Arterial HOV Lanes

Where (and Why) Now?

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Abstract. High Occupancy Vehicle (HOV) lanes are intended to combine the swift movement of transit passengers through crowded city arteries with attractive incentives for those who choose to share a private vehicle. Freeway HOV projects are well established, and there are close to eighty arterial HOV lanes in operation worldwide, in Canada, the U.S., Australia, the U.K, Norway, Austria, and elsewhere. Extending the definition to Bus-only lanes, there are literally hundreds of examples in use.

Yet, the general sense is that arterial HOV lanes have failed to live up to their promise. There are many questions that arise as a consequence. What has gone wrong? Are arterial HOV lanes fundamentally flawed, or have they just not been implemented or operated properly? Are bus lanes better? Is the addition of the carpool component beneficial, irrelevant, or harmful to bus objectives? Are there other ways to achieve the same goals as the HOV strategy? And where do we go from here?

This paper will analyze current arterial HOV operations (Canadian and worldwide); describe the issues that have arisen; summarize how those issues have been or can be addressed; and present an action plan for Canadian practitioners to bring the arterial HOV lane concept into the future.

INTRODUCTION

An arterial HOV lane is, for the purposes of this discussion, an HOV lane on a signalized roadway. This may range from a central city street to a suburban quasi-expressway, but excludes any fully controlled-access highway. This paper focuses on on-street traveled lanes and does not address spot treatments for HOV priority (ramp meter bypass lanes, queue jumps, signal priority, special parking spaces, etc.) or temporary HOV facilities.

All references in this paper to “HOV” mean facilities open to all vehicles carrying more than a specified number of occupants. This includes private autos and buses. Where an HOV facility is limited to buses only, it is referred to as a Reserved Bus Lane (RBL). HOV 2+ refers to a facility that can be used by any vehicle (excluding heavy trucks) carrying two or more occupants – a driver and at least one passenger.

It is important to avoid comparing – or confusing - arterial HOV lanes with freeway HOV projects. While the fundamental principle of providing priority treatment for preferred vehicles applies to both, the two categories are fundamentally different in terms of objectives, operating conditions, geometric design, implementation, and Measures of Effectiveness (MOEs).

HOV LANE INVENTORY

There are currently over 80 separate arterial HOV lane projects in operation around the world, as tabulated below. More details can be found at www.mrc.ca/hovworldwide2.htm

Country	Urban Centres with Arterial HOV Lanes in Operation	Total No. of Arterial HOV Projects in Operation
Australia	Brisbane, Sydney	18
Austria	Linz	1
Canada	Calgary, Gatineau, Toronto, Vancouver	24
Indonesia	Jakarta	1
New Zealand	Auckland, Wellington	2
Norway	Trondheim	1
United Kingdom	Bristol, Leeds	3
United States	Alexandria (VA), Denver, Honolulu, Houston, New York, Pittsburgh, Santa Clara Co. (CA), Seattle	32
8 countries	20 Urban Centres	82 Projects

Table 1 – Worldwide Distribution of Arterial HOV Lanes in Operation (2006)

Some projects date back to the 1970s, but most have been implemented since 1990. There is almost an even split between those requiring two or more occupants (42 projects) and those with a 3+ designation (39 projects)

Sixty-seven of the projects (83 %) are for HOV use only during peak periods. A couple operate for longer periods, while the remainder are permanent 24 hour per day operations.

While several HOV lanes have been implemented as part of an arterial widening program, the firm majority have been created by redesignating existing general purpose lanes to HOV use.

This list will change over time: there may be facilities not included in this summary, and there are additional projects known to be in various stages of planning and delivery.

CANADIAN ARTERIAL HOV LANES

The four Canadian urban areas with arterial HOV lanes illustrate the different approaches that may be taken to implementation:

- The Vancouver area features a variety of standalone facilities, with site-specific designs and eligibility rules.
- Calgary has a single HOV lane aimed at expediting buses into the CBD.

- The Toronto area has several elements of a (partially implemented) regional-scale suburban HOV lane network, with consistent rules and operations across the network.
- Gatineau's HOV lanes cover most key radial commuting routes and join with HOV lanes on Ottawa river crossings.

It may be noted that a few freeway HOV lanes are in operation in the Vancouver, Toronto, and Montreal regions, but there is no interconnection or co-ordination between the provincial freeway facilities and municipal arterial HOV programs.

Several Canadian cities (Quebec, Montreal, Ottawa, Toronto, Winnipeg, Regina, Vancouver) have implemented Reserved Bus Lanes; such lanes are often open to taxis but not to carpools.

ARTERIAL HOV LANES ELSEWHERE

Arterial HOV lanes grew out of the U.S. freeway HOV experience, whereby the notion of promoting carpooling as an energy-saving measure emerged in the early 1970s. The U.S. thus has some of the oldest arterial HOV lanes in use. Some projects have been implemented as a transit (bus) priority measure on urban streets, while several (Honolulu, Denver, Santa Clara County) are on high-standard high-capacity signalized suburban roadways. The projects in New York and Pittsburgh make use of unique opportunities but are not conceived as part of a system. In three centres (Houston, Santa Clara, Seattle) HOV lanes have been planned and implemented as part of an integrated multi-modal transportation system. The Seattle area provides perhaps the best example of a set of effective arterial-based HOV facilities tied into a regional-scale freeway HOV system within a transportation policy framework that explicitly supports carpooling.

Most major urban centres in the U.S. have freeway HOV lanes, and Reserved Bus Lanes are common in central cities. There is a considerable policy and program emphasis on carpool promotion, as an element in the Transportation Demand Management and Clean Air toolkits. It may be noted that arterial HOV lanes have been implemented and later removed in a further eight centres; some removals were due to flawed operation or underutilization, while other projects were intended as interim measures pending major corridor upgrades and had an intentionally finite life span.

In Australia, Sydney has long had an aggressive program of implementing bus priority measures, including busways, freeway and arterial bus lanes, and arterial HOV lanes making use of as many opportunities as possible in key commuting corridors. Effective arterial operation is key to the Sydney transportation system in light of the lesser role the freeway network plays there than in North America. Brisbane has a similar approach, on a smaller scale. Auckland currently has a single arterial HOV lane, feeding into a bus priority lane on the critical harbour crossing spine.

Arterial HOV lanes have emerged in Europe in recent years, as selected centres move beyond the traditional reliance on reserved transit lanes. Facilities to date have been

implemented as isolated standalone projects, but experience gained from successful operation has triggered consideration of HOV opportunities on other streets and motorways, particularly in the U.K.

ARTERIAL HOV LANE OPERATING EXPERIENCE

Most HOV lane projects are subject to intense technical, public, and political scrutiny before they are ever implemented, so the projects that do get built have already passed their greatest hurdles. Operationally, each facility will have certain objectives set for it, but the wide range of projects and their objectives frustrates comparative measures and a uniform definition of "success" or "failure". Perhaps the key MOE is project longevity – if a facility is still in use a decade after it was implemented, it would appear to have been accepted as a functioning part of the regional transportation system and can be assumed to be operating within range of its expectations.

Nevertheless, there are certain characteristics of any HOV facility that can point to "successful" operations:

- Adequate HOV lane usage (either carrying more people than the equivalent general purpose lane, or carrying enough vehicles to generate public acceptance)
- HOV lane travel time advantage over general purpose lanes
- Positive effect of HOV lane on total person-moving capacity of corridor
- Demonstrated effect of HOV project on travel mode choice in corridor
- Motorist compliance with HOV lane rules

Note that the impacts of arterial HOV lanes are limited to the transportation corridor in which they operate; few, if any, centres have created networks or expanded HOV priority to the extent that regional-scale impacts (in terms of mode shift, vehicle kilometres of travel, emissions, etc.) can be measured. Another point is that reduced emissions and energy use, often cited as primary HOV lane objectives, in fact are secondary impacts that follow directly from the achievement of usage and travel time objectives.

Unfortunately, there is little useful data available for many arterial HOV lane projects; once one has been implemented there is usually an immediate survey or two to check that operations are satisfactory, and little follow-up unless a particular operational problem is identified later on. Only a few centres have an ongoing regular monitoring program. The following discussion uses readily available data to highlight selected examples of arterial HOV lane operating experience, but lack of information prevents it from being a comprehensive overview.

Positive Results

Although not every arterial HOV lane facility is considered a success, there are numerous examples of HOV lanes that operate safely and effectively, move people more efficiently than equivalent general purpose lanes, and have a record of attracting new HOV patrons.

The following Table summarizes key results of selected HOV facilities. It should be noted that there may be other outstanding projects for which information is not available.

Project	In Use Since	HOV Lane Usage	HOV Lane Travel Time Advantage	Effect on Corridor
Onewa Rd. 3+, Auckland	1982	2640 people in 37 bus / 324 carpools in peak pd.	11 min. (HOV 7 min. vs. GPL 18 min.)	Carpooling share rose from 9% to 26%
A-647 2+, Leeds	1998	Initially 2225 people in HOVs; 1420 people in non-HOVs; HOV lane attracted minor increase in HOVs	2½ min. in AM; project also improved GPL time by 1½ min.	Auto occupancy rose from 1.35 to 1.51; bus ridership increased 20%
Mains Road 3+, Brisbane	1993	140 carpools / 40 buses	5 – 10 minutes	Auto occupancy rose from 1.33 to 1.40
Waterworks Road 2+, Brisbane	2002	420 carpools / 17 buses in AM peak hour	5 ½ minutes	Lane carries 70% of people in 36% of vehicles
Barnet-Hastings 2+, Vancouver	1996	1530 2-occ, 145 3+ occ in peak period	8 minutes (AM); more consistent travel time	HOV vehicles nearly tripled upon opening
Centre Street 2+, Calgary	2000	4080 people in 82 bus / 1224 carpoolers in 700 HOVs (incl. violators) in 1 ½ hour AM peak	n/a	Bus use up 56%; auto occupancy up from 1.32 to 1.39; car volume down 32%

Table 2 – Arterial HOV Lane Projects with Positive Results

Some of the most successful HOV lane projects no longer exist. The HOV market is dynamic; the congestion and operating conditions that warrant an HOV lane at one time may change over time. It is common for a successful HOV projects to evolve into something else:

> **US1, Miami**: A carpool lane operated effectively for a decade as a precursor to a higher-order transit facility in the corridor; the lane was removed once the rail line was built.
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> **Yonge Street, Toronto**: Transit priority (3+) lane in busy urban corridor helped feed buses to and from the end of a subway line; bus traffic became so heavy that carpools tended to avoid the lane and even buses often used general traffic lanes to bypass stopped or turning vehicles. Plans are underway to replace the HOV lanes with an upgraded, dedicated bus facility, and eventually with an extended subway.

Lion's Gate Bridge (Vancouver), **Eglinton Avenue** (Toronto), **Kalanianaole Highway** (Honolulu): These projects began life as Reserved Bus Lanes, but had carpools added without significant negative effects

US 12, Minneapolis: A median reversible HOV lane was implemented as a traffic management measure during reconstruction of arterial highway to freeway standards; it operated effectively and was replaced by the freeway HOV lanes.

Centre Street, Calgary: A bus lane was implemented as a construction mitigation project, then opened to HOV 2+ use once construction was completed

Negative Results

There are three main areas where HOV lane projects run the risk of posting negative results: where implementation has a severe negative impact on general purpose lane operations; where the HOV lane usage does not live up to expectations; and where non-compliance threatens the operational viability of the lane.

The outcome of such negative results is usually public – and hence political – dissatisfaction leading to project termination or at least a halt in considering any new HOV projects; or "benign neglect" whereby the HOV signs remain but the facility is unenforced and functions as in effect another general purpose lane.

If a project has been implemented by adding an HOV lane, there is generally some initial public tolerance for underperformance because implementation will not have made the general traffic conditions any worse. If a project has been implemented by converting a general purpose lane to HOV use, the public is more likely to demand immediate visible results and to be less tolerant of any disruption caused to general purpose traffic.

There are relatively few HOV projects in operation with demonstrably negative results (compounded by the lack of operational monitoring data on hand) but several projects in the Toronto area, for example, have failed to meet their expectations, and the same could be said for the downtown Houston lanes, Lutwyche Road in Brisbane, and selected facilities in other cities. They may be characterized as being routinely violated, providing little travel time advantage to transit or carpools, having had little to no impact on travel mode choice, and all traffic would operate somewhat better in their absence.

Yet the fact remains that very few permanent arterial HOV lanes have ever been terminated for reasons of underutilization or impact on general traffic. Generally, if they have enough merit to warrant implementation, the operating jurisdiction is reluctant to give up a hard-won gain; furthermore, if protecting the HOV lane for future use is part of the regional transportation strategy, operators recognize that improvements to enforcement, signing, pavement marking, etc. can readily be made to improve the performance of a neglected facility.

Neutral Results

There are HOV projects that, for various reasons, do not perform exceptionally well but by the same token are not obvious failures. They may be little-used but have no negative impact on general purpose operations. Functionally, it is not very important that the lane is designated for HOV use but the designation stays in place because there is no real benefit to removing the designation. Such facilities are typically not rigorously enforced and compliance rates are low. There are several such projects in operation; the following are examples drawn from situations where operational data is available.

> **Champlain Bridge, Ottawa-Gatineau:** This HOV 2+ project yielded a minor decrease in auto occupancy rates and a violation rate of close to 50%. There has been little enforcement. However, the addition of the (reversible) HOV lane produced improved overall traffic flow and allowed some bus routes to use the bridge (buses had previously been subject to a load restriction). With the high violation rate, the HOV lane is effectively functioning as almost a second general purpose lane, and there is no strong movement to rescind the HOV designation.
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> **Dundas Street West, Mississauga** – Toronto: This HOV 3+ project on a 6-lane suburban arterial was the first in the Toronto area (1992) but has not been enforced for the past decade. Initial time savings were minor (in the order of 1 minute) and HOV lane usage was less than 100 HOVs (including 55 buses) in the AM peak two hours compared with 2,500 vehicles in the two other lanes. Subsequent counts showed half of the eligible HOVs staying in the general purpose lanes and the HOV lane violation rate in the 70% - 80% range. Nevertheless, the HOV lanes continue to attract fewer vehicles than the GPLs, which yields shorter queues at signals and some transit travel time advantage.

As with the "negative" projects above, HOV lane operators are generally capable of improving enforcement, signing, design, operating rules, etc. in order to improve HOV lane performance if called upon.

ADDRESSING THE ISSUES

It is important to remember that HOV lanes are different from "normal" transportation system elements, in that they are only a marketing tool – the point of an HOV program is not to build HOV lanes, rather it is to shape individuals' mode choice and travel patterns in a way that is more sustainable and efficient than driving alone and which ultimately benefits society as a whole. Most arterial HOV issues arise from the uneasiness with which market-oriented HOV facilities sit within a functionally-based urban transportation system.

Arterial HOV lanes face inherent operational design problems, primarily related to the competition among several user groups for that particular lane. Arterial HOV lanes are usually aimed primarily at supporting bus operations, and consequently they usually use the outside lane, where bus stops are located.

However, a typical curbside HOV lane must also accommodate non-HOV turning traffic, bus stops, driveways, crossing traffic, parked / stopped vehicles, bicyclists, and crossing pedestrians. These demands furthermore make it impractical to physically preclude non-HOVs from the curb lane. Turning moves at intersections conflict with the need for uninterrupted through HOV movement. It is a considerable accomplishment to achieve any HOV priority at all under such conditions.

Recognizing these inherent problems, arterial HOV lanes are often further hampered by (avoidable) flaws in their organization, planning, and operation:

- lack of co-ordination between arterial HOV projects and other HOV facilities in the region and with supporting / related TDM programs
- lack of information, from facility-specific operating conditions to long-term monitoring of project impacts to shared worldwide experience
- poor motorist compliance, compounded by lack of enforcement
- conflicting views and objectives among transit proponents and carpool proponents
- ineffective geometric design, signage, and lane marking (particularly related to bus stops and intersection approaches)
- treatment as insignificant and low priority in terms of budget allocation for capital investment, operating, monitoring, and enforcement

EXPERIENCE IN ADDRESSING ISSUES

There are two points at which the HOV practitioner can address the issues – inherent and project-specific – that face all HOV lanes: in the planning and design stages prior to opening; and in response to undesirable field conditions.

In the planning and design stage, there are typically two paths to choose from: treat the HOV lane project as an important, high-profile commitment to that particular transportation strategy; or downplay the implementation so as to minimize risk of failure (or of there being severe consequences of failure). While it is true that a failed HOV lane that most people didn't realize was ever in operation minimizes the risk to the proponent, experience suggests that "planning for success" is far more likely to actually produce a positive result than "planning to avoid the consequences of failure".

The most successful arterial HOV projects are in fact those which have been given a high profile by their proponents, and where a long-term commitment to their success has been demonstrated. Sydney, for example, now has such a long-standing and extensive program of HOV lanes throughout the region that it can withstand an isolated failure, and there is widespread public knowledge of the HOV principle so proposed new facilities are taken as part of the normal way of operating streets in the region. This does not relieve the facility planners of the need to create the best possible configuration and to minimize negative impacts on traffic and the community, but it gets past the hurdles of public education and resistance to change that has hampered so many plans elsewhere.

Toronto was on the way to achieving that level of HOV lane development but neither municipal staff commitment nor political will was strong enough to overcome an early setback (Eglinton Avenue West widening) and its program has stalled far short of its objectives. As a consequence, there is now a lot of work to do to "undo" the damage of the past decade (lost credibility, high violation, poor functionality) to even get back to a position where Toronto can move forward with HOV priority. Vancouver, on the other hand, has achieved some success by "picking and choosing" HOV projects on the basis of technical merit and their potential for public support, and early successes have helped create a foundation upon which future HOV initiatives can build and a regional-scale system can eventually emerge.

One good example of an HOV lane project planned for success yet protected against failure was the A647 facility in Leeds. This was a challenging situation, being only a four lane road, but Leeds was able to capitalize on widespread acceptance of the notion that something needed to be done to resolve problematic operations. By taking on the project as a serious, high-profile, innovative effort, Leeds was able to build public and motorist support, position itself as being forward-thinking (this was the first arterial HOV project in the country), and put the onus on the motorists themselves to "get with the program". It was clearly communicated to the public that the benefits (time savings, reduced congestion, improved safety) that would accrue to everyone depended on the willing participation of corridor travellers. Furthermore, A647 was positioned as a pilot project with a finite duration, after which there was a commitment to a public review and analysis that would feed into the decision to carry on with the HOV plan or delete it. As it turns out, initial operation went smoothly, benefits were as predicted, public support was there, and it was an easy decision, one year later, to make it a permanent part of the region's transportation picture.

Given that corridor-specific design and operational issues can usually be resolved if the commitment to succeed is there, the real drag on HOV program effectiveness is often related to organizational issues; as noted above, this largely stems from lack of leadership among the responsible transportation authorities. Transportation authorities are quite capable of promoting, planning, designing, operating, and co-ordinating complex facilities; they do it every day. There is nothing special about HOV lanes in that respect, other than the fact that there is a "marketing" aspect to them that does not apply to typical street and highway projects. Even so, transit agencies, which should be deeply involved in creating and operating these transit priority facilities, have both the knowledge and the means to market HOV use. Their problem is that they lack the will (or mandate) to promote what is often seen as a competitor.

The Seattle area provides one positive example of how HOV facilities can fit within a multi-modal system, in that the transit agencies there are configured as "people moving companies" under which buses, trains, carpools, vanpools, and all their various facilities are organized and co-ordinated. Different levels of government, various municipal jurisdictions, and multiple agencies work together to achieve common regional objectives. It is no accident that the Seattle region has a rich and growing system of arterial and freeway HOV facilities, preferential carpool parking, an extensive network of

park and ride lots, and a lower rate of drive-alone vehicle use than most comparable regions.

The carpool vs. transit situation is played out on a smaller scale in Canada's Capital region. On the Quebec side of the Ottawa River, Gatineau has an aggressive arterial HOV lane program that has emerged as the primary means to ensure transit priority during peak commute times, and to help build transit ridership to the point where dedicated transit facilities are warranted and effective. Carpooling is not the primary focus, but it is viewed as complementary to transit and is used as a means (warranting HOV lanes) to an end (transit priority). On the other hand, on the Ontario side, the City of Ottawa has a very strong public transit tradition, relying to a considerable extent on busways, light rail lines, and arterial bus lanes. There is little interest in promoting carpooling or vanpooling with HOV lanes (other than in sectors outside the OC Transpo service area) because of the perception that the City would be "competing with itself" in terms of attracting transit users.

Given that few HOV facilities (arterial or freeway) have ever demonstrated a negative impact on bus operations or ridership), the sense of "competition" between carpooling and public transit appears to be misplaced. If an HOV lane is implemented as a means to improve transit operations in a corridor, logic dictates that improved operations will both attract new transit riders and not induce any pre-existing transit users to shift out of that mode.

A key HOV issue, and one particularly germane to the arterial situation, is the demonstrated inability to commit enough resources to effectively monitor and enforce motorist compliance. This is perhaps the number one problem facing the Toronto network, and concerns about enforcement temper the enthusiasm of proponents in many centres. Arterial HOV facilities are inherently difficult to enforce by conventional means, while there is as yet no off-the-shelf technological solution. Recent research does, however, point towards progress in automating the vehicle occupancy monitoring and enforcement task.

Rather than the oft-attempted – and inherently flawed - use of external photography / video to "count heads", use may be made of in-vehicle sensors to register the number of occupants and communicate that information to the roadside via transponder. That data (which is not photographic and is anonymous) can then be used directly in enforcement as well as myriad other applications (e.g. HOV lane performance monitoring, carpool incentive programs, preferential parking, dynamic operations management, preferential toll rates, etc.). Since most new vehicles have such passenger sensing systems already installed (as part of mandatory "smart" airbag systems) as well as communications systems (toll tags, OnStar, etc.), it is a short step to integrate those systems with roadside monitoring provisions, and to restrict priority lane use to those vehicles equipped with occupancy monitoring systems *and* the appropriate number of occupants. This strategy is discussed in more detail in the report posted on the ENTERPRISE ITS Pooled-Fund web site http://enterprise.prog.org/ftp/0304carpool.pdf.

SOLUTIONS

Arterial HOV facilities are, in general, not particularly expensive; most either make use of an existing lane or utilize a lane that would have been built for general traffic in any case. In most regions, arterial HOV facilities would affect only a tiny percentage of the total road network, while creating disproportionately large people-moving benefits. The difference between a bus-only lane and a 3+ HOV lane is usually very minor (a few revised signs). There is good public understanding of the role of public transit in urban life, and general support for transit priority measures. There is even widespread public recognition that ridesharing is a "good thing", even if it is only done by others. And in most large centres, there is dissatisfaction with the extent of roadway congestion.

These circumstances form a positive framework within which to pursue the contributions of arterial HOV lanes to achieving regional transportation management objectives.

When facing arterial HOV issues, there are both numerous examples of successful practice to draw from and a variety of project-specific options to consider. A selection follows:

1) Accommodate conflicting needs of HOV lane users
    a. Limit HOV lane designation to the minimum time period required for transit priority
    b. Locate HOV lanes as second lane from the curb (with bus bulbs or in-street islands to accommodate bus passengers)
    c. Locate and design bus stops very carefully; indented bus bays are required to avoid blocking through HOV traffic
    d. Resolve local issues (alternative business access, peak period turn restrictions, storage lanes at intersection approaches, etc.)
    e. Make lane wide enough to share between HOVs and bicyclists
    f. Use large, clear signage and pavement markings, particularly at intersection approaches, to segregate turning vehicles, HOVs, and non-HOV traffic
    g. Clarify (legally and by signage) use of the lane by turning non-HOVs
    h. Institute and enforce "no-stopping" zones along HOV routes

2) Misuse (Violation) of the HOV lane by non-HOVs
    a. Use large, clear signage and pavement markings
    b. Design the lane so as to minimize the need for non-HOVs to use or cross it
    c. Make adequate provisions for police to observe and pull over violators
    d. Establish and fund an ongoing enforcement program
        i. Make the penalty significant enough to be effective, and post the value on a sign above the lane (Ottawa does both)
        ii. Designate all or part of the HOV lane fine revenue for HOV lane enforcement, public education, and improvements
        iii. Reserve a line item in the construction budget to fund initial enforcement efforts

iv. Develop and apply a randomized program of periodic, ongoing police monitoring and enforcement

e. Focus on public awareness and education, using transit agencies and the media to spell out the rationale, benefits, and rules of the HOV facility
f. Monitor lane usage, violation, effectiveness of various enforcement strategies, and public views. Continue to track developments in the automated monitoring and enforcement field.
g. Raise public awareness of the problem, but only if the operator is in a position to respond (with more enforcement, stiffer fines, etc.)

3) Lack of regional-scale co-ordination of HOV initiatives
    a. Embed HOV programs and facilities in various levels of corridor, city, and regional transportation master plans
    b. Use a region-wide co-ordinating committee (existing or purpose-built) to ensure compatibility and effective prioritization among HOV, transit, TDM carpooling, and capacity initiatives. Resolve philosophical differences between transit, highway, and carpool proponents at this level.
    c. Lead program with infrastructure agencies having regional-level interests rather than local municipalities or transit operators who do not have the mandate to look beyond their service areas
    d. Use HOV facilities to bridge between transportation infrastructure (capital), road operations (operating), and support programs (Transportation Demand Management – special funding); ideally, the traveler (customer) will have information about where the HOV lanes are, how to use them, when the bus comes, how to get a ridematch, where to park, and how the lanes are performing all in one place.

4) Lack of Information
    a. Define appropriate Measures of Effectiveness
    b. Undertake a comprehensive baseline monitoring study prior to HOV lane implementation
    c. Commit to a regular (at least biennial) performance monitoring program that tracks key Measures of Effectiveness, in co-ordination with other jurisdictions
    d. Report on the monitoring results to the responsible elected officials
    e. Publish monitoring information on the internet
    f. Establish a national / international forum for sharing arterial HOV (and related) information among different practitioners and jurisdictions

5) Sub-optimum geometric design
    a. Review municipal, provincial and national arterial HOV operational design guidelines to define Best Practices, and bring non-conforming guides into sync
    b. Train planning and engineering staff with respect to transit and HOV needs

c. Treat HOV alternatives seriously during the planning process, so that adequate provisions are made to allow appropriate optimum geometric designs to be developed and built
d. Fully involve transit operators and enforcement agencies in the development of design standards, and in laying out each HOV project
e. Protect / acquire adequate property to implement optimum designs rather than having to retrofit sub-standard provisions

ACTION PLAN FOR CANADIAN HOV PRACTITIONERS

Those responsible for urban transportation in Canada have been using the HOV lane tool for over a decade now, so the time has come to consolidate the lessons learned from the range of field experience, and use that knowledge to move forward with better, more effective programs and projects. Organizations with a national scope (particularly Transport Canada, CUTA, TAC, and CITE) are in the best position to facilitate this effort, with the support of the provinces and municipalities that are or plan to be active in the HOV / TDM field. Discussions among them should occur regarding responsibilities and funding mechanisms.

The objectives would be:

- to create a "living" database of Canadian arterial HOV facilities and their performance;
- to establish consistent, effective, national operational design guidelines for HOV facilities; and
- to create a sustainable and ongoing national forum for discussing and sharing information in the HOV field.

Co-ordination with U.S. efforts in this are will yield added value.

The process of educating the public, motorists, transit operators, engineers, and planners about HOV programs and facilities will go on at the local level for years. Using the national guidelines outlined above, HOV proponents need to follow up with dedicated funding and a concentrated effort to raise the profile of HOV strategies and plans. Ultimately, the aim is to embed HOV thinking in the plans, processes, and public options associated with all future arterial improvement projects. HOV lanes may not be the right solution in all – or even many – corridors, but planners are doing a disservice to its potential by dismissing it out of hand as it is so often now.

Simultaneously, continued effort is needed to pursue advances in automated occupancy monitoring systems; national-level co-operation with U.S. research initiatives will be more effective than the limited scope individual municipalities are capable of in this area.

Finally, all jurisdictions with HOV lanes currently in use will need to continue to make every effort to help them succeed, to improve, and to function as models for expanded transit and shared-ride priority programs across Canada. It is in the best interest of key stakeholders such as TDM organizations, private rideshare firms, Transportation

Management Associations, Transport Canada, Environment Canada, agencies with an interest in congestion management / urban planning / parking / air quality, cycling organizations, and transit operators (public *and* private) to participate in the arterial HOV field and to support proponents in creating and operating effective facilities. Proponents must, however, take the lead in engaging these stakeholder groups.

CONCLUSIONS

Conceived, implemented, and operated well, arterial HOV lanes are fully capable of achieving the objectives set out for them: to combine the swift movement of transit passengers through crowded city arteries with attractive incentives for those who choose to share a private vehicle. The fact that so few cities have managed to do so demonstrates the harsh reality facing the application of a market-based consumer-oriented transportation strategy within an established operational and infrastructure setting.

These challenges can be overcome with proponent leadership, an effective organizational structure, a commitment to applying the highest standards of planning and design, an engaged police force and transit agency(ies), and in-depth knowledge of how HOV facilities function and succeed.

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