Moving Millions with the Mumbai Metro

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INTRODUCTION

On 26 February 2019, the Asian Development Bank (ADB) approved a $926 million loan for the Mumbai Metro Rail Systems Project. The project will support work including the (i) design, manufacture, testing, and maintenance of 378 energy-efficient rolling stock carriages; (ii) procurement, installation, and testing of an advanced signaling, train control, and platform access system for 58 kilometers (km) of metro lines; and (iii) establishment of a Mumbai Metro operations organization. It will contribute to the development of a modern and safe rail-based urban transit system, which is expected to reduce pollution and traffic congestion, increase public transport ridership, and improve the overall quality of the city’s transport system.

BACKGROUND

Mumbai, the capital of the state of Maharashtra, is one of India’s largest metropolitan areas. It is also known as the financial capital of the country. The Mumbai Metropolitan Region (MMR) covers an area of about 4,355 square km with a population of more than 18 million. Hosting the two major ports that handle more than 30% of India’s sea trade—Mumbai Port Trust and Jawaharlal Nehru Port Trust—the MMR makes a very substantial contribution to the country’s economy. Data show that the state of Maharashtra produced about 15% of India’s gross domestic product in 2017, about 40% of which is estimated to be from the MMR.1

CURRENT PUBLIC TRANSPORT SYSTEM

The current public transport system in Mumbai is extremely crowded, unsafe, and slow. Among all users, vulnerable groups including the poor, women, and children are the worst affected. The public transport share of trips has declined steadily—from 88% in 1994 to 78% in 2005, and 70% in 2015. Yet, Mumbai still has one of the highest rates of public transport among cities worldwide. The primary reasons for the decline are the expansion of the urban area and the inability of the existing public transport system to serve the increasing demand. This has resulted in a 400% increase in private vehicles from 2008 to 2015.

The suburban railway lines carry more than 7.5 million passengers per day, often under “super dense crush load” conditions that exceed 14 passengers per square meter. As a result, the rail system in Mumbai has become the most crowded public transport system in the world. Each train carries about 5,000 passengers, more than its actual design capacity of 1,750 passengers. Suburban trains have severe safety problems, with more than 3,000 fatalities per year due to overcrowding and right-of-way encroachment. These constraints, in addition to the overwhelming demand, also limit the speed of the rail service and its ability to accommodate more passengers.

Meanwhile, the bus system operated by the state-owned Brihanmumbai Electric Supply and Transport Undertaking carries more than 5 million passengers per day in highly congested conditions.

The rail system in Mumbai has become one of the most crowded public transport systems in the world.
Moving Millions with the Mumbai Metro

PLANS FOR A NEW METRO SYSTEM

Increased public transport capacity in Mumbai is crucial to addressing commuting problems and, consequently, improving livability; providing safe and convenient mobility, especially for the poor, women, and children; arresting the decline in public transport mode share; and enabling the city to develop to its potential. The geographic and infrastructure constraints and extremely high population density in Mumbai make a metro rail system a viable solution to its commuting problems. The government has thus developed a plan for 12 metro lines covering 276 km.

The first line of this metro network (Line 1) has been operating since 2014. This single metro rail line, from Versova to Ghatkopar, carries about 400,000 passengers per day. It has reduced travel time and congestion. The geographic and infrastructure constraints and extremely high population density in Mumbai make a metro rail system a viable solution to its commuting problems.

time along the corridor from 71 minutes to 21 minutes and addressed traffic congestion by shifting the demand for travel via private vehicles toward informal public transport modes to the Metro. Line 1 was built and now operates through a public–private partnership model.

For subsequent lines, however, the Government of Maharashtra has decided to entrust construction to the Metropolitan Mumbai Regional Development Authority (MMRDA). The scale of investment for the multiple lines is very large, and it is difficult for metro rail systems to meet equity return expectations of the private sector. Hence, the proposal is to follow a model whereby the government finances the assets using its own funds and development assistance, and then outsources service contracts for operation and maintenance. This is common practice for most metro systems worldwide.

Line 3, which extends from South Mumbai (Colaba) to the Santacruz Electronic Export Processing Zone, will be an underground line covering 34 km and is being developed by the MMRDA with assistance from the Japan International Cooperation Agency. For the other lines, which are currently at different stages of planning and construction, the MMRDA is seeking financing from development agencies, including ADB, the Japan International Cooperation Agency, and the New Development Bank.

India’s Metro Rail Story

The first rapid transit system in India was the Kolkata Metro, which began operation in 1984. The next was Delhi Metro, which was launched in New Delhi in 2002. The Delhi Metro has the country’s largest network and established good practices of metro project implementation and operation and management, backed by a strong institutional mechanism of acquiring, accumulating, and scaling expertise within its organization, such as an extensive training program.

Following the success of the Delhi Metro, many cities in India began exploring options to implement metro rail projects. There are currently 10 operational rapid transit (or metro) systems in India covering 647 kilometers. Another 880 kilometers of lines are under construction.

Growth of Metro Rail Line in India (km)

km = kilometer.
Source: Ministry of Housing and Urban Affairs.
PROJECT OUTPUTS AND HIGH-LEVEL TECHNOLOGY

ADB is providing financial assistance to the following lines: (i) Line 2A from Dahisar to D. N. Nagar, (ii) Line 2B for D. N. Nagar–Bandra–Mandale, and (iii) Line 7 from Dahisar to Andheri (East). The aggregate length of these lines is about 58 km. ADB will assist the MMRDA in financing the procurement of rolling stock, signaling and train control systems, and station access and platform systems; and support multimodal integration. The project, which is expected to cater to about 2,000,000 passengers per day after operations stabilize (Table 1), will improve urban transport safety and comfort and provide residents, especially the poor and vulnerable, with enhanced access to economic opportunities and social service facilities.

Table 1: Daily Ridership Estimates

<table>
<thead>
<tr>
<th>Year</th>
<th>Maximum Design Capacity (PPHPD)</th>
<th>Daily Ridership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Line 2</td>
<td>Line 7</td>
</tr>
<tr>
<td>2024</td>
<td>36,150</td>
<td>18,100</td>
</tr>
<tr>
<td>2031</td>
<td>38,500</td>
<td>18,600</td>
</tr>
</tbody>
</table>

PPHPD = passengers per hour per direction.
Source: Metropolitan Mumbai Regional Development Authority estimates.

The new Metro lines also offer an opportunity to create a modern public transport system with innovative technological features:

- **Speedier operation.** The Metro will use modern signaling systems that employ communications-based train control technology. This will allow more trains to run at shorter intervals safely.

DEVELOPMENT IMPACT OF METRO RAIL SYSTEM

Once all the 12 lines are complete, the metro network will provide easy access across Mumbai. The Metro will also relieve pressure on the existing suburban railway and buses, reducing overcrowding and enhancing safety. It will pave the way for smart urban growth in India’s financial capital. In the process, it will also reduce emissions from vehicles—carbon dioxide emissions are expected to fall by about 166,000 tons a year.

By 2021, the metro rail corridor development in Mumbai should result in a substantial improvement to its urban transit system, with the overall public transport share expected to reach around 80%. Table 2 shows the changes in projected mode shares from 2014 to 2034.

Table 2: Projected Mode Share with Planned Metro, 2014–2034

<table>
<thead>
<tr>
<th>Modes</th>
<th>2014</th>
<th>2019</th>
<th>2024</th>
<th>2034</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>8.5</td>
<td>10.3</td>
<td>9.5</td>
<td>8.6</td>
</tr>
<tr>
<td>Two-wheeler</td>
<td>10.8</td>
<td>8.1</td>
<td>7.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Auto rickshaw</td>
<td>4.2</td>
<td>4.6</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Taxi</td>
<td>4.9</td>
<td>6.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Bus</td>
<td>25.6</td>
<td>23.5</td>
<td>12.6</td>
<td>11.4</td>
</tr>
<tr>
<td>Suburban rail</td>
<td>43.5</td>
<td>44.2</td>
<td>38.7</td>
<td>38.1</td>
</tr>
<tr>
<td>Metro and monorail</td>
<td>2.4</td>
<td>2.8</td>
<td>27.4</td>
<td>30.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note: Numbers may not sum precisely because of rounding.

The Metro will relieve pressure on the existing suburban railway and buses, reducing overcrowding and enhancing safety.
Bus share is also expected to drop, as bus services are redesigned to primarily serve as a major access and egress mode for the suburban train and metro systems. Consequently, the overall informal public transport and share of private vehicles is expected to decrease from around 30% to about 20%. The mode shift will improve travel conditions for commuters on suburban trains, reducing fatalities and accidents associated with overcrowding on trains. The additional metro lines are expected to reduce the number of private vehicles in use, informal public transport, and bus trips in the city. As motorized vehicles are major contributors to poor air quality, this modal shift can contribute to a better urban environment by reducing vehicle emissions as well as environmental, business, and social costs associated with traffic congestion. Road safety will also improve.

Low ticket prices will bring comfortable public transport within reach of low-income commuters, and some stations will be easily accessible to serve the poor areas in the city. Female commuters will also benefit from women-only carriages, mobile applications for security, separate ticket counters, and reporting desks to address incidents of harassment.