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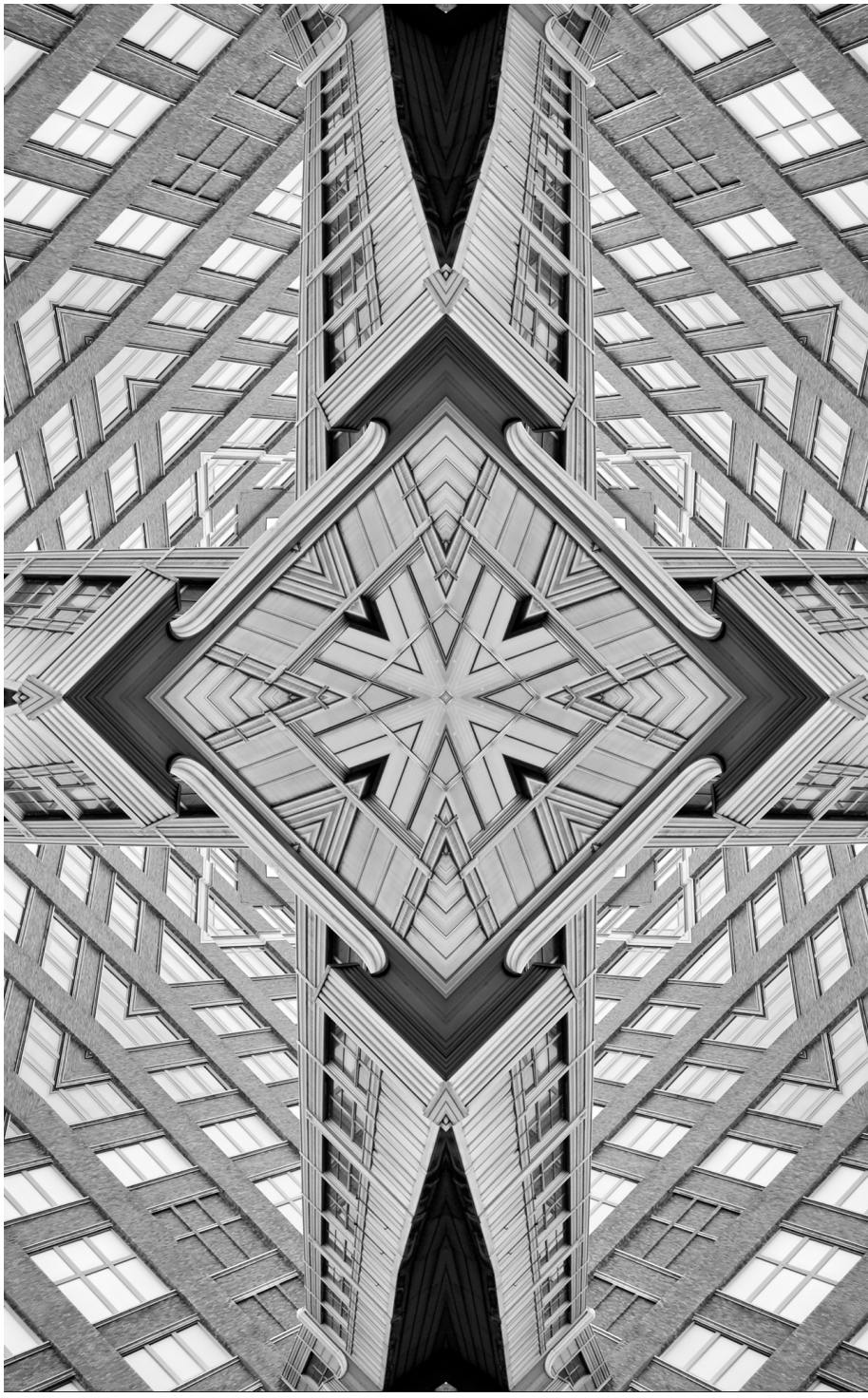

A Proposed Roadmap to Enhance Last-Mile Connectivity in India's Metro Rail Transit Systems

Farha Irani

Abstract

Evidence from several countries suggests that last-mile connectivity solutions—the transport options available to commuters from the origin of their journey to the point of accessing a public transit system—enhance citizens' mobility and increase metro rail ridership. This brief evaluates India's operational metro rail transit systems to identify the missing links in the provision and effective implementation of last-mile connectivity. It assesses India's existing policies related to metro rail transit systems and several global practices to present a holistic view of last-mile connectivity initiatives. The brief offers specific recommendations for structured last-mile connectivity to improve the commuter experience and augment the sustainability gains from metro rail transit systems.

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Introduction

By 2025, India's population is expected to grow to 1.4 billion,[1] about 40 percent of whom are urban. The number of cities with populations exceeding 50 million is projected to double by 2025,[2] 15 cities are estimated to have a population of over 10 million, and 85 cities will have between one million and 10 million people. This population growth will accentuate the existing pressures on India's public transportation systems.

In India, the size of a city and the percentage of daily trips[a] taken by commuters are directly linked. A 2008 study by the Ministry of Housing and Urban Affairs (MoHUA) estimated that the number of daily trips in the top 87 urban centres will more than double from 228 million in 2007 to 482 million in 2031.[3] This growth has increased the demand for public transport, which most Indian cities have been unable to meet due to the prevailing imbalance in the modal split[b] favouring private vehicle usage amid the inadequate public transport infrastructure and its suboptimal use.

Metro rail transit systems encounter the same issues as other public mass transit systems. It is essential to provide easy access for commuters to the metro stations to increase the ridership and efficiency of India's metro rail transit systems. However, the provision of economical and convenient last-mile connectivity—the transport options available to a commuter from the commencement of a trip to the point of accessing a public transit system (see Figure 1)—is a much-neglected area of planning in Indian cities. This brief assesses the need to improve and expand public transportation services in Indian cities by integrating different transit modes and enabling commuters to effectively transfer between them to enhance last-mile connectivity to metro rail transit systems.

Figure 1: Last-Mile Connectivity

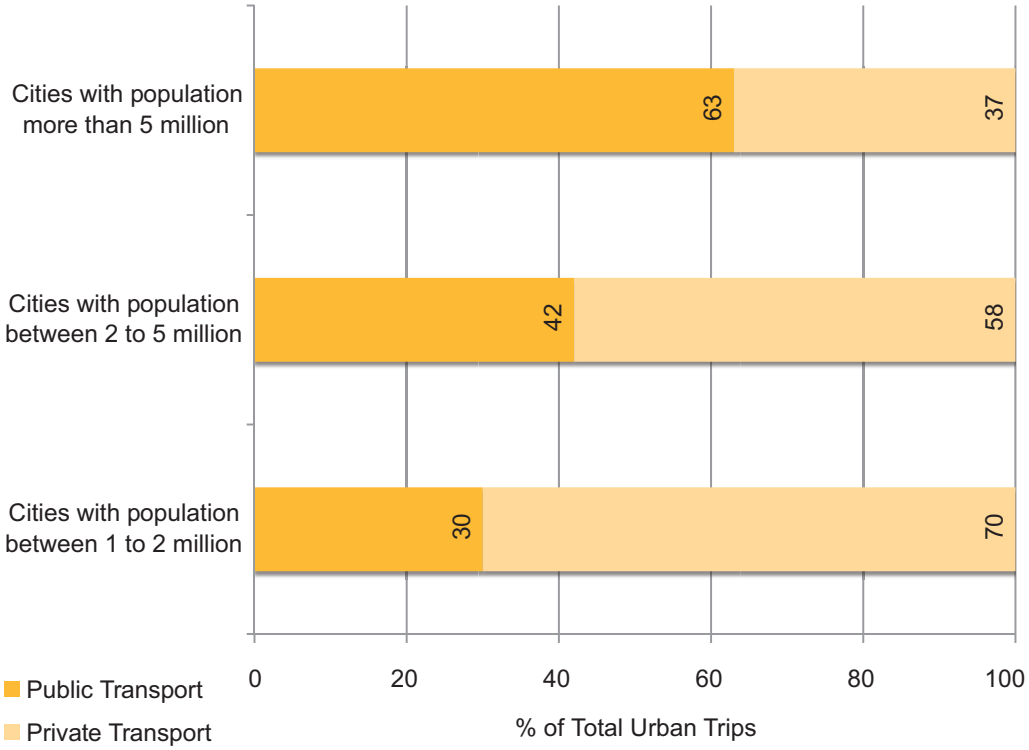
Source: Author's own

a The entire journey from the point of origin to the destination.

b Defined as the percentage of commuters using a specific transport mode compared to the ratio of all trips made.

The rapid growth of India's urban population has triggered an increased demand for transport in the cities and surrounding areas, with commuters taking multiple long trips each day. This has also meant an augmented need for public transport. Public transportation systems account for 30 percent of trips in cities with populations between one and two million, 42 percent in areas with populations between two and five million, and 63 percent in cities with populations over five million (see Figure 2).[4]

Figure 2: Urban Trips in Indian Cities Based on City Size



Source: Census 2011[5]

However, given the inadequacy of the public transportation system in meeting the demand for transport, the dependence on private vehicles has increased exponentially.[6] As a result, while the number of cities in India increased threefold (from 2,363 to 7,935) and the urban population increased five times (from 79 million to 377 million) between 1961 and 2011, the number of private vehicles increased 200 times (from 0.7 million to 142 million).[7] Metropolitan cities constitute the maximum share of this private vehicular growth, with New Delhi leading.

Within the urban transport framework, intermediate public transport (IPT) modes, such as auto-rickshaws, cycle rickshaws, battery rickshaws and taxis, constitute up to 8 percent of daily trips in Indian cities. Although convenient, IPT modes are expensive to use, often costing the commuter over 50 percent of the total journey fare.[8] Additionally, they can ferry a limited number of commuters compared to public transportation systems, thereby taking up more road space.

Commuters may also face different site-specific challenges. For instance, the public transportation system may be too far to access, may require navigating through uneven footpaths and hazardous street crossings, or may not be entirely safe, especially for women commuters. In addition, an undesirable and unsafe pedestrian environment forces commuters to switch to using private vehicles.

The potential extra time needed and inconvenience faced while travelling from home to a transit station and from the station to the destination is a major deterrent to public transport use. This is further exacerbated by the lack of physical integration for different modes at transit stations, leading to accessibility issues that create a mental block against using public transport. The lack of information on the availability of parking spaces, public transport schedules, and traffic signage also act as deterrents.

City planning in India has often not accounted for the most vulnerable users of public transport systems—low-income groups, persons with disabilities, the elderly, women, and those with debilitating medical conditions. In addition, footpaths and other pedestrian facilities are not equipped for universal accessibility, which may discourage economic, social, and cultural participation.[9]

Urban planners and managers have become cognisant of the need to establish a city-wide integrated and multimodal transportation system to address challenges and promote the use of public transportation.

However, several independent agencies plan, manage and operate the different transport modes in India. These agencies are not accountable to each other and often lack any coordination. At the same time, no agency has been mandated to integrate different public transit services and private modes, which is a major issue.

Commuters may use one or several modes of transport to complete a journey. Public transit agencies typically provide bus and rail services that may form the nucleus of such trips, but commuters must complete the first and last portions of their trips on their own—they must walk, drive, or be driven to the closest station. This is referred to as the 'first and last-mile' of the user's trip, or 'last-mile connectivity' (see Figure 1). Last-mile connectivity boosts the overall efficiency of a public transit system.

Last-mile connectivity highlights the significance of planning for an enhanced commuter environment in the larger context of the station catchment area,[c] in contrast to the current myopic approach of station-centric infrastructure.

The provision of last-mile connectivity is imperative to shift private car users to public transportation services. Public mass transit systems serve a growing city's economic and social requirements. Therefore, all efforts should be focused on enhancing ridership and the easy transfer of commuters to their primary transportation mode. Poor last-mile connectivity forces commuters to rely on private vehicles, aggravating traffic congestion and increasing journey times, fuel consumption and pollution.

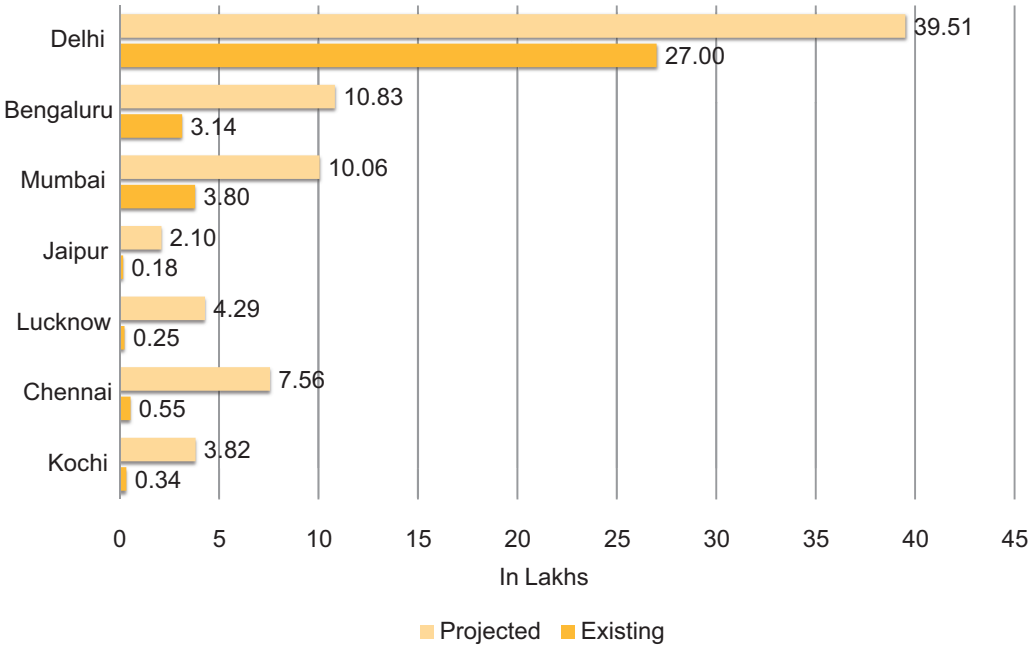
Metro rail scenario

The metro rail has played a key role in reducing urban transport-related issues, such as traffic congestion, air and noise pollution, and accidents. It is also a faster and safer mode of mass transport.[10] As a result, many Indian cities have developed or are seeking to develop metro rail transit systems.

c Ideal walking distance (500 metres) from the mass transit station.

At the same time, most existing metro systems in the country have not achieved their projected ridership (see Figure 3), despite a growing demand for transit options.[11] This shortfall has been attributed to fare hikes, poor last-mile connectivity, a lack of integration and operational reforms, and enabling policies for private-vehicle use (such as the availability of economical or free parking and subsidised road taxes for cars).[12]

Figure 3: Projected vs. Existing Ridership of Metro Rail Systems in India



Note: Projected ridership is subject to network completion. Ridership figures vary from 2014 to 2018.
Source: The Cost of Urban Commute: Balancing Affordability and Sustainability[13]

While feeder services, which transfer commuters to metro stations from their points of journey origin (shared autos, minibuses, shuttle cabs, or app-based bikes and cars), exist for operational metros, they are limited to a few places. The demand for last-mile connectivity is mainly met through IPT services, which may be expensive and confined to specific regions. In addition,

the infrastructure surrounding the metro stations, which make up the last-mile connectivity system, is beyond the jurisdiction of metro agencies, raising accessibility issues for commuters. The lack of dedicated walking and cycling paths further hinders access to metro stations.

Although metro agencies have begun to integrate innovative technologies and business models to enhance the level of service at metro rail transit systems, the majority of these are small-scale pilot projects that deploy feeder services to metro systems. Additionally, there is also a lack of sufficient data on the impact of last-mile connectivity services on metro systems or the reduction of private vehicle usage. This makes it difficult to assess the importance of last-mile connectivity for Indian cities.

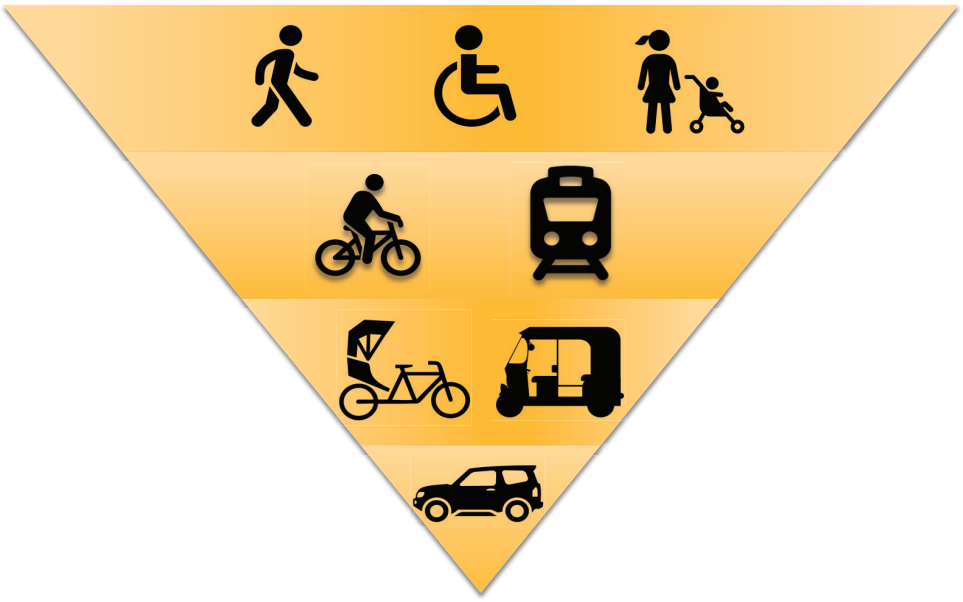
> “Most existing metro systems in India have not achieved their projected ridership due to factors like fare hikes, poor last-mile connectivity, a lack of integration and operational reforms, and enabling policies for private-vehicle use (such as economical or free parking and subsidised road taxes for cars).”

Last-Mile Connectivity: Policies in Focus

While India's major transport policies promote public transit systems, multimodal integration, and non-motorised transport (NMT), they are largely silent on the last-mile connectivity aspect. As more cities across the country build metro networks, the role of last-mile connectivity in consolidating the advantages of public transport and promoting sustainable transportation goals must be prioritised through policies.

The 2014 National Urban Transport Policy (NUTP)[14] focuses on the movement of people rather than vehicles (see Figure 4). The movement of pedestrians and persons with disabilities generating zero-emissions is prioritised, followed by NMT (bicycles), public transport, IPT users, and lastly, those using private modes of transport. According to the NUTP, this structure of priority will help reduce congestion and emissions arising from the use of private modes of transport. Similarly, for metro networks, pedestrians and NMT modes are given precedence for first and last-mile connectivity, and the NUTP mandates that facilities for these modes be provided within 50 metres of metro stations. The next important aspect is pick-up and drop-off facilities for feeder services (to be located less than 100 metres from metro stations' entry and exit structures), followed by IPT stops, private vehicles pick-up and drop-off facilities and parking spaces.

Figure 4: National Urban Transport Policy: Structure of Priority



Source: Author's own

The MoHUA's 2017 Metro Rail Policy[15] focuses on improving last-mile connectivity for metro commuters. As part of the existing last-mile connectivity provisions, the ministry has focused on feeder bus services, e-rickshaws, rentable smart cycles, e-scooter services, and partnerships with cab aggregators. A further objective is to ensure that the cheapest mass transit mode is selected and used for public transport. Additionally, the policy mandates that every metro rail plan include proposals for feeder systems that enhance the catchment area of each metro station by at least five kilometres. The provision of last-mile connectivity through pedestrian pathways, NMT infrastructure, and the induction of facilities for IPT modes are essential requirements to avail any central assistance for the planned metro rail projects.

Metro rail executing agencies, such as the Delhi Metro Rail Corporation (DMRC), Bengaluru Metro Rail Corporation Limited (BMRCL) and Mumbai Metropolitan Region Development Authority (MMRDA), are beginning to adopt plans focused on first and last-mile connections in an attempt to go beyond traditional practices (see Table 1).

Table 1: Service Providers Offering Last-Mile Connectivity for Metro Rails

Service Type	Services Providers		
	DMRC	**BMRCL**	**MMRDA**
E-rickshaws	SmartE	HAIL	-
	OYE! Rickshaw	PepRide	-
E-scooters	YULU	YULU	YULU
	Zypp	Bounce	-
	qQuick	-	-
Public Bicycle Sharing	Greenolution	-	MYBYK
	Planet Green Bikes	-	AllMiles *(proposed)*
	GreenRide	-	-
Cab Aggregator Services	Uber	LocaRides	-

Source: Author's own

The DMRC is providing multiple options to enhance last-mile connectivity, which is also crucial given the increasing vehicular congestion and pollution in Delhi and the surrounding areas. The DMRC is encouraging the adoption of electric mobility through partnerships with YULU (micro-mobility vehicle startup), SmartE (providing e-rickshaws), and cab aggregator Uber, among others.[16] Additionally, the Delhi Transport Corporation currently operates about 174 non-AC CNG buses on 32 routes that are available at 69 metro stations. However, the infrequent service of such feeder buses, especially during peak hours, means commuter usage is poor. This can be addressed by assessing demand levels on all routes to enhance coverage and operational efficiency.

In its 2021 report on the traffic situation in Delhi, the Parliamentary Standing Committee on Home Affairs[17] recommended multimodal integration at metro stations to encourage commuters to use public transport and discourage the use of private vehicles for long distances. Multimodal integration plans for 59 stations have been firmed up for Phase-III of the metro project, and another 96 stations are under finalisation. However, the committee raised concerns that the lack of coordination between the various project executing agencies (the DMRC, the Public Works Department and the Municipal Corporation of Delhi) could affect the swift implementation of these plans.

In Bengaluru, the BMRCL has added inexpensive travel options like e-cycle rentals and e-bikes to the existing bus service operated by the state-owned Bengaluru Metropolitan Transport Corporation (BMTC). The BMTC manages metro feeder bus services covering 17 metro stations and running 1,981 trips.[18] In addition, bengaluru-based bike-sharing startup Bounce operates keyless scooters, and YULU provides e-bikes at several metro stations.[19]

Similarly, in Mumbai, last-mile connectivity is set to improve as new innovative solutions have been implemented across the currently operational Metro Line-1. Ahead of more lines becoming functional, the MMRDA, World Resources Institute India, and Toyota Mobility Foundation jointly launched the Station Access and Mobility Program to foster public-private partnership through innovative data and technology-based solutions to improve crowd management and last-mile connectivity to the Mumbai metro. Three startups—Orbo.ai, MYBYK and AllMiles—were selected to roll out solutions at the Metro Line-1 stations.[20] While Orbo.ai uses artificial intelligence to reduce travel time through the fare collection gates, MYBK and AllMiles provide app-based transport facilities for last-mile connectivity. As a result, Mumbai Metro One

Private Limited, the operator of the Metro Line-1, launched a bicycle-on-rent service in collaboration with MYBYK to enhance last-mile connectivity.

Global Experiences

Polluted air, economic costs, and increased stress levels associated with traffic congestion make it imperative for cities worldwide to reduce the number of private cars and develop efficient public transport solutions. But while metro, bus, or tram networks help ease congestion, they must also be financially feasible for commuters and operators.

Planning for improved access to transit systems, focusing on NMT, is practised worldwide through different innovative approaches. In Asia, Singapore is rolling out its National Cycling Plan (NCP) to utilise bicycles to provide last-mile connectivity for mass rapid transit systems.[21] Given the country's limited land resources, Singapore facilitated a smart first and last-mile strategy by building a cycling network, part of the NCP, and redesigning streets to enable pedestrians, cyclists, buses, and cars to coexist. The Land Transport Authority (LTA) plans to increase the country's cycling path network by a third, to 1,000 kilometres by 2040, an increase from the 2013 commitment to construct 700 kilometres of cycling paths by 2030. Expanding Singapore's cycling path network is part of LTA's vision to improve first and last-mile connectivity while creating a '45-minute city with 20-minute towns' (where commuters need only a 45-minute journey to get to work, and 20 minutes to reach amenities within residential towns).

Similarly, the UK is exploring the 'travel hub' concept as an alternative to the traditional 'park and ride' idea of leaving private cars in a designated facility and taking public transport for the remainder of the journey. A travel hub is a bus, tram, metro, or train station with more facilities than the existing public transport stops, with walking and cycling as the dominant modes of access. It enables easy access to public transport facilitates and an interchange between different transport modes. It also provides regular public transit services and makes clear and comprehensive travel information available. Crucially, where large car parks are needed to accommodate private cars that are the dominant or sole mode of access for 'park and ride' facilities, this need is done away with in the 'travel hubs' concept since connectivity by other modes like cycling is improved.

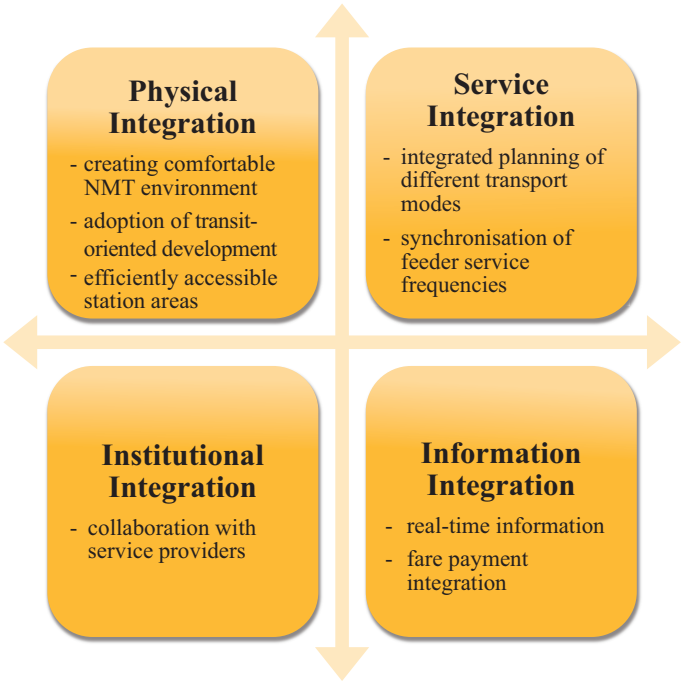
Pilot projects for 'BiTiBi'[d,22] implemented in Barcelona (Spain), Milan (Italy), Liverpool (UK) and Ghent (Belgium) were funded by the European Union between 2014 and 2017. Data showed that around 10 percent of bicycle parking users at railway stations were previously car users for the whole distance, and a further 15 percent to 20 percent stopped driving to the railway station.[23]

Europe's Sustainable Urban Mobility Plan (SUMP)[24] is another initiative that guides cities to make better transport strategies. A city-specific SUMP considers the whole functional urban area and foresees collaboration across different policy areas, levels of government, and with locals and other principal stakeholders. It ensures a variety of sustainable transport options for commuters and goods, with due consideration for locals and the urban environment. The French experience shows that it takes one to three years to prepare a SUMP. Since 1996, all French cities with more than 100,000 inhabitants have been obligated to develop and implement the SUMP. Although SUMPs are concerned with all urban transport modes, the French promote cycling, and cyclists and cycling organisations are important stakeholders and contributors in the SUMP process when identifying problems, objectives, and measures.[25]

d A 'bike-train-bike' solution, where commuters use bicycles for short distances and trains for longer distances.

Structured last-mile connectivity could play a vital role in the twin pursuits of retaining and augmenting the sustainability gains from metro rail transit systems and improving the commuter experience. Tailoring last-mile connectivity options to the needs of commuters at metro stations will go a long way in its adoption. This can be done in four ways—physical, service, information, and institutional integration (see Figure 5).

Figure 5: Means to Achieve Last-Mile Connectivity



Source: Author's own

a. Physical Integration

Expanding the metro rail network to bring stations closer to residential areas and prominent destinations, adding new stations on the existing network, creating a comfortable walking and cycling environment near metro stations, and providing infrastructure for e-mobility and shared modes are effective physical interventions to ensure structured last-mile connectivity systems.

State governments in India can consider adopting transit-oriented development within 500 metres on either side of metro corridors to promote integrated land use and transport planning. This will encourage high-density developments near metro stations so that more people can stay or work near a station and walk directly to it. Planners should also consider providing ground-level or underground direct access from nearby developments to metro stations.

The quality of access, while a fraction of the total cost of a metro rail system, directly influences its ridership. An efficiently accessible station area will maximise metro ridership, enable a barrier-free environment, manage parking effectively, provide affordable options to commuters, and create vibrant public spaces. This will help realise the economic development benefits of metro rail systems and serve the commuters' needs.

b. Service Integration

Authorities must enable integrated planning of different modes of transport at station areas. The integration of the various public transport, IPT, and NMT modes with the metros will achieve a better level of service at the stations and improve the connectivity at station areas for the smooth and orderly movement of vehicular and pedestrian traffic. It is also essential to increase the frequency of feeder services and synchronise frequencies and headways with metro rail services to reduce the wait time for commuters while changing transport modes.

c. Institutional Integration

Different agencies regulate last-mile connectivity services. For example, the state transport departments typically govern taxis and auto-rickshaws. Likewise, creating pathways for cycling and walking is under the purview of the urban local bodies, while lighting for the pathway is the mandate of the electricity service provider. The lack of coordination, coupled with each institution

forming its own rules and procedures, eventually hinders the execution of well-intentioned policies and plans. Metro rail authorities must collaborate with the various service providers to seamlessly integrate all last-mile connectivity plans.

d. Information Integration

Available data and technology solutions will further strengthen the effort to promote last-mile connectivity. Providing real-time service information on the arrival and departure of feeder services will encourage commuters to use public transport modes. For example, an urban bus service should be integrated with metro rail services, such that when a train arrives, it must have bus services available within a short time. Similarly, the integration of fare payments between feeder services and the metro rail and enabling smart cards and cashless transactions for fare payments will make things easier for metro rail users.

> “Structured last-mile connectivity can improve the commuter experience and augment the sustainability gains from metro rail transit systems.”

Conclusion

Metro rail transit systems facilitate the quick movement of people, goods and services, significantly improving a city's economic competitiveness. They also reduce per capita vehicle ownership and usage, resulting in decreased traffic congestion, reduced parking and transport costs, and minimal per capita traffic accidents.[26] Thus, metro rail transit systems encourage compact and walkable development patterns in urban areas.

Providing safe and accessible last-mile connectivity is important to reap the benefits of metro rail transit systems. Creating a network of safe and commuter-friendly last-mile connectivity solutions to access metro stations is imperative to ensure the long-term sustainability of such a mass transit system.

Getting commuters to their destination requires collaboration between multiple stakeholders to design, develop, and implement a cohesive network of integrated transport modes. New infrastructure built to bridge accessibility gaps without proper access cannot be fully utilised. Public transit agencies and government organisations responsible for streets and infrastructure must work together to establish accessible and safe last-mile connectivity services to metro rail transit systems. Doing so will effectively improve people's quality of life and positively impact urban economic growth. It may also inspire and serve as a model of development for other public mass transit systems.

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