INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN: 2277-7881; IMPACT FACTOR – 6.014; IC VALUE:5.16; ISI VALUE:2.286
VOLUME 8, ISSUE 8(6), AUGUST 2019

URBAN TRANSPORT: A STUDY OF METRO RAIL PROJECTS IN INDIA

Dr.B Sunitha Padmavathi
H.O.D Public Administration
Govt.Degree College Sitaphalmandi, Hyderabad.

Abstract

With the rapid growth of urbanization, the size and population of metropolitan regions are expanding rapidly. This puts more pressure on urban traffic in the c system. Several problems such as traffic congestion, and improper driving of private vehicles have led city buses to slow and decrease the efficiency of urban public transport. With the increasing travel demand and inadequate transportation system, the transport situation in most Indian metropolitan cities is rapidly deteriorating. The crisis of urban transport is facing all sizes of Indian cities. Despite investments in road infrastructure and plans for land use and transport development, all face the problem of congestion traffic accidents and air pollution and the problems continue to grow. Metro rail projects provide high-capacity public transit and are capital intensive. However, considering the rapid urbanization and the imminent need for enhancing mobility in cities through metro rail, it is imperative to explore alternative and innovative sources of funds to supplement budgetary resources. At the same time, it is also important to ensure that the proposals are prepared and appraised in a comprehensive manner to enhance urban mobility as well as the speed and quality of implementation of metro projects. In this context, this study analysed the trends of urban transport in India and examined the performance and challenges of metro system in India.

Keywords: urbanization, Metro, urban transport, Multi-modal Transport system (MMTS) etc.

Introduction:

The urban population of the world has grown rapidly from746a million in 1950 to 3.9 billion in 2014. Asia, despite its lower level of urbanization, is home to 53 per cent of the world's urban population, followed by Europe (14 per cent) and Latin America and the Caribbean (13 per cent). Just three countries—India, China and Nigeria— together are expected to account for 37 per cent of the projected growth of the world's urban population between 2014 and 2050. India is projected to add 404 million urban dwellers, China 292 million and Nigeria 212 million. Tokyo is the world's largest city with an agglomeration of 38 million inhabitants, followed by Delhi with 25 million, Shanghai with 23 million, and Mexico City, Mumbai and São Paulo, each with around 21 million inhabitants. By 2030, the world is projected to have 41 mega-cities with more than 10 million inhabitants.

As the step of urbanization accelerated, the size and population of metropolitan regions are expanding rapidly, and this gives increasingly more pressure on urban traffic system. A series of problems such as traffic congestion, car excess has led city bus to slow and the efficiency of urban public transport is decreasing. Furthermore, a more disturbing problem is that frequent traffic accidents are threatening people's life safety and health.

Metro Rail Network in Global Context:

Metro rail is a form of mass transit public transport system employing trains. The metro rail system, unlike conventional rail-based systems is grade separated from the other traffic or provided with separate right of way (ROW) to avoid conflict with other urban transportation networks (Niraj Sharma, Rajni Dhyani and Gangopadhyay S., 2013:68). Globally, metros have evolved as a major form of public transport, since the first underground railway opened in London in 1863.

The building of metro systems accelerated from currently, 187 cities have metros, with more to come amid a fresh spurt of construction in developing countries. (UN-Habitat, 213:44-45). These metro systems

are with an average daily ridership of more than 2 million passengers per day. Six of these 16 systems are in cities in developing countries, while the rest are in developed countries. The world's largest or most used metro systems are Tokyo (Japan), Seoul (Republic of Korea), and Beijing (China) with 8.5 million, 6.9 million and 6.7 million passengers per day, respectively.

Table-1
Metro systems with average daily ridership of more than 2 million passengers per day

Rank	City, Country	Initial year	Length (km)	Stations	Average daily ridership (millions)
1	Tokyo, Japan	1927	305	290	8.50
2	Seoul, Republic of Korea	1974	327	303	6.55
3	Beijing, China	1969	442	252	6.74
4	Moscow, Russia	1935	309	187	6.65
5	Shanghai, China	1995	437	279	6.24
6	Guangzhou, China	1999	232	146	5.00
7	New York, US	1904	368	468	4.53
8	Mexico City, Mexico	1969	180	175	4.41
9	Paris, France	1900	218	383	4.18
10	Hong Kong, China	1979	175	95	3.96
11	London, UK	1863	402	270	3.21
12	Cairo, Egypt	1987	90	55	3.00
13	São Paulo, Brazil	1974	74	67	2.40
14	Osaka, Japan	1933	138	133	2.29
15	Singapore	1987	147	100	2.18

UN-Habitat, 213:46

At present, there are 160 metro rail systems covering a total length of approximately 10,000 km, are operating throughout the world, mostly in Europe and North America. However, such metro rail systems are very few in the African continent which is also an indirect reflection of the development status of the region. The situation is far better in

Asia. Asia is the region in which China and India are two countries where the metro rail network is expanding very fast.

Urban Metros in India:

The transport situation in most Indian metropolitan cities is rapidly deteriorating because of the increasing travel demand and inadequate transportation system. Indian cities of all sizes are facing the crisis of urban transport. Despite investments in road infrastructure and plans for land use and transport development, all face the problem of congestion traffic accidents and air pollution and the problems continue to grow. Large cities are facing an unprecedented growth of personal vehicles (two wheelers and cars) and in medium and small cities different forms of intermediate public transport provided by informal sector are struggling to meet the mobility demands of city resident.

Urban travel in Indian cities predominantly happens through walking, cycling and public transport, including intermediate public transport (IPT). Despite high growth rates of motorised two wheelers and cars in the last two decades (15 per cent and 10 per cent per annum respectively), car ownership remains at 3–13 per cent of the households and two wheelers at 40–50 per cent. It is clear that the public-transport agenda has failed in Indian cities. With the fascination for capital-intensive rail-based projects, investments in pedestrian, bicycle and road-based public transport infrastructure continues to be neglected.

Metro Systems in India:

In India, Kolkata has a first metro rail system operating since 1984, which is even older than the Delhi metro rail system. In fact, the Delhi Metro project is considered as the one of the biggest urban interventions in India since independence. Moreover, it is being constructed to world class stand¬ards with frontline technologies keeping in view the future requirements for upgradation. Apart from Delhi, Bengaluru and Kolkata, metro rail construction activities are in an advanced stage of construction in cities like Jaipur, Mumbai, Chennai and Hyderabad.

Feasibility studies including preparation of a Detailed Project Report (DPR) and other technical stud¬ies in major cities of India, such as Navi Mumbai, Pune, Chandigarh, Kanpur, Ludhiana, Bhopal, Indore and Ahmadabad have already been completed and are in different stages of planning.

Delhi Metro:

Delhi Metro Rail Corporation (DMRC) was established by the Government of India and the Government of Delhi in March 1995 to build a new metro system in the capital. The project is being carried out in phases – Phase I (65 kilometres) containing 3 lines was completed by 2006, and Phase II (124.63 kilometres) in 2011. Work on Phase III started in 2011 and scheduled for completion by 2018 (originally planned for 2016). The capital investment for Phases I and II was $2.7bn. Thirty percent of the total investment was funded by Government of India (GoI) and Government of Delhi, while another 60% was financed through a loan from Japan International Cooperation Agency (JICA) (Delhi Metro Rail System in India, and (Delhi Metro, Wikipedia, the free encyclopaedia, https://en.wikipedia.org/wiki/Delhi_Metro).

The Master Plan of Delhi Metro (2021) has recommended that the metro rail network for Delhi and other neighbouring areas of the NCR (which includes the neighbouring states of Haryana and UP) be con¬structed in four phases. A part of the Delhi metro Phase I and II project cost was financed by the Government of Japan through a soft loan from the Japan Bank of International Cooperation (JBIC) along with the central government of India and state government of Delhi. Also, the remaining fund was internally generated by the Delhi metro through property development. The funding pattern for Phase III is likely to be similar to that of Phases I and II (Niraj Sharma, Rajni Dhyani and Gangopadhyay S., 2013:71-72).

Bangalore Metro:

The Bangalore Metro project, popularly known as “Namma Metro”, is being implemented by the Bangalore Metro Rail Corporation Limited (BMRCL) – a joint venture of the Government of India and the Government of Karnataka, it is being financed on a debt-equity ratio

of 70:30. The BMRCL is a Special Purpose Vehicle entrusted with the responsibility of implementing the Bangalore Metro Rail Project. The Bangalore Metro project was undertaken in 2007.

Chennai Metro:

The Chennai Metro project was approved by the Ministry of Urban Development (MoUD) in January 2009. The Government of Tamil Nadu created a Special Purpose Vehicle for implementing the Chennai Metro Rail Project. This Special Purpose Vehicle (SPV), named "Chennai Metro Rail Limited", was incorporated in December 2007 under the Companies Act, and is a joint venture of the Government of India and the Government of Tamil Nadu – with equal equity holdings.

The estimated base cost of this project is about USD 2.8 billion (US dollar, currency code: USD), of which the Central and State Governments, together, are expected to contribute approximately 41%. The balance will be met by a loan granted by the Japan International Cooperation Agency (JICA). In November 2008, JICA agreed to finance the project, and the loan agreement between the Governments of India and Japan were signed in Tokyo .

Hyderabad Metro:

The Hyderabad Metro is a public-private partnership (PPP) project. It is implemented through a special purpose vehicle – "L&T Metro Rail (Hyderabad) Limited". The project is estimated to cost USD 2.8 billion, and will be executed on a Design, Build, Finance, Operate and Transfer (DBFOT) basis. The Government of India (GoI) only has a minority stake in the project, contributing 10% of the total project cost as viability gap funding. The State Government is contributing another ~USD 400 million towards land acquisition, R&R package, shifting of utilities, etc. This funding does not count as part of the project cost, as per Viability Gap Funding (VGF) guidelines of Government of India. It is scheduled to be completed within a span of 5 years from the appointed date. The concession period for the project is 35 years, with an entitlement of an additional 25 years. The project is expected to serve three high density corridors. The collaboration will

be to integrate the Metro Rail with other public transport systems in Hyderabad, such as Multi-modal Transport system (MMTS).

Mumbai Metro – Phase I:

The first line of Phase I of the Mumbai Metro project (Versova-Ghatkopar Corridor) is also a PPP project, being implemented by a RInfra-led consortium (a private infrastructure company). For the implementation of this project, a special purpose vehicle – Mumbai Metro One Private Limited (MMOPL) – has been incorporated. The PPP project entails design, financing, construction, operation and maintenance of about 12 km of elevated metro, with 12 stations en route. The metro will provide the much-needed East to West connectivity, and will carry an estimated 600,000 commuters per day. A trial run of this line was conducted in May 2013, in advance of its start of operation by October 2013 (Rahul Goel and Geetam Tiwari, 2014:670).

Financing Metros Systems in India:

Metro rail projects entail large investments and have long gestation periods. Worldwide, most metro rail projects are not financially viable on their own and have the required public funding support. In India, most projects have either been developed entirely by the government, or in part through the PPP mode, in recent years. While the Kolkata Metro was fully funded by the Federal Government of India, the Delhi Metro included equal shares from Federal and State Governments, and the remainder from loan and property development. A similar model was followed by the Bangalore Metro and the Chennai Metro. The four metro projects with a PPP model are: Delhi Airport Link, Mumbai, Hyderabad and Gurgaon. Gurgaon is India's first metro system to be privately built and operated – with 100% private funding.

Table-2
Financing pattern of metro projects in India

Metro Project	GOI * (%)	State Govt. (%)	JICA** (%)	Others* (%)	Total (USD Billion)
Delhi Metro Phases I & II	18	18	53	10	5.9

Kolkata	100	0	0	0	0.4
Kolkata East-West Corridor	24	30	46	0	0.9
Bangalore	15	15	45	25	1.6
Chennai	20	20	59	0	2.96
Public-Private Partnerships (PPP)					
Delhi Airport Express Link	19	19	0	62	0.8
Mumbai Phase I	9	22	28	41	5.1
Hyderabad	9	0	0	91	3.3
Gurgaon	0	0	0	100	0.22

Source: Rahul Goel and Geetam Tiwari, 2014:71.
*Government of India, **Japan International Cooperation Agency

Models of Financing Metro Rail in India:

1. The existing 50:50 Joint Venture model that is predominantly the major model available for the financing and organization structure was started with Delhi Metro Rail Corporation and later followed in other metros like Mumbai Line-3, Chennai, Bangalore, Nagpur, Lucknow, Kochi and Ahmedabad.
2. The second model is that of full funding by the central government. Examples of this model are the first metro in the city of Calcutta (now Kolkata) by Indian Railways, followed by East-West corridor in Kolkata being implemented on a 74:26 equity sharing between Ministry of Railways and Ministry of Housing and Urban Affairs respectively.
3. The third model is that of complete funding by state government; examples are Metro rail in Jaipur and Monorail in Mumbai.
4. The other model is the Public Private Partnership (PPP). Mumbai Metro Line1 and Hyderabad metro rail have been taken up with Viability Gap Funding (VGF) from Government of India. The Rapid Metro in Gurugram is an initiative of Government of Haryana where full funding is by the private concessionaire,

According to the Metro Policy 2017, the country is witnessing a revolution in metro transport facilities at present. As on August 2017, metro projects with a total length of 370 kms are operational in 8 cities across the country. These projects are: Delhi (217 kms), Bengaluru (42.30 kms), Kolkata (27.39 kms), Chennai (27.36 kms), Kochi (13.30 kms), Mumbai (Metro Line 1-11.40 km, Mono Rail Phase 1-9.0 km), Jaipur-9.00 kms and Gurugram (Rapid Metro-1.60 km).

Construction of another 595 kms metro projects are in progress in 13 cities including in some of the above-mentioned cities (phase II). New cities acquiring metro services are; Hyderabad (71 kms), Nagpur (38 kms), Ahmedabad (36 kms), Pune (31.25 kms) and Lucknow (23 kms). The new funding regulations under the policy is expected to give a boost to metro projects by attracting private funds to finance at least a part of the capital to be invested (Tojo Jose, 2017).

Status of Metro System in India:

The metro rail network in the country is increasing with the mass rapid transit system emerging as one of the best solutions for urban transportation. Even as eight metro rail networks covering a length of 370 km are operational in the country, over two dozen more projects are lined up. Out of the two dozen projects, around 15 are lined up with the urban development ministry. The cities that have lined up their plans include Pune, Nagpur, Ahmedabad, Chennai, Vijayawada, Kozhikode, Indore, Bhopal, Patna, Guwahati, Kanpur and Varanasi.
During the years, from 2014-2017, the urban development ministry sanctioned Rs.30,653.78 crore, out of which only Rs.12,345.33 crore was released to various metro rail companies in the country. Similarly, in the Financial Year 2018, the ministry allocated around Rs.17,960 crore for metro rail companies and till the first quarter ending June only Rs. 4,650 crore was spent. The figures are for Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Tamil Nadu, Kerala, Karnataka, Maharashtra and Delhi-NCR region.

However, officials from states like Punjab and Madhya Pradesh, which are yet to get approval for the first metro projects in their states, said that there has been a huge delay from the Centre for their

projects. Some of these states are ready for the PPP route too (Jyotika Sood, 2017).

Working Group on Urban Transport for 12th Five Year Plan recommended the following PPP approach:

- PPP in MRTS projects should be permitted if a project is found to be fit and viable for this approach on account of ridership. This, however, should not be linked with providing land for property development beyond what is needed for the operation of rail transit;
- The decision of using PPP for O&M should be left to the project owner;
- Different models of PPP should be allowed to develop and flourish;
- This should be done in the overall ambit of realization that very few Metro Rail projects are amenable to PPP (Recommendations of Working Group on Urban Transport for 12th Five Year Plan, 2011:52).

National Urban Transport Policy 2006:

The objective of this policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities (Government of India, 2006).

The major elements of the National Urban Transport Policy are the following:

- Incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement
- Encouraging integrated land use and transport planning in all cities so that travel distances are minimized and access to livelihoods, education, and other social needs, especially for the marginal segments of the urban population is improved
- Improving access of business to markets and the various factors of production
- Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus

- Encourage greater use of public transport and nonmotorized modes by offering Central financial assistance for this purpose
- Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes
- Establishing effective regulatory and enforcement mechanisms that allow a level playing field for all operators of transport services and enhanced safety for the transport system users
- Establishing institutional mechanisms for enhanced coordination in the planning and management of transport systems
- Reducing pollution levels through changes in traveling practices, better enforcement, stricter norms, technological improvements, etc.

The policy acknowledged problems of road congestion and associated air pollution. To address these issues, the National Urban Transport Policy (NUTP) proposed four strategies primarily focusing on increasing efficiency of road space by favouring public transport, using traffic management instruments to improve traffic performance, restraining growth of private vehicular traffic and technological improvements in vehicles and fuels to reduce vehicle emissions. The NUTP recognized the states as the main facilitators in the process of policy implementation and the central government's role was confined to supporting the states with the necessary financial support and technical expertise.

The policy very appropriately prioritises people over private motorised vehicles in transport planning. This fundamental objective is to be achieved by providing financial resources to State governments that come forward to strengthen public transport, discourage personal commuting, and facilitate walking and cycling. Some States have recognised the imperative and acted speedily. Metro rail projects for Hyderabad, Mumbai, and Bangalore have been cleared with an offer of Central funds. A number of cities are examining high-capacity bus rapid transit systems and New Delhi is actively pursuing such a project.

The National Urban Transport Policy, 2006, pushed for public transport to rise from 22 per cent to 60 per cent, only 30 major Indian cities out of 90 have an in-place bus system. Even Delhi, with its extensive metro, faces significant gaps in its efforts to provide cross-sectional connectivity, with just 6,500 buses instead of 20,000.

National Urban Transport Policy, 2014

The objective of this policy is to plan for the people rather than vehicles by providing sustainable mobility and accessibility to all citizens to jobs, education, social services and recreation at affordable cost and within reasonable time.

The major elements are:

- Incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement.
- Bringing about a more equitable allocation of road space with people, rather than
- vehicles, as its main focus
- Public Transport should be citywide, safe, seamless, user friendly, reliable and should provide good ambience with well-behaved drivers and conductors.
- Walk and cycle should become safe modes of Urban Transport.
- Introducing Intelligent Transport Systems for traffic management
- Establishing institutional mechanisms for enhanced coordination in the planning and management of transport systems.
- Building capacity (institutional and manpower) to plan for sustainable urban transport and establishing knowledge management system that would service the needs of all urban transport professionals, such as planners, researchers, teachers, students, etc.

New Metro Rail Policy 2017

The Union Cabinet has approved a Metro Rail Policy aimed at promoting metro rails in Indian cities through supportive resource mobilization policies on August 16th, 2017. The Policy comes in the context of rising difficulties of availing funds to finance metro projects. According to the policy, participation of private investment across a

range of metro operations is necessary to avail central government's financial support for the projects. The stand of the government comes in the context of large number of metro project proposals involving huge capital investment. Till now, most of the metro projects have used considerable level of central government grants with limited use of outside sources like PPP.

Importance to private sector participation:

The Policy declares that "Private participation either for complete provision of metro rail or for some unbundled components (like Automatic Fare Collection, Operation and Maintenance of services etc) will form an essential requirement for all metro rail projects seeking central financial assistance." States should ensure that last mile connectivity within five miles are provided through feeder services in Metro projects. This last mile connectivity aspect should be elaborated in the project report by the submitting state governments. Associated infrastructure like walking and cycling pathways and introduction of para-transport facilities etc., should be shown in the proposals with investment implications.

The policy also encourages mass transport modes overall: - be in the form of BRTS (Bus Rapid Transit System), Light Rail Transit, Tramways or the Metro Rail and Regional Rail. Project evaluation in terms of demand, capacity, cost and ease of implementation should be prepared by considering multiple factors. The Policy also instructs mandatory setting up of Urban Metropolitan Transport Authority (UMTA) for cities to ensure complete multi-modal integration for optimal utilization of capacities. Similarly, the Metro Rail Policy also demands assessment by independent third-party agencies that are identified by the government like the Institute of Urban Transport and other such Centres of Excellence.

Another major feature of the Policy is the adoption of Economic Internal Rate of Return (EIRR) criteria that considers all economic costs and benefits rather than just financial factors. At present, Financial Internal Rate of Return criterial is followed. According to the policy, an Economic Internal Rate of Return (EIRR) of 14% is needed for approving projects.

The Policy substantiates that urban mass transit projects are actually urban transformation projects. Here, the policy envisages Transit

Oriented Development (TOD) to promote compact and dense urban development to reduce travel distances and to ensure efficient land use in urban areas. The Policy also asks states to adopt innovative mechanisms like the imposition of 'Betterment Levy'.

On the fixation of metro fares, the policy empowers states to set up permanent Fare Fixation Authority for timely revision of fares. Already, the operational metros are increasing fares to recollect the capital invested. The Policy suggests three financing options for states to launch metro projects with a condition that private sector investment should be availed. These models are:

- PPP with central assistance under the Viability Gap Funding scheme of the Ministry of Finance,
- Grant by Government of India under which 10% of the project cost will be given as lump sum central assistance and
- 50:50 Equity sharing model between central and state governments.

All these modes should ensure private investment. Under the mandatory private sector participation clause, metro rail policy also gives three operational methods for private sector on operation and maintenance of projects: Cost plus fee contract, Gross Cost Contract and Net Cost Contract.

Status of Metro Rail Projects in India

City	System	State	Opening	System Length (km)			No of Lines	No of Stations	Gauge	Traction	Notes
				In Operation	Under Construction	Planned					
Kolkata	Kolkata Metro	West Bengal	24-Oct-84	27.22	113.42		1	24	1,676 mm (5 ft 6 in) broad gauge 1,435 mm (4 ft 8 1/2 in) standard gauge	750 V DC Third rail	It's First in India to have the Third rail for power supply and the first to use fully Made in India metro coaches by ICF & BEML.
Delhi NCR	Delhi Metro	Delhi, Haryana, Uttar Pradesh	24-Dec-02	327	18.11	103..9	8	236	1,676 mm (5 ft 6 in) broad gauge	25 kV AC OHE	India's largest rapid transit/metro system.
	Rapid Metro Gurgaon	Haryana	14-Nov-13	11.7			1	12	1,435 mm (4 ft 8 1/2 in) standard gauge	750 V DC Third rail	India's first fully privately financed metro. Currently undertaken by Delhi Metro
	Noida Metro	Uttar Pradesh	25-Jan-19	29.7		15	1	22	1,435 mm (4 ft 8 1/2 in)standard gauge	25 kV AC OHE	
Bengaluru	Namma Metro	Karnataka	20-Oct-11	42.3	34.37	57.07	2	41	1,435 mm (4 ft 8 1/2 in) standard gauge	750 V DC Third rail	First metro in southern India, the first to have the third rail for power supply in southern India, and the first to introduce Wi-Fi onboard trains.
Mumbai	Mumbai Metro	Maharashtra	08-Jun-14	11.4	163	200	1	12	1,435 mm (4 ft 8 1/2 in) standard gauge	25 kV AC OHE	India's first public private partnership (PPP) metro system with Reliance group. 14 lines and line extensions are at different stages of planning.
Jaipur	Jaipur Metro	Rajasthan	03-Jun-15	9.63	2.4	23.01	1	9	1,435 mm (4 ft 8 1/2 in) standard gauge	25 kV AC OHE	Double-story elevated road and Metro track project for the first time in the country.
Chennai	Chennai Metro	Tamil Nadu	29-Jun-15	45	8.52	104.4	2	32	1,435 mm (4 ft 8 1/2 in) standard gauge	25 kV AC OHE	First metro rail in the country to connect two lines (blue & green) through loop line to run direct service from the airport to central even though had interchange station at Alandur. First metro in India for underground stations with sliding doors.
Kochi	Kochi Metro	Kerala	17-Jun-17	18.4	25.6	56.7	1	16	1,435 mm (4 ft 8 1/2 in) standard gauge	750 V DC Third rail	First Indian metro to go live with CBTC signalling.
Lucknow	Lucknow Metro	Uttar Pradesh	05-Sep-17	8.5	33	140	1	8	1,435 mm (4 ft 8 1/2 in) standard gauge	25 kV AC OHE	The fastest built and commissioned metro system in the world. Opened to the public on 5 September 2017.
Hyderabad	Hyderabad Metro	Telangana	29-Nov-17	46.5	25.7	168	2	41	1,435 mm (4 ft 8 1/2 in) standard gauge	25 kV AC OHE	India's first metro to have CBTC and integrated telecommunications and supervision systems, i.e. driver less metro.

Source: Urban Rail Transit in India, Wikipedia, https://en.m.wikipedia.org/wiki/Urban_rail_transit_in_India

The metro rail network in the country is increasing with the mass rapid transit system emerging as one of the best solutions for urban transportation. Even as eight metro rail networks covering a length of 370 km are operational in the country, over two dozen more projects are lined up.Out of the two dozen projects, around 15 are lined up with

the urban development ministry. The cities that have lined up their plans include Pune, Nagpur, Ahmedabad, Chennai, Vijayawada, Kozhikode, Indore, Bhopal, Patna, Guwahati, Kanpur and Varanasi.
There are currently 11 operational rapid transit (also called 'metro') systems in ten cities in India. As of September 2018, India has 515 kilometres (320 miles) of operational metro lines and 381 stations. A further 500+ km of lines is under construction. Metro rail lines in India are composed of mainly standard gauge. Projects like the Kolkata Metro and Delhi Metro used broad gauge for their earliest lines but all new projects in India are on standard gauge as rolling stock imported is of standard gauge. The first rapid transit system in India is Kolkata Metro, which started operations in 1984. The Delhi Metro has the largest network in the entire country. The newest metro opened is Noida-Greater Noida Metro on 25 January 2019.
In 2006, the National Urban Transport Policy proposed the construction of a metro rail system in every city with a population of 20 lakh (2 million). On 11 August 2014, Union Government announced that it would provide financial assistance, for the implementation of a metro rail system, to all Indian cities having a population of more than 1 million. In May 2015, the Union Government approved the Union Urban Development Ministry's proposal to implement metro rail systems in 50 cities. The majority of the planned projects will be implemented through special purpose vehicles, which will be established as 50:50 joint ventures between the Union and respective State Government. The Union Government will invest an estimated ₹5 lakh crore (US$70 billion). In a new draft policy unveiled in March 2017, the Central Government stated that it wanted state governments to consider metro rail as the "last option" and implement it only after considering all other possible mass rapid transit systems. The decision was taken due to the high cost of constructing metro rail systems. In August 2017, the Union Government announced that it would not provide financial assistance to new metro rail project, unless some sort of private partnership is involved (Urban Rail Transit in India, Interestingly, PPP for metro projects has been limited to five in India. Out of these five, one project (Mumbai Metro Phase 2) was terminated before it started, while another (Delhi Airport Line) was terminated after becoming operational. Currently,

there are three operational PPP-based metro projects (one in Mumbai, and two in Gurugram) while one project is under implementation.

Challenges:

Laws and Regulations: Presently, there is no legislation at central, state or local level that comprehensively covers urban transport requirements of Indian cities. The current systems of laws, regulations and governance for urban transport are the legacy of an era when Indian cities were sparsely populated and had not yet witnessed the kind of transport problems they are encountering today. Many Acts that are in place today are the legacy of the British Raj and a few of these have evolved to address specific issues in urban transport resulting in fragmentation or overlap of jurisdictions.

Lack of Transport Infrastructure: Common standards for design, operation and maintenance of transport infrastructure and rolling stock are relatively absent in India. Even if there are existing standards for road construction or metro systems, they are not mandatorily applied during design and construction. Except for road and conventional rail infrastructure systems, the design, operation and maintenance standards for mass transit technologies such as metro, light rail, mono rail or Bus Rapid Transport Systems are non-existent.

Lack of Co-ordination: Urban transport systems require several functions to be performed in a well-coordinated manner for seamless and comfortable travel experience for commuters. Unfortunately, these are performed by multiple agencies under the central, state and city governments which do not necessarily work together

Underground Corridors: While the requirement for an efficient public transportation system like a metro rail system in Indian cities is no longer a matter of dispute, the question about whether these should be elevated or underground has attracted a lot of attention and has generated spirited debate among various stakeholders, with some even taking this issue to the courts of law.

Land/Property Related Issues: Land/property acquisition has always been an integral part of any mega infrastructure developmental project. The land/property acquisition in some areas along the metro corridors sometimes becomes inevitable no other option related to

alternate alignment requiring less R&R impacts is feasible due to technical reasons (including those related to ridership), environmental considerations and financial constraints.

Loss of Trees: During the construction phase of metro rail projects, many times trees have to be cut, resulting in the loss of green cover along the metro rail corridors. The loss of tree/green cover may cause micro-climatic changes and affects the aesthetics of the area.

Pollution and Vibration: During the operation of the metro rail, rail–wheel contacts with tracks generate noise and vibration. Engine, cooling fans and generators further increase ambient noise and vibration levels inside the coaches and also outside the metro rail corridor.

Accident: Ideally, no accidents during construction should take place. However, during the construction of complex structures such as metro rail corridors, which involve the use of huge machinery and equipment, some freak fatal accidents are always a possibility. A few accidents have been reported in the Delhi, Mumbai and Bengaluru metros during the ongoing construction phase.

Traffic Issues: Most of the metro rail corridors (especially elevated corridors) are being built along the existing roads or within the existing ROW of the roads. As a result, traffic needs to be diverted temporarily (or only a narrow width of the existing road is allowed to be used for traffic flow) for carrying out construction activities smoothly and to avoid any accident involving construction machinery/equipment.

Conclusion:

The metro rail network in India is increasing with the mass rapid transit system emerging as one of the best solutions for urban transportation. Mass Rapid Transit Systems (MRTS) is the best way to decongest traffic. However, a number of considerations should be kept in mind in order to run a successful Mass Rapid Transit Systems (MRTS). In India, Kolkata Metro has lagged behind, it is first Metro system, started working almost 25 years ago. The reasons could be attributed to lack of funds planning as is known that such projects require huge capital investments, a long gestation period and complex technology. Other reasons could include the lack of integration

between various systems of mass transportation and the absence of comprehensive traffic and transportation planning. India is looking to create a world class infrastructure with its existent Kolkata and Delhi Metros with the addition of Mumbai, Bengaluru, Hyderabad, Chennai, Jaipur, and Kochi metros in the next few years while proposals for Mass Rapid Transit Systems (MRTS) for Pune, Chandigarh, Ahmedabad, Kanpur, Ludhiana, Bhopal, Indore and Faridabad are being chalked out.

The uncertainty about Mass Rapid Transit Systems (MRTS), which has plagued the importance of such systems in India seems to be resolving. Though the Kolkata metro was designed without a rule book and the Delhi Metro was designed on international norms but now India has a set of rules being adopted for metro constructions. The National Mass Transit and Training Research Institute (NMTTRI) in Mumbai (established by MMRDA), is one of its kind in Asia imparting training and research on mass transit systems. The annual training courses cater to key issues like Public Transport Security, Safety and Emergency/Disaster Management, Noise Pollution and abatement Measures for Urban Transportation, Integrated Ticketing, seamless Travel across Modes, and Intelligent Transportation System.

References:

1. Geetam Tiwari, (2007), Urban Transport in Indian Cities, Urban India: Understanding the Maximum City, Report, Ricky Burdett (ed), LSE Research Online, pp.9-11. http://eprints.lse.ac.uk/33348/1/Burdett_Urban_India_2007.pdf
2. Government of India, (2006), National Urban Transport Policy 2006, Ministry of Urban Transport, http://www.indiaenvironmentportal.org.in/files/TransportPolicy.pdf
3. Government of India, (2014), National Urban Transport Policy 2014, Ministry of Urban Development, March, p.2, http://itdp.in/wp-content/uploads/2014/11/NUTP-2014.pdf
4. Indian Institute for Human Settlements (IIHS), (2015), Urban Transport in India Challenges and Recommendations, p.24,

http://iihs.co.in/knowledge-gateway/wp-content/uploads/2015/07/RF-Working-Paper-

5. Jyotika Sood, (2017), How metro rail networks are spreading across India, livemint, http://www.livemint.com/Politics/ylEObaYWxcC7lGO2E2e4wJ/The-rise-of-metro-rail-network-in-India.html

6. Metro Rail Policy-2017, pp.1-2, http://moud.gov.in/upload/whatsnew/59a3f7f130eecMetro_Rail_Policy_2017.pdf

7. Mukti Advani and Geetam Tiwari, (2005), "Evaluation of Public Transport Systems: Case Study of Delhi Metro", Proceeding in START-2005 Conference held at IIT Kharagpur, India, http://tripp.iitd.ernet.in/publications/paper/planning/mukti_metro_kharagpur_05.pdf

8. Niraj Sharma, Rajni Dhyani and Gangopadhyay S. (2013), Critical Issues Related to Metro Rail Projects in India, Journal of Infrastructure Development, Vol. 5, No.1, pp. 67–86,

9. Rahul Goel and Geetam Tiwari (2014), Overview of Metro Rail Projects in India, Promoting Low Carbon Transport In India- Case Study of Metro Rails in Indian Cities, UNEP, June 2014, pp. 67-70