

Bus System Reform in Delhi

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1.0 Introduction

India's capital, Delhi, covers an area of nearly 1,483 sq km with a population of almost 16.8 million people. Delhi is the world's most populous city with a high growth rate of nearly four percent a year, roughly half of which is composed of new migrants searching for economic opportunities and a better quality of life.

A fast growing population, urban sprawl, one of the largest road networks in India (2,103 km/100km sq), and the third highest per capita income level in India, have translated into high levels of demand for motor vehicles. Rising appetites for personal mobility are buttressed by the association of car ownership with high social status. In 2008, there were 5.5 million vehicles in Delhi, the largest number in any world city. Nearly 1,000 more are added on a daily basis. Delhi is likely to be a lucrative vehicle market for years to come as ownership levels are still comparatively low, 85 vehicles per 1,000 inhabitants, while the figure is 760 vehicles per 1,000 inhabitants in the UK. Neither is road congestion as severe yet as in developed cities of the world, making it harder to introduce policies that restrain car use and encourage bus ridership.

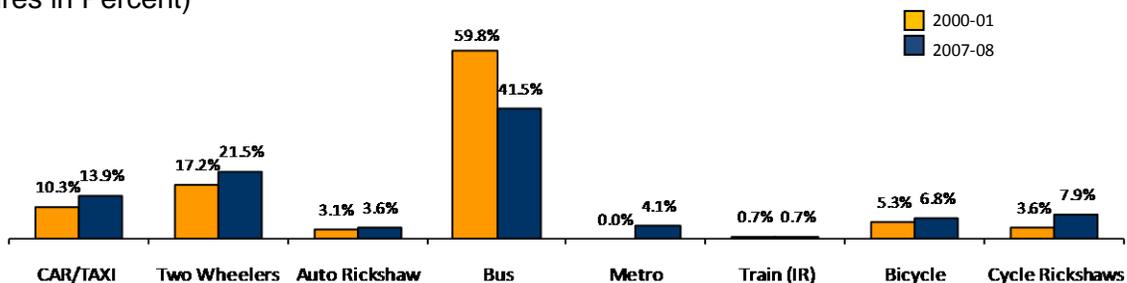
2.0 Challenges to Bus System Reform

In this context, public transport faces an uphill struggle to compete with private vehicles to cater for rising travel demand. The story of public transport so far in Delhi is one of a gradual decrease in modal share, only partially ameliorated by a new metro network.

The Fig 1 below shows that, between 2001 and 2008, public transport fell from nearly 60% of mode share to little more than 45%, including journeys by metro. More alarmingly bus use fell from 60% to 41.5% of trips. The proportion of walking trips alone is 35%.

Fig 1: Modal Split - % of Person Trips in Delhi*

(Figures in Percent)



Source: RITES Delhi Traffic and Forecast Study (2008)

3.0 The Case for Reform

From a public policy perspective a declining share of bus journeys is problematic for a number of reasons. Following the High Court Order, all of Delhi's bus fleet runs on Compressed Natural Gas (CNG) since 2002. CNG emits between 60-90% less local smog inducing pollutants, and

30-40% fewer greenhouse gas emissions (USDEEERE, 2008). The fewer the number of passengers opting for public transport, who switch instead to private motorized vehicles, the greater the amount of pollution both because cars and motorcycles are using dirtier fuels, and because they are consuming more energy to transport each passenger.

The hemorrhaging of passengers away from public transit also increases the costs of running a public bus service as the revenue accrued for each journey falls. This threatens the ability of the state to peg bus fares at low levels to tackle social exclusion - the difficulties that unaffordable bus fares pose to poorer residents trying access employment, goods and services. For society as a whole the increasing number of vehicles adds to congestion and threatens economic growth through longer, unpredictable travel times, more road casualties, greater expenditures on road infrastructure, and higher incidences of respiratory and cardio-vascular disease.

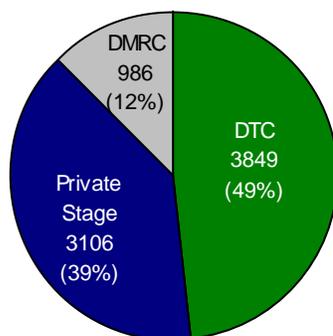
But there is an alternative path to take. Many cities of the world have demonstrated that there is no inevitable link between rising prosperity, population growth and automobile dependency. Appropriately designed land use and transport policies, necessarily involving measures to constrain private vehicles, can preserve and even increase the share of public transport. Although the political will does not yet exist in Delhi for vehicle restraint measures, and land use and transport planning remains split, in theory and practice, there is rising awareness of the need to augment, and improve the quality of public transport.

Since buses are the workhorse of the transport system, still catering for more than a third of travel demand in Delhi, an overarching public policy priority would make buses the mode of choice for India's rising middle class. This is the aim of Govt. of National Capital Territory of Delhi's (GNCTD) plan to re-structure the operation of Private Stage Carriages, a project "Scheme of Private Stage Carriage Corpportisation" currently being implemented by Delhi Integrated Multi-Modal Transport Services (DIMTS) Limited. Inaugurated in 2007, the project's goal is to see 60% of city journeys taken by bus by 2010.

4.0 Bus Services in Delhi – Private Operators and State Run Corporation

Bus services in Delhi are currently provided by private stage carriage operators (PSCs), Delhi Transport Corporation (DTC) and the Delhi Metro Rail Corporation (DMRC), which provides connecting services to the metro rail system. The fig 2 below shows the relative strengths of each fleet in the capital.

Fig 2: Public Bus Fleets in Delhi



Private stage carriage in Delhi is composed of small, individual operators running individual routes with limited ability to cross subsidize services or use one route to increase traffic on another.

In part, this is due to the initial contracting regime, introduced in 1992 to augment a strike-bound and underutilized DTC fleet. The contracting regime for PSCs restricts the total number of buses to be held by one individual to five and each company to 10. Permit holders were also exempt from the Motor Transport

Workers Act, 1961 that defined the labor conditions of drivers employed by owners employing five or more transport workers. It comes as little surprise therefore that over three quarters of the PSCs fleet are run by single-bus operators.

Whilst the aim was to increase competition on the network, this limited bus operations to small investors who could not be expected to hire a professional management team to manage and improve performance, or who had property rights over routes to incentivize long term investment.

Despite this atomized, profit-driven, de-integrated market structure, individual operators have filled some of the service gaps left by the DTC. In narrow financial terms, the PSC scheme is run with extreme levels of efficiency. Each bus makes money in a market where fares are kept artificially low for electoral gain. However, what the state is saving on bus subsidies, the taxpayer is funding in the way of higher traffic enforcement costs, more accidents, road building and maintenance, more pollution and congestion.

5.0 Issues with the Current System

A fully privatized system has also failed to deliver a comprehensive, integrated network in Delhi. A combination of high DTC costs and PSCs that only run on profitable routes, mean that almost half of Delhi's 657 registered bus routes are not operated at all, depriving citizens of access and forcing them onto more expensive transport modes.

5.1. Passengers

Different operators with separate fare baskets running on the same route means that individual bus drivers compete vigorously to pick up as many passengers as possible before their competitor has a chance to do so. For the passenger this leads to overcrowding and discomfort and undesirable driving practices. Examples of undesirable driving practices include:

- The driver may also miss stops when, for instance, another stop, further ahead or off the route, promises greater custom.
- If there are more passengers on the other side of the road the operator may sometimes consider turning round to pick them up, leaving passengers on the bus short of their destination.
- Other undesirable practices include blocking competing buses at a terminal so that they wait until the lead bus is full. This causes unnecessary delays, congestion, vehicle pollution, and instances of road rage.

Overall, the lack of adherence to a schedule can lead to 'waiting anxiety' amongst passengers who remain uncertain about the time of bus arrival. One symptom of 'waiting anxiety' is to see passengers spilling out on the road because their numbers have increased to unacceptable levels and they are anxious to board the bus faster than fellow travelers in order to bag a seat.

'Waiting anxiety' can increase too when vehicles are impounded for any conceivable offence. Whilst some routes have an unpredictable service, others will become cartelized by particular owners who fill a route so much that it becomes uneconomic for other owners to enter the market.

5.2. The General Public

For other road users, competition for passengers translates into dangerous driving practices with buses racing against each other, or cutting one another up to 'win' revenues. Rather than trusting legally employed staff to return passenger revenue, an owner may sub-let their bus to a

third party for a fixed daily fee. Known in Delhi as the 'theke' system, this transfers all revenue risk to the driver who speeds in order to ensure he is not out of pocket by the end of the day.

In a sub-letting scenario it becomes very difficult to keep a check on the competency of each driver. In order to increase bus speeds to overtake potential competitors, engine tampering is also common, reducing stopping distances and increasing road risk. Since 2002 the share of PSC buses in road casualties compared to DTC buses has risen from 51% to 71%.

6.0 The Reform Recipe

Changes to this pattern would not only require an upping of enforcement activity. An analysis conducted by Steer Davies Gleave (SDG) into the Delhi bus network highlighted on-road competition as 'the largest systemic contributor to unsafe driving and accidents.' (DIMTS 2007) According to SDG, a lasting remedy would require nothing short of a root and branch overhaul of the institutional incentive structure for private competitors providing public buses. A lynchpin of that reform would involve decoupling operator revenue from the number of passengers carried to avoid the negative effects that result from competition for passengers on the streets.

7.0 Vision

The city combined this goal with a vision of a network that could cater as much for the urban poor as for the rising middle classes who would otherwise switch to private transport as soon as they were able to. It is this comprehensive vision which guides Delhi's Corporatisation of Private Stage Carriage Service Scheme, the key features of which include:

- A safe, high quality bus network, passenger-guided and responsive to changes in demand due to economic growth and demographic shifts
- A universal bus network providing service availability on all scheduled routes to people from all sections of the community
- A cost-effective network that minimizes user tariffs and recourses to public subsidy
- An integrated network that is simple to use, has high standards of reliability, comfort and customer service

8.0 Principles of the Scheme

A number of guiding principles were applied to find a solution and set out a number of important service planning objectives that the new institutional incentive structure would have to meet.

Safe Network

- a) Mitigation of safety risk by replacing 'competition *in* the market' to 'competition *for* the market'.

Economic Network

- a) A minimum scale of operation to facilitate appropriate management skills.
- b) Network rationalization and optimization.

Effective Network

- a) Clear contractual obligations and responsibilities.
- b) Capability to accommodate changes in regulatory policy (e.g. fares).
- c) The majority of passengers should be able to use the network on a 'turn up and go' basis

- d) The service pattern should be as simple as possible.

Universal Network

- a) Maintain service levels on existing routes and extend coverage to residential and employment centers, ensuring that people have access to local amenities like shops, hospitals, schools and transport interchanges.

Responsive Network

- a) Greater scope needed to respond to shifts in demand.
- b) Ability to test for and respond to demographic changes and economic growth.
- c) Providing even service intervals when frequencies are high and running to time when they are low.
- d) Integrating with the existing and proposed mass transit system.

9.0 Striking the Right Balance Between Cost and Quality – the Gross Cost Model

In order to realize these objectives DIMTS understood that a better balance needed to be struck between the need for narrow, financial efficiency delivered by the PSCs and improvements to journey quality that Delhi's citizens demanded if the bus market in Delhi were to grow. This would involve breaking the link between profit-making and passenger numbers with the provision that incentives were in place for operators to deliver a frequent, reliable, and high quality service.

DIMTS adopts the successful working examples of regulatory systems that paid bus companies according to quality variables and schedule completion rather than passengers carried. In London and Bogota, for instance, the efficiency benefits of competition are substantially retained by replacing competition on the road to competition to win a concession. Once the concession is awarded on the operator's estimate of how much it will cost to deliver the regulator's contract specifications in entirety, the revenue risk falls on the shoulders of the government.

Known as the 'Gross Cost Model', the regulator defines a package of service schedules and functional specifications under one recognizable brand, 'Delhi Transit'. In the case of Delhi, DIMTS has divided 657 routes into 17 area based clusters. Each of the 17 concessions has been designed to allow the operator to integrate services sufficiently within his/her area-based cluster. New service permits will allow the operator to ply any bus on all routes in a given cluster, in competition with DTC buses only. All ticket revenue is returned to the government and paid to the operator on the basis of pre-defined costs that they set out in their original tender to run each contracted bus kilometer.

There are a number of important benefits that attracted DIMTS to the gross cost model. The tender specifies rates for 'Short Term Marginal Service' and 'Long Term Marginal Service' increments, enabling the regulator to add routes, change frequency or redeploy resources. This is especially important in Delhi, where the government is nearly doubling the number of effective routes, and significantly improving the journey experience on existing services. Route enhancements will take time to test and bed-in the minds of Delhi's citizens. The government will also be able to alter fares and ticketing policy without protracted negotiations with operators. Since the government is guaranteeing a revenue stream, the costs of project finance are comparatively low and there is no disincentive to refuse concessionary fares.

A social cost benefit analysis was also undertaken to assess the economic rate of return for the project. Under nearly all scenarios the analysis was found to be positive.

Social Cost Benefit Analysis of Private Bus Operation Re-structuring in Delhi

A cost-benefit analysis was carried out to determine the most likely economic rate of return (ERR) of the proposed bus restructuring in New Delhi. It is assumed that the decline in public transit usage (4.8% p.a from 2000 to 2007) will be reversed. The benefits are reduced private vehicles on the road leading to less casualties, less fuel consumption, lesser vehicle operating costs, reduced passenger time, and reduced environmental and health related costs. The main cost of restructuring would be GNCTD payments to the private operator on the basis of the gross cost model. Capex, operation and maintenance have not been considered in the analysis as these will be taken care of by the operator and as such are not public expenditure.

Table 1 below sets out the ERR for a gradual (2009-2014) and an immediate arrest in the decline of bus patronage in Delhi. Benefits are expressed in terms of journey time savings arising from congestion relief. In all cases the ERR is positive from 11% with a 0.5% mode shift and three minute time saving, to 52% under a 2% modal shift and a 6min time saving.

Table 1: Economic Rates of Return for Bus restructuring project in Delhi

Passenger Time savings	ERR for Gradual Arrest in Decline of Bus Patronage (full arrest in 2014)				ERR for Immediate Arrest in Decline of Bus Patronage (from 2009 onward)			
	Mode shift from private vehicles				Mode shift from private vehicles			
	0.5%	1%	1.5%	2.0%	0.5%	1%	1.5%	2.0%
3 minutes	11%	16%	18%	21%	15%	20%	24%	28%
6 minutes	18%	22%	25%	27%	34%	41%	47%	52%

Sensitivity Analysis

A sensitivity analysis determined the ERRs for the scenarios assessed in the financial model of the restructuring. For the worst case scenario (Rs. 45 crore/cluster in year 1), the ERR turns out to be only 7%. The benefits start accruing from year 2025 for the two options of bus patronage.

Table 2: Economic Rates of Return for various scenarios

Scenario	Economic Rate of Return (assuming gradual arrest in decline of bus patronage as most likely)			
	Mode shift from private vehicles			
	0.5%	1%	1.5%	2.0%
Most Likely Scenario	11% (2020)	16% (2016)	18% (2013)	21% (2013)
Worst Case Scenario	Negative	Negative	7% (2026)	9% (2021)
Best Case Scenario	Benefits far outweigh costs for this scenario			

Note: Figures in parentheses indicate year from which benefits will accrue

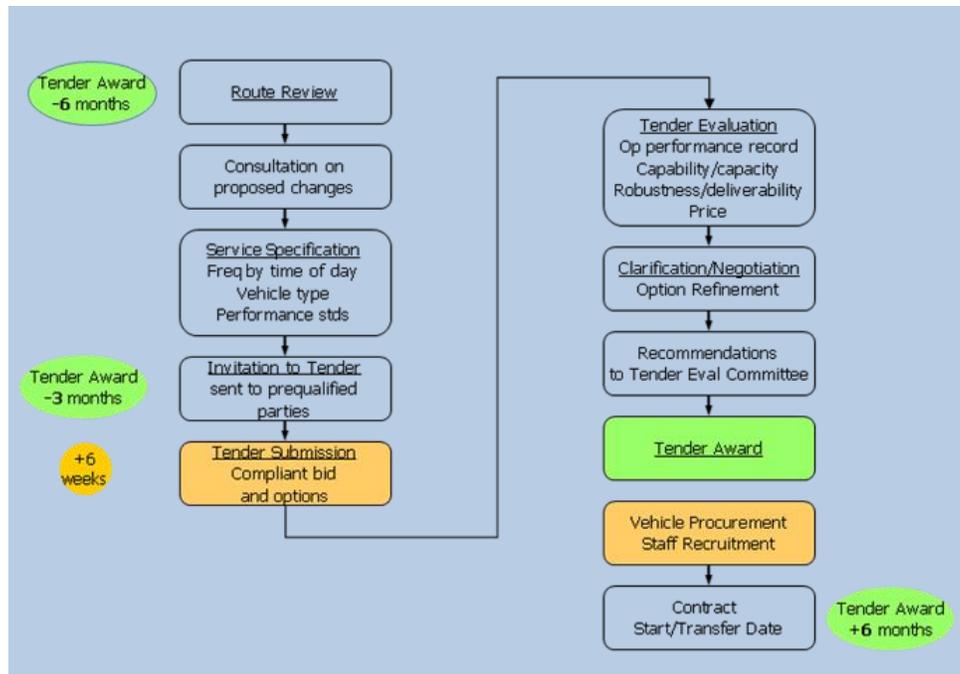
Conclusions

The economic rate of return of 16% (which is above the criteria of 12% prescribed by the Planning Commission for infrastructure projects) assuming just a 1% modal shift from 2014 and a gradual arrest in decline of bus patronage and a 3 minute time savings, implies that the restructuring project will yield substantial benefits to the entire economy of Delhi.

10.0 The Contracting Process

After conducting the Cost-Benefit analysis, DIMTS embarked on a tender process, which, with some minor modifications, is set out below. Pre-qualified parties were considered to have sufficient financial strength and operational experience in a transparent Request for Qualification (RFQ) stage conducted by DIMTS. DIMTS' tender evaluation included an examination of the bidder's ability to meet bus quality, driver competency, and performance standard criteria.

Fig 3: The Contracting Process



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To tailor the model specifically to the conditions in Delhi, DIMTS decided to increase the concessionary period of each contract from five years, as evinced in other cities using gross cost, to ten years. This allowed bidders a sufficient period to recoup the extra costs involved in procuring CNG buses. In assessing 'value for money' DIMTS used a public sector comparator, the costs of running equivalent services by the DTC.

One potential downside with the gross cost model is that, once the bid for a concession has been won, in the case of Delhi for the next ten years, the incentives to run a service in accordance with the contract can be very low. Since the operator's revenue is not dependent on how many passengers they carry there is a possibility that they cut corners to reduce costs. This could involve not stopping at bus stops, reducing service frequencies and cutting down expenditures on driver and vehicle standards. Neither does a gross cost contract eliminate risk entirely. Changing input prices and a lack of control over bus depots could increase costs over and above those specified in the original tender.

11.0 Performance Management System

DIMTS therefore set about developing a performance incentive regime to reward or penalize the operator on the basis of the quality of service delivered. Following public consultation and research parameters chosen for operator evaluation by DIMTS included:

- Service Reliability and Frequency (*)
- Bus Crowding (*)
- Journey Time (1/2*)
- Affordability (1/4*)
- Accessibility to Bus Stops
- Bus Accessibility*
- Staff Attitude and Behavior*
- Personal Safety and Security during the Journey*
- Vehicle Cleanliness*
- Vehicle Repair*
- Access to Travel Information (1/2*)

= Degree of operator influence (1/2 = Some, * = Substantial)

A number of important principles informed DIMTS' approach to achieving these objectives. Targets needed to be realistic and achievable. DIMTS also developed careful estimates of the costs of delivering the required standard to calibrate rewards at a level slightly higher; high enough to encourage compliance, but low enough not to represent an unnecessary drain on the public purse. Based on ten years of experience implementing the gross cost contract model in London, DIMTS set caps on the scale of reward and penalty at 15% and 10% respectively.

Each of the parameters above required a metric to assess operator performance and serve as the yardstick against which to issue operator payments or deductions.

Table 3: DIMTS Performance Management Regime

Performance Objective	Performance Measurement	Conditions	Way of checking
Reliability and Frequency (1)	Adherence to Unified Time Table (UTT) (2 mins early to 10mins late)	Earliest and latest starts specified for each bus at different checkpoints en-route	Route scheduling software and Operator Control Centre (OCC)
Reliability and Frequency (2)	Lost Kilometerage (0% of journey to 99.9% of journey undertaken)	Loss of between 150% to 50% of contract price for each bus trip	Route scheduling software and OCC
Reliability and Frequency (3)	Operating more kilometers than specified	Loss of 200% to 400% of service payment	Route scheduling software and OCC
Personal safety	Infraction Categories (A-F)	Fines ranging from Rs. 50 to 2,000 for each	Visual checks, electro-magnetic reviews, data from OCC
Operational best practice	Infraction Categories (A-F)	Fines ranging from Rs. 50 to 2,000 for each	Visual checks, electro-magnetic reviews, data from OCC
Accidents	Incident reporting	Driver re-training and fine up to Rs. 25,000	OCC and incident reporting

Source: DIMTS, 2008

12.0 The Role of Information Technology

As the table shows, there is a strong reliance upon modern location technology and intelligent transport systems to monitor operator performance and calibrate rewards and penalties. In Delhi reliance on information technology is important as the introduction of a manual checking regime would face a high risk of rent-seeking from enforcement personnel. Likewise, a concentrated effort to introduce automatic fare collection via a smartcard based system is likely to help reduce revenue 'leakage' through a cash-based fare box controlled by the operator. A Designated Bank account will be used to manage cash, smartcard and concessionary fare subsidy revenue, including a system to disburse operator payments in strict order of priority.

DIMTS' plan is to equip each vehicle with an automatic vehicle location system (AVL). The OCC will monitor the movement of each vehicle set against its adherence to the Unified Time Table (UTT) set by DIMTS. An algorithmic software system will calculate penalties and rewards for reliability and frequency. In case of foreseeable defaults the operator will notify DIMTS of the inability to deliver a service, allowing a suitable replacement to fill the gap.

13.0 Systematic, Manual Checking

Operational best practice, passenger safety and accident risk are essentially a function of driver performance and vehicle care and management. It may be possible to verify certain performance parameters such as vehicle speeding, using logistical software, but DIMTS is equally aware of the need to rely on manual checking for verification. For instance, it would be very difficult to check on driver care during passenger alighting and boarding using AVL alone. For this reason, infraction reports and vehicle checking will be undertaken manually, at least for the time being. In addition to this, DIMTS will also introduce a biometric identification system to register and certify drivers, as well as, conductors.

14.0 With in-built Performance Incentives

Operator adherence to high vehicle maintenance standards is likely to have a strong incentive through the provision of financial rewards for running a reliable system. Under-maintained buses are likely to break down more often, incurring the operator a financial penalty. In order to improve maintenance operations and reduce 'dead mileage', DIMTS is developing a number of strategically located bus depots with recourse to government funding.

Greater reliability will also lead to important consumer benefits including reductions in waiting anxiety, especially when combined with another aspect of DIMTS corporatization project, the establishment of real time 'Passenger Information Systems' (PIS) at all main stop. Other improvements proposed by DIMTS include a rationalization of fares structures and permit conditions to simplify the system both for passengers and operators. Fares are currently infrequently revised with the result that they are too low to cover costs, whilst the multiplicity of permit conditions increases costs and introduces opportunities for illegitimate rent seeking by enforcement authorities.

15.0 Conclusion

The challenges facing the GNCTD in reforming the bus network are immense but not insurmountable. Delhi's bus network is doubling in size to cope with a population of 16.8 million people and begin winning people back off their motorcycles and out of their cars. To make the

scheme successful, DIMTS is designing routes, timetables and organizing area-based clusters to promote competition but also building a framework that encourages operators to integrate their transport in passengers' interests. The new bus network will need to meet the traditional goals of affordability but also raise enough revenue to invest in a better quality system than the private stage carriage operations that preceded it. In this regard a high level of importance is being accorded to a quality management regime that can measure performance delivery, reward the best and deliver improvements from the rest.

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