MANAGED LANES: A POTENTIAL SOLUTION TO ROADWAY CONGESTION

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ABSTRACT

Urban roadway congestion in cities across the world is increasing and roadway capacity and expansion are not keeping pace. It is the classic case of supply and demand. If revenue to build additional capacity existed, other factors make building new highways difficult. Many agencies are exploring other options to better manage the flow of traffic. In America, a few states have implemented and many states are studying the concept of managed lanes.

The definition of managed lanes varies but there are common elements. The lanes have a high degree of operational flexibility, and the management strategies can be categorized into three groups: pricing, vehicle eligibility and access control.

This paper examines aspects of each of the operating strategies. Successful practices are documented and gaps in knowledge are identified. The case studies examine the planning and coordination of operating managed lanes projects; how particular operating strategies were analyzed and selected; and how agencies plan for active management of the facilities.

Lastly, the paper highlights emerging issues related to managed lanes projects. The issues include performance measures, institutional arrangements, forecasting methodology, enforcement, driver information and signing.

1. INTRODUCTION

Urban roadway congestion in cities across the world is increasing at a staggering rate. At the same time, roadway capacity expansion is failing dismally at keeping pace. It is the classic case of supply and demand. Americans are driving more now than ever before. Vehicle travel has increased more than 70 percent in the past 20 years while highway capacity has increased only 0.3 percent each year for the last decade [1]. Even if sources of revenue to build additional capacity existed, other factors such as right-of-way limitations, environmental obstacles and social objections make building new highways difficult. Many agencies are exploring other operational options to better manage the flow of traffic on existing facilities. In many parts of the world agencies have implemented a cordon type toll system or instituted a congestion charge for entering the most congested areas of downtown. In the United States, a few states have implemented and many states are studying the concept of managed lanes.

2. DEFINING MANAGED LANES

The term "managed lanes" has different meanings to difference agencies but there are common elements. The concept is typically a set of lanes operating within a freeway cross-section. The lanes have a high degree of operational flexibility and management strategies that can be categorized into three groups: pricing, vehicle eligibility and access control. In some agencies the managed lane concept is commonly thought of as high-occupancy toll (HOT) lanes. In other agencies a broader definition is customary, one in which a variety of management tools and techniques are combined in order to improve freeway efficiency and meet certain corridor and community objectives. This broader definition includes high-occupancy vehicle (HOV) lanes, value priced lanes (including HOT lanes), and exclusive or special use lanes such as express lanes, bus-only lanes or truck-only lanes. Figure 1 is a diagram that captures the potential lane management applications that fall into this broad definition of managed lanes [2].

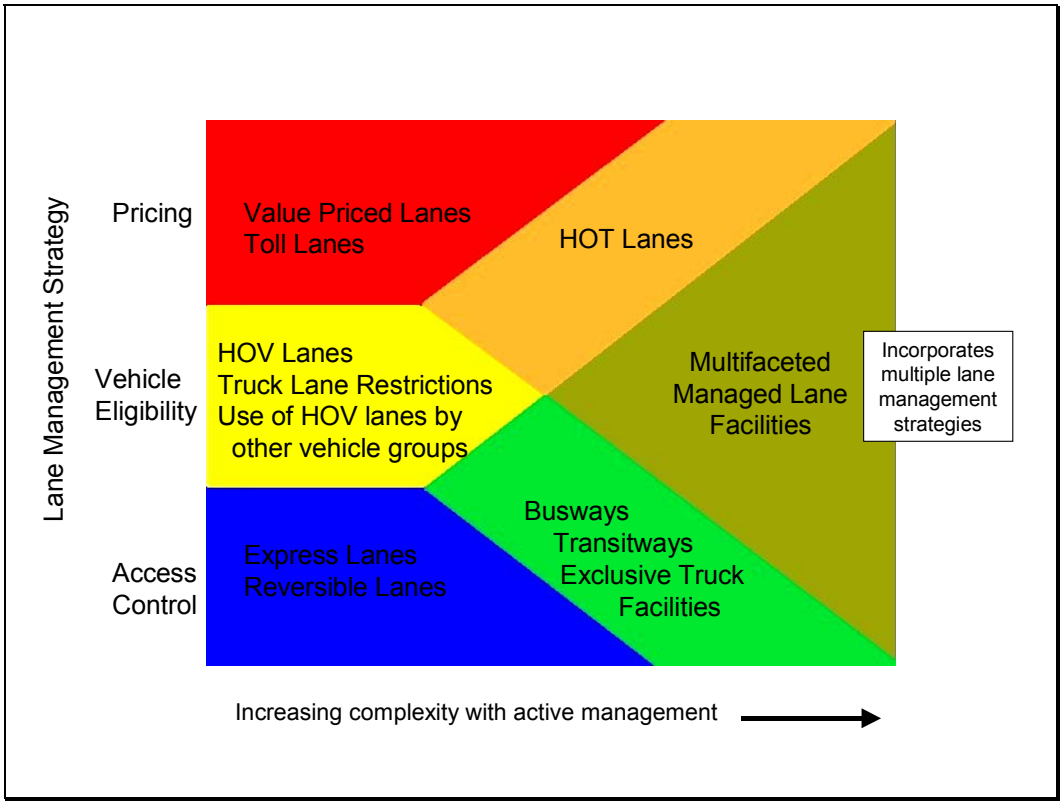

Figure 1. Lane Management Strategy Complexity.

On the left of the diagram are the applications of a single operational strategy – pricing, vehicle eligibility, or access control - and on the right are the more complicated managed lane facilities that blend more than one of these strategies. The multifaceted facilities on the far right of the diagram are those that incorporate or blend multiple lane management strategies.

The common themes among the different managed lane definitions in use today are as follows:

- The managed lane concept is typically a "freeway-within-a-freeway" facility, where a set of lanes within the freeway cross-section is physically separated from general purpose lanes;
- The facility incorporates a high degree of operational flexibility, so that over time operations can be actively managed to respond to growth and changing needs;

- The operation of the facility is managed using a combination of tools and techniques in order to continuously achieve an optimal condition, such as free-flow speeds;
- The principal management strategies can be categorized into three groups: pricing, vehicle eligibility, and access control.

3. PRICING STRATEGIES

Value pricing or congestion pricing, was introduced to United States transportation officials through a federal pilot program included as part of the Transportation Efficiency Act for the 21st Century (TEA-21). The pilot program allowed agencies to work with the Federal Highway Administration (FHWA) to employ road pricing strategies, including the idea of charging motorists a toll for travel during the most congested times or offering a discount for traveling in the off-peak. Value priced lanes use pricing as the primary mechanism to regulate demand.

The program ushered in the use of High-Occupancy Toll (HOT) lanes as an operational strategy. HOT lanes take advantage of available unused capacity in the HOV lane by allowing vehicles that do not meet the minimum occupancy requirement to pay a toll for access to the lane(s). The price may be set in a regular toll schedule, it may change by time of day or day of the week, or it may change dynamically in response to the current level of congestion. HOT lanes use both vehicle eligibility and pricing to regulate demand.

Table 1 illustrates the ways in which pricing can be used as a demand management strategy for managed lanes. The primary advantage of pricing over other forms of lane management is the demonstrated ability of variable tolling to actively manage demand. Variations in vehicle eligibility and access control as dynamic active management strategies have not been demonstrated in field application as pricing has.

Table 1. Pricing as a Lane Management Strategy.

PRICE Price refers to management that uses prices to regulate demand.	**HOT Lanes**	HOT lanes give access to vehicles that do not meet occupancy requirements by assessing a toll for these vehicles.	• SR 91, San Diego • I-15, San Diego • I-10 and US 290, Houston
	Variable Toll Lanes	Toll lanes may charge a toll that fluctuates depending on time of day, day of week or amount of congestion in an attempt to more effectively distribute traffic.	• New Jersey Turnpike • Port Authority of New Jersey and New York

4. HIGHLIGHTS OF CASE STUDIES

This chapter highlights several of the managed lane projects in operation around the country. The four selected case studies, which represent a geographical and operational cross section of managed lanes currently in practice, are:

- State Route 91 Express Lanes, Orange County, California
- Interstate 15 Express Lanes, San Diego, California
- Interstate 10 and US 290 HOT Lanes, Houston, Texas
- New Jersey Turnpike Dual-Dual Section, New Jersey

Each is unique in the operational strategy or combination of strategies that are used. The profiles of these projects, which were developed from published information and phone contacts, include five categories of questions that are integral in the success of the project. The five categories are:

- Concept Planning
- Project Planning and Design
- Operations
- Enforcement.

4.1. State Route 91

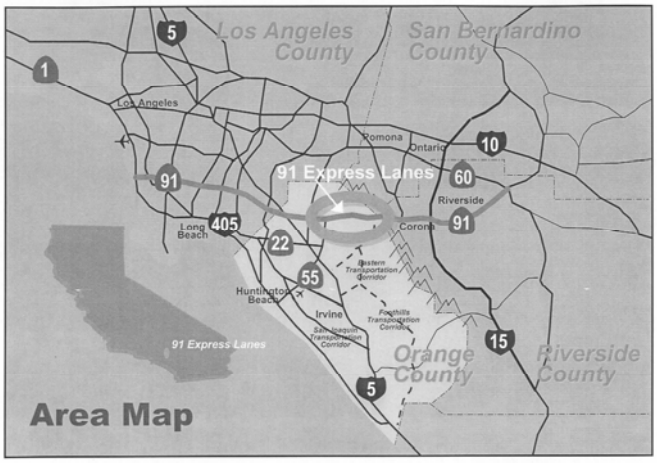

Figure 2. SR 91 Express Lanes Boundaries [3].

State Route 91 (SR 91) Express Lanes in California (Figure 2) was the first fully automated toll road in the world and the first toll road in the United States to vary tolls by the level of congestion on the roadway. The four-lane roadway, built within the median of SR 91, is 10 miles in length with no intermediate access. Two lanes are provided in each direction and they are separated from the mainlanes by plastic pylons and a painted buffer. The toll rates are set according to level of congestion typically experienced on the roadway, thereby making travel during the peak periods the most expensive time to travel. Although, the facility is open 24 hours a day, seven days a week and tolls are charged at all times, the operators use price in an attempt to shift vehicles out of the peak period.

Motorists that choose to use the lanes are notified of the current toll well in advance of the facility via dynamic message signs. The tolls are paid exclusively through electronic toll collection. Users of the facility must have an account and a transponder. The facility is also managed to encourage travel in high occupancy vehicles. Carpools with three or more occupants, motorcycles, zero-emission vehicles and vehicles with disabled person license plates are free at all times with the exception of the evening peak period in the peak direction, when HOVs are charged 50% of the posted toll. Again, price is used to encourage certain travel behaviors and conveyances.

The operators of the SR 91 Express Lanes have implemented a toll policy that is based on active management of the facility. The lanes are continuously monitored and this data is used the make adjustments to the tolls as necessary to keep the facility free-flowing. Hourly traffic volumes are monitored over a 12-week period. If vehicle volumes per hour, per direction approach levels where speeds become unstable or slow the tolls may be adjusted. The new toll rate will stay in effect for six months. If, after six months, it is determined that traffic volumes have fallen, creating excess capacity, the toll may be reduced. The operators of the facility are actively managing the lanes to optimize traffic flow.

4.2. Interstate 15, San Diego, California

The I-15 Express Lanes in San Diego, California, is an eight-mile, two-lane reversible facility that stretches between State Route 52 and State Route 56. Figure 3 depicts the Express lanes boundaries. The lanes are separated from the mainlanes by concrete barriers. Access is only available at the termini. The lanes originally operated as HOV lanes but often had unused capacity available. The lanes operate Monday through Friday from 5:45 – 11:00 am in the southbound direction and 1:00 – 7:00 pm in the northbound direction. In 1996 the HOV lanes were converted to HOT lanes, where SOVs are charged to use the facility and HOVs travel in the lanes free of charge.

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I-15 employs dynamic tolling, the first of its kind implemented. Toll rates typically vary from $ .50 to $ 4.00 but can rise as high as $ 8.00 during severely congested conditions. Technology deployed in the corridor allows for the assessment of current traffic conditions and the toll rate is adjusted dynamically to ensure free flow conditions in the express lanes. Dynamic message signs prior to the entrance of the facility alert drivers to the current toll. The drivers then have ample time to choose whether or not to enter the lanes and pay the toll. As with SR 91, all users must be registered and have an established FasTrak account. A FasTrak account allows tolls to be collected electronically. No manual or cash toll collection is accommodated. The average daily traffic on the Express lanes is between 15,000 and 18,000 vehicles.

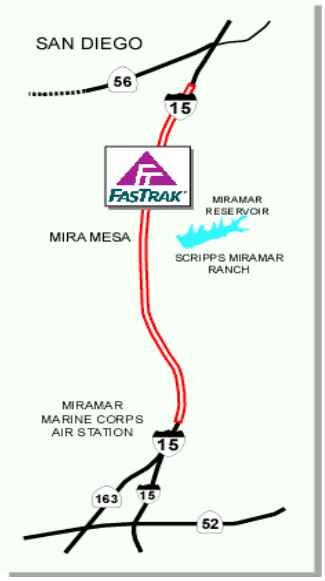


Figure 3. I-15 Express Lane Boundaries [4].

4.3. I-10 and US 290, Houston, Texas

A slightly different pricing project has been implemented on I-10, also known as the Katy Freeway, and US 290, known as the Northwest Freeway, in Houston, Texas. The program is marketed under the name QuickRide. QuickRide began operating on the Katy Freeway in January 1998 and was expanded to the Northwest Freeway in 2000. The project was implemented as part of the Value-Pricing Pilot Project Program. The facility essentially operates as a HOT lane although SOVs are not allowed on the facility.

4.3.1 I-10, Katy Freeway

The HOV lane on the Katy Freeway is a one-lane reversible facility separated from the mainlanes with a concrete barrier with access allowed at intermediate locations in addition to the termini. The lane is 13 miles long and provides access to downtown Houston and the Galleria area from suburban communities west of the city. The HOV lane operates Monday through Friday from 6:00-11:00am in the inbound direction and 2:00-8:00pm in the outbound direction. Since 1986 the HOV lane operates with a 3+ restriction during the peak periods which are from 6:45-8:00am and 5:00-6:00pm. The lane is also open from 5:00am – 8:00pm in the outbound direction on Saturdays and the same hours in the inbound direction on Sundays. There is a 2+ restriction on both these days. However, this 3+ restriction left unused capacity while allowing all HOV2s on the facility impeded operations. The Metropolitan Transit Authority of Harris County (METRO), working with the Texas Department of Transportation (TxDOT), and FHWA implemented tolling of HOV2s during the 3+ restriction to utilize the available capacity on the HOV lane.

4.3.2 US 290, Northwest Freeway

Many of the same issues were encountered on the Northwest Freeway as well. By the late 1990s congestion on this 13.5 single lane reversible facility had caused speeds to slow to 20-30MPH in the HOV lane. This was particularly bad in the AM peak period.

In early 2000 the occupancy requirement on the Northwest HOV was raised to 3+. This resulted in improved conditions on the facility but, as expected, additional capacity remained. Therefore, in November 2000 the QuickRide program was expanded to the Northwest HOV lane. The program is in effect during the 3+ restriction which is in the AM peak only from 6:45-8:00am.

The QuickRide program is operated much like the FasTrak program in California. HOV2s are required to establish an account and are issued a transponder. HOV2s that wish to travel on the facility during the 3+ restriction are charged $ 2.00 each way via their transponder. HOV 3+ carpools are not required to establish an account nor are they required to have a transponder. If motorists do have a transponder and are traveling in a 3+ carpool the transponder is inserted into a silver static bag to prevent it from being read and a toll assessed.

4.4. New Jersey Turnpike

The New Jersey Turnpike is a limited access facility that utilizes a variety of management techniques to optimize flow. The entire toll facility is 148 miles long and connects New York to Philadelphia. The entire turnpike is shown in Figure 4. In the 1970s a 32-mile segment of the roadway was expanded into two separate roadways. The objective of the dual-dual roadway was to improve operations and safety by separating heavy vehicles from light vehicles and to increase capacity in the most heavily traveled section of the Turnpike. It was also intended to provide greater flexibility for using the roadway during periods of heavy congestion such as a major incident, since changeable message signs technology could be applied to warn approaching drivers and divert them to the less-congested roadway.

The inside lanes of the dual-dual roadway are for automobiles only while the outer lanes accommodate all vehicles types. These lanes are separated from the outer lanes by concrete barriers. Each part of the roadway has its own entrance and exit ramps and there are periodic openings in each of the roadways to allow traffic to be diverted from one facility to the other as conditions may warrant. Between Interchanges 11 and 14, the left-most lane of the outer roadway is designated as a HOV lane between the hours of 6 a.m. and 9 a.m. in the northbound direction and between 4 p.m. and 7 p.m. in the southbound direction. The HOV lanes are reserved for cars and vans carrying three or more persons and to all buses and motorcycles. These lanes act as general-purpose lanes at times other than the peak and are open to all traffic at these times.

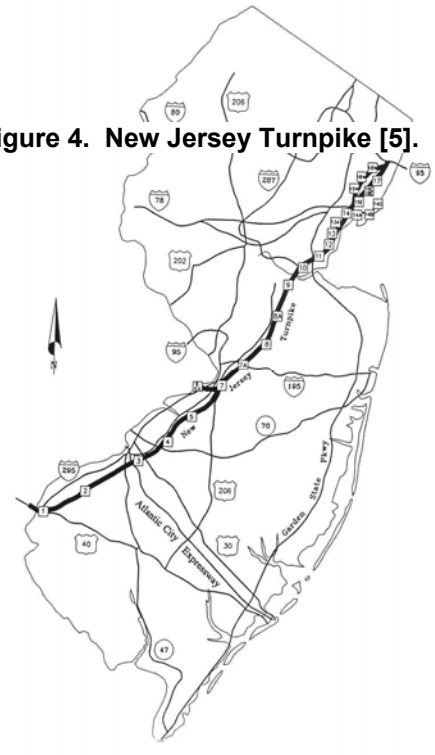


Figure 4. New Jersey Turnpike [5].

The Turnpike Authority has recently implemented a value pricing incentive to shift travel out of the peak. Customers using E-ZPass electronic toll collection, traveling in the off-peak hours (hours other than

7:00-9:00 a.m. and 4:30-6:30 p.m. Monday through Friday) receive a 20 percent discount off the toll rate.

This project differs from the others, foremost, in that the NJTP had adequate right-of-way to expand the facility and the financial ability to do so. The Northeast has a much longer history and familiarity with tolling than do other parts of the country. The corridor exists primarily to serve long distance trips. In fact, 35 percent of its toll revenue is derived from out-of-state motorists. The Authority continues to make improvements to the corridor that furthers the management capabilities of the facility. A recent interchange improvement provides travellers with direct access to a transit transfer station.

Table 2 depicts the case-study projects and the characteristics of the managed lanes.

Table 2. Characteristics of Operating Managed Lanes

Project	No. of lanes per direction	Project Objectives	Daily Corridor Volume*	Daily Managed Lanes Volume*	Percent Exempt Vehicles*	Revenue * (in millions, 2006)	Use of Revenue
91 Express Lanes	Two	• Fast, safe, reliable commute • Maintain financial viability of lanes	290,000	40,000	20%	$46	60% debt service 40% operations
I-15 FasTrak Express Lanes	Two (reversible)	• Better use of available capacity • Fund new transit service	170,000 – 295,000	15,000 – 18,000	76%	$1.3	55% operations 45% transit service
Houston Quickride	One (reversible)	• Better use of available capacity • Maintain bus operating speeds	210,000	9,200	98%	$0.11	100% operations
NJ Turnpike Dual-Dual Section	Six	• Separate large trucks • Provide flexible operations during heavy congestion	200,000	200,000	0%	$200**	45% debt service 45% operations 10% other

*Approximate value given for comparison purposes.
**2003 total revenue proportioned by vehicle miles travelled for the dual-dual section.

5. BEST PRACTICES IN MANAGED LANES

The managed lane projects in operation today use a combination of strategies and have common characteristics that led to their success. The best practices focus on three key areas: planning and project development, facility monitoring and evaluation and life-cycle considerations.

5.1. Project Planning and Development

5.1.1 Agency Collaboration

The successful projects have been the cooperative efforts of various agencies from the initial stages of project development throughout operations. These projects are large

undertakings that required the assistance of several agencies. They have frequently crossed jurisdictional boundaries. Planning for the managed lanes projects has required input from the federal agencies, the state department of transportation, the metropolitan planning organization and other local agencies.

None of the operating pricing projects highlighted in this paper were developed out of the long-range plan for the community, but rather they were largely opportunities to apply pricing strategies as pilot projects.

In addition to the traditional agency coordination, the success stories have shown that including as many potentially affected stakeholders as possible early in the process elevates your chances for success. Others to be included, based on project experiences, are:

- Transit agencies,
- Regional transportation authorities,
- Toll agencies,
- Law enforcement personnel,
- Court personnel,
- Environmental groups,
- Special interest groups, and
- Citizens.

Just as important as the cooperative efforts of agencies, are the institutional arrangements that define the scope and the operation of the project. The institutional arrangements surrounding the construction and subsequent operation of a managed lanes project will involve many entities that may not have previously worked together. Forging and fostering these relationships by clearly defining roles and responsibilities can forestall many issues as project development progresses.

5.1.2 Selecting a Managed Lane Strategy

An important factor in a successful project is the careful analysis of the design and desired operating characteristics of the facility. The lane management strategies may vary depending on (1) the objectives of the project, (2) whether the strategy is implemented on new capacity or an existing facility, (3) the availability of right-of-way, (4) current operational characteristics in the corridor, and (5) environmental and societal concerns.

The managed lane success stories have shown us that effective project development and planning results from a thorough understanding of the purpose of the project and the goals that may be achieved through project delivery. It requires an assessment of current conditions in the corridor and designing a facility that will operate in a manner that meets the needs of the community. Additionally, the facility incorporates the flexibility to alter those strategies as conditions in the corridor change or community goals change. On-going facility evaluation ensures that the facility functions at its peak performance under the chosen operating strategy. Successful projects employ operating strategies that can be adjusted as the facility matures and changes over time as the community's needs evolve.

5.1.3 Identifying a Hierarchy of Users

Determining a hierarchy of users is a common characteristic of operating managed lanes projects. Essentially this means that the operating agency has defined its higher priority users and lower priority users, with the lower priority users experiencing the impact of increased prices and /or restricted access as strategies are applied to manage demand.

For instance, each of the pricing projects in California and Texas has chosen to give preferential treatment to HOVs. On the I-15 Express lanes and on the QuickRide project very specific parameters have been established so as not to adversely impact the HOVs that travel on these facilities. The QuickRide program gives priority to transit vehicles and ensures that the operating speeds of buses are not compromised by the HOV2s allowed on the facility. The I-15 Express lanes' parameters have been defined by state law. Level of service requirements must be maintained for HOVs on the facility.

5.1.4 Establishing Threshold Values

Inherent in the premise of active management is the necessity for establishing threshold values for maintaining a prescribed level of operating service. That threshold value could be based on traffic volumes, operating speed, or similar measure. When the threshold value is exceeded it triggers an action to modify the lane management strategies - whether that be price or occupancy or both - in order to maintain operating objectives.

5.2. Facility Operations and Continual Monitoring

5.2.1 Project Flexibility

It is important to note that successful projects have the flexibility to alter operations as conditions warrant and priorities change. The two managed lanes facilities in California offer the flexibility of variable and/or dynamic tolling with the ability to adjust operations according to demand. As managed lanes projects are mainstreamed, planners and engineers will be exploring ways to include flexibility in the design of a facility, such as moveable barriers, larger design vehicles, and strengthened bridge structures to accommodate future rail in the corridor. By addressing flexibility as a design element the facility's life may be extended because operations on the facility can be changed as traffic conditions in the corridor change or as community objectives for the project change.

5.2.2 Monitoring and Evaluation

Under the principle of active management, the need for continual monitoring and evaluation of the managed lanes is imperative. At the outset of a project, specific performance measures and threshold values are defined and those measures are continually evaluated. For instance, I-15 established a performance measure of level of service (LOS) C and set that threshold at 1,525 vehicles per half hour. SR 91 Express lanes operators monitor volumes in the lanes and have raised tolls several times as a result of increased congestion on the facility in effort to maintain free flow condition and return a profit. In both cases, pricing is the strategy that is used to stimulate changes in demand.

Monitoring technology used successfully today include vehicle sensors, automatic vehicle identification, license plate recognition, and user information systems. Each of these components has been demonstrated in the case studies to be integral in ensuring effective operation of a facility. Likewise, more comprehensive, historical data can be collected and analyzed to determine if adjustments to the overall operating strategies should be made.

5.3. Life-Cycle Considerations

Given a flexible, actively-managed facility, what are the expectations of its performance and mobility contribution over the full life of the project? The notion of life-cycle operations takes agencies beyond the day-to-day adjustments in price to a thoughtful plan of facility changes triggered by pre-established performance measures. It goes beyond the policies and procedures necessary to establish pricing changes to more long-term modifications:

When should vehicle eligibility requirements be modified? How and when should access control, including ramp closures, metering, or exclusive use by specific vehicle groups, be used? Are the managed lanes envisioned to become a future rail corridor? And what are the performance thresholds that activate these changes? The challenge becomes communicating the long-term active management premise to policy-makers and the public. It will be important to find effective ways to continually communicate the possibility of change as the project matures over time. The Colorado Department of Transportation developed a graphic that illustrates a life-cycle operation for the managed lane facility on Interstate 25 [6]. The graphic, shown as Figure 5, also incorporates the established hierarchy of users.

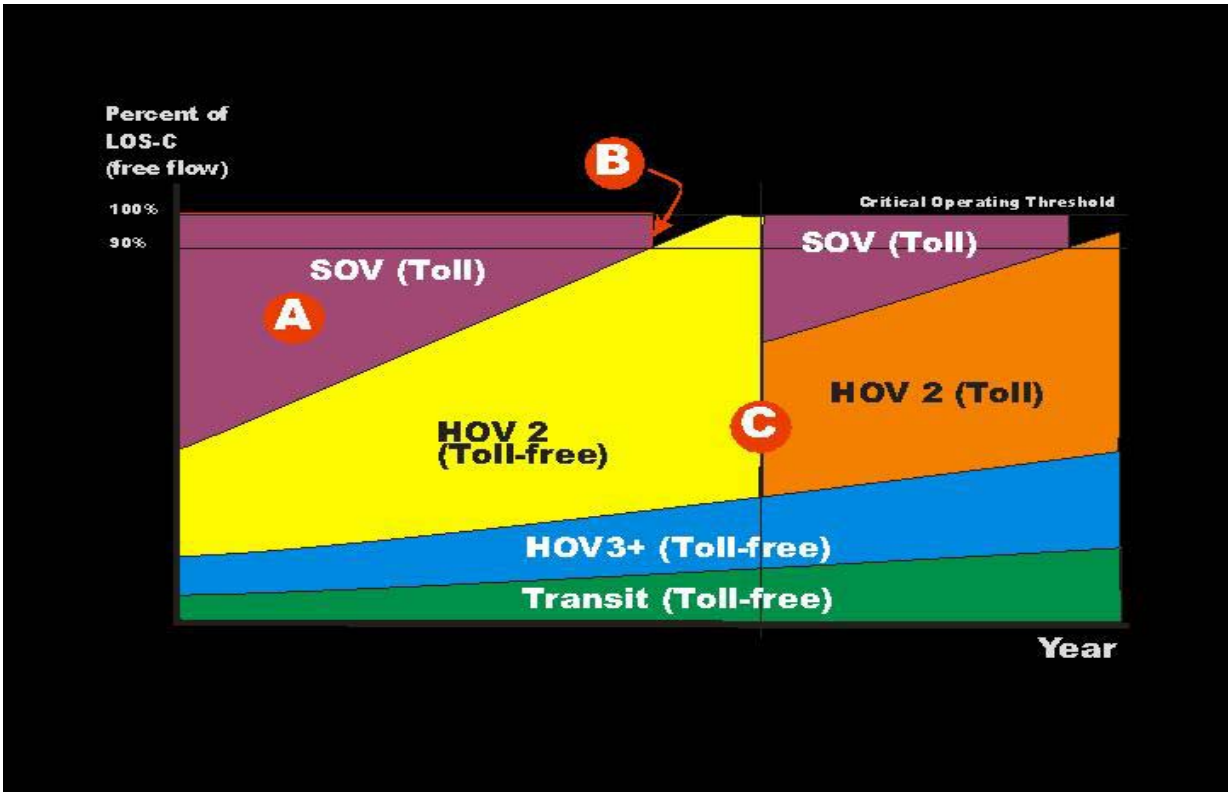


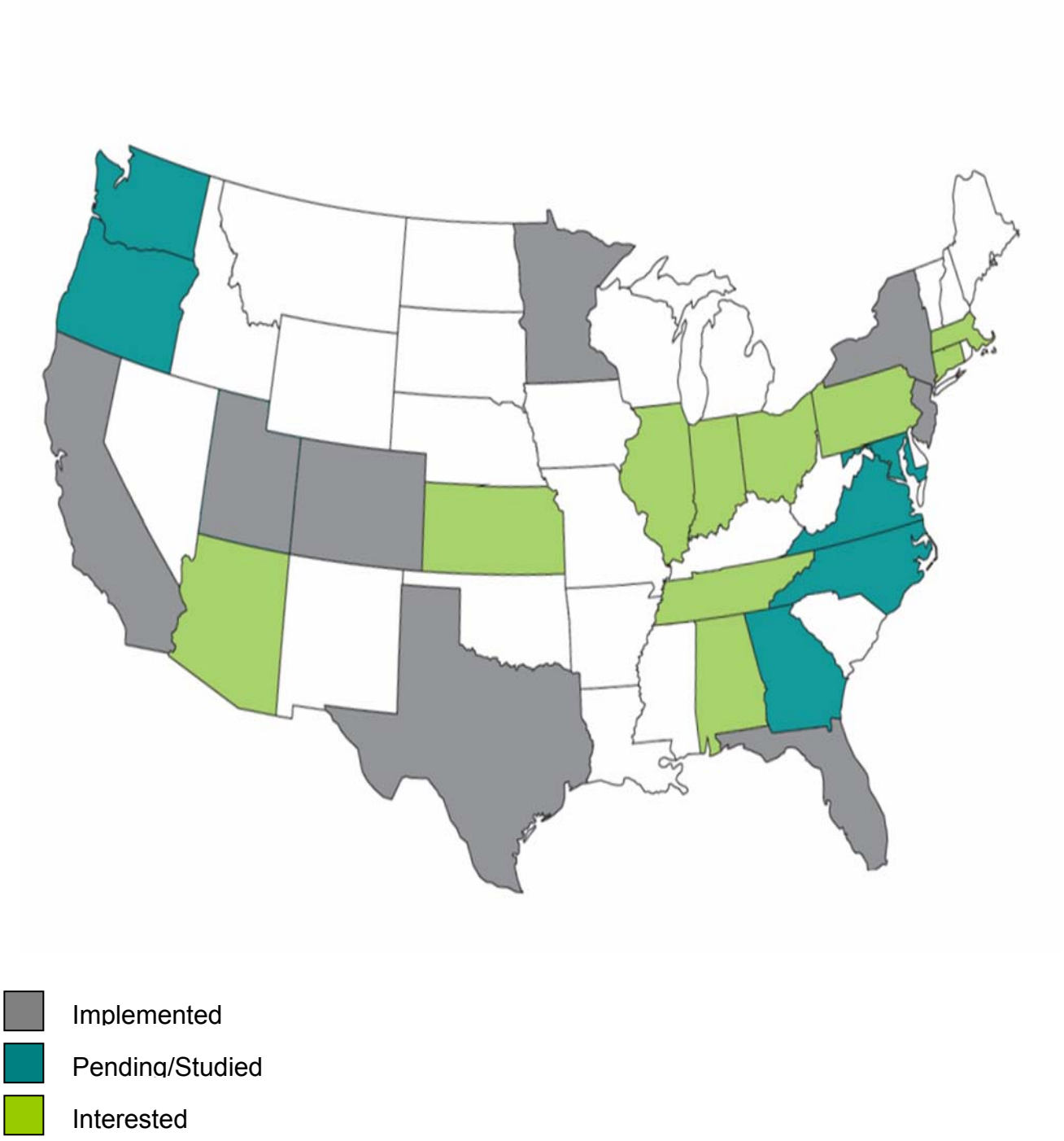
Figure 5. Life-Cycle of a Facility [6].

In this scenario, single-occupant vehicles (SOVs) are permitted access to the managed lane by paying the prevailing toll. Through the use of dynamic pricing, which varies the toll with the level of congestion on the manage lane, the number of SOVs who use the facility is never allowed to exceed the critical operating threshold.

6. FUTURE CHALLENGES

The managed lane projects in operation today are successful models for using multiple operating strategies to achieve intended objectives. However, these are "first generation" projects with relatively simple design and operating conditions. Figure 6 below illustrates the number of states that either have operating projects or are actively planning for managed lanes on state facilities. As the projects are implemented, transportation professionals are faced with more challenges. The early projects allowed planners and engineers to realize that the more flexible the system, the easier it is to manage demand. However they also recognize the challenges involved with designing for ultimate flexibility.

Considerations are being given to distance-based pricing, time-of-day pricing, varying occupancies with price, reversible lane operations and design of facilities with multiple intermediate access points.



6.1. Analysis Techniques and Demand Forecasting Models

Figure 6. States Considering Managed Lanes [7]

Traffic and revenue studies are conducted to satisfy investment requirements and bond indentures. However, these studies are often conducted after basic project parameters are defined. The need exists for a more comprehensive tool to address the impacts of managed lanes design, access and operational strategies on factors such as demand management, revenue generation, and air quality conformity. Development of these tools and techniques will allow agencies to incorporate managed lanes into the long-range planning process. Not only will this produce a more meaningful and useful long-range plan it will also enable planning personnel to analyze the connectivity of the managed lanes

facility with other types of systems such as HOV lanes, arterial streets, toll roads and free roads.

6.2. Enforcement

Stringent enforcement protects the integrity of the facility. The advancement of electronic toll collection technology has aided the use of pricing as a management tool; however, occupancy enforcement technology has not made as many significant advances. Moreover, when multiple operating strategies are employed on a facility, enforcement becomes increasingly complex.

Automated technologies are being explored and these new tools will aid in enforcing a facility. Technologies such as infrared occupancy detection, remote toll reading, and license plate capture are being tested and used in some instances but more evaluation is needed before there is widespread use. Furthermore, legislation is needed in several states to make automated enforcement legal.

A need exists for a synthesis of the current state-of-the-practice for determining vehicle occupancy. This information would allow for an assessment of the applicability of these systems to managed lanes that vary eligibility or cost to use the lane throughout the day based on conditions in the corridor.

Because automated technology is not sufficiently reliable or legal at this time, enforcement, especially for occupancy, is performed visually by law enforcement personnel. For this reason, ongoing training and education of personnel charged with enforcing a managed lanes facility and education within the court system on the effects of effective enforcement and the repercussions associated with non-enforcement, are both critical, on-going needs.

6.3. Performance Measures

Many agencies establish operating thresholds for HOV lanes. Currently there is no uniform standard for managed lanes operations and to a certain extent the thresholds will be based on the objectives of the project as well as design elements such as cross section, location of access points, and bottlenecks. However, a need exists to apply standards to managed lanes much like standards are applied to freeway operations. A review of existing measures of effectiveness can identify which are applicable to managed lanes. New measures can be developed as projects evolve. Moreover, by establishing performance measures the effectiveness of the facility in reducing roadway congestion can be quantitatively measured.

6.4. Driver Information and Signing

Currently operating managed lanes facilities employ a number of techniques to provide drivers with information. Dynamic message signs alert drivers to conditions on the roadway as well as current toll rates, enabling the driver to make an informed decision. Websites now contain published toll schedules and toll rate calculators to allow the driver to map his preferred route. Variable speed limits are also being used to communicate roadway conditions to drivers. Variable speed limits have been used successful to warn motorists of weather conditions and have shown promise in their usefulness in improving traffic flow. More research and testing is needed in the United States for the applicability of variable speed limits to operate in response to congestion.

Many lane management strategies are used in tandem with one another. This results in the need to deliver an array of information to the driver. Information must be conveyed in

a manner that is easy for the driver to read and understand, and with enough advance notification for the driver to make a decision, and safely maneuver to the desired location. The SR 91 Express lanes are the simplest plan operating. A changeable message sign indicates the current toll prior to the entrance to the facility. A driver may then use that information to choose whether or not to enter the lanes. The scenario is more complicated on the I-15 Express lanes where the tolls may change as often as every six minutes. The QuickRide program has a set toll rate but the occupancy requirements change relative to the time of day.

Research is needed to determine the most effective way for communicating information to the motorists while maintaining safe operations on the roadway. The projects currently being planned involve multiple agencies, a greater number of access points and a more varied group of users. Information that has to be communicated may include:

- Ingress and egress locations,
- Occupancy requirements,
- Operating hours,
- Toll amounts, and
- Operating agencies.

7. CONCLUSIONS

The managed lane concept seeks to address the issue of growing congestion. It is the evolution of traditional lane management strategies, with the primary difference being the idea of active management over the life of the facility. It is a way to address the issue of growing congestion in a proactive manner within the constraints of limited resources. Agencies are using a variety of management techniques to manage demand. As these techniques become more complex many new issues will need to be addressed. This document has provided information from operating projects around the country in an effort to increase awareness and understanding of the managed lane concept.

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