Traveler Information and Decision-Making for Managed Lanes

An implied goal of the managed lane concept is to offer additional choices to motorists on a section of freeway. These choices can vary by time of day or possibly in response to changing traffic conditions on either the managed lane or the other general-purpose lanes in the corridor or region. The extent to which travelers can and will accommodate such operational flexibility hinges on getting the right information to travelers, at the right time, and in the right format so that they can make effective decisions pertaining to their trip.

Some users of managed lanes will make decisions prior to the start of their trip. However, others may make such decisions en route to their destination. The information needed to support such decisions must be safely and effectively interwoven with that information required for motorists to safely control, guide, and navigate their vehicles into and along the managed lanes. To further complicate matters, this information must often also be interwoven with similar control, guidance, and navigation information required for motorists operating in adjacent general-purpose lanes. Obviously, in such a complex information environment the potential for information conflicts and overload exist. Positive guidance principles indicate that efforts to design facilities and information systems to be consistent with driver expectancies will minimize their overall driving workload, minimize errors, and maximize the consistency of the resulting driving behaviors.

Driver Decision-Making Model

Managed lane facilities are more likely to present unfamiliar decision-making needs for drivers who have not experienced them before. Additionally, with the newer combinations of managed lane types, users who may be familiar with more traditional managed lane types (i.e., HOV-only lanes) may still be confused by newer types such combination HOV/toll lanes (HOT lanes) or toll lanes with dynamic pricing. They may not have knowledge of the hours of operation, enforcement regulations, or how and when to pay, or even if payment is necessary.

The process of how a driver makes the decision of whether or not to enter a managed lane is a multi-step one. Also, in order to make a properly informed decision, the driver must be able to take in several different types of pertinent information. The list of specific pieces of information needed at each point in the decision-making process is shown in Table 1 *(1)*. This information list is highly dependent on the specific managed lane design and operational strategy, and thus these needs would not likely exist at all facilities. For example, information regarding tolls or payment methods would not apply at a facility that is only for HOV traffic. This information is needed in addition to the other information drivers must access and use to operate their vehicle, such as speed limits, geometric changes, and the flow of traffic immediately surrounding the driver. The information categories are described below.

Table 1. Information Needs for Managed Lane Decision-Making Process *(1)*.

General Information Category	Types of Information that May be Needed
Managed Lane Information	• Type of managed lane (HOV, fixed toll, variable toll, transit-only, some combination of these) • Vehicle restrictions • Hours of service • Open/closed information • Entrance information • Exit information for the managed lane • Tolling information (if any) • Required method of payment (if any) • Penalty for improper use
Traffic Condition Information	• Current traffic congestion in general-purpose lanes • Incident management information • Travel time and estimated time savings for use of managed lane
Vehicle Information	• Occupancy requirements • Presence of transponder or cash (if required) • Specific prohibitions of certain vehicles (trucks, towed trailers)
Driver Information	• Need to save time • Penalty for late arrival at destination • Desire to spend the money for a toll • Perceived value of time • Comfort level with barrier-separated facilities • Comfort level with concurrent lane facilities if there is a large speed differential between managed lanes and general-purpose lanes

Type of Managed Lane – This type of information helps drivers understand if they are even eligible to use the managed lane. Examples include "BUS ONLY LANE," "TOLL LANE," or "HOV LANE."

Vehicle Restrictions – If certain vehicles are not allowed into the managed lane this should be conspicuously displayed. Common examples of restricted vehicles on existing managed lane facilities include trucks, vehicles with trailers, and wide loads.

Hours of Service – For some managed lane facilities that are only open certain times of day, this type of information would typically be the hours that the facility is open. This is also true for managed lanes that reverse direction at different times of day.

Open/Closed Information – Similar to hours of service information, but may be simplified to only show "OPEN" or "CLOSED" with no other information such as when and how long the facility will be open or closed. Full listing of hours of service facilitates planning for future trips.

Entrance Information – This category includes information such as how a driver can enter the managed lane facility, and subsequent entrance information. If this is the only chance for a driver to enter the managed lane or whether subsequent opportunities exist downstream can be useful in helping a driver make an informed decision.

Exit Information – Being able to understand potential exit points will help a driver better understand if the managed lane could useful in completing their trip and if it would require a longer driving distance than would be the case if he or she remained in the general-purpose lanes.

Tolling Information – This information may be fixed, it may vary by time of day in an attempt to shift some drivers from peak times to off-peak times,

Incident Management Information – This type of information includes real-time information on the presence of any downstream crashes or other unexpected delays in either the managed lanes or the general-purpose lanes.

Travel Time – The total amount of time it takes to travel to a downstream location using either the managed lane or the general-purpose lanes. An example of this is "23 MINUTES TO DOWNTOWN."

Time Savings – The difference in the amount of time that it takes to reach the terminal destination of the managed lane (such as "downtown" for example) when using the managed lane compared to the general-purpose lanes.

Occupancy Requirements – The minimum number of occupants that must be in a vehicle in order to properly use the managed lane. This information is typically related to HOV or HOT facilities.

Ultimately, this information interacts with individual driver perceptions and desires as part of the decision-making process. Some of those intrinsic factors are listed and described below:

Desire to Avoid Late Arrival – Getting fired or losing pay at work, or needing to pick up children from daycare before the daycare closes, are some examples of what would be considered by drivers to evaluate their desire to avoid a late arrival.

Perceived Value of Time – The monetary value placed on an individual's time in traffic can vary with transitory factors such as mood, weather, passengers, or with stationary traits such as income level.

Perceived Discomfort from Barrier-Separated Facility – Some drivers perceive discomfort when traveling immediately next to a concrete barrier wall, such as exists in some barrier-separated facilities. Furthermore, some drivers may feel "trapped" in the managed lane if they cannot move back to the general-purpose lanes easily in the event of managed lane congestion. Such perceptions will reduce the likelihood of managed lane use, all other factors held constant.

Perceived Safety From Barrier-Separated Facility – In contrast to the previous bullet, it is also possible that some drivers feel safer when separated from other traffic by a barrier, such as may exist in some barrier-separated facilities. This type of perception increases the likelihood of managed lane use, holding all other factors constant.

Combining the extrinsic roadway information with the intrinsic driver perceptions yields the conceptualized decision model shown in Figure 1 *(1)*. This model incorporates what information a driver needs to correctly answer each of the questions required in the process of deciding whether a managed lane facility is a better choice than the general-purpose lanes. It also takes into account not only the specifics of the managed lane facility and traffic conditions, but also the qualitative specifics of the individual driver. The assessment is alluded to as a benefit-cost analysis, but it is not performed with numbers and mathematics. Rather, this information is processed in the mind of the driver in real time or just prior to the trip, and may be thought more as a perceptual assessment rather than a precise computation.

Types of Drivers

One of the more important considerations for facility designers is that managed lane information needs are also highly dependent upon traveler experience and other individual factors. Certainly, not all of the information needed to make an informed decision must come from the highway agency in terms of information dissemination

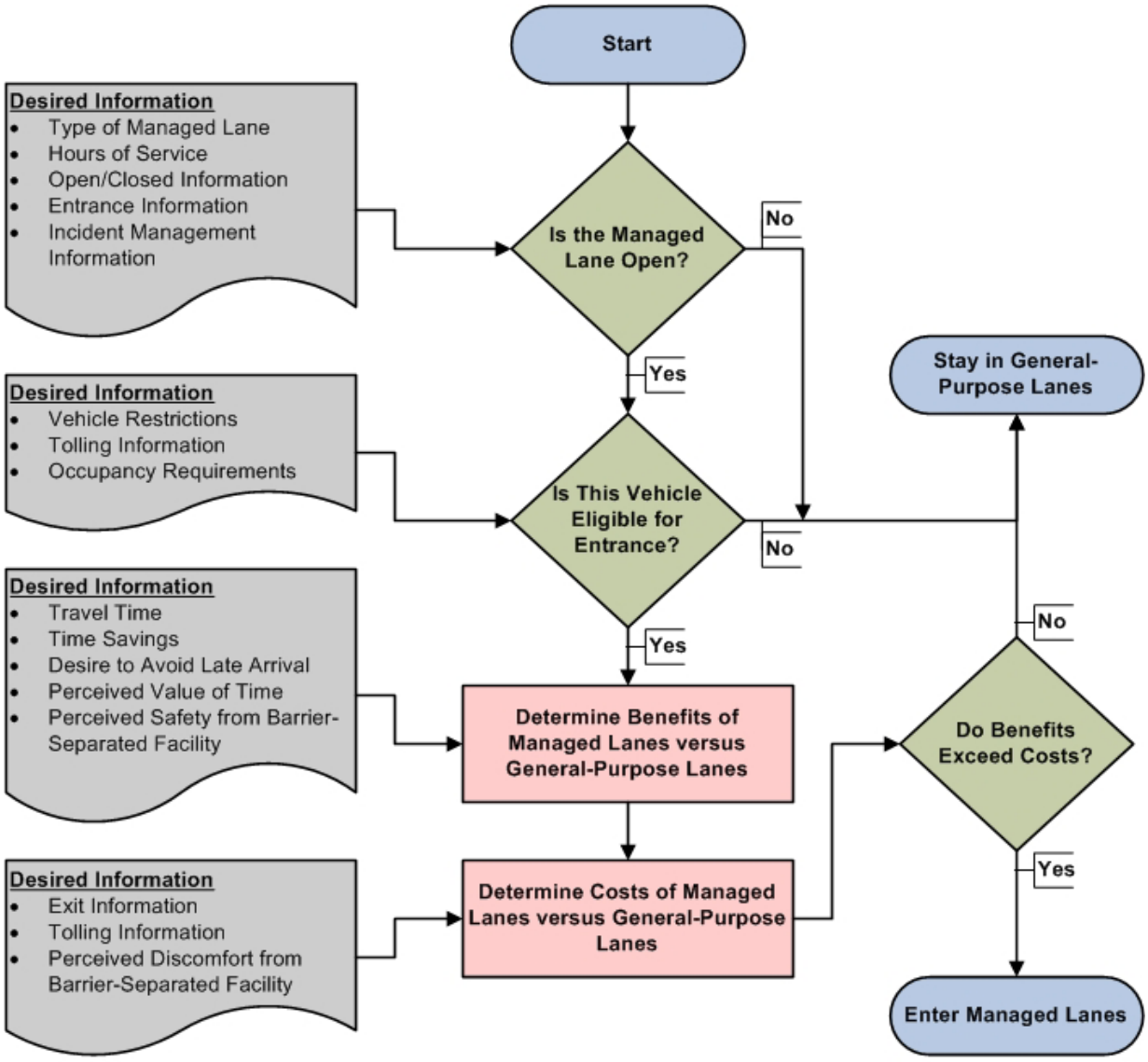

Figure 1. Conceptualized Traveler Decision Model *(1)*.

devices (overhead and shoulder-mounted static signs, overhead and shoulder-mounted dynamic message signs, pavement markings, etc.); some of the information required is internal to each individual driver, such as the perceived value of time, and the level of comfort with entering a barrier-separated facility. Other information, such as geometric features or specific sign locations and content, can be learned over time through repeated trips through a corridor. Drivers experienced with a particular roadway would also be likely to have some expectations of typical traffic conditions during their trips, including speed and congestion at different times of day as well as areas where additional attentional demand is required such as at interchanges with weave areas. Drivers who have been through a specific corridor before would rely more on intrinsic than on extrinsic information to make the choice of whether or not to use a managed lane.

The traveler decision model is related to the issue of driver familiarity. A general classification of drivers who might reasonably be confronted with the decision of whether or not to enter a managed lanes facility includes the unfamiliar driver, the semi-familiar driver, and the very familiar driver. While the entire driving population would fill the continuum between the extremes of a completely unfamiliar driver and a completely familiar driver, the three examples presented are for planning considerations and represent the wider distribution of drivers. The general classifications of the types of drivers are detailed in the following sections. Figure 2 illustrates the concept that familiarity with managed lanes facilities reduces the amount of information needed by the driver during a trip.

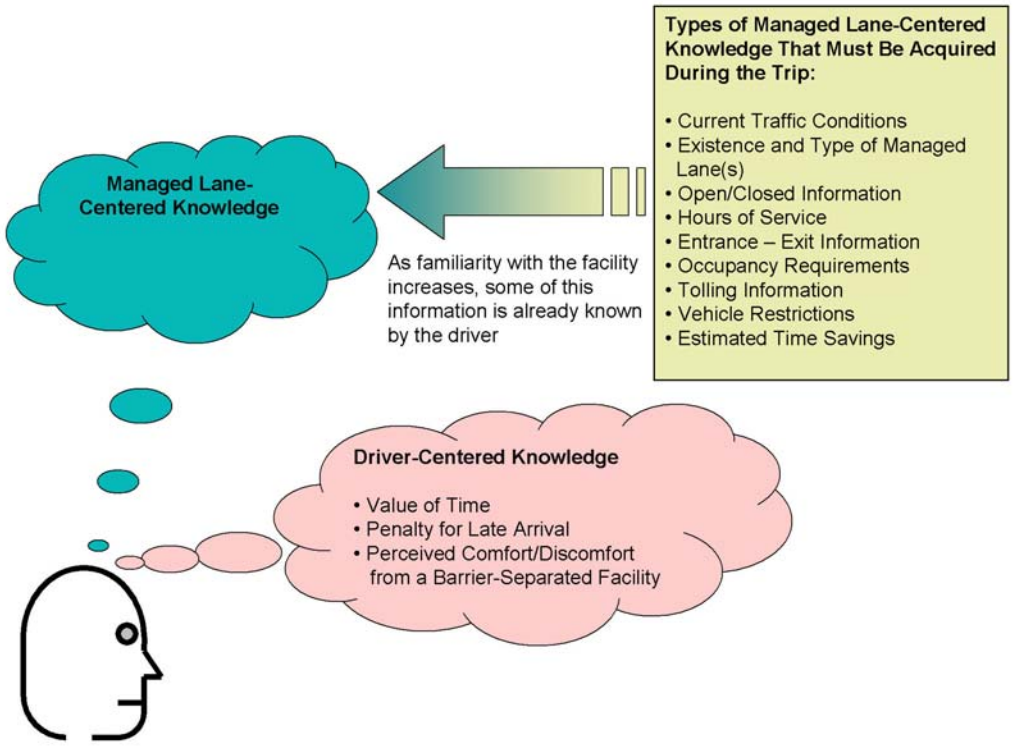

Figure 2. Driver Information Needs *(1)*.

Unfamiliar Driver

An unfamiliar driver has little or no experience on the roadway in question. In the extreme case, this driver may have never driven on this particular roadway before, may not be aware that a managed lane is ahead, and may not have encountered a managed lane of this type before. In order to make an informed decision on the proper path to take, this driver would need to acquire all of his/her knowledge from the roadway environment en route (or have researched the potential use of the facility beforehand via the internet, promotional brochures, etc.). This type of driver would need the highest amount of information presented to him/her, and would be at highest risk of experiencing information overload from the information presented, particularly at locations where control and guidance tasks are more severe (i.e., weaving areas, near entrances to the managed lanes or at exits from the managed lanes or general-purpose lanes, etc.).

Semi-familiar Driver

A semi-familiar driver is one who fits between the other classifications. This driver could be considered one who has occasionally used the facility, or one who may have driven on the general purpose lanes adjacent to the managed lanes and is considering using the managed lanes for the first time. This driver would know some information, such as geometry, speed, and direction of the roadway, but may need to determine additional information, such as tolling information en route. Depending on the type and amount of information needed by this type of driver, the amount of information that must be acquired from the roadway could be extensive and could result in a driver who is overloaded with information.

Familiar Driver

The familiar driver can be considered one who is intimately acquainted with the roadway in question. This driver may be a daily user, such as a commuter who drives the route every day at the same time. Alternatively, this may be a driver who is an experienced driver in a general sense, and may have extensive knowledge of other managed lanes, and who has taken the effort to learn about this managed lane prior to the trip from other

information sources such as the Internet or from other drivers. This driver would need relatively little information about the geometry of the roadway, and little signing information. In fact, in the extreme case, this type of driver could successfully maneuver through the route in question without even looking at a single sign, hearing a radio broadcast, review a navigational aid, etc. This group of drivers would be least likely to be burdened with information overload.

The interaction between driver familiarity and information requirements implies that information requirements should be considered early in the managed lane design process, as choices are being made regarding access and egress points, types of tolling facility, and type and amount of vehicle occupancy adjustments to accommodate. As an example, Table 2 has been generated to help guide practitioners in considering what en route information is needed for a variable-priced HOT lane. One noteworthy point is that more complex managed lane facilities require even familiar drivers to acquire a substantial amount of en route information. If this cannot be effectively accommodated into the overall information system via static and dynamic signing, other mechanisms such as the mobile internet, two-way transponder communications, or other in-vehicle communications with the motorists may be necessary.

Table 2. Typical Information Needs for HOT Lane Users *(1)*.

	Toll Lanes	
	Static Pricing or Pricing that Changes by Time of Day	**Dynamic Pricing**
Unfamiliar Drivers	• Entrance Information • Exit Information • Hours of Service and/or Open/Closed Information • Incident Information • Occupancy Requirements • Tolling Information • Travel Time and/or Time Saving • Vehicle Restrictions	• Entrance Information • Exit Information • Hours of Service and/or Open/Closed Information • Incident Information • Occupancy Requirements • Tolling Information • Travel Time and/or Time Saving • Vehicle Restrictions
Semi-Familiar Drivers	• Exit Information • Hours of Service and/or Open/Closed Information • Incident Information • Occupancy Requirements • Tolling Information • Travel Time and/or Time Saving	• Entrance Information • Exit Information • Hours of Service and/or Open/Closed Information • Incident Information • Occupancy Requirements • Tolling Information • Travel Time and/or Time Saving • Vehicle Restrictions
Familiar Drivers	• Hours of Service and/or Open/Closed Information • Incident Information • Travel Time and/or Time Saving	• Hours of Service and/or Open/Closed Information • Incident Information • Tolling Information • Travel Time and/or Time Saving

Note: The information categories shown in this table are typical examples shown merely for illustrative purposes. It is entirely likely that specific managed lane facilities may exhibit different information-dissemination needs and/or capabilities.

Other Information Sources

There are limits to human information processing. Not all drivers are able to process information at the same capacity, and it is possible in some driving instances to provide so much information that some drivers are not able to process it all. Additionally, as many types of managed lane driver information are complicated and must come in addition to the general-purpose lanes, these drivers with lowered information processing capabilities will be hard-pressed to correctly read and process the information provided. Presenting information in such a way to minimize driver information overload will allow more drivers to understand managed lane information and may be

more likely to use the facility if eligible. While no upper limit on information that can be presented to drivers on roadway signing, previous researchers recommended not exceeding four sign panels of information with more than six units of information on each panel. If general-purpose and managed lane information are presented on the same overhead guide sign or on separate sign structures but are still readable at a single point, then this recommendation should be considered. A review of the information may reveal that some of the information can safely be shifted upstream or downstream to spread the information load.

As drivers traverse a roadway again and again they become familiar with the signs and information that is required to properly travel the managed lane or general-purpose lanes in that area. Because the needs of drivers change over time, and each driver has a different threshold of information processing, the designers of the information dissemination for a managed lane facility need to determine which members of the driving population they are targeting (or can target) to use the managed lane. This step needs to happen early in the design process so the designers can make rational decisions about what levels of information need to be presented.

Determination of who the target audience really is (familiar, semi-familiar, or unfamiliar) can help determine how much information must be presented within the managed lane corridor regarding the managed lane. Additionally, if the target audience can be defined specifically, such as toll users who have electronic transponders, other options for information dissemination become available. The target audience is a process that should be explicitly determined in the design process, as it directly relates to the dissemination alternatives available for certain kinds of information.

In the above example, the users with transponders have provided their mailing information, and some information regarding the managed lanes can be mailed to them in regular newsletters and thus, removed from signing. Examples of possible information that could be removed from signs and put into mailings could include hours of service, toll structure, average time savings, and any planned uses for the managed lane facility. In this manner the information acquisition activity would move from during the trip to prior to the trip. Internet information pages can also serve a similar purpose for unfamiliar drivers who desire to learn more during pre-trip planning. Even other traffic devices such as highway advisory radios could be used to great effect for certain information.

Based on current trends and results of focus groups conducted for this research, several innovative methods of managed lane information dissemination are recommended for further research to determine their usefulness and applicability. These include:

- Color-coding signs for better differentiation between information intended for managed lane traffic and that intended for general-purpose lane traffic. This coding could take the form of banners across the top of the sign, or the color of the entire sign. Further research is needed to determine the manner that would aid drivers the most in understanding the information presented, and the amount of benefit that can be achieved through this type of coding process.

- Consideration should be given to removing managed lane information from signs and that can be effectively be presented in other formats to drivers. Examples of other dissemination methods include highway advisory radio, Internet, and direct mailing to electronic transponder carriers. It is unclear at the present time which kinds of information can be best moved or repeated on these alternate formats, and further research is needed to address this.

- By considering the intended target user group for the managed lane earlier in the design process, decisions of how much and what type of managed lane-specific information can be better assessed. This early consideration can allow for innovative information dissemination strategies, such as direct mailings to transponder subscribers. Further, designers will be better able to design the facility with the information needs fully addressed rather than as an afterthought at the end of the project.

1. Schrock, S., G. Ullman, A. Williams, and S. Chrysler. *Identification of Traveler Information and Decision-Making Needs for Managed Lane Users*. Report No. FHWA/TX-04/0-4160-13, Texas Transportation Institute, College Station, Texas, 2004.

For More Details . . .

Related Report:
Report 4160-13, *Identification of Traveler Information and Decision-Making Needs for Managed Lanes Users*
Report 4160-16, *Traffic Control Devices for Managed Lanes*

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