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Legal Issues in Management Service Contracts – Issues Specific to Traffic Management

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The Rise of Advanced Traffic Management

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The Problem of Traffic: Recurring and Non-Recurring Congestion is increasing around the globe imposing significant societal costs…

- Decreased Mobility
- Increased Costs
- Increased Energy Use
- Increased Pollution
- Reduced Commerce and Productivity
- Decreased Health

"About half of congestion is caused by temporary disruptions that take away part of the roadway from use – or "nonrecurring" congestion. The three main causes of nonrecurring congestion are: incidents ranging from a flat tire to an overturned hazardous material truck (25 percent of congestion), work zones (10 percent of congestion), and weather (15 percent of congestion)." US DOT FHWA.

The Rise of Advanced Traffic Management

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Two Basic Options to Improve Urban Mobility – Build more road capacity or make better use of existing capacity through urban traffic management measures.

Build More Road Capacity

- New roads
- Roadway widening
- Flyovers
- Underpasses
- Often subject to physical and fiscal constraints

Urban Traffic Management Measures

- Computerized traffic signal control (**Urban Traffic Control**) to balance demand and flow
- Planned management of road space
  - Lane assignment to busses, HOV, bicycles, taxis, etc.
  - Parking controls
  - Turning bans
  - One-way street systems
- Traffic Management Center (**TMC**)
- Other Active Transportation Management (**ATM**) and Active Demand Management (**ADM**) to improve trip reliability, safety, and throughput

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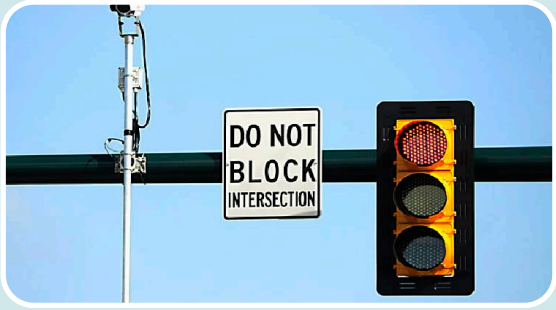
Urban Traffic Control (UTC) is the method of coordinating traffic signals in a network from a centralized computer.



Fixed-Time Control

- First appeared in the 1960s
- Did not require "feedback" of real time information
- Plans developed using historical traffic counts
- Provided ability to control from central location
- Provided ability to change signal plan
- Provided detection of malfunction

Systems with Feedback

- Next generation of UTC provided feedback from field sensors
- Automatically chooses from menu of existing plans based on existing traffic conditions
- First generation - plans still developed "off-line"
- Second and Third generation – prepare the plan in real time, requiring additional computing power

Adaptive Traffic Control

- SCOOT (Split, Cycle, Offset Optimisation Technique) attempts to minimize a performance index (PI) – typically, the sum of the average queue length and the number of stops across the controlled network – by modifying the length of the cycle, the amount of green time (the Split), and the offset time for each set of signals.
- SCATS (Sydney Co-ordinated Adaptive Traffic System)
- RHODES (Real-time Hierarchical Distributed Effective System)

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Traffic control covers all measures aimed at distributing and controlling road traffic flows in time and space in order to avoid the onset of incidents or to reduce their impacts.

CCTV

- Coverage of high-traffic areas for accidents or congestion
- Operators scan CCTV images looking for disruptions
- Image recognition techniques allow automation

Variable Message Signs

- Any sign or graphics board where the message changes
- Controlled remotely or locally
- Communicates with drivers
- Warns of approaching conditions – congestion, unplanned events, road works, weather

Enforcement Systems

- Against violations of traffic laws and control measures
- Speed cameras
- Red-light running detection
- Automatic Number Plate Recognition
- Heavy Vehicle (Truck) Monitoring

Travel Information Systems

- Gather and make information available to travelers
- May include parking information systems, public transport information.

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Traffic control covers all measures aimed at distributing and controlling road traffic flows in time and space in order to avoid the onset of incidents or to reduce their impacts.

Public Transport Priority

- Known as Transit Signal Priority in US
- Reduces delay for buses, trams, taxis at signalised intersections by giving their movements preferential treatment
- Transmitters on public transportation
- Green extensions, early green, phase rotation or insertion, etc.

Planned management of road space

- Lane assignment to busses, HOV, bicycles, taxis, etc.
- Parking controls
- Turning bans
- One-way street systems

Dynamic Lane Reversal

- Tidal Flow
- Reverse the direction of one or all lanes based on traffic
- Could be for commuter traffic or for special events
- Requires dynamic signage and barriers

Traffic Incident Management

- Detection: sensors detect traffic problem, CCTV captures images
- Verification: communication with emergency responders
- Response: set VMS displays and radio and social media alert, strategic diversions and safety zones

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Active Demand Management (ADM) uses information and technology to dynamically manage demand, which could include redistributing travel to less congested times of day or routes, or reducing overall vehicle trips by influencing a mode choice.

Dynamic Fare Reduction

- Reduces fair for transit system during congested times
- Fares provided on website and personalised messages
- Encourages mode shift

Dynamic HOV / Managed Lanes

- Changes qualification for using lane

Congestion Pricing

- Changes the price for driving in the urban area based on real-time and anticipated traffic conditions
- Drivers enjoy more consistent journey times
- Electronic charging

Dynamic Routing

- Recommends different routes to drivers based on traffic

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All of these strategies require sensors and cameras connected to a Traffic Management Center.

- Connected to field equipment
- Collect/analyse data on traffic in real time (speed, traffic volume, queues)
- Control signal systems and other ATM and ADM
- Respond to traffic incidents, emergency conditions, system failures
- Disseminate information to travelers, media, emergency responders

Private Sector Involvement

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The private sector is likely better qualified to implement an Advanced Traffic Management System than traditional DOTs.

- Compared with traditional DOT or Municipality projects, Advanced Traffic Management Systems require integrated approach toward real-time operations and robust systems management
- DOTs and Cities are better equipped for traditional capacity improvements
- Agencies with low capability in systems management and operations are probably not ready to implement Advanced Traffic Management on their own
- Private sector better at identifying and utilizing new technology and communications
- Advanced Traffic Management requires high number of skilled and motivated staff – may be easier for private sector to recruit and pay

Private Sector Involvement

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There are different ways to involve the private sector in Advanced Traffic Management.

Implementation Model	Role of Private Partner	Role of Public Authority	Advantages & Disadvantages
DBFO (User Charges)	• Design, supply and implement • Operation, maintenance and management • Contribute debt/equity for the project • Generate revenues by charging users for services • Transfer the project assets to the public sector at the end of the project	• Grant right to private partner to implement the project, levy user charges, and grant right of way • Monitor performance of private partner • Regulate the user charges	**Advantages:** • Mobilises alternative financing sources • Risk is on the private sector • Efficiencies and innovations in construction, scheduling and finance **Disadvantages:** • Revenues may be inadequate • Transaction costs are high • May be too risky for traditional contractors
DBFO (Availability Payments)	• Design, supply and implement • Operation, maintenance and management • Contribute debt/equity for the project • Recovery of costs and investment through periodic payments (monthly, quarterly or annually) from the public entity • Transfer the project assets to the public sector at the end of the project	• Grant right to private partner to implement the project, and grant right of way • Monitor performance of private partner • Pay the Availability Payment to private partner	**Advantages:** • Mobilises alternative financing sources to cover capital costs • Efficiencies and innovations in construction, scheduling and finance • Government can delay payment for capital costs **Disadvantages:** • Government will need to have the funding to pay Availability Payments • The payment mechanism may not result in the optimal performance if designed incorrectly

Private Sector Involvement

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There are different ways to involve the private sector in Advanced Traffic Management.

Implementation Model	Role of Private Partner	Role of Public Authority	Advantages & Disadvantages
DBOM (DB paid for by public sector and OM paid for by Availability Payments)	• Design, supply and implement • Operation, maintenance and management • Recovery of costs and investment through periodic payments (monthly, quarterly or annually) from the public entity	• Monitor performance of private partner • Owner of assets • Pay the Availability Payment to the private partner	**Advantages:** • Model more familiar to public entities • DB contractor will be "on the hook" if the design is inadequate, as it will also be doing the O&M • O&M fully integrated with DB approach **Disadvantages:** • Government must pay capital costs and operation & maintenance costs sooner • The payment mechanism may not result in the optimal performance if designed incorrectly • Government relinquishes control
Management Contract for OM (Availability Payment)	• Operation, maintenance and management • Recovery of costs and investment through periodic payments (monthly, quarterly or annually) from the public entity	• Design, supply and implement, or enter into a separate DB contract to do so • Owner of assets • Monitor performance of private partner • Pay the Availability Payment to private partner	**Advantages:** • Model more familiar to public entities and public • Sensitive data may be more secure • Government has more control **Disadvantages:** • Government must pay capital costs and operation & maintenance costs sooner • The payment mechanism may not result in the optimal performance if designed incorrectly • May be difficult to pass all performance risks onto an operator if they did not design the system

Advantages of Management Services Contracts

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Despite the advantages that P3 models such as DBFO or DBOM have for large infrastructure facilities, many DOTs may not be willing to undertake the up-front transaction costs and may prefer the Supply and/or Service Contract model they have used in the past.

Paraphrasing the *Operations Document for Traffic Management and Information Control Centre (TMICC)*, Ministry of Urban Development, Government of India, Nirman Bhawan, New Delhi (November, 2016):

- These arrangements are complex to set up and cumbersome to administer and manage considering the large number of stakeholders involved such as concessionaire, financiers, public authority, public etc. P3 models may often turn out to be not the most appropriate models for implementing Advanced Traffic Management
- There is relatively small revenue stream that can be generated from a traffic- focused system to satisfy the concessionaire or financiers, except for toll operations, parking operations or transit operations that can generate revenues to satisfy the financier's requirements
- The nature of activities being discharged through Advanced Traffic Management Systems is regulatory and highly sensitive in nature viz. surveillance, enforcement, signal operation etc.
- Advanced Traffic Management facilities are not in the nature of services being provided to public where-under they can be made to pay while they avail services
- Administration of such arrangements is likely to be cumbersome in terms of the contract administration and management
- In view of the above, the Supply and/or Service Contract could be the models of choice while undertaking Advanced Traffic Management implementation in India, as it is the case abroad, where such facilities have been set up

Advantages of Management Services Contracts

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For a Management Services Contract, certain risks can be allocated to the private sector and some cannot. Drawing the line is difficult and depends on the situation.

Type	Nature of Risk	Private Sector Risk MSC?
Technical Design	Requirements not properly worked out leading to project not achieving the desire outcome; Obsolescence	✗
Technical Operation	Adjusting ATM thresholds to get maximum from existing design	✓
Institutional	All institutions whose support is critical for project success are not on board, or not fully supportive	✗
Construction Schedule	Delay in construction or completion	✗
Maintenance Schedule	Delay in any scheduled maintenance	✓
Cost	Project cost overrun	✗
Quality	Qualify of project assets/processes not up to the mark	✗
Funding	Funding for the project activities not forthcoming in a timely manner	✗
Personnel	Availability and training	✓
Commercial	Funding the gap between costs and revenues	✗
Security	Physical and data security	✓
Communication	Availability and adequacy	✓

Performance Metrics for Management Services Contracts

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Linking payment to the achievement of performance thresholds has found its fullest expression in P3s, but DOTs need to start incorporating these concepts into MSCs in order to unlock the full potential in their Advanced Traffic Management systems. Even if the Management Contractor did not design the system, there is a lot of work involved with adjusting thresholds in order to get the most out of the system. It makes sense for the MSC to tie remuneration to how good a job the contractor does in making these adjustments.

> *The inclusion of performance thresholds in the payment contract is essential to a successful project. Transportation based performance measures tied to contract incentives include improved operations, reduced delay, fewer incidents, and similar measures important to users.*

Performance Metrics for Management Services Contracts

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The payment mechanism should be based, at least in part, on performance metrics appropriate to Advanced Traffic Management. When the service contractor was not involved in the design and construction of the system, they *may* be less willing to bear performance risk tied to outcome.

Outcome Based

- Reduce congestion
- Reduce travel times
- Encourage public transport usage
- Enhancing compliance with traffic rules
- Reducing incident impact including response time
- Reducing number of accidents
- Improving coordination among various agencies
- Adoption of modern means and technologies
- Dissemination of Information: quality, coverage, reach, modes
- Reducing negative environmental impacts of traffic and travel
- Citizen satisfaction
- Movement of people and goods on streets and highways

Input Based

- Number of junctions monitored by contractor
- Number of junctions with adaptive signal control
- Coverage of roads managed by contractor as proportion of total major roads in the area
- Coverage of transit agencies managed as proportion of total number of transit agencies in the area
- Number of incidents handled by the contractor
- Number of pieces of Traffic Equipment connected to the TMC
- Number of agencies associated with TMC
- Number of Messages displayed on Variable Message Signs
- Uptime, downtime, mean time between failure of the field equipment

Source: Traffic Management and Information Control Centre (TMICC) Operations Document, Ministry of Urban Development, Government of India (November, 2016)

Performance Metrics for Management Services Contracts

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Although project revenues won't be retained by the private partner and used by the private partner to finance the project, the MSC may want to include the collection of revenue as a responsibility of the private partner.

- Fines collected by the Traffic Police through the enforcement measures
- Parking charges collected from users
- Receipts from private entities for sharing data
- Receipts from media for sharing data
- Receipts from users for providing personalised information sent through mailers, Short Message Service (SMS), mobile apps or providing personalised access to certain information
- Receipts from advertisers against grant of right to display advertisements on website
- Receipts from advertisers against grant of right to display advertisements on mobile apps
- Receipts from advertisers against grant of right to undertake advertisements on helpline
- Receipts from sponsorship by corporates in lieu of exclusive right to co-brand
- Receipts from mobile apps downloads
- Receipts from subscription services offered on mobile apps

John J. Sullivan IV for FHWA

Performance Metrics for Management Services Contracts

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There are different ways to structure the payment mechanism for the MSC. One way is to deduct points for Availability Events or Performance Failures from a Base Availability Payment bid by the Concessionaire.

- Contractor bids a Base Availability Payment
- Base Availability Payment (parts of which may be subject to indexation)
- Availability Deductions for Availability Events
  - Availability events would be period and frequency dependent
  - Examples: 3 different cameras/sensors not working during 10 minute interval; center not operating in a given 10 minute period; software not working in a 10 minute period; emergency dispatch not connected in a 10 minute period
  - Deductions could be indexed for inflation
  - No deductions for planned maintenance and other permitted unavailability
  - May be weighted to take into account past unavailability
  - May be weighted so that unavailability is more heavily penalized at certain times of day than others
- Performance Deductions for failure to meet performance criteria
  - Throughput goals, crash reductions, miles driven, etc.
  - Could also include failure of maintenance to meet specified criteria
  - Could result in termination rights
- Could offset revenues collected

Total of Availability Deductions in Calculation Period 'n' is defined as follows:

$$AD_n = \sum_{i=1}^{NE} AD_i$$

Where:

AD_n = Total of Availability Deductions for Calculation Period 'n'

NE = Number of Unavailability Events that fall in Calculation Period 'n'

AD_i = Availability Deduction from Unavailability Event 'i'

Availability Deductions apply in every event of Unavailability in the Calculation Period. If an Unavailability Event starts in one Calculation Period and ends in another Calculation Period, Availability Deductions applicable to the Net Service Payment calculation for a certain Calculation Period should be calculated based on the duration of the Unavailability Event that falls in the respective Calculation Period.

Performance Metrics for Management Services Contracts

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An alternative approach would be to pay a management fee tied to the completion of specified pieces of work, with liquidated damages for the occurrence of availability events and bonuses for the achievement of performance criteria.

- How different this is from the Availability Payment model will depend on how the liquidated damages and performance bonuses are sized. The "Management Fee" approach suggests that less performance risk is being put on the Contractor
- If the liquidated damages and performance bonuses are smaller in relation to the management fee, the contractor will bear less risk for system performance. This may be more appropriate where the system was designed by someone else or is acknowledged to be inadequate
- The decision as to how much the performance risk should be placed on the contractor will be driven by an analysis of the contractors that are actually interested in bidding. Local parties that are less sophisticated and do not have adequate financial resources may not be able to bear performance risk

Private Sector Case Studies

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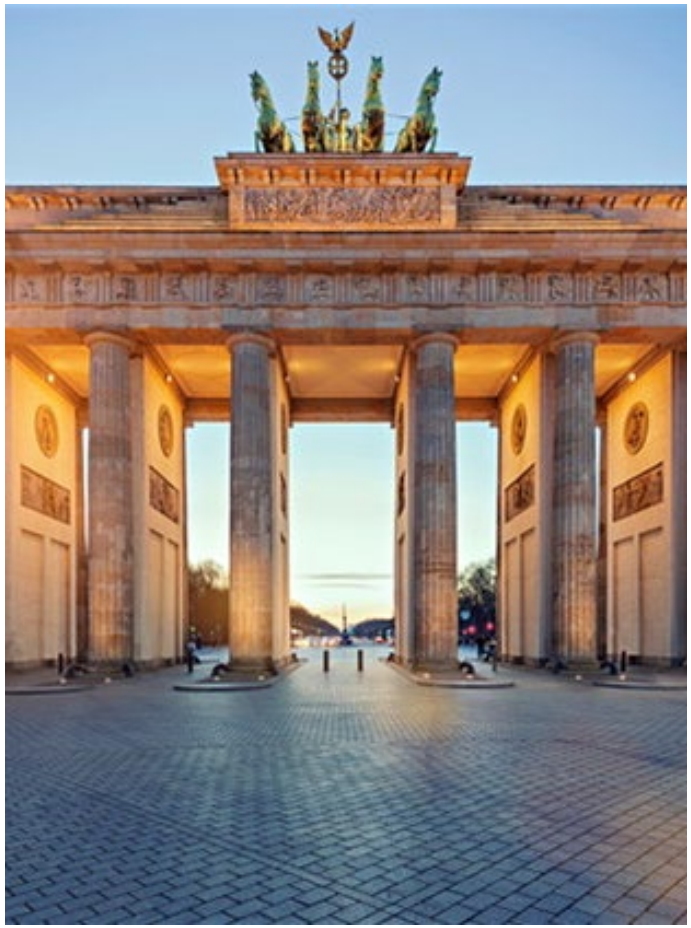
From 2000-2010, Berlin tried a DBO P3 with DB paid for by Berlin and O funded by sale of traffic data, but revenue was insufficient so now they are trying a conventional commercial service contract awarded for 10 years and Berlin is paying for the operation.

- 10 year DBO PPP ended 2011
- Between Land of Berlin and a private consortium consisting of DaimlerChrysler Services and Siemens
- Berlin owned the TMC infrastructure and provided capital costs in hardware and software
- SPV covered operating costs
- Revenue from SPV was supposed to come from sale of traffic information to private and public transport users, but didn't work:
  - Customised travel planning over SMS or smartphones
  - Pre-book car parking spaces
  - Hotels would order branded location maps
- City of Berlin is now paying for the operation under a new 10 year service contract



Private Sector Case Studies

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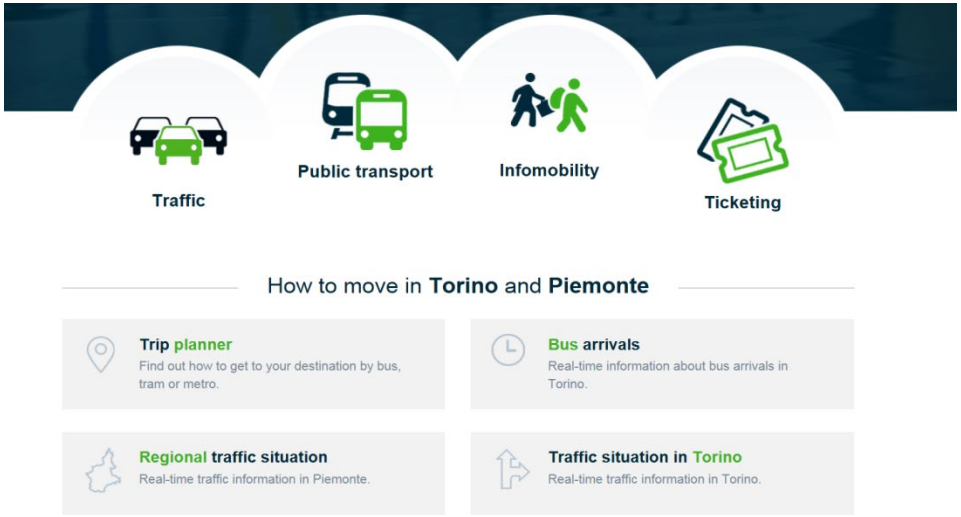
Italy's P3 experiment with the Turin Traffic and Transport Telematics Technologies (5T) ended with the public owning the project company.

- Started as a P3 with Fiat and ITS specialist Mizar Automazione
- US$22 million traffic operations centre integrated with real time public transport monitoring system
- Ultimately failed as a P3 and the public took over the project company
- Initially, by planning and implementing the current system of citywide monitoring and control of over 300 urban traffic lights in the Torino area. The system is managed daily through a traffic operations center whose main task is to manage the infrastructures installed on the territory (3.000 traffic sensors, 26 info panels, 71 traffic cameras etc...) in order to monitor the situation of urban traffic and promptly inform citizens



Private Sector Case Studies

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The UK National Traffic Control Centre is the hub of the English motorway network and was designed, built, financed, operated and maintained as a P3.

- The main objectives of the National Traffic Control Centre are:
  - Providing accurate real-time traffic information to the public using a number of different methods
  - Minimising the congestion caused by incidents, roadworks and events taking place near the motorway and trunk road network
  - Providing information on diversions to help motorists avoid the queues
- In order to achieve these objectives, it collects information from many different sources, analyse it and then disseminate it to the public in a number of different ways
- A special purpose company known as Traffic Information Services (TiS) Ltd, wholly owned by Serco, was established to deliver the project
- Both Halcrow Group Ltd and Balfour Beatty supported Serco with the provision of traffic engineering expertise. IBI Group worked with the NTCC advising on advanced traffic management systems
- The NTCC uses Open Systems Interconnection (OSI) transport software from Boldon James for its control systems
- The contract with TiS is for ten years (2001 to 2011); this includes the 29-month design and build phase followed by a seven year, seven month management and operation contract
- The NTCC building consists of two rooms with a host of redundant computer equipment which is based on PC and Windows NT technology and manned with Serco's team of 150 intelligent transport system software engineers

Private Sector Case Studies

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Payment to TiS was linked to a strict set of guidelines and targets although TiS was also able to subsidise this through the sale of information to value-added service providers. The contract requires 22 distinct services to be delivered to specified standards in exchange for agreed sums of money.

- Collecting a description of the Agency network & its location references
- Collecting roadworks information
- Collecting planned events information
- Collecting unplanned events information
- Monitoring of traffic conditions
- Collecting weather information
- Collecting information about significant congestion
- Off-line development of strategic response to events
- On-line development of strategic response to events
- Off-line evaluation of strategic response to events
- Provision of information via VMS
- Provision of information via the telephone service and internet site
- Provision of information to the media
- Assistance to the Secretary of State with roadworks planning
- Supply of network management and statistics
- Provision of information to the Police
- Assisting Local/other Highway Authorities
- Operate the Traffic Control Centre
- Provide a tours and presentation facility at the Traffic Control Centre
- Administration of the Travel Information Highway
- Provision of journey times on VMS
- Daily delivery of real-time traffic data
- Provision of the Atlas Professional web service

Private Sector Case Studies

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The Mumbai Urban Transport Project, done in conjunction with the World Bank, included an Area Traffic Control Centre operated by ARS T&TT since November 2016

- Awarded by the Municipal Corporation of Greater Mumbai (MCGM)
- ARS T&TT manages the monitoring, audit, calibration and maintenance of the adaptive signaling systems at over 250 traffic intersections and the associated control centre operations for Mumbai Traffic Police and MCGM with the objective of optimizing traffic management in the city of Mumbai
- Adaptive ATM
- Center includes over 250 adaptive traffic signalling systems, video feeds from over 200 surveillance cameras and management of information to several VMS signs across Mumbai city
- As of July 2018, the Traffic Department stated publicly that it wants to blacklist ARS T&TT for failing to maintain the traffic lights.

Private Sector Case Studies

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There have been problems with the intelligent traffic system in Mumbai and angry calls to cancel the contract and blacklist ARS T&TT.

- As of July 2018, the Traffic Department stated publicly that it wants to blacklist ARS T&TT for failing to maintain the traffic lights.
- System has not been working because of software problems and the lights have had to be operated manually at signals by traffic police.
- There have been suggestions that the personnel that have been hired are not familiar with the software and are not competent to operate the system.
- Transport expert Ashok Datar said the ATC was problematic from the get-go. "*The BMC shouldn't have spent crores on it. If one stands at a traffic junction, it becomes evident that these ATCs are a lost cause. ATC, per se, is a good idea, but it doesn't work in Mumbai, which sees heavy traffic.*"

Private Sector Case Studies

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London just entered into a 10 year concession that will result in a significant upgrade to the urban road network traffic control system.

- Previous approach was to award five-year Traffic Control Maintenance and Related Services contracts for different areas of London. Over time, these contracts increasingly tied compensation to performance. Included maintenance of variable message signs, overheight vehicle detectors, safety cameras
- Now, Transport for London (TfL) has awarded Siemens Mobility Limited a 10 year contract which includes design of a new Real Time Optimiser (RTO) system to replace the 30-year-old traffic light control system
- When the road network is disrupted by an unplanned incident, planned work or events, TfL's 24/7 control centre will have a more sophisticated tool to help return the road network back to normal as quickly as possible
- London already has an extensive network of SCOOT-controlled traffic lights, which use sensors to detect traffic and adjust the signal timings to manage queues and give buses priority if they are running late
- Working closely with TfL, Siemens will develop and maintain the new system. The RTO contract allows for ongoing development of the system throughout the duration of the partnership to maximize its potential benefits and ensure a market-leading product
- The RTO system will be made commercially available to other organizations, with TfL benefitting from future revenues

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The new London RTO project consists of three phases.

Phase one: Developing a cloud-hosted traffic control solution to replace the existing Urban Traffic Control system, due to be delivered in 2020

Phase two: Further developing the RTO and working on new adaptive control algorithms for the network, which is due to be completed in stages, starting in 2021

Phase three: From the system going live in 2020, Siemens will maintain the system until 2028

RTO will replace this current capability, and then build on the current optimisation technique, SCOOT. This system automatically adjusts traffic signal timings to minimise traffic delays, give priority to buses, especially when they are detected as running late, give additional time to cyclists using segregated lanes when numbers are high, and at busy pedestrian locations, extend the green pedestrian invitation to cross signal.

Private Sector Case Studies

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Dubai is at the cutting edge of Advanced Traffic Management, but is using consultancy services rather than a P3 or MSC model.

- Enterprise Command and Control Centre (EC3) is operated by the Roads and Transport Authority (RTA).
- The E3 manages operations of the Dubai Metro, Dubai Tram, public buses, taxis and marine transit modes in addition to the traffic control systems. It links the controls of RTA's operational agencies with a central, integrated system unit.
- It will use artificial intelligence (AI) in the management of accidents and crises and use mobile phone data in planning and managing the movement of crowds. It will also simulate the virtual presence on the ground using 3D technology, and monitor mobility movement using drones.
- The RTA's Intelligent Transport Systems department maintains a number of traffic management centres monitoring major arterial routes, centralised intersections and freeways in and around Dubai.
- Atkins has recently entered into a contract with the RTA which will provide traffic control centre consultancy services, as well as traffic signal improvement consultancy for the Dubai Emirate. In addition the team is providing consultancy and training services on traffic signals – looking at current configuration and potential city-wide improvements
- "Smart Drive" mobile app has been a success and downloaded by more than a million people.
- Increasing the number of traffic signals that are connected by wireless to the traffic management centre.

Lessons from Case Studies

- Bankruptcies in Berlin and Turin support decision to use either (i) DBOM (DB paid for by public sector and OM paid for by Availability Payments); or (ii) Management Contract for OM (Availability Payment) as revenues from sale of information have not yet proven sufficient to finance the projects.
- There seems to be a consensus that contracts that include DB elements should last 10 years.
- As the trajectory of UK concessions related to traffic management show, contracts should focus on outputs as well as inputs.
- In order to push performance risk onto the private sector, it may be necessary to involve the same contractor in the DB and OM work, as was done with the UK National Traffic Centre and London TfL Concession. In Dubai, where DB for the cutting edge EC3 was done separately from the OM, Dubai is operating the facility itself with advice/training from consultants.
- As the problems in Mumbai reveal, it will be extremely embarrassing if expensive investments in ATM are not operated and maintained properly. The OM Contractor needs to be on the hook if it fails to utilize the systems provided. The best way to do this may be to have the same party to be responsible for the DB and OM. Regardless, the OM Contractor needs to be competent.

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