Dynamic Road Pricing

DETAILS

SECTOR | Transport
STAGE | Operations and Maintenance
TECHNOLOGIES | ORT, DSRC tags, Automatic license plate reading, big data, drone

SUMMARY

Managed lanes are dedicated lanes within a highway set aside to specifically ensure non-congested free flowing travel throughout a specific corridor, thereby giving travellers an option of using the normal "congested" lanes, or the free-flowing lanes. High-occupancy vehicle (HOV) lanes are an example of managed lanes, as well as dynamically tolled lanes with the dynamically tolled lanes the only lanes able to utilize technology to manage demand to ensure free-flowing throughput.

Effectively managed dynamically priced managed lanes can form an important tool in the overall transportation management strategy of an urban region. This strategy can utilize managed lanes to maximize existing capacity, manage demand, offer choices, improve safety, and generate revenue.

Managed lanes utilize a number of Infratech, technologies to ensure a superior level of service for the highway users as well as the economic benefit of freeing up scarce funding resources for the public sector to invest elsewhere.

Advanced versions of the technology aim to maintain free-flow travel and minimum traffic density, as a consequence a dynamic tolling algorithm, while considering local factors and recalibrating toll rates based on traffic congestion every several minutes; with the toll rate being locked in from the time a vehicle enters the corridor until it exits the corridor. Users can be provided the flexibility to utilize electronic payment systems through either electronic tags, to facilitate the use of the lanes and make payment, or through post-pay billing done through the capture of their license plates with automatic license plate reading technology. Registration with third party providers can allow for utilization of additional discounts for HOV and carpooling as an incentive.

The technologies required to ensure the managed lanes work efficiently in meeting the broader transportation goals include a multitude of roadside equipment including, cameras, toll tag readers, dynamic message signs, roadway weather stations, air quality monitoring, over height detection systems and vehicle categorization technology. In addition there is a significant back-office component which requires a data warehouse, a business intelligence processor and a toll setting module algorithm.

Advanced lane management can also allow for priority utilization of smart vehicles that are integrated with smart infrastructure.

This use case is a contribution from the D20 Long Term Investors Club, with some adaptions from the Global Infrastructure Hub.

VALUE CREATED

Improving efficiency and reducing costs:

- Guaranteed travel times for congested corridors to ensure efficient throughput with priority for high value transportation needs
- Efficient demand management through big data developed algorithms which assess traffic patterns to optimize toll rates in real time
- Free flow tag reading allows for travel to efficiently continue while collecting the necessary data for tolling
- Automatic (video image reading software) license plate reading minimizes back-office for non-tagged users and provides flexibility to users with a non-tag option

Enhancing economic, social and environmental value:

- High value trips (school pick-up, airport trips, business etc.) are guaranteed travel time
- Expanded highway capacity has reduced emissions by reducing the fumes from vehicles idling in congestion
- Embedded technology and capacity for further technology will allow for integration with smart vehicles
- Optimization of toll rates to maintain travel time reliability, reduces the economic inefficiencies of traffic congestion
- Potential revenue generation mechanism when applied at scale. For example, in Stockholm net revenues have increased since the variable fares were introduced in 2016. The net revenue from the system used to be around 500 million krona/year (USD $51 million/year); after January 2016, the net revenue is now around 1.3 billion krona/year (USD $155 million/year)[1]

POLICY TOOLS AND LEVERS

Legislation and regulation:

- Congestion management tolling regulation
- Privacy and information sharing for license plate recognition and payment processes
- Revenue sharing mechanisms between private developer and the public owner

Procurement and contract management:

- Public private partnership development agreement with infrastructure developers
- Competitive DBFOM tender where all factors (technology, infrastructure development and cost, operations and maintenance and tolling) sit with the same party to ensure the developed solution is optimized for the long-term

Funding and Financing:

- Utilizes long-term financial infrastructure investors who are able to take a view on the effectiveness of the applied technology and economic benefits of the managed lanes over a number of decades, rather than the short-term to truly align interests with the public benefit

[1] "Road Pricing in London, Stockholm and Singapore: A Way Forward for New York City", Tri-State Transportation Campaign, Accessed 4th May 2020.

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IMPLEMENTATION

Ease of Implementation

The rapid advancements in sensor and related technologies mean that implementation is becoming easier. One key element required to effectively manage pricing, is up-to-date integrated data from various input sources. This enables the data to be analysed in order to drive decisions and provide real-time information.

Cost

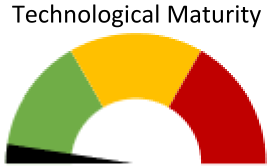
The incremental cost of implementing the technology associated with the priced demand management on the managed lanes is small compared to the cost to build the highway infrastructure. There is some additional construction infrastructure cost associated with ensuring separation of the managed lanes and direct connection ramps to the highway network it connects into. These costs need to be considered, however given the levels of congestion that would be in the corridor for this to be effective, these costs are generally outweighed by the additional capacity that is provided with the majority of funding being from the users who value the safety and reliability of the lanes, which is ensured through the active technology utilized on the highway.

In Stockholm, London and Singapore, the upfront costs of implementing the system, and the associated public transit improvements, were recouped in less than 5 years. It was estimated that alternatives to the system (e.g., ring roads to divert traffic away from the urban centre) would require far greater investment to achieve comparable traffic reduction goals.

Country Readiness

Dynamic pricing is one piece of a holistic traffic reduction strategy and begin to move away from privately-owned motor vehicles, and affordable, accessible public transportation options are also necessary. Complementary measures should be put in place, in addition to the dynamic pricing scheme.

Technological Maturity



Some technology associated with dynamic pricing is mature, and variations of the systems are already in place in multiple cities including Stockholm and Singapore. Vehicles using the infrastructure can be registered automatically by Automatic License Plate Recognition technology.

RISKS AND MITIGATIONS

Implementation Risks

The integration of technology into large linear civil infrastructure brings with it additional complexities, which are necessary to ensure the infrastructure can be an operational success for the transportation management plan. These complexities include the interface between the different technologies as well as the physical infrastructure as well as the inherently “short-term” life of technology versus long dated infrastructure. An essential tool in ensuring mitigating these complexities has been through effective partnering with and within the team developing the project. By aligning with long-term investors performance outlook a developer has the freedom to partner with technology provider’s of choice and invest in both research as well as technological replacements to continue to foster the relationship with the highway users. Ultimately managed lanes success as a tool within a broader travel management strategy ensures seamless use and positive perception by users, so ensuring a constant review of the users experience and engaging with users will drive technological and infrastructure changes.

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EXAMPLES

Example	Implementation	Cost	Timeframe
Dallas-Fort Worth region highways	The Dallas-Fort Worth region has some of the most congested highways in North America and is utilizing managed lanes as a way to effectively manage highway demand as well as to fund expansion of the transportation network.	This is demonstrated in Dallas-Fort Worth with the LBJ managed lane corridor realizing 20% more traffic (after installation of the lanes) and the general-purpose lanes have experienced a more than 70% reduction in congestion due to improved design of the roadway and traffic that has shifted to the express lanes.	
Stockholm Dynamic Congestion Zone and Bridge Tolls	The cordon scheme uses automatic number plate recognition, in a 35 km^2 zone. The scheme was launched in 2007 after a successful trial in 2006. In 2016 the scheme was updated to a dynamic pricing system based on time of day.	Initial investment of 2 billion krona (USD $236.7 million). Annual operating cost of 100 million krona (USD $11.8 million). Annual net revenue (for reinvestment in roadway improvements) of 1.3 billion krona/year (USD $155 million).	Scheme launched in 2007. Ancillary public transport also implemented to provide alternate travel options to previous road users.

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