis	Automated travel time equipment provides more cost-effective evaluation method to tabulate speed changes.
8	Roadway Geometric Improvements	Intersection level of service Vehicle delay (intersection, segment) Average travel speed (arterial segment) Number of accidents/accident rate	Level of service analysis Intersection delay study Moving car runs Accident rate analysis	Delay (intersection) and speed (arterial) are best measures of actual effect. Traffic volume should be measured to gauge diversion effect (i.e. more vehicles taking advantage of improved operation)

Table 7 (continued)
Effectiveness Evaluation Measures and Methods

	STRATEGY	Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
9	Time-of-Day Restrictions	Average travel speed (arterial segment) Travel time (arterial segment) Traffic volumes (especially trucks/turns and on "unrestricted" facilities) Number of accidents/accident rate		Noticeable changes in traffic patterns may occur for restrictions affecting significant volumes of traffic. Left turn restrictions may significantly improve speed.
10	Ramp Metering	Freeway and arterial speeds Freeway and arterial volumes Ramp queue lengths and delays Freeway mainline/ramp accidents	Surveillance system data collection Traffic counts Moving car runs	Expressway surveillance systems can be used to gather data, but may not be available prior to turning metering on. This is a difficult strategy to evaluate.
11	Commercial Vehicle Improvements	Truck travel time/speed (segment) Accident rates (segment)	Truck travel time monitoring Truck tracking devices (e.g. GPS) Truck accident tabulations	A wealth of data may be available from trucking companies, but most would be reluctant to release such information. Evaluations would need to be targeted to the specific improvements made.
12	Construction Management	Travel time/Speed (segment) Delay (segment) Accident rates (site) Duration of queues (site)	Moving car runs Monitoring of diversion of trips to other modes, routes or time periods through counts and surveys.	For the most part, adjustments are made at construction sites to deal with traffic congestion problems. An evaluation of a total construction management program may be helpful in some cases (e.g. experience with TDM measures, diversion, etc.)
HOV Measures				
13	HOV Priority Systems	HOV use/volumes (facility, link) HOV travel time/speed (facility) AVO (link) Person throughput (link) Park-and-ride lot utilization	Volume counts by vehicle class Moving car runs on HOV lanes and regular lanes Transit travel time tracking Vehicle occupancy counts	Conducting a comprehensive evaluation of HOV priority systems is very difficult. Existing HOVs may have been attracted from other routes or time periods. Usually a survey on mode shift is needed in addition to counts.
14	HOV Support Services	HOV use (facility, link) AVO (region, corridor) Park-and-ride lot utilization	Parking counts at park-and-ride facilities Counts of transit riders or carpoolers Surveys tracking mode shift	Usage of a carpool/park-and-ride facility does not mean that these are new riders. A full evaluation would need to track (e.g. through a survey) how many shifted from other modes.

Table 7 (continued)
Effectiveness Evaluation Measures and Methods

	STRATEGY	Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
Transit Capital Improvements				
15	Exclusive Right-of-Way Facilities	Transit travel time (corridor) Transit ridership (corridor)	Ridership counts Mode shift/rider satisfaction surveys.	On-going monitoring programs normally provide ridership information on a regular basis.
16	Fleet Improvements	Transit ridership (corridor, area, region) Maintenance costs (system) Breakdowns (system) On-time arrivals	Ridership counts Maintenance records Schedule adherence monitoring	Some of this information is collected routinely. Route-based ridership and schedule adherence may require extra effort or can be monitored periodically.
17	Transit Support Facilities	Transit ridership (services connecting to facility) Facility usage	Counts of facility usage Mode shift/rider satisfaction surveys	These facilities may help to boost ridership, but it is often difficult to make the connection between the facility and a change in ridership.
Transit Operational Improvements				
18	Transit Service Improvements	Transit ridership (route, corridor, area, region) Peak load factor Cost/passenger (route, area, region) Mode share/shift (area) % population/employment served (area, region) Transfer time Station delay/wait time Travel time	Ridership counts Mode shift/rider satisfaction surveys Bus travel time monitoring Surveys of transfer time	Special studies can be targeted toward specific routes that have undergone the most change. To detect changes in ridership, monitoring would typically need to occur over a period of time (e.g. one month before and one month after)
19	Transit Marketing/ Information	Transit ridership (region) Mode share (region)	Ridership counts Mode shift/rider satisfaction surveys	Surveys should include questions regarding the knowledge of the system. Surveys should include the general public, not just existing transit riders.
20	Fare Incentives	Transit ridership (service area, region) Revenue (system) Mode share (region)	Ridership counts Mode shift surveys	Regular ridership monitoring may capture system-wide changes. Special studies may be needed to target particular groups.
21	Traffic Operations for Transit	Transit travel times (segment or facility) Transit ridership (route, corridor) Schedule reliability (route) Roadway impacts - intersection LOS, vehicle delay, arterial speeds Mode share (region)	Ridership counts Mode shift/rider satisfaction surveys Bus travel time monitoring	Most of these changes would require special, route-specific data collection efforts. Signal priority would require not only bus-related travel time information, but also an assessment of impacts on other traffic.

Table 7 (continued)
Effectiveness Evaluation Measures and Methods

	STRATEGY	Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
Non-Motorized Modes				
22	Bike/Ped Infrastructure Improvements	Bike/ped volumes (link, site)	Bike/ped counts at representative locations	Taking counts is relatively simple. Gauging impact on congestion will be impractical, for the most part.
23	Bike/Ped Support Services	Usage of facilities Mode share (area, region, site)	Counts of facility usage Usage/customer satisfaction surveys	Usage of support services/facilities can often be easily counted, but recording is not usually done routinely.
Congestion Pricing				
24	Road User Fees	Vehicle trips LOS (intersection, segment) Mode share (corridor, area, region)	Traffic counts (peak and off-peak) Mode shift surveys	The changes induced by pricing mechanisms can be complex and difficult to track. A full evaluation would need to track diversions among modes, routes, and time periods.
25	Parking Fees	Parking utilization (area) Vehicle trips (area) Mode share (area)	Parking occupancy counts Work place surveys	Parking occupancy counts tell only a partial story (parking locations may have shifted). Surveys of mode choice in the work place are usually the most direct approach.
Growth Management				
26 ***27*** ***28*** ***29*** ***30*** ***31*** ***32***	Compact Development Redevelopment & Infill Location Efficient Mortgages Mixed Use Development Jobs/Housing Balance Transit-Oriented Development Corridor Land Use & Transportation Coordination	Person trips (region) Vehicle trips (region) Mode share (region) Average trip length/time (region) VMT/person trip (region)	Periodic origin-destination surveys Long term traffic volume trends	Because land use changes take a long time, the ability to evaluate such changes is limited. Many other factors also influence travel over that period.

Table 7 (continued)
Effectiveness Evaluation Measures and Methods

	STRATEGY	Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
Access Management				
33 ***34*** ***35***	Driveway Management Median Management Frontage Roads	Travel speed - arterial level of service Accident rates Miles/intersection with access control Side-street delay Effects on business	Traffic counts Moving car runs Accident tabulations	Businesses often fear a major impact from access restrictions. Data may be needed to support a finding that impacts were minimal. Most difficult part of traffic analysis is gauging effect on side street delay or ease of access.
Incident Management				
36 ***37*** ***38***	Incident Detection Incident Response Incident Clearance	Average duration of incident Average speed/vehicle delay Occurrence of secondary accidents Incident detection time Response time	Log of incident duration (e.g. from dispatcher records) Moving car runs Measurement of speeds and volumes from surveillance system	Evaluating an incident management program is extremely difficult. The most cost-effective approach usually involves tracking incident duration for a period of time before and after. Simulation may be needed to estimate delay reductions.
39	Incident Information/ Routing	Average speed/vehicle delay Amount/proportion of traffic diverted	Traffic volume counts on mainline, ramps, and arterials Moving car runs Speed and volume data from surveillance system	Field evaluation of traveler information and routing systems in response to incidents is very difficult. A before/after comparison is not usually practical. Documenting travel responses to information may be possible in some cases.
ITS				
40	Advanced Traffic Management Systems	Average speed (freeway and arterial segments) Intersection/arterial delay (for surface street systems) Number of stops (surface street systems)	Traffic counts Moving car runs Speed and volume data from surveillance system	Ability to access surveillance data before system control functions are operational is main determinant of whether data can be used from surveillance system. Calibration of system is critical.
41	Advanced Traveler Information Systems (ATIS)	Door-to-door trip time Traffic volume on segments used for diversion	Trip logs (e.g. by regular commuters) Traffic counts	Average trip time for specific origin-destination pairs and time periods is one of the only ways to document ATIS effect. Tracking volume effects is very difficult.

Table 7 (continued)
Effectiveness Evaluation Measures and Methods

	STRATEGY	Measures for Field Evaluation	Data Collection Methods	Comment on Methodology
42	Advanced Public Transportation Systems (APTS)	Transit ridership Mode share/vehicle trips On-time arrivals Transit transfer time	Ridership counts Transit travel time logging Mode shift surveys Rider response surveys	The methods employed for evaluation will depend on the type of APTS strategy. "After" data may be easily collected using the installed systems. Problem will usually be collecting "before" data. Surveys of riders can be used to gauge views on new APTS systems.
43	Commercial Vehicle Operations	Delay reductions (site) Administrative efficiency improvements	Number/percent of participating vehicles Delay studies at weigh stations, border crossings, etc. Analysis of labor requirements	Gauging the penetration of CVO systems into the overall fleet is an important evaluation component.
44	Advanced Vehicle Control Systems (AVCS)	Volume throughput Accident rates for equipped vs. non-equipped vehicles	Traffic counts in critical locations	It will be well into future before significant penetration of most these devices will occur
Capacity Expansion				
45 ***46***	Freeway Lanes Arterial Lanes	Traffic volume Level of service (V/C ratio, vehicle density) Travel speed Delay Mode shift Miles of congested roadway	Traffic counts on improved and parallel routes Moving car runs on improved and parallel routes Transit ridership and carpooling on route	Full evaluation should include evaluation of parallel routes, as well as impact on transit ridership.

Appendix A

ACRONYMS AND KEY TERMS

APTS	Advanced Public Transportation Systems
ATIS	Advanced Traveler Information Systems
ATMS	Advanced Traffic Management Systems
AVI	Automated Vehicle Identification System
AVL	Automated Vehicle Location System
AVO	Average Vehicle Occupancy
CATS	Chicago Area Transportation Study
CDOT	Chicago Department of Transportation
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CTA	Chicago Transit Authority
CVISN	Commercial Vehicle Information Systems and Networks
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GCM	Gary-Chicago-Milwaukee Corridor
GRH	Guaranteed Ride Home
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HOV	High Occupancy Vehicle
IDOT	Illinois Department of Transportation
ISTHA	Illinois State Toll Highway Authority
ITS	Intelligent Transportation Systems
LOS	Level-of-Service
NIPC	Northeastern Illinois Planning Commission
ROW	Right-of-Way
RTA	Regional Transportation Authority
RTP	Regional Transportation Plan
SCAT	Signal Coordination and Timing Program
SEDP	Strategic Early Deployment Plan for ITS
SRA	Strategic Regional Arterial(s)
SRT	Strategic Regional Transit
Surface Streets	All Roadways other than Expressways
TDM	Transportation Demand Management
TDR	Travel Demand Reduction
TSM	Traffic System Management
V/C Ratio	Volume-to-Capacity Ratio
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VPH	Vehicles Per Hour

Appendix B

DESCRIPTION OF ANALYSIS TOOLS/MODELS

Within Chapter 3 of this handbook, a number of transportation analysis models or software packages are identified. These tools can be used to assist in the evaluation, planning, design and operations of various transportation facilities and strategies. Most of the models identified are designed to simulate vehicular traffic operations and may used in conjunction with the evaluation of various strategies. These models, however, are often designed to simulate traffic operations for distinct transportation subnetworks such as:

- freeways,
- corridors including a freeway and major arterials,
- arterial networks,
- intersections, and
- rural highways.

Several more recent models, such as INTEGRATION and CORFLO, are able to simulate operations on a network-wide basis. Other tools identified in Chapter 3, such as the TDM Model, are designed to assist in the evaluation of a specific strategy or group of strategies.

Another important distinction between these models is how they model travel behavior. From a theoretical viewpoint, there are two types of traffic simulation models: macroscopic and microscopic simulation models.

- **Macroscopic models** are based on deterministic relationships developed through research on highway capacity and traffic flow. The simulation for a macroscopic model takes place on a section-by-section basis rather than tracking individual vehicles. The computer requirements to run macroscopic models are considerably less demanding than the requirements of microscopic models. Macroscopic models do not, however, have the ability to analyze improvements and designs in as much detail as microscopic models.

- **Microscopic models** simulate the movement of individual vehicles based on theories of car-following and lane-changing. Typically, vehicles enter a transportation network using a statistical distribution of arrivals (a stochastic process) and are tracked through the network on a second-by-second basis. Because microscopic models have large computer time and storage requirements, the network size and amount of time that can be reasonably simulated is usually limited.

This appendix includes a discussion of ten transportation analysis models, including two (CORFLO and CORSIM) that are actually a family of submodels. Table B-1 summarizes operating environments for each of these models. Following this table, a general description of each model is provided, as well as the contact point from which the necessary software or additional information may be obtained. **It should be noted this represents only a sampling of the transportation analysis models or software packages that are currently available**.

Table B-1

Operating Environments For Simulation Models

Model		Type	Application Capability					
			Freeway	**Corridor**	**Arterial Network**	**Intersection**	**Rural Highway**	**Areawide/ TDM**
1	HCS	M	X			X	X	
2	TRANSYT-7F	M			X			
3	PASSER	M			X	X		
4	SYNCHRO	M			X	X		
5	FREQ	M	X	P				
6	CORFLO	M	X	X	X			
	FREFLO	M	X					
	NETFLO1	M		X	X			
	NETFLO2	M		X	X			
7	CORSIM	m	X	X	X			
	FRESIM	m	X					
	NETSIM	m			X			
8	INTEGRATION	m	X	X	X			
9	TDM Model	M						X
10	QUEWZ	M	X					
11	DELAY	M	X					

Model Type:
M: Macroscopic Model
m: Microscopic Model

Application Capability:
X: Existing
P: Partially Existing

1. HIGHWAY CAPACITY SOFTWARE (HCS)

HCS is the software implementation of the procedures in the 1994 update of the Highway Capacity Manual (HCM). The software automates the procedures in the HCM, and was prepared under FHWA sponsorship. HCS contains independent modules that correspond to chapters in the HCM:

- Basic Freeway Segments (Chapter 3),
- Ramps and Ramp Junctions (Chapter 5),
- Signalized Intersections (Chapter 9),
- Unsignalized Intersections (Chapter 10), and
- Urban and Suburban Arterials (Chapter 11).

Input and output vary depending on the specific modules, but are consistent with the data in the HCM. Like the HCM, the HCS is focused on providing capacity and level-of-service estimates. Typical inputs are traffic volume and geometric information. The program runs on an IBM-compatible PC.

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2. TRANSYT-7F

TRANSYT-7F is a macroscopic model that simulates traffic flow in a signalized surface street network, optimizes signal timing parameters, and evaluates the effectiveness of new signal timing plans in reducing stops, delays and fuel consumption. It considers platoons of vehicles rather than individual vehicles and simulates traffic flow in small time increments. Its representation of traffic is therefore more detailed than other macroscopic models that assume uniform distributions within the traffic platoons. TRANSYT-7F runs on an IBM-compatible PC.

TRANSYT-7F requires a considerable amount of data. Inputs include network data, signal timing parameters, geometric and traffic data including link lengths, saturation flows, average cruise speeds, bus stop delay for buses and traffic volumes, and control data and parameters. TRANSYT-7F offers a number of different outputs including tables, plots, and reports. These outputs include a table of all Measures of Effectiveness (MOEs), a table of controller timing settings, stopline flow profile plots (arrival and discharge flow rate profiles), space-time diagrams, cycle length evaluation summary and a route summary report. TRANSYT is also capable of several special outputs which can be used by several available post-processor programs. The post-processor programs are capable of creating platoon progression diagrams and graphic display files.

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3. PASSER

PASSER includes a family of programs for use in analyzing signalized intersections. Available models include:

- PASSER II - this program may be used for the analysis of isolated signal timing or optimizing arterial progression. Features include signalized left turn treatment, existing timing evaluation, advanced highway capacity analysis, and fuel consumption estimation.
- PASSER III - this program is designed to analyze pretimed or traffic-responsive, fixed sequence signalized diamond interchanges. It is capable of analyzing complicated left turn signal treatments, and can calculate signal plans for interconnecting a series of interchanges along continuous frontage roads.
- PASSER IV - this is an advanced arterial street network signal timing optimization program. It can optimize signal timings for large multi-arterial networks.

All PASSER programs run on IBM-compatible computers.

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4. SYNCHRO

SYNCHRO is a Windows-based signal timing program. Its basic function is similar to the HCS: it provides quick signalized intersection capacity analysis based on the procedures in the 1994 HCM. SYNCHRO goes beyond the HCS in providing signal coordination and optimization features. The software can also handle complex timing plans, including full actuation, and is compatible with NEMA and 170-type controllers. Inputs include intersection geometrics, signal timing parameters, and traffic volumes. Analysis outputs include V/C ratios, LOS, queue lengths, stops, and fuel consumption. Graphical features include time-space diagrams (showing individual vehicle paths) and timing plans. The program can also create input files for TRANSYT, PASSER, and NETSIM; some use SYNCHRO as a front-end data input program for these programs. SYNCHRO operates on an IBM-compatible computer with Windows 3.1 or higher.

Contact: Trafficware
1442A Walnut St., #210
Berkeley, CA 94709
(800) 379-6247
synchro@trafficware.com, or http://www.trafficware.com

Also available through McTRANS Center - University of Florida

5. FREQ

FREQ is a macroscopic model for the analysis of freeway systems (straight-pipe directional freeways and freeway corridors). Analysis corridors may include the freeway and one parallel arterial. FREQ is best suited to corridor evaluations with the emphasis on computing the effectiveness portion of a cost/effectiveness analysis for various geometric alternatives, and evaluating traffic management and traffic control alternatives (such as incident management, ramp metering, mainline HOV lanes, and HOV bypass lanes at ramp meters). Recent enhancements to the program have included the functionality to model priority lane (HOV), priority entry controls (ramp metering), and modal and spatial response. FREQ can run on any IBM personal computer with a math co-processor. To accommodate microcomputer limitations, the model is separated into two sub-programs: priority lane (PL) and priority entry (PE) modules. A limitation of FREQ is that the current microcomputer version cannot analyze ramp metering and HOV lane scenarios simultaneously. A manual approach of sequential investigations between the PL and PE sides of the model is required. FREQ is the most widely used model for freeway analysis in the United States and has been applied in numerous foreign countries.

The model requires detailed input describing the freeway supply (number of lanes, ramp configurations, capacities, and speed/flow relationships) as well as demand data for each on- and off-ramp and mainline freeway start and end point. Output includes detailed tables and contour maps of traffic performance measures, both at the level of individual subsections and time intervals, and for aggregate data. MOEs include VMT, VHT, PMT, PHT, ramp-to-ramp travel time, emissions, noise, and a variety of others. A typical FREQ timeslice report shows subsection number, number of lanes, length, traffic demand based on the O/D data, modified traffic volumes based on subsection capacity and unserved volume, freeway capacity, capacity reduction due to weaving, queue length in feet, storage rate (whether a queue is growing or dissipating), v/c ratio, average speed, fuel consumption and emissions.

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6. CORFLO (FREFLO/NETFLO1/NETFLO2)

CORFLO is a family of surface street and freeway macroscopic submodels designed for integrated urban network or corridor analysis. CORFLO is the macroscopic component of the FHWA TRAF model system that also includes the FRESIM, NETSIM, and CORSIM microscopic simulation models. CORFLO can be used to evaluate freeway and surface streets design and control modifications, impacts of incidents, and diversion policies. CORFLO consists of the following four submodels:

- FREFLO is a macroscopic freeway simulation model. The model can handle different vehicle classes (buses, carpools), HOV facilities, and incidents on the freeway, but it cannot model ramp operations.
- NETFLO1 is a microscopic event scanning simulator (a simplification of the NETSIM model) for surface street networks.
- NETFLO2 is a simulation adaptation of the TRANSYT-7F signal timing optimization program. Unlike TRANSYT, however, it can simulate signals with different cycle lengths and queue spillbacks.

- TRAFFIC is a highway assignment program with user and system equilibrium capabilities.

Each CORFLO submodel can be run independently or be applied to a specific subnetwork that is a part of a larger network. The interface of adjoining subnetworks is accomplished by defining "Interface Nodes", which represent points at which vehicles leave one subnetwork and enter another. Most of the reported applications involved the use of FREFLO model for evaluating freeway operations. CORFLO runs on either an IBM mainframe system or on IBM-compatible microcomputers.

The input data required by CORFLO includes subnetwork-specific data (link capacity, geometric configurations, lane channelization of uses, sign/signal control, roadway blockages, traffic volumes, traffic composition, turning percentages, etc.), and global network data (O/D trip table, traffic assignment parameters, and bus operations data). Outputs from CORFLO vary according to the module being run. FREFLO reports congested speeds, densities, volumes, and delays on freeway sections for both the end of each time slice as well as a cumulative total for the relevant measures-of-effectiveness (MOEs). Derivative MOEs include VMT, VHT and other measures. NETFLO 1 and 2 generate volumes, speeds, travel times, delays, fuel consumption, and emissions rates. These MOEs can be obtained at the network-wide, link-specific, and movement-specific levels.

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7. CORSIM (FRESIM/NETSIM)

CORSIM is a family of microscopic models designed for the simulation of freeway and urban arterial traffic operations. The sub-model components of CORSIM are:

- FRESIM - a microscopic freeway simulation model designed to simulate freeway and ramp traffic. The FRESIM model is an enhancement of the INTRAS model and includes improvements to the geometric and operational capabilities. Enhancements were made to portions of the logic dealing with lane-changing behavior, freeway incidents, traffic composition and other variables.
- NETSIM - a microscopic surface street simulation model designed to simulate traffic on signalized arterials and closed networks. NETSIM is suitable for urban networks requiring detailed intersection analysis, and for which detailed input data or ample resources for data collection are available. NETSIM can be used to optimize signal timing, and to evaluate the impacts of converting a street to one-way, adding lanes or turn pockets, moving the location of a bus stop or installing a new signal. One strength of NETSIM is that it can incorporate vehicle pre-emption. NETSIM can also generate congestion (queues and delay) resulting from a user-specified incident (time duration and capacity reduction).

Similar to CORFLO, the CORSIM submodels can be run independently or as part of an integrated system. The interface of the freeway and surface streets subnetworks is handled through interface nodes. Within earlier versions of CORSIM, the freeway/urban street system was modeled as composite rather than integrated networks. A recent enhancement of the program (TSIS/CORSIM) was developed to provide an integrated, user-friendly, graphical user interface and environment for executing CORSIM. CORSIM and its component sub-models run on an IBM-compatible computer.

Both FRESIM and NETSIM are extremely data intensive. Required inputs include detailed network physical, operational and volume data, as well as topology and motorist behavior. FRESIM produces a variety of outputs including link statistics, freeway station headways and speeds, cumulative values of fuel consumption and emissions, and surveillance detector data. NETSIM outputs estimates of several measures of effectiveness, including average vehicle speed, vehicle stops, vehicle-miles of travel, average queue length, and fuel consumption.

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8. INTEGRATION

INTEGRATION is a microscopic network simulation model for combined freeway and arterial simulation. The model is fully microscopic, simulating the movements of individual vehicles based on car-following and gap acceptance logic. INTEGRATION dynamically assigns (and re-assigns en-route) vehicles in view of any traffic congestion or control strategies (e.g., ramp metering) that occur during the course of a simulation run. The model considers the impacts of dynamic diversion on arterials and freeways, and can introduce both dynamic traffic control (i.e., real-time changes in signal timing) and ramp metering optimization as travel patterns change. The current version of the model is release 2, and runs on any IBM personal computer with a math co-processor, although a 486 or Pentium processor is recommended.

INTEGRATION requires detailed input describing the network supply side (number of lanes, ramp configurations, capacities, and speed/flow relationships) and control data (signal phasing and timing). Demand data are specified in INTEGRATION as a series of origin-destination (O-D) tables for each time interval of the simulation. These O-D tables can be created by the user, or can be synthesized with an accompanying program called QUEENSOD. Output of INTEGRATION includes a set of tabular files that provide detailed information on vehicle and traffic flow characteristics for user-specified time intervals in the simulation run. During the run, INTEGRATION also provides an on-screen animated graphical output of current traffic conditions. Users can select individual links or vehicles to dynamically assess traffic performance. The model provides detailed output statistics on travel time, distance, number of stops, queue lengths, fuel consumption, and emissions.

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9. FHWA TDM MODEL

The TDM Model is an analytical tool that supports the design and quantitative evaluation of TDM programs. The purpose of the TDM Model is to provide information on the probable impact of various TDM strategies. It allows the user to review a wide range of TDM actions, alone or in combination as realistic programs. The TDM Model is capable of analyzing employer-based (e.g. vanpool support, alternative work schedules, incentives) and areawide or government-based (e.g. regulatory requirements, transit service improvements) strategies. The model was designed primarily for application at an areawide level. The TDM model operates on an IBM-compatible computer.

The TDM Model consists of a system of spreadsheets where the user enters different assumptions about the types of TDM strategies to be implemented. These strategies are then related to a system of travel demand forecasting procedures which estimate their impact on existing travel conditions. Typical outputs include expected changes in mode split, vehicle occupancy, VMT and number of trips.

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Note: This model is currently being used by CATS. Contact CATS Transportation Management Division Director, at (312) 793-5554, for further information.

10. QUEWZ

QUEWZ is designed to evaluate freeway work zones, although it can be used for other highway types. Single direction closure and crossover are two methods used to analyze work zones. The cost calculations include estimation of vehicle capacity through work zones, calculation of average speeds, calculation of delay through lane closure section, calculation of queue delay, cost of speed change cycles, change in vehicle running costs and total user cost.

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11. DELAY

DELAY is a simple spreadsheet program that estimates delay time and queue length in response to incidents occurring on urban freeways. The formulas developed for the spreadsheet were originally derived from the FHWA research project "Alternative Surveillance Concepts and Methods of Freeway Incident Management." The user must input the number of freeway lanes, the number of lanes blocked by the incident, the traffic demand volume, and the duration of the incident. Additional inputs can be provided on a change in volume and a change in the number of lanes blocked (e.g. when an incident is moved to the shoulder). The spreadsheet provides the user with an estimate of vehicle hours of delay, maximum length of queue, and the time at which the queue dissipates. The program assumes only "pipeline" flow. It assumes no exit or entry ramps. More complete analyses of incident delays would require a freeway simulation model. As of early 1998, the DELAY analysis model is in the process of being updated by FHWA.

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