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A study of Mumbai and Hyderabad's intermodal transportation hubs and their potential in the future railway-led urban development in India

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Abstract

With the rapid urbanization and growing transportation demand in India, innovative solutions and methods are being evolved and borrowed from other countries. Over the last decade numerous Mass Rapid Transit Systems have come up in various cities like Metro Rails, Monorails and Bus Rapid Transit Systems. These systems meant for transport of large number of passengers at quick intervals spanning lengthy distances have simplified the life of the citizens. The interconnection of these public transport modes with intermediate public transport (IPT) is now an important issue not only from the user point of view for seamless travel across the city, but also from the authorities' perspective to be able to offer higher quality of services. The railway-led urban development in India corresponds to the spatial planning around it and has direct impacts on population density, land use change and economy. This paper is an attempt to understand the intermodal transport hubs in Mumbai and Hyderabad and their potential in future railway-led urban development in India. This is achieved through the investigation of stations along the comparatively new Metro lines and reviewing the prevalent policies and the stakeholders that can influence the development around the station nodes.

Keywords: Railway-led urban development; Intermodal; Spatial Planning; India.

1. Introduction

With India looking forward towards a new age of railways with the advent of much awaited bullet trains, Mono Rail, and new Metro lines in its Tier 1 and Tier 2 cities, it becomes important to understand the existence of a system that encourages or inhibits intermodal transportation hubs and their potential in the future railway led urban development in India. Railways, beyond doubt, have an important relation with the urban development and if planned diligently can result into vibrant urban spaces that can advance better quality of life and facilitate more adept urban management. The physical components of urban transport and urban utilities are established by the city's spatial networks which in turn are determined by its urban spatial structure. Additionally, the urban spatial structure, or more commonly land use, is the product of the interaction between land markets and the regulations.

In this paper the potential of transportation development as a major trigger for growth in Indian cities has been explored, through the examples of Mumbai and Hyderabad. The challenges that emerge from the insertion of large scale transportation infrastructure and its effect on real estate, quality of life, and other integrated aspects of urban living are points to be resolved as urban India moves into an era of transportation advancement. The inherent characteristics like land ownership, presence of multiple stakeholders, variety of competing transportation also raises complexities in urban development. Recently, Indian Railways' Station Redevelopment Programme has focused on making railway stations as the epicenter of activities with the railway premises (Indian Railways (2017)). The idea is to raise revenue for modernization of stations through commercial development on railway land.

Across India, 8 cities have functional metro railway lines, while 7 cities' metro lines are under construction. Close to 19 cities are planning to develop metro lines within their limits. Mumbai is the first city in India to come up with a Monorail, while 4 other cities (Chennai, Kolkata, Coimbatore and Ranchi) are planning to introduce it. The two cities have been selected as representative of new era of railway transportation development in the form of Metro and Monorail, while Mumbai has had five years of Metro rail, Hyderabad started with the railway only in November 2017. Also, Mumbai has been a pioneer in implementing a plethora of policies which might not be directly influencing the intermodal transportation hubs, but can facilitate the same if integrated together. The rigid and salient topography of Mumbai makes the entire city a bi-directional rail transport corridor. This is an example where urban transport has influenced the land market and the city structure without much formative intervention (even probably at odd with regulations). In Mumbai, the adjoining areas to the major stations have been hosting highest densities of population, activities and informal transportation hub which have been linked on surface. This inherent potential of high density and rail-integrated urban development can be utilized to shape the urban development with multi-nuclei instead of around one or two CBDs. Hyderabad, the fifth most populous city of India has witnessed an enormous growth of private vehicles due to which it has been experiencing tremendous pressures on its transport services. The metro rail project is poised to give Hyderabad, India's IT and pharmaceutical powerhouse, a people-friendly, green, seamlessly connected intermodal mass transit system.

This paper, in the next section, discusses the location, demographics, social-economic profiles and transportation network, to introduce to these major urban agglomerations. Section 3 looks into the development framework, enlists the invested stakeholders, and explores the policies that can impact intermodal transportation hubs. The subsequent Section 4 classifies the stations into typologies and examines the development potential within 500 meters radius, and if it has been facilitated and planned or ad-hoc. Section 5 synthesizes the case studies which focuses on the Metro Line 1 in Mumbai and new Metro lines in Hyderabad. Finally, Section 6 concludes by posing the challenges and the potential in future railway-led urban development in India.

2. Background

2.1 Location

Mumbai is the capital city of the Indian state of Maharashtra. It lies on the Konkan coast on the west coast of India and has a deep natural harbour. Mumbai consists of two distinct regions: Mumbai City district and Mumbai Suburban district, which form two separate revenue districts of Maharashtra. The total area of Mumbai is 603.4 km² (233 sq mi). Of this, the island city spans 67.79 km² (26 sq mi), while the suburban district spans 370 km²(143 sq mi), together accounting for 437.71 km² (169 sq mi) under the administration of Municipal Corporation of Greater Mumbai(MCGM). The remaining areas belong to various Defence establishments, the Mumbai Port Trust, the Atomic Energy Commission and the Borivali National Park, which are out of the jurisdiction of the MCGM. The Mumbai Metropolitan Region which includes portions of Thane, Palghar and Raigad districts in addition to Greater Mumbai, covers an area of 4,355 km² (1681.5 sq mi).

Hyderabad is the capital of the state of Telangana, located in southern India. Hyderabad Metropolitan Area (HMA) is one of the fastest growing metropolises in India formed by merging the following erstwhile entities: Buddha Purnima Project Authority, the Cyberabad Development Authority, the Hyderabad Urban Development Authority and Hyderabad Airport Development Authority. It covers an area of approximately 7,200 km² (Source: CTS 2013). Hyderabad Metropolitan Development Authority (HMDA) is the urban planning authority for the HMA region while the Greater Hyderabad Municipal Corporation (GHMC) is responsible for the civic administration of this area. The GHMC is divided into 5 zones, 18 circles and 150 wards. Each ward covers approximately 37,000 people. (Source: Greater Hyderabad Municipal Corporation)

Fig. 1. Location of Mumbai and Hyderabad in India

2.2 Demographics

Mumbai is the most populous city in India with an estimated city population of 12.4 million as of 2011. Along with the neighboring regions of the Mumbai Metropolitan Region, it is the second most populous metropolitan area in India, with a population of 21.3 million as of 2016. The population density is estimated to be about 29,000 persons per square kilometer (0.621 sq. mile). There are 925 females to every 1,000 males – which is lower than the national average. The overall literacy rate of the city is above 86 percent, which is higher than the national average.

Hyderabad has a population of 9.5 million (Source: Census 2011), it is India's sixth largest metropolitan region. Hyderabad city is located within the HMA limits and houses 6.81 million people in an area of 650 square kilometres. The population density is estimated to be about 18,480 persons per square kilometer. There are 945 females to every 1000 males. The overall literacy rate of the city is 82.96%.

2.3 Socio-Economic Indicators

Mumbai is the entertainment, fashion and commercial centre of India. As of 2016 recent estimates of the economy of the Mumbai Metropolitan Region have ranged from $151 to $368 billion (PPP metro GDP) ranking it either the most or second-most productive metro area of India. Mumbai accounts for slightly more than 6.16% of India's economy. As of 2009-10, Mumbai enjoys a Per Capita Income of $2,845. This is 16.6% higher than 2008-09 levels of $2,440. Mumbai has traditionally owed its prosperity largely to its textile mills and its seaport till the 1980s. These are now increasingly being replaced by industries employing more skilled labour such as engineering, diamond polishing, healthcare and information technology. As Mumbai is the capital of Maharashtra, government employees make up a large percentage of the city's workforce. Mumbai also has a large unskilled and semi-skilled labour population, who primarily earn their livelihood as hawkers, taxi drivers, mechanics and other such proletarian professions. Like most metropolitan cities, Mumbai also has a large influx of people from rural areas looking for employment. The crime index in Mumbai is 43.92 (Crime Index 2018 Mid Year - Numbeo). Indices between 20 and 40 are considered to be 'low'.

Hyderabad and the areas surrounding it form the economic core of the state representing about 30% of the gross state domestic product. The per capita income in 2014-15 was INR 2,94,000 (US$4,600) (CTS (2013)). The economy of Hyderabad is based on traditional manufacturing, the knowledge sector, and tourism. In the 1990s, the economic pattern of the city changed from a primarily service hub to a more diversified economy, but the service industry remains a major contributor, with 90% of the employed workforce engaged in this sector. Hyderabad has also emerged as a hub for IT & IT related services in the country due to shift in government policies that favour the establishment of such facilities and the large employable workforce in the region. Based on studies conducted for the CTS 2013, the socio-economic strata in Hyderabad consist of 20% upper class, 50% middle class and 30% working class. The estimated type of employment by office, industry, agriculture and other is 28%, 10%, 11% and 51% respectively. Around 20% of the GHMC population is qualified with at least a diploma, graduate or post-graduate degree or above. The crime index in Hyderabad is 37.49 (Crime Index 2018 Mid Year - Numbeo).

2.4 Transportation Modes and Network

Mumbai's public transport comprises of rapid transit (suburban railway, metro, and monorail), the bus services of the three municipalities making up the metropolitan area, public taxis and auto rickshaws, and a few ferry services. A metro and a monorail system have been added in the last few years, which is planned to grow further catering to the persisted demands of the city. The existing suburban rail and the bus network already have great outreach, with well functional feeder systems. As is common with complex urban structures, these different modes sometimes overlap and run parallel, at other times they cross over. For example, many of the new planned lines would juxtapose and link the network of the railway lines to bus routes, resulting in potential inter-modal transportation hubs, which requires dedicated attention in its planning and implementation. Suburban station areas, inter-city rail terminal areas, inter-city bus terminal areas throughout the study area are typically congested. Located in close proximity to commercial areas and markets, and surrounded by informal markets; they experience increasing number of vehicles and pedestrians, all competing for limited available road space.

Fig. 2. Transport Network (Source: WikiProjects Indian Cities)

Fig. 3. Mumbai Suburban Rail Network (Source: sa PlaneMad/Wikimedia)

a) Bus Services: Mumbai has the largest organized bus transport network among major Indian cities. In Greater Mumbai, Brihanmumbai Electric Supply and Transport Undertaking (BEST) is the largest public bus transport service provider with a fleet strength of 4,336 and operating on 507 routes (2013). It operates services within Greater Mumbai, and to major destinations outside Greater Mumbai. As per 2012-13 data there are a total of 3,799 buses on road per day and one-way passenger trips originated daily is about 3.86 million (31.4 million Passenger-km/day). There has been a decline in bus ridership attributed to reasons like relatively high travel times due to traffic congestion, better reliance on IPT modes on share basis, etc. (CMP (2016)).

b) Railway Services: The Mumbai Suburban Railway is the oldest commuter rail in Asia, founded in 1853. It is owned by Indian Railways and operated by its Western Railways and Central Railways divisions. Most economical transport subsidized by government of India via Railway ministry. With a length of 430 km, it has highest passenger density in the world, 6.3 million people daily, more than half of daily capacity of Indian Railways.[16] It has four radial lines: Western, Central, Harbour, and Trans-Harbour. At present, Mumbai Metro Railways have one operational line (11.4 km in length with 12 stations) and 10 planned lines in total. Mumbai Monorail has one operational line (8.26 km in length with 17 stations) and 8 planned lines in total.
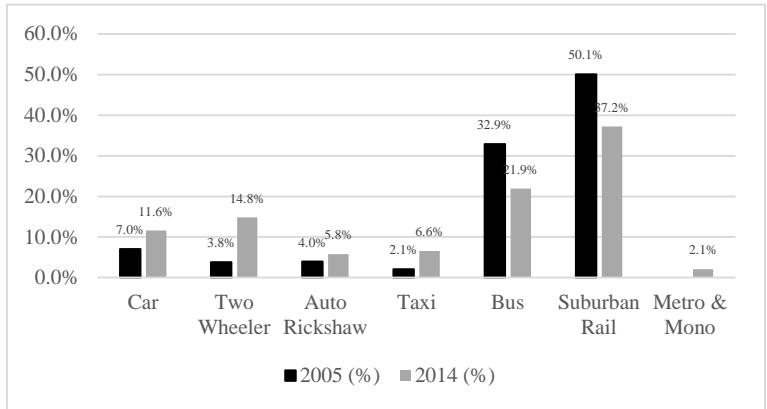

Fig 4. Comparison of mode-split assessed for Greater Mumbai in 2005 (CTS for MMR Study) and 2014 (CMP for Greater Mumbai study

Transport in Hyderabad is the network of roads, railways, rapid transit system in the state of Telangana. It has comprehensive highway network. Three National Highways (NH) pass through the city. Five State Highways (SH) begin at Hyderabad. The Inner Ring Road (IRR), Outer Ring Road (ORR) and Elevated Expressway were constructed by the HMDA to relieve traffic congestion. Hyderabad's public transport comprises a light rail system, Metro rail, city and private bus services, taxis, auto-rickshaws and intercity rail services. The Metro rail services are a new addition to the transportation system – one section of the planned service commenced operations on November 29, 2017.
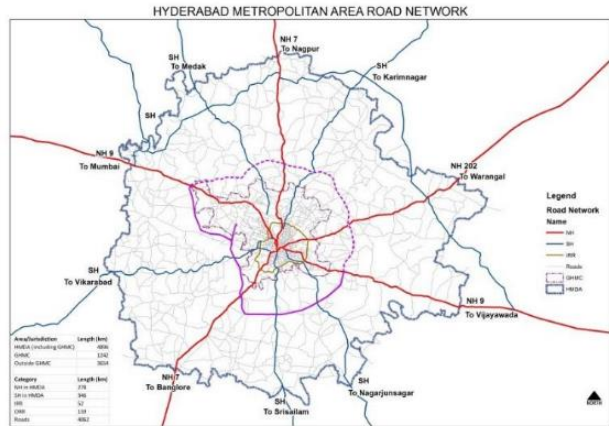

Fig. 2. HMA Road Network (CTS 2013)

a) Bus Services:

City Bus Services - These are run by the Telangana State Road Transport Corporation (TSRTC). A total number of 776 bus routes are in operation on the roads for public transport (other than hired/company/institution Buses) with 1207 bus stops. The total trips performed in these 776 routes per day are about 44,000 (CTS (2013)).

Private Bus Services - The State government provides services through SETWIN (a private organization running the public transportation). Due to the high accident rate and pollution caused by the buses, services were stopped for a few years but resumed in 2006. As of now SETWIN runs 100 buses within the city limits (CTS (2013)).

b) Railway Services - Light Rail System: Hyderabad has a light rail transportation system known as the Multi Modal Transport System (MMTS). The MMTS is owned and operated by Indian Railways. A total of 9 MMTS routes are operating in HMA. This was launched in 2003 and has been heavily criticized for its poor punctuality, absence of feeder bus services to the stations and failure to augment its existing services in keeping with the ridership (CTS (2013)).
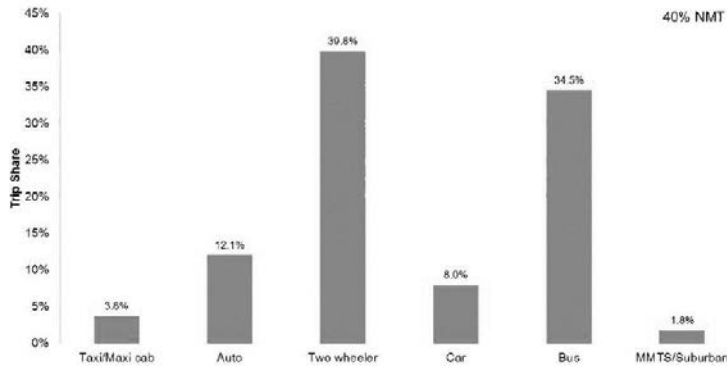
Fig. 3. Modal Shares of Trips made in HMA excluding walk (Source: CTS 2013)

3.   Urban Development Framework

3.1.   *Major Stakeholders*

   i.   Local Government

Greater Mumbai (and by extension Mumbai Metropolitan Region) and Hyderabad have a polycentric governance system; a system that has been acknowledged to work the best for metropolitan regions. However, a great number of scholars and practitioners, have established the missing links of governance between the two major agencies, MMRDA(Mumbai Metropolitan Region Development Authority; an agency responsible for regional development) and MCGM (Municipal Corporation of Greater Mumbai; an agency responsible for urban governance in Greater Mumbai region) (Pethe et al. (2011)). Similarly, Hyderabad is governed by overlapping authorities of Hyderabad Metropolitan Development Authority (HMDA) and Greater Hyderabad Municipal Corporation (GHMC).

   ii.   Transportation Authorities

Railway authorities: Indian Railways (Central Railway, Western Railway) runs the suburban railways and the large distance trains from and through Mumbai, while the metro trains are run by Mumbai Metropolitan Region Development Authority (MMRDA) in partnership with private sector entities, where ridership started from as recently as 8 June 2014. The Mumbai Monorail is a monorail system for the city of Mumbai, contracted by the Mumbai Metropolitan Region Development Authority. Similarly, railways are under the purview of Indian Railways, while the Metro is under the special purpose vehicles like Mumbai Metro One Private Ltd (MMOPL) and Hyderabad Metro Rail Ltd (HMR).

Bus authorities: Brihanmumbai Electric Supply and Transport Undertaking (BEST) operates services within Greater Mumbai, and to major destinations outside Greater Mumbai. The other municipal transportation authorities which operate buses includes, Navi Mumbai Municipal Transport (NMMT), Kalyan-Dombivli Municipal Transport (KDMT), Thane Municipal Transport (TMT), Mira-Bhayandar Municipal Transport (MBMT), and Vasai-Virar Municipal Transport (VVMT). These multitude bus authorities would need gigantic efforts to take them on board for implementation of any system which promotes integrated transportation hubs.

   iii.   Private Sector

The private sector has important role to play in railway-led urban development as:
   1. a shareholder of joint venture companies operating, and maintaining the transport infrastructure (e.g. The contract for Metro Line 1 (Mumbai) corridor was awarded to the Mumbai Metro One Private Ltd (MMOPL), a special purpose vehicle, and a joint venture company owned by Reliance Infrastructure(69%), Veolia Transport(5%) and the MMRDA (26%). In Hyderabad, it was awarded to Hyderabad Metro Rail Ltd (HMR) with development rights to L&T Hyderabad Metro Rail Private Ltd

(LTMR).

2. a developer of stations (Larsen and Toubro (L&T) Realty was instrumental in coming up with "first TOD project of India" in Navi Mumbai, known as Seawoods Central), and
3. a developer of station destinations (GVK Sky City is an integrated mixed use destination planned by Mumbai International Airport Limited (MIAL) and is contemplated to include development of a wide spread of assets. In Hyderabad, LTMR, the concessionaire of the Metro project, along with developing the metro rail tracks, is also entitled to the development, maintenance and operation of certain real estate parcels along the corridors. These parcels, cumulatively branded as 'Hyderabad Next', are handed over to LTMR by the government and allow a total permissible built up area of 18.5 million sqft (1.71 million sq.m.). So far, out of 15 parcels, 4 have been developed and are comprised largely of malls and retail).

3.2. *Planning Regulations & Development Control*

i. Draft Development Plan (DP)

An earlier version of the draft Development Plan (DP) (2014-2034), released in February 2015, proposed a transit-oriented development (TOD) strategy for Mumbai. TOD zones were created around transport nodes to encourage sustainable poly-centric growth in the city, as well as to form a basis by which affordable housing stock may be provided. DP 2034 promoted the consolidation of employment nodes in the Island City, Eastern and Western Suburbs. These are further integrated with public transit corridors in order to enhance efficiency and travel costs. An FSI of 3.5 to 8 was proposed along the Metro Line 1 corridor under this mechanism. It was aimed at avoiding distortion to the market by creation of scarcity of development rights. On the contrary, establishing "a framework within which market can competitively operate" (DP 2034). The DP fell under heavy criticism for its TOD policy when it was released and was subsequently scrapped.

The revised Draft Development Plan (2016-2036) has given a new and simple concept of Station Area Development Scheme (SADS). As per the document "…the development of lands located within 500 meters from the center of existing operational suburban and metro railway stations, as indicated in the Proposed Land Use Plan shall be treated as the Station Area Development Scheme (SADS)". The area under such scheme shall be governed by the following regulations (MMRDA (2017)):

a. A maximum FSI of 1.0 shall be permissible in the Station area Development Scheme subject to payment of premium calculated at 30% of the land rate as prescribed in the Annual Statement of Rates of the year of granting such developments. The premium shall be charged on FSI granted over and above the permissible Zonal FSI. Out of the total premium, 50% shall be payable to the Authority and 50% to the State Government.
b. The first 100 m of the 500 m shall be earmarked for the railway operations, traffic dispersal facilities and parking lots and no individual developments shall be permitted within this area.
c. In case of land parcels within 500 m but partly located within the 100 m belt, the owner shall be permitted to use the full development potential on lands located beyond 100 m from the station.
d. Land under the said scheme shall be governed in accordance with the provisions for the U Zone, provided that no industrial development except Service Industries shall be permitted.
e. A maximum building height of 24.0 meters shall be permitted in the Station Area Development Scheme.
f. Minimum right of way of any existing road within the 500 m shall be maintained as 24.0 m and accordingly, no construction shall be permitted within 12.0 from the centre of the road.

ii. Comprehensive Mobility Plan 2016 for 2036

The CMP identifies and addresses the issues with the current institutional framework with focus on lack of expertise in Traffic & Transportation Planning/ Engineering field, difficulty in coordinating with Central, State and Local Government agencies, amongst many. To overcome the issues mentioned above, the following changes have been suggested in the report:

a. Renaming of existing Traffic Department as "Traffic & Transportation Department", supported by "Traffic

Advisory Panel" with stakeholders to coordinate local activities. This would facilitate in effective coordination with regional level, state level and central level authorities

b. Strengthening of Traffic & Transportation Department by recruiting post graduates with academic qualifications and experience in Transportation Planning, Transportation Engineering and Highway Engineering

c. Creation of "Parking Cell" for effective planning, coordination, operation of on-street and off-street parking facilities

d. Skill & Technology transfer (traffic engineering, road safety, transportation planning, highway engineering, GIS, etc.) through professional organizations

The report gave a structured way forward with the following actions:

a. Prepare DPRs;
b. Introduce Travel Demand Management measures and implement NMT measures (Parking policy and NMT Policy);
c. Secure encroachment removal along major transportation corridors and restore capacities to safely and effectively move people and vehicles;
d. Implementation of proposed institutional changes in Traffic Department of MCGM and Mumbai Traffic Police;
e. Implement measures to protect long term transportation corridors (protection of Right of Way);
f. Review and updating of transport investment plans and priorities every 5 years;
g. Implement policies to promote Transit Oriented Development; and
h. Implementation of Integrated Fare Structure and common ticketing among public transport systems.

iii. Housing Policy

A steady supply of livable and affordable housing is pivotal to quality of life, more so, in cities with high demand for housing. These housing can be provided near the transit zones, to incorporate the low-income and affordable housing in the main fabric of the cities. There is no existing policy for land use developments along the Metro corridor in both Mumbai and Hyderabad. However, as per an Urban Development Department, Mumbai notification in 2016 there was an amendment to the pre-existing Accommodation Reservation policy. This amendment detailed out for Metro car sheds or MRTS stations an incentive for the original land owner. The owner of the land reserved for such purposes is encouraged to submit 50% of the plot with the constructed amenity of total area free of cost in lieu of construction amenity TDR (transfer of development rights). The owner is then permitted to develop the remaining 50% of land for uses permissible in the adjoining zone with full permissible FSI (floor space index) of the entire plot and permissible TDR potential of the entire plot.

3.3. Policies related to Land & Transportation

In recent past, the national, state and local governments have come up with standalone policies which influences the intermodal transit hubs in one way or the other. In this sub-section, the authors explore these policies and try to gather information which when combined can bring a number of players together to develop a successful system for creation and sustenance of intermodal transit hubs.

i. Parking Policy, 2016

Mumbai has one of the lowest parking price to office rental ratios of 0.03. They are evidently far from having parking prices take account of land prices as stated in India's National Urban Transport Policy (ADB (2011)). The new parking policy of Mumbai has been formulated in 2016 to deal with the unmitigated parking problems in Mumbai. At present provisions has not been established for the parking of IPT vehicles in and around the stations (except Station Area Traffic Improvement Scheme (SATIS) project in Thane which has provided for IPT vehicles). The policy categorizes parking facilities into three parts: Category 'A' covers areas like Colaba, Fort and Nariman Point, where the parking charge shall be Rs. 60 per hour. This category also includes areas around railway stations and markets. In category 'B' areas like Prabhadevi and Siddhivinayak the charges will be Rs. 40 per hour. In category 'C' which has one parking lot in Chembur and another in the Malabar Hill area the charge will be Rs. 20. There is a discount on

these charges for public transport vehicles (DNA (2013)).

> ii.   Open Space Policy, 2016

The currents status of open spaces in Mumbai and Hyderabad is alarming by any standards of urban planning. In 2012, the MCGM survey reported that the per capita availability of open spaces in Mumbai was 0.99 sq. m, while Hyderabad has it at a low of 0.22 sq m./person. According to the Central government's Urban and Regional Development Plans Formulation & Implementation (UDPFI) Guidelines 1996, the open space available in urban areas should be 10 sq m. Mumbai's open spaces for free public use account for a mere 3.26 per cent of the city's total area, which is 483 sq. kms (excluding the 11 per cent of Sanjay Gandhi National Park) (Hindu 2016), while Hyderabad has 3.78% of its land as open space.

In Mumbai, a new Open Space Policy was considered in early 2016, which allowed gardens, playgrounds and recreation grounds, to be adopted by corporates, individuals, non-government organizations and residents' associations. Under the policy, these plots may be adopted for a period of five years on payment of a deposit of Rs 25,000. No construction will be allowed on these lands at all, except toilets. There are 1068 number of open spaces, 458 plots already given under care taker policy, 601: Plots left to be given out under the new policy. Average annual MCGM budget for maintenance and upkeep of these opens paces is INR 200 crore. The grounds will have to be kept open for access to people from 6 am to 9 pm, at a nominal entry fee of Rs 2 to Rs 5. Entry for children and senior citizens will be free. This draft policy was followed by an interim policy in September 2016.The interim policy revised the maintenance period to 11 months.

> iii.   Hawker Policy, 2009 & Street Vendor's Act, 2014

Hawkers, in India and many other South Asian and South-Eastern countries are considered to be the lifeline of the street they operate on. They exhibit and communicate the local culture, keep the streets vibrant, busy and safer than a deserted one. They are also the provider of cheaper options for food and retail. On the other side, proliferation of street vendors in congested areas causes failure to maintain hygiene standards, free-flowing traffic and corruption. If the hawkers are regulated and licensed, they can be part of the formal economy, providing employment to the local populace and revenue for the local governments. BMC in its new hawkers' policy, has demarcated special zones for hawkers to operate in and will monitor and regulate hawkers. The National (India) Hawker Policy of 2009 mandated that a city should have at least as many licensed hawkers as 2.5% of its total population. For Mumbai, this amounts to 300,000 vendors. By some estimates, this is also the approximate number of unauthorized hawkers in Mumbai. Once plagued by the similar problems, Singapore has done a wonderful job in regularizing and promoting Hawker entrepreneurship, which have provided a boost to the tourism by attracting thousands of tourists every year, exhibiting the social and cultural aspects of Singapore (Ghani (2011)).

> iv.   Cluster Redevelopment Policy, 2015

A cluster development scheme for Mumbai suburbs was announced in 2015, which is an encouragement to infill and redevelopment. It aims at advancing a larger area with social and civic infrastructure facilities. This scheme has already been applied in Mumbai city in projects such as Bhendi Bazar redevelopment. The government has approved the scheme for Thane in February 2016, and for Navi Mumbai in 2013.

> v.   Station Redevelopment Programme, 2017

Government of India's (Ministry of Railways) Station Redevelopment Programme (Indian Railways (2017)) has been dubbed as "largest TOD programme in the world" by utilizing around 1100 Hectares of prime real estate land on lease for 45 years, including 400 stations across the nation. General guidelines on redevelopment of 'A-1' & 'A' Category stations, identifies Mumbai CST and Mumbai Central stations as candidates for redevelopment. It primarily focuses on passenger amenities, intermodal connectivity, integrated safety and security, access, leisure facilities and check-in facilities.

Other important characteristics of such redevelopment are as follows:
- Financial Mechanism: The policy hoped to leverage the commercial development of land & air space in and around the station which would generate the revenue from the real estate to at least cover the entire cost of station redevelopment after meeting the full expenditure on real estate development and maintenance obligations.

▫   The proposals to be in conformity with Local Development Control Norms:
▫   Constraint in commercial development - Vacant railway land/air space shall not be sold under any circumstances. For commercial development, available vacant railway land/air space shall be leased only with lease period up to 45 years. It would exclude residential development.

vi.   Kiosk Policy at Metro Station

A maximum of 100 sqm of 'basic convenience' retail is permitted at metro stations allowing for the provision of ATMs, basic stalls etc. This is built into the development agreement signed with MMRDA. It has been observed however, that there is much more space available at the metro stations than what is being currently used by kiosks. The probable reason for this under use could be the lack of capacity to manage such establishments and lack of clarity on the sharing of revenue generated.

vii.   Skywalk Guidelines

No specific policy for Skywalks exists. In Mumbai, even though MCGM is responsible for building skywalks, in absence of funds, the onus lies on MMRDA. The Mumbai Skywalk Project is the erection of skywalks for pedestrian use in the Mumbai Metropolitan Region by MMRDA. In all, 36 skywalks have been completed out of which the MMRDA constructed 28, MSRDC 7 and 1 was constructed by Kalyan-Dombivali Municipal Corporation. The survey conducted by MMRDA shows that more than 15 lakhs commuters make use of the skywalk, running over 23 kilometers. These were primarily installed to connect the high density suburban railway to other modes of transportation, and for efficient dispersal of commuters from congested areas to strategic locations, such as bus stations, taxi stands, shopping areas, etc. Skywalks were also part of SATIS in Thane. Skywalks have also been constructed connecting the suburban railway station to the metro station at Andheri and Ghatkopar.
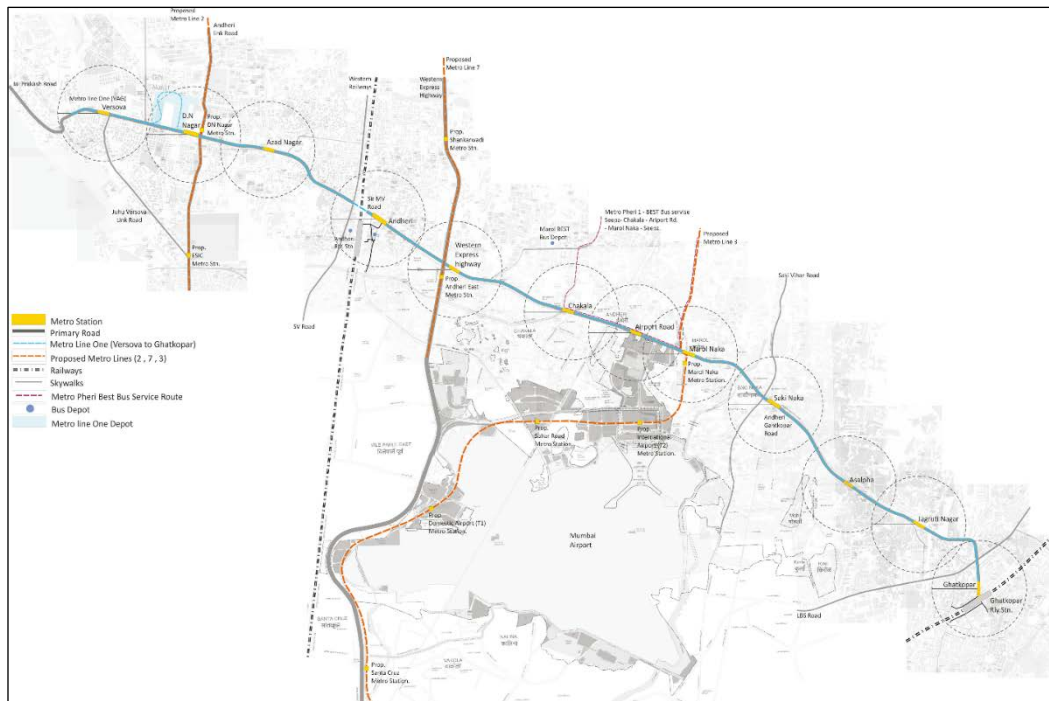
4.   Station and Hub Typologies

Fig. 4. Location Map of Andheri and WEH on Metro Line 1 in Mumbai

This paper classifies the various stations along the metro line in two typologies: multi-modal interchange hub and metro interchange stations. It attempts an elaborate mapping of selected stations under for both the cities. Station

areas are studied along with its connection to intermediate public transport, stakeholders and construction status, amongst other criteria, as potential stations where the intermodal transportation hubs can be envisioned and consequently the challenges and the potential can be identified.

4.1. *Multi-Modal Interchange*

This typology focuses on the Metro stations which have more than one mode of transportation situated close to each other to be able to leverage the proximity of the modes to create a destination.

(a) Andheri

Table 1. Fact Sheet, Multi - Modal Interchange - Andheri (Mumbai)

Interchanges	Andheri Suburban Railway Station (Western Line/ Harbour Line) Andheri Metro Station (Metro Line 1) Andheri Bus Depot (East/ West)
Distance between furthest Stations	To Versova – 3.1km To Ghatkopar – 7.71km
Stakeholders	Indian Railways, BEST, MOOPL (Metro One Operation Private Limited)
Status	Andheri Metro Station - Operational

Andheri is a passenger rail station serving the Western line and Harbour lines of the Mumbai Suburban Railway. The station inter-connects the Line 1 of the Andheri metro station. With a pre-eminent number of passengers boarding daily, it has been termed "one of the busiest stations" in Mumbai on the Central line. In 2014, the station, along with Jogeshwari and Goregaon stations, was re-developed and expanded with the expenditure of INR 103 crore (US$15 million). In addition, the station has two bus stations operating more than 30 bus routes. As Figure 8 shows it is a potential intermodal transportation hub with Railway stations, Metro station, Bus stations, all interconnected with Skywalks and Foot-over bridges. However, this has been done over the years in an adhoc manner.
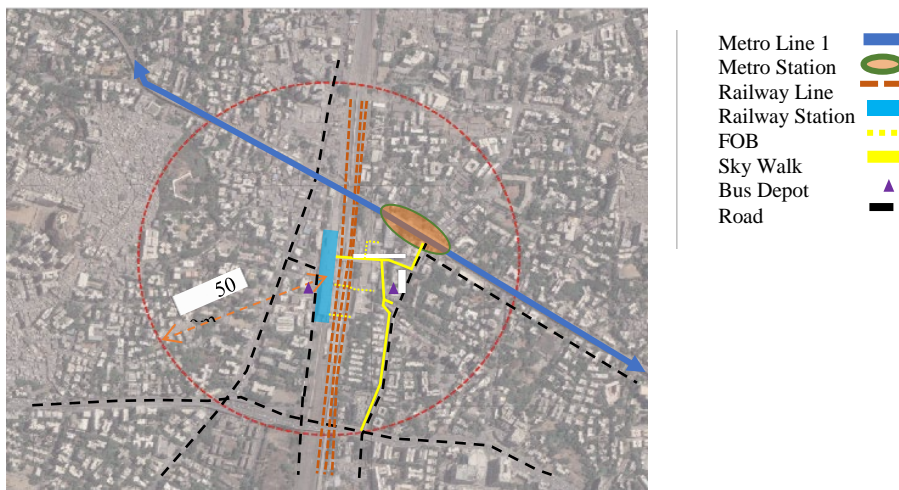

Fig. 5. Station Area Map of Andheri in Mumbai

(b) Secunderabad

Located in the heart of the city, Secunderabad Junction is an existing major intercity railway station and a commuter rail hub in the city. It is further connected to the rest of the city through the Hyderabad MMTS and the bus services at Rathifile station. This is one of the most major interchanges located within the city limits, although as yet unplanned in nature. It has recently been undertaken under the Indian Railways' Station Redevelopment Programme. As Figure 10 shows Secunderabad East & West stations on Corridor 2 and 3 are close to each other, with a 6.3 acres of parcel which can be earmarked for Transit Oriented Development (TOD) to integrate various modes.
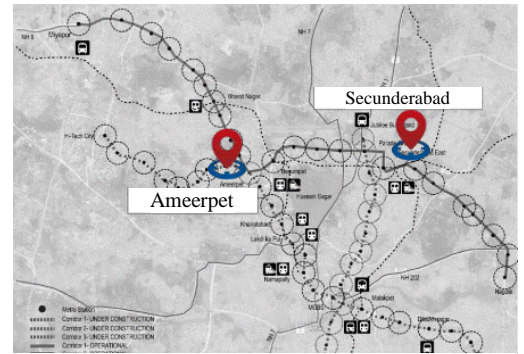

Fig. 6. Location Map of Secunderabad and Ameerpet in Hyderabad

Table 2. Fact Sheet, Multi – Modal Interchange – Secunderabad (Hyderabad)

Interchanges	Secunderabad Junction Railway Station (South Central Railways – Indian Railways) Secunderabad East Metro Station (Metro Corridor 3) Secunderabad West Metro Station (Metro Corridor 2) Rathifile Bus Station Hyderabad MMTS
Distance between furthest stations	1 km approx
TOD Parcel	Yes, at Secunderabad West Metro Station. 2.55 ha approx.
Stakeholders	Indian Railways – South Central, Telangana State Road Transport Corporation (TSRTC), HMR, LTMR
Status	Secunderabad East Metro Station - Operational Secunderabad West Metro Station – Under Construction
Other Details	A skywalk is proposed connecting Secunderabad East Metro station to the railway station foot over bridge.

Fig. 10. Secunderabad Station Area

Fig. 11. Station Area Map of WEH

4.2. Metro Interchange Station

This station type has interchange of Metro stations within walking distance.

(a) Western Express Highway Station (WEH)

Western Express Highway, abbreviated to WEH, (rebranded as MagicBricks WEH due to a naming rights deal) is

a metro station on Line 1 of the Mumbai Metro serving the Andheri suburb of Mumbai, India. It is the flagship station of the line and was opened to the public on 8 June 2014.

Table 3. Fact Sheet, Metro Interchange Station – WEH (Mumbai)

Interchanges	WEH (Line 1 and 7)
Stakeholders	MOOPL (Metro One Operation Private Limited) MMRDA
Status	Line 1 (operational), Line 7 (planned)

(b) Ameerpet

Table 4. Fact Sheet, Metro Interchange Station - Ameerpet (Hyderabad)

Interchanges	Ameerpet (Corridor 1 & 3)
Station size & configuration	Largest Metro station – 140m long and 40m wide Vertical stacking of two stations Corridor 3 – Lower Platform Level Corridor 1 – Upper Platform Level
Stakeholders	LTMR
Status	Operational
Expected ridership	40,000 commuters per day
Other details	Presence of 'paid' and 'unpaid' zones within the station as well as retail areas. Ticketing & Major Retail occurs at Concourse Level, entry to which does not require a ticket.

Ameerpet is a major commercial and educational hub located in Hyderabad and is known as India's 'unofficial IT training hub'. The entire area also witnesses high levels of pedestrian and vehicular traffic during peak hours. The Ameerpet metro station is a major interchange station planned between Corridors 1 and 3. It is unique as it has the interchange at two different levels. It also allows retail within the station area for upto 3800 sq. m., for four module types.

Fig. 12. Ameerpet Station Area in Hyderabad

5. Comparative Analysis

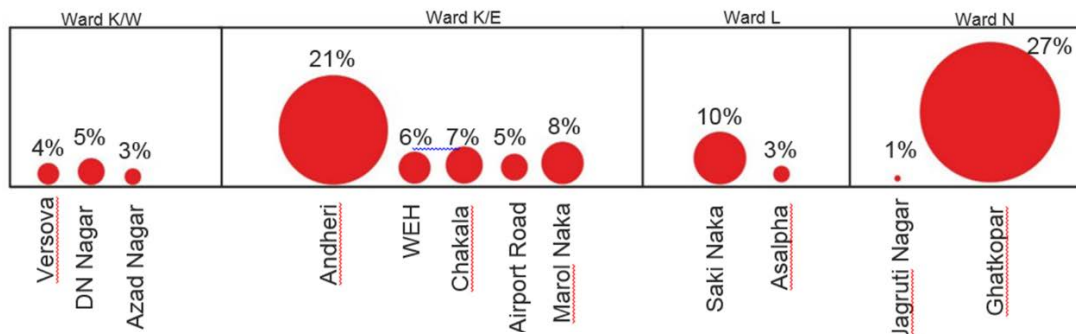*5.1.   Case Study of Metro Line 1*

Fig. 7. Ridership Distribution for the Metro Line 1 (2016) (Source: Reliance Infrastructure)

The Mumbai Metro is a planned urban rail transit system that aims to improve connectivity for people residing in

areas in Mumbai that are not connected by the suburban railway station. The Master Plan for Mumbai Metro was commissioned by the Mumbai Metropolitan Region Development Authority (MMRDA) with the objective of improving the traffic and transportation scenario in the Mumbai Metropolitan Region (MMR). There are now 8 lines which are proposed in 3 phases, covering a total of 172 km in distance. Out of this, Line 1 is already functional, while overall completion of all the remaining lines is expected in 2021. As per MMRDA, a distance of 1 to 2 kms has been considered as the catchment area around each metro station. The metro system is planned for interchanges at major nodes such as Chhatrapati Shivaji Terminus, Mumbai Central, International & Domestic Airports etc.

Metro Line 1 was initiated under the Indian Tramways Act, 1886. In 2013, the Department of Urban Development brought the Mumbai Metro under the Metro Railways (Construction of Works) Act of 1978. This had a major impact on the fixation of fares, as under new Act, MMOPL was granted the authority to fix the fares, after obtaining recommendations from the Fare Fixation Committee.

The aim of this case study is to study the impact of Metro Line 1 on the surrounding city fabric. Metro Line 1 is the first metro rail system introduced in Mumbai in 2014. It connects Versova in the western suburbs to Ghatkopar in the eastern suburbs of Mumbai. As a recently implemented transit corridor in a brownfield scenario, this case provides the opportunity:
•   To study the integration of Line 1 with the existing transportation networks (formal and informal), existing buildings and city structure, and
•   To examine the changes (if any) seen in the land parcels along the line and near the stations

Ownership and Developers: Mumbai Metro Line 1 is conceived on the Build-Operate-Transfer model, where MMRDA holds responsibility for right-of-way easements and Reliance Infrastructure handles the civil works and day-to-day operation of the line. Revenue from the fares, advertisements and kiosks goes directly to Reliance Infrastructure. There are other agencies that operate in the urban realm such as MCGM, Brihanmumbai Electric Supply and Transport (BEST), Railways etc which also have a stake in the development of the Metro corridor. The scope of this case study is limited to the following two parameters:
1. Land Use i.e. the change in the nature of land uses
2. Transportation i.e. pedestrian & IPT networks, street design etc.

Project Components: Mumbai Metro Line 1 was introduced with the intent of improving the east-west connectivity in the city, under Phase 1 of the Master Plan for Mumbai Metro. It extends from Versova in the western suburbs to Ghatkopar in the eastern suburbs. There are 12 stations on this metro corridor, the major ones being Versova, Andheri and Ghatkopar. Two interchanges are created at Andheri and at Ghatkopar, with the suburban railway lines. With the introduction of this metro line, the travel time from Ghatkopar to Versova was reduced to 21 minute . Metro line also provides improved connectivity to the employment hubs of SEEPZ & MIDC.

Real Estate Development along Major Transportation Corridors: Transportation infrastructure economics have historically proven to have a positive impact on real estate values in a city like Mumbai – residential and commercial properties located close to transportation infrastructure tend to command a premium. Independent analyses of pricing reveal that proximity to a Metro station can single-handedly account for a 22 per cent variation in land values, the other factors being location, distance of the land from the central point and income groups. Developers interest in projects near the Metro has been increasing since the start of construction. With the commencement of the project, the surrounding region has definitely experienced a certain boom in terms of new offerings and price hikes. Rates on both the commercial and residential market have increased.
▫   Multi-modal interchange at Ghatkopar and Andheri is enabled through the construction of skywalks which connect the railway station to the Metro station.
▫   Most of the new developments in the Versova to Andheri stretch and in the Saki Naka to Ghatkopar stretch are residential in nature as shown in Figure 16.

Overall Project Framework: The Mumbai Metro is classified as a 'public vital infrastructure project' by the Government of Maharashtra (GoM). MMRDA has been designated the 'Project Implementation Agency' for the Metro by the GoM. For implementation of Metro Line 1, a Special Purpose Vehicle (SPV) was incorporated under the

Companies Act, 1956, forming Mumbai Metro One Pvt. Ltd (MMOPL). The MMOPL is a joint venture company formed by Reliance Energy Limited, a Reliance ADA Group Company, Veolia Transport, France and MMRDA. As per the Concession Agreement, the implementation period was to be from 2007 to 2012 and project cost was estimated to be around Rs 2,356 crores. Viability Gap Funding (VGF) of Rs.650 crores is provided by the Government.
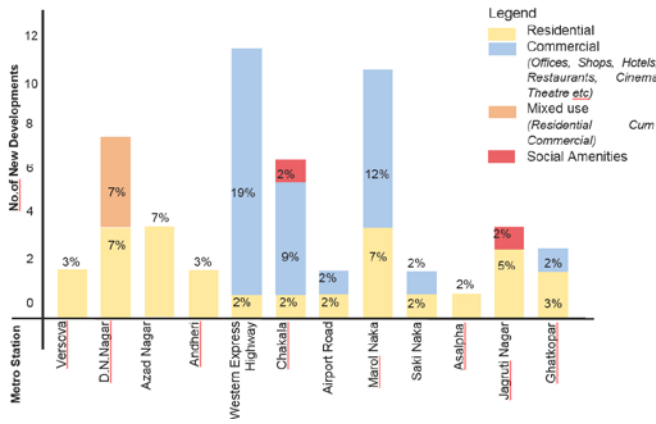

Fig. 8. New Development (Building Use Percentage Distribution – Station wise)

5.2. Comparison between Mumbai Line 1 and Hyderabad Metro Phase 1

To identify the potential of these transit corridors in developing intermodal transportation hubs and to understand the challenges an Indian urban scenario poses, the metro corridors in Mumbai and Hyderabad were evaluated, and enlisted in the following table.

Fig. 15. Source: Google Earth, Existing Land Use Plan 2014-2034

Table 5. Comparative Evaluation of Mumbai and Hyderabad

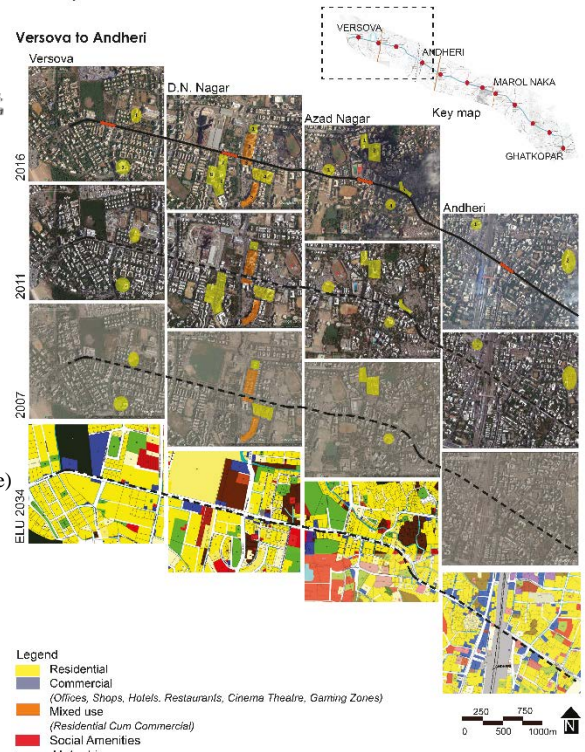|		Mumbai Metro Line 1	Hyderabad Metro Phase 1
	Governing Act	Initially, Indian Tramways Act, 1886. In 2013, Department of Urban Development brought the Mumbai Metro under the Metro Railways (Construction of Works) Act, 1978.	AP Municipal Tramways (Construction, Operation & Maintenance) Bill, 2008
	Project Model	Build-Operate-Transfer model (BOT)	Design-Build-Finance-Operate-Transfer model (DBFOT)
	Agencies Involved	Mumbai Metro One Private Ltd (MMOPL) is an SPV created between MMRDA, Reliance Infrastructure and Veolia Transport for Line 1. Mumbai Metropolitan Region Development Authority (MMRDA) is responsible for right-of-way easements Reliance Infrastructure as the private entity is responsible for civil works and day-to-day operations. It receives revenue from fares, advertisements and kiosks	Hyderabad Metro Rail Limited is the SPV created by State Government for Phase 1 HMDA and GHMC are the Municipal Corporation and Metropolitan Authority Facilitators for land acquisition, permissions etc L&T Metro Rail (Hyderabad) Limited is the Concessionaire and is responsible for construction, day-to-day-operations. It receives revenue from fares, advertisements, retail and TOD

|		
Policies	TOD-related Earlier version of the draft Development Plan, which proposed a TOD strategy for Mumbai and an FSI of 3.5 to 8 along the Metro Line 1 corridor has been scrapped. There is no existing policy for land use developments along the Metro corridor. Retail at Stations A maximum of 100 sqm of 'basic convenience' retail is permitted at metro stations allowing for the provision of ATMs, basic stalls etc. It has been observed however, that there is much more space available at the metro stations than what is being currently used by kiosks.	TOD-related When the metro development plan was complete, an amendment was made to the master plan of the Greater Hyderabad Municipal Corporation (GHMC), introducing 300m wide 'multiple-use' zones on either side of the metro corridor. This regulates redevelopment of plots, building lines and minimum plot areas in the zone. Retail at Stations Well defined retail strategy within stations. Each station will have retail spaces ranging from 2,500 to 9,000 sqft (232 to 836 sqm). Interchange and special stations will have retail spaces ranging from 10,000 to 40,000 sqft (929 to 3,716 sqm). 3-4 types of retail modules available depending on the size of the store
Real Estate Development along Metro Corridor	Most of the new developments along the Metro corridor are either residential or commercial in nature. Redevelopment of plots and change in building uses in the WEH to Marol Naka stretch. Most new constructions are by private developers	Too early to observe impact of Metro on surrounding real estate. All planned real estate development is under the Concessionaire's TOD strategy i.e. across 15 government allotted plots along the Metro corridor. Most of the new buildings are constructed by the Concessionaire i.e. LTMR.
Building Typology Development Trends	Vertical Mixed Use typology i.e. residential/commercial with a shopfront in Saki Naka to Andheri stretch. Commercial towers and restaurants to cater to office crowds. High rise residential gated communities in Andheri-Versova stretch.	Largely single use buildings observed in the constructed TOD parcels – mostly cinema theatres. These are walled developments with no direct connection to the Metro. Lower levels of the building cater to parking.
Adherence to TOD Principles	Varies. Plots closer to the metro station have active edges with visually permeable and physically accessible frontages. Those further away are gated.	Very low, despite being pre-planned and executed by a single agency.
Actual TOD Intent	Nil.	Minimal. More like Transit ADJACENT Development. Focus is on maximising profitability of the plots.
Transportation	Multi-modal interchange at Ghatkopar and Andheri is enabled through the construction of skywalks which connect the railway station to the Metro station. Two-wheeler parking at stations observed. Formal IPT stands not planned. Informal auto pick-up points have emerged near the station entry-exits, causing a lot of congestion observed on the R.O.W.	Multimodal interchange hubs proposals have not yet been approved the government. Skywalk connecting Secunderabad railway and metro station is proposed. Parking for Metro and non-Metro users is provided within the TOD. Detailed transportation plans for station areas have been prepared but not yet approved by the government.
Last mile connectivity	Inter-agency collaborations observed such as Metro Pheri and Ola. Ola taxi pick-up points located at Metro stations with discounted fares for Metro users.	Tie-ups with private taxi services - Uber, Ola – on the cards Mobility Card to be introduced for seamless mobility across Metro, bus etc
Place-making	Branding & advertising on a few stations by altering station name. Eg - MagicBricks WEH station etc	Overall strategy is missing, but attempts at giving each station a unique identity through street improvements around the station have been carried out. Public plaza designed at a terminal station.
Major Challenges	Presence of multiple agencies with varying roles and responsibilities within the urban realm	Challenges faced were either due to changes in local policies such as the New Land Acquisition Act or due to on-site difficulties in finalizing and constructing certain parts of the Metro corridor

6. Conclusion : Challenges & Potential
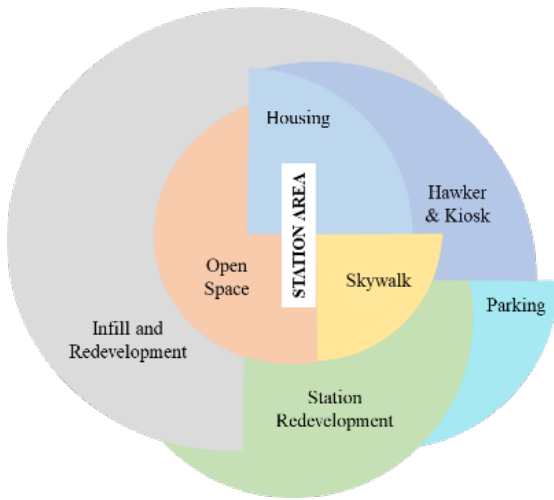
Fig. 16. Policies relevant to a Rail-integrated urban development
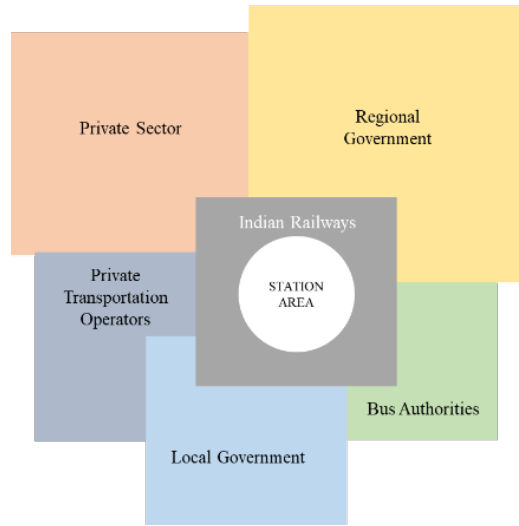

Fig. 9. Relevant stakeholders to a Rail-integrated urban development

The following observations with recommendations could go a long way in improving the way the railwapolicies could focus on the following content:

1. Need for a pre-emptive integrated land use -transport policy

Earmarking the zone for station related development similar to Mumbai's case where the first 100 m of the 500 m shall be earmarked for the railway operations, traffic dispersal facilities and parking lots and no individual developments shall be permitted within this area. Additionally, the policy could focus on

2. Multi -modal hub planning

Multi-modal hubs require a dedicated planning strategy to effectively handle the transfer of passengers. Currently, there is no such planning strategy in place at Andheri or Ghatkopar, resulting in pedestrian and vehicular chaos at the interchanges.

3. Designation of roles and responsibilities for various stakeholders

Mumbai's case presents the interests of multitude agencies. MMRDA is the planning agency, while MCGM is responsible for the day-to-day upkeep of the ROW under the Metro line. Fare collection dues lie with the private entity while any benefits due to increased property tax collection go towards MCGM. Within this framework, it is a challenge to execute a sustainable transportation development model unless the powers of planning and execution lie with a single agency, or clearly divided. A special purpose vehicle with members from the stakeholders is the easiest way to overcome the bureaucracy, as exhibited by both Hyderabad and Mumbai's case.

4. Prioritizing the leading role of the Private Sector

A clear vision should be formulated and planning should be done for the development of a transportation route/line. The policy should provide for ownership for private sector. Risk sharing for the PPP model should be improved. Most of the risk is borne by the private sector, especially due to delays in handing over the land, arbitration issues, resorting fare fixing issues, ROW easements, etc. as exhibited by the case of Hyderabad. The frequent changes in Master Plan induces number of risks for the private sector interested in purchasing a land near the station and developing it. There should be a clause for maintenance assigning responsibility, when a collaborative project is undertaken by the government and a private sector entity.

5. Regional and Local Government

The land ownership around the station gives an upper hand to the government concerned, in the promotion of development around transit stations. Parking and FSI incentives given within 500m range of existing and upcoming metro stations. Metro railway depots and BEST depots (handed over to Public Works Department (PWD)) are planned to be developed. Transit Oriented Development found mention in Development Plans 2014 in Mumbai but limited guidelines were proposed to implement it. Draft Development Plan 2016 also mentions the policy as Station Area Development Scheme (SADS). However, it has limited implications to encourage the development.

The current state of affairs in both these cities presents the challenges and highlights the potential. This would require comprehensive involvement from the governments at various levels, as well as leading role from the private sector, which would need encouragement from the policies. Indian cities, with its push for development and especially transportation network, can do well with a preemptive approach in planning for rail integrated development, involving all stakeholders.

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