A3A06: Committee on High-Occupancy Vehicle Systems
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Integrating HOV to Enhance Operations of the Transportation System

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The old man yawned, stretched, rubbed his eyes, and looked around. Something was not right. He closed his eyes, rubbed them again, and took a second look at his surroundings.

He was still on a bus, but it was much different from the one he remembered boarding that morning. Why was it so close to the vehicle ahead, why was it traveling so fast, and why didn't any landmarks look familiar?

"Excuse me," he said to the woman sitting next to him, "My name is Rip Vanpool Winkle, could you please tell me if I am on Bus 54 to the Emerald City." Somewhat startled, she responded, "Why of course you are! You have been sleeping so soundly and snoring so loudly I was beginning to worry."

Sheepishly, Rip glanced at the newspaper she was reading. None of the headlines made sense to him. What was going on? He froze when he saw the date on the paper—April 1, 2020. Rip was confused. Could the stories about his Great-Great-Great Grandfather, Rip Van Winkle, and the family curse be true? Could he have fallen asleep for 20 years? With his Smart Card, paying the correct fare was no problem, so he knew he would not end up like his Great-Uncle Charlie who couldn't get off the MTA.

Maybe the woman could help with his predicament. He ventured another question, "The Emerald City and this corridor sure look different these days. Has the Wizard been up to something?"

"My, you are out of touch. How long have you been sleeping?" she responded. "Surely you remember the recommendations from the Yellow Brick Road Major Investment Study? They improved the HOV lane, changed to carrot-juice powered vehicles, and implemented an automatic vehicle following system."

"All that is news to me," Rip said. "I remember the old days when carrot juice was found in health stores. Let me tell you a little about those days."

And here is the story he told.

OVERVIEW OF HIGH-OCCUPANCY VEHICLE FACILITIES

Although differing in design and operation, high-occupancy vehicle (HOV) facilities share similar goals. In general, HOV facilities are intended to help address traffic congestion and mobility issues in major travel corridors by maximizing the person-carrying capacity of a roadway or corridor by providing priority treatment to high-occupancy vehicles. An HOV can include buses, vanpools, carpools, and other authorized vehicles. By encouraging greater use of these modes, HOV projects increase the *number of people*, rather than the *number of vehicles*, being carried on a freeway or roadway.

The primary concept behind these priority facilities is to provide HOVs with both savings in travel time and more predictable travel times. These two benefits serve as incentives for individuals to choose a higher-occupancy mode over driving alone. In many areas, support facilities, policies, and additional incentives have been used to further encourage individuals to change their commuting habits.

HOV facilities have commonly been used in corridors that are either at or near capacity and where the physical and financial feasibility of expanding a roadway is limited. By emphasizing *person movement* rather than *vehicle movement*, HOV lanes allow the overall transportation facility to operate more efficiently and they promote mobility choices for travelers. A variety of HOV applications have been in use for more than 30 years. Valuable lessons have been learned during this time about when and where these techniques contribute most to enhancing the operation of the transportation system.

HOV facilities come in all shapes and sizes, and no one approach fits all. In fact, one advantage of HOV facilities is the ability to tailor the technique, design, and operation to meet local needs and conditions. HOV facilities include busways in separate rights of way, lanes on freeways, and arterial street applications.

Busways are roadways designed, built, and operated exclusively for buses. Exclusive HOV projects on freeways are physically separated from the general-purpose lanes by a barrier. Freeway concurrent flow HOV lanes are separated from the adjacent lanes by either normal paint striping or a 2- to 4-foot buffer. A variety of direct access ramps and slip ramps are used with different projects. In addition, HOV bypass lanes at metered freeway entrance ramps and priority treatments for HOVs at toll plazas operate in some metropolitan areas. Bus malls, bus-only lanes, HOV lanes, priority treatments at signalized intersections, and queue bypass lanes represent the most common arterial street applications. Recent projects in San Diego and Houston have tested the use of value pricing, allowing lower-occupant or single-occupant vehicles to access the exclusive freeway HOV lanes for a fee.

HOV facilities can be operated to meet local needs, and a variety of approaches are currently in use. Some HOV facilities operate on a 24-hour basis, others are in effect for extended periods, and still others are open only during peak periods. The vehicle eligibility and vehicle-occupancy requirements also can be matched to local needs, and can be modified over time to respond to changing conditions. With the exception of busways and a few other projects, most HOV lanes are open to buses, vanpools, and carpools. Most facilities use a two person (2+) per vehicle carpool definition, but some require three person (3+) carpools.

Many early HOV lanes were implemented in response to specific issues and opportunities on a congested freeway or in a corridor. These stand-alone projects addressed the needs in these areas. More recently, the focus in many regions has been on developing

comprehensive HOV systems that encompass HOV lanes, access treatments, park-and-ride lots, transit services, and other supporting facilities and policies. Seattle, Southern California, Houston, and Northern Virginia/Washington, D.C., represent a few examples of areas taking a more comprehensive, system-wide approach.

EXPERIENCE WITH HOV FACILITIES

The first freeway HOV lane in the United States was opened as a bus-only lane on the Shirley Highway (I-395) in Washington, D.C./Northern Virginia in 1969. Other early examples of HOV lanes included the contraflow bus lane on I-495 on the approach to the Lincoln Tunnel in New York City and the San Bernardino Freeway (I-10) Busway in Los Angeles. Use of HOV lanes increased significantly in the 1980s and 1990s, and additional projects are being planned in many urban areas. Existing projects on freeways and in separate rights of way in some 26 North American metropolitan areas encompass approximately 2,000 centerline miles of HOV lanes. Many more arterial street applications are in operation. HOV facilities also are found throughout the world.

Although nationwide statistics show that carpool usage has declined significantly in recent years, trends are just the opposite in most corridors with HOV facilities. Experience in several cities indicates that HOV facilities are an effective tool to encourage commuters to change from driving alone to riding the bus, joining a vanpool, or forming a carpool.

Factors that appear to influence the use of HOV facilities include the type of project, the orientation, the nature and level of bus service, the presence of supporting facilities and programs, and congestion levels in the corridor. The presence of significant congestion in the general-purpose lanes or parallel highways is common with most successful projects. A majority of HOV freeway facilities carry more people than the adjacent general-purpose lanes. The following are a few examples of the current morning peak-hour vehicle and person volumes on HOV facilities:

- 725 buses carry 34,685 passengers on the I-495 contraflow lane approaching the Lincoln Tunnel in New York City.
- 1,543 vehicles, including 22 buses, carry 4,065 people (including 1,035 bus passengers) on the exclusive Northwest (U.S. 290) HOV lane in Houston.
- 1,233 vehicles, including 64 buses, carry 5,644 people (including 2,605 bus passengers) on the I-5 North concurrent flow lanes in Seattle.
- 1,294 carpools and vanpools carry 3,112 occupants on the State Route 91 concurrent flow HOV lanes in Los Angeles County, California.
- 2,700 buses, vanpools, and carpools carry some 18,500 people on the Shirley Highway (I-95) HOV lanes in the Northern Virginia/Washington, D.C., area.

The savings in travel time and improvements in trip time reliability contribute to the attractiveness of HOV lanes for users. Documented a.m. peak hour travel time savings provided by HOV facilities versus traveling on the general-purpose lanes range from only a few minutes to a high of 39 minutes on the 27-mile I-95/I-395 HOV lane in the Northern Virginia–Washington, D.C., area.

Not all of the HOV lanes implemented have continued to operate, however. Some projects, such as the Santa Monica diamond lanes in Los Angeles, the HOV lanes on the Dulles Access Road in Northern Virginia, and the HOV lanes on I-287 and I-80 in New

Jersey, were discontinued. These projects could be considered successful from a technical standpoint in that they operated as planned, but were viewed as unsuccessful by the public and policy makers. Some of these projects suffered from the "empty lane syndrome;" that is, there were not enough buses, vanpools, and carpools to make the lane look well used. The Santa Monica Freeway and the Dulles Access Road projects also indicated the difficulty of converting an existing general-purpose travel lane to an HOV lane.

KEYS TO SUCCESSFUL HOV FACILITIES

Experience with successful and unsuccessful HOV facilities in the 20th century highlights the following key elements to achieving desired project goals and objectives.

Congested Corridors

HOV facilities are most appropriate and are most needed in corridors with high levels of travel demand and traffic congestion. In these situations, HOV facilities can provide the savings in travel time and improved travel time reliability necessary to encourage commuters to change from driving alone to using a bus, vanpool, or carpool.

Interagency Coordination

HOV facilities require that staff from agencies responsible for the freeway and roadway systems, transit services, rideshare programs, enforcement agencies, and local communities work together. Interagency teams or project management committees are often used to help facilitate the needed coordination and cooperation. A lead agency and a project champion or champions are also keys to successful projects.

Public and Policy Maker Involvement and Support

An HOV facility must have support from policymakers and the public to be successful. Involving these groups early and often throughout planning, designing, and implementing a project can help ensure this support. Both traditional and new techniques can be used to encourage the participation of policy makers, travelers, neighborhood groups, and other organizations.

Education and Marketing Programs

Building on the early involvement of the public and policy makers, ongoing public education and marketing activities also can enhance the chance for a successful HOV project. Ongoing reinforcement of travel options is important for new residents as well as for long-term commuters.

Supporting Facilities and Services

Successful HOV projects encompass more than just the HOV facility. Elements such as park-and-ride and park-and-pool lots, new or expanded bus services, transit stations, and other supporting components all contribute to the success of an HOV project. These elements provide commuters with a range of alternatives to driving alone.

Supporting Programs and Policies

The existence of other supporting programs and policies also enhances the likelihood of a successful project. Ridesharing programs, guaranteed ride home programs, parking management and pricing policies, employer efforts, trip reduction ordinances, growth controls, land use policies, and zoning ordinances may all encourage HOV use.

Enforcement

Public acceptance of an HOV project is closely linked to the perception that the facility is well-used and operating requirements are enforced. Support for an HOV facility will be lessened if commuters traveling in the adjacent freeway lanes feel the privilege of using the HOV lanes is being abused. Ensuring that the project design includes adequate and safe enforcement areas and that visible, ongoing enforcement is provided are important to the success of an HOV project.

Comprehensive HOV Systems Approach

Stand-alone HOV projects address specific problems and contribute to improving the operation of a specific facility. A comprehensive, system-wide approach to planning, designing, implementing, and operating HOV facilities can help ensure successful projects. A comprehensive approach includes all of the key elements noted above and is coordinated with other roadway and transit improvements to ensure an integrated multimodal transportation system.

CHALLENGES FOR HOV FACILITIES

Like all types of transportation improvements, HOV facilities have limitations and may not be logical alternatives in many situations. Enforcing the operating requirements, monitoring and documenting use levels, enhancing planning techniques, and presenting realistic expectations represent some of the major challenges facing HOV projects.

Enforcement

Effective enforcement is critical to the success of any type of HOV facility. Experience indicates that violation rates increase significantly when the traveling public perceives the facilities are not being enforced. The variety of designs and operating scenarios present an increasing range of enforcement options and problems. At the same time, many police agencies are facing funding cutbacks, which often limit the personnel available for assignment to HOV projects.

To maximize available personnel, more efficient and effective enforcement approaches must be developed, evaluated, and implemented. Enforcement approaches being considered include automated enforcement techniques, ticket by mail programs, stiffer fines, enhanced design features, and building strong working relationships between enforcement agencies and the court systems to ensure lane violation enforcement will be upheld. Different techniques also are needed for arterial street applications.

Improving Methods for Monitoring and Measuring Performance

Development and implementation of programs to monitor HOV facility performance are necessary to identify the benefits accrued from the project and to determine if the goals and

objectives are being met. Currently, the performance data that can be used to evaluate the effectiveness of HOV facilities are limited.

Information on usage, travel times, violation rates, and accidents are critical for ensuring the efficient and safe operation of a facility. Monitoring these and other aspects of the facility will help identify problems to address. Results from an evaluation, along with the experience gained from a project, can enhance the decision-making process on future HOV or managed lane projects.

Enhanced Planning Techniques

Improved methods to estimate the use of HOV facilities and the demand for value pricing are needed. New methods will be important to address the growing interest in pricing alternatives and managed lane concepts. Needed planning elements include assessing demand estimation techniques, pricing elasticities, and factors influencing public and political acceptance.

Realistic Expectations

The utility of HOV facilities has been questioned recently in a few urban areas. These questions are usually based on perceptions of HOV facility ineffectiveness relating to reducing congestion, improving air quality, and addressing other needs. HOV facilities alone cannot solve these issues in the face of population and employment growth, increasing automobile ownership, and increasing vehicle-miles of travel. Developing realistic expectation for all types of HOV facilities is a critical need in most areas.

OPPORTUNITIES FOR HOV FACILITIES

HOV facilities will continue to play important roles in helping manage the urban transportation system in the 21st century. Existing projects will be enhanced and new HOV systems will be incorporated into regional visions and plans.

HOV Facilities and Systems

The development and operation of traditional HOV facilities will continue. More areas will look at HOV system approaches, linking and coordinating with other transit and transportation improvements, as part of region-wide intermodal visions.

Value Pricing and Travel Options

Value pricing and other travel alternatives will continue to be tested and implemented with HOV facilities to maximize use and to better manage congested travel corridors. Testing different pricing scenarios, payment technologies, sticker programs, and other alternatives will continue.

Managed Lanes

This concept provides other user groups with the travel time savings and travel time reliability offered by HOV facilities to buses, vanpools, and carpools. Facilities oriented toward commercial vehicles, low-emission vehicles, and other user groups will be considered and implemented in some areas as part of a managed lane system.

Bus Rapid Transit

The Bus Rapid Transit demonstration program provides approaches and techniques for improving bus operations in congested travel corridors. Innovative combinations of fixed facilities, advanced technologies, and operating scenarios will continue to be deployed to provide buses with speed, reliability, and efficiency similar to fixed-guideway alternatives.

ITS and HOV Systems

Intelligent transportation systems (ITS) and other advanced technologies will continue to be deployed in all parts of the transportation system, including HOV facilities. These technologies will enhance the management, operation, and enforcement of HOV projects. HOV lanes will continue to serve as test beds for the Intelligent Vehicle Initiative (IVI).

> *Now it was the woman's turn to yawn and rub her eyes. "Yes, dear, that was a very strange dream," she said with feigned interest. "Let me get you another cup of coffee to go with your cereal. I know the doctor recommended it, but you might want to stop drinking that glass of carrot juice late at night while you are watching those old movies."*

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