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Delhi Metro – The Changing Face Of Urban Public Transport in India

E. SREEDHARAN *

For many years, India lagged behind the rest of the world in the field of urban public transport. This changed with the formation of the Delhi Metro Rail Corporation Ltd. (DMRC) in 1995, with the mandate to build a Metro system in the Indian capital New Delhi. Construction began on 1 October 1998 and today the Metro system spreads across 65.1 km. The project has provided significant environmental and social benefits to the city. At present, Phase II of the project is being constructed. It is very ambitious because about 125 km have to be completed before the Commonwealth Games in October 2010.

Since gaining independence, India has witnessed significant socio-economic developments. However, most cities rely almost exclusively on road transport and roads are rapidly becoming choked. Kolkata introduced a Metro railway system in the 1980s but the project exceeded its budget and completion schedule, seriously undermining the confidence of the Government and people in Metro systems.

It was in this milieu that the Delhi Metro project was planned. The need for a reliable public transportation system had been felt for a long time. Delhi's population stands at 13,782,976 spread over 1,483 square km. The city has more vehicles (4,183,609)¹ on the road than the other Indian metropolises Mumbai, Kolkata and Chennai combined. A comprehensive traffic and transportation study completed in 1990 highlighted the urgent need for a rail-based transit system comprising a network of underground, elevated and surface corridors to meet the traffic demand projected for 2021.

To make this dream a reality, the Delhi Metro Rail Corporation Limited (DMRC) was registered on 3 May 1995 under the Companies Act 1956 with equal equity participation by the Central Government and the Delhi Government. DMRC is solely responsible for the construction and operation

* Dr. Sreedharan is Managing Director, Delhi Metro Rail Corporation Ltd., New Delhi.

of the Metro system in Delhi. The Transport Department of Delhi government (the public transport authority) is a separate entity and DMRC has no contract with it for the running of the Metro system.

Phase I Fully Operational

The first section of the Delhi Metro was opened to the public on 25 December 2002. Over the next four years, newer sections were regularly opened. The last section of Phase I was opened on 11 November 2006 and today this phase is fully operational.

Even though the whole scope of the work was changed from the original proposal, DMRC was able to complete Phase I in seven years and nine months as opposed to the projected ten year period. The project was also completed within the estimated cost of EUR 1.59 billion, which includes infrastructure, equipment and rolling stock costs.

Today, the Metro network spreads across 65.1 km in New Delhi and connects some of its most populated areas. Of this, 47.43 km are elevated (mostly along central median strips), 13.17 km are underground and 4.5 km. are at grade. It is the largest urban intervention in the transportation sector in India since independence and has completely changed the way the city travels.

One Hundred Per Cent Punctual Operations

At present, DMRC has 70 train-sets consisting of four coaches each. Over 1,200 train trips operate from 6 am to 11 pm with a punctuality rate of nearly 100%. The Delhi Metro has a very lean staff strength of just 45 employees per km, making it comparable to the best in the world. Over 0.6 million commuters travel on the system every day and DMRC has an enviable safety record in nearly five years of operation.

Technological Difficulties

Construction of the Metro was not an easy task and several technological difficulties were encountered. Tunnelling below the historic Old Delhi area posed a major challenge, as the buildings there have weak foundations. It was therefore, decided to construct the tunnel at a depth of more than 20 metres.

Tunnelling difficulties were also encountered in some sections due to hard rock. Special cutter heads were procured for Tunnel Boring Machines (TBM) to tackle this problem. In several locations, the Metro viaduct had to be built over railway bridges and flyovers without disturbing the traffic using steel span bridges.

DMRC also built India's first extra dosed bridge over operational railway lines. The bridge is 196.3 m long and the main span of the bridge - which is 93 m long - does not have any supporting piers. In addition, the bridge has a 302 m radius curvature as required by the alignment.

Delhi Metro built a state of the art, 553m long continuous, single prestressed box girder, for two tracks across the river Yamuna. The bridge was completed in period of just 30 months by using a special technique called "incremental launching", which is ideal for busy cities because it allows construction without any major disruption of traffic. Also, since the bridge is advanced by sections, unlike conventionally built bridges, there are no joints and this ensures a smoother journey for commuters.

Latest Technology Used

A showcase of the latest in railway technology, the Delhi Metro trains run on "ballast-less tracks" on the elevated viaduct and the underground corridor, thus minimising the need for track maintenance and also reducing the running dimensions on structures. Besides lower maintenance costs and improved safety, this promises minimal vibration and greater riding comfort for passengers.

DMRC has also used the latest technology in the fields of signalling, telecommunications, rolling stock manufacturing, automatic fare collection systems and traction and track technology. In fact, contact less tokens were introduced for the first time by Delhi Metro and have now been adopted by the Hong Kong, Bangkok and Taipei Metros. Initially, rolling stock was imported but now assembly has commenced in India. Local vendors are also being encouraged to absorb new technologies in other areas.

Funding of the Project

Of the total project cost for Phase I, 28% was financed through equity contributions subscribed equally by the Central Government and the State Government. The two Governments also agreed to provide an interest free subordinate loan to cover the cost of land acquisition, which equates to roughly 5% of the project cost.

The Japanese Government financed about 60% of the cost by way of a soft loan through the JBIC. The remaining 7% of the project cost was met by raising money through property development.

Operational Profits from Day One

Delhi Metro has been making operational profits from the first day of operation and has already started paying back the JBIC loan. In fact, the construction of the second phase is being partially funded from these

operational profits. DMRC is carrying out property development activities to keep fares at a minimum. It has developed Delhi's largest IT park, while shopping centres and kiosks are present at almost all Metro stations.

Environmental and Social Benefits

DMRC has provided significant environmental and social benefits to the city. According to a recent study conducted by the Central Road Research Institute (CRRI), these benefits will help recover the full cost of Phase I by 2013. These benefits are result of several factors including:

- Passenger time saved
- Fuel costs saved
- Reduction in capital and operating costs of vehicles
- Reduction in environmental damage
- Time savings
- Lower maintenance costs for infrastructure
- Reduction in road accidents
- Improvement in road traffic conditions

Since DMRC began operations in December 2002, there has been a progressive reduction in daily vehicle demand. By the end of 2007, the Metro will have taken the load of 40,000 vehicles. The Metro has also resulted in reduced consumption of petrol, diesel and compressed natural gas (CNG): by the end of this year 57,858 tonnes will have been saved.

Future developments include plans to establish fare integration with the bus system operated by the Delhi Transport Corporation, a Government undertaking, and the future LRT system. Preliminary steps in this direction have already been taken and plans are underway to integrate fares with a fleet of feeder buses owned by DMRC itself.

Construction of Phase II Progressing Swiftly

Construction of Phase II of the project is currently underway. This phase consists of 128.06 km, of which 94.13 km will be elevated, 29.83 km underground and 4.10 km at grade. This includes a 19.5 km high-speed line from the city centre to the international airport. This distance will be covered in 15 minutes and the stations will have check in facilities.

Phase II of Delhi Metro is very ambitious because the entire project has to be completed before the Commonwealth Games in October 2010. This means that while Phase I was completed in seven years and nine months, Phase II has to be constructed in just three and a half years. DMRC has designated a number of project managers who will be responsible for timely completion of their respective corridors.

Phase III and IV are planned to be taken up after 2010. It is envisaged that the Delhi Metro will spread across 413 km by 2021, making it one of the biggest Metro system in the world.

Spread of Metro Culture to other Indian Cities

The success of the Delhi Metro has encouraged other Indian cities to seriously attempt to introduce Metro systems. DMRC has already been appointed the Prime Consultant for Hyderabad and Kochi Metro and is the in house consultant for Mumbai Metro. DMRC has also submitted Detailed Project Reports (DPRs) for Metro systems in Bangalore, Kolkata (East-West Line), Mumbai, Ahmedabad and Chennai. DPRs are being prepared for Pune and Ludhiana. In fact, work has already begun on the Bangalore and Hyderabad Metros.

Conclusion

Today, the Delhi Metro project is a model of how urban transport systems can be successfully built in crowded cities. Visitors from the US, the UK, Japan, South East Asia and South Asia have toured the system to understand DMRC technologies and project management techniques. Delhi Metro has also attracted the attention of other countries such as Ireland, Pakistan, Sri Lanka, Bangladesh and Vietnam. DMRC recently received its first international consultancy assignment for Special Assistance on Project Implementation (SAPI) study for the Jakarta Mass Rapid Transit (MRT) System in Indonesia.

However, perhaps the greatest achievement of DMRC is that it has given Indians the confidence to believe in themselves and trust that they can efficiently build the most challenging and technically complex projects.

1. Source: Transport Department, Govt. of Delhi (2003-04).

* Source: *Public Transport International*, November/December 2007.