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Transit-Oriented Development: Lessons from Indian Experiences



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About Centre for Urban Equity (CUE)

CUE was established at CEPT University in 2009, evolving from the Urban Poverty Alleviation (UPA) Cell established in 2008. CUE advocates a human-centered and equitable urban development paradigm. CUE undertakes research and advocacy; conducts training and capacity-building; imparts education; and networks with stakeholders on various aspects of human settlements with a focus on urban equity.

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Abstract

Transit-Oriented Development (TOD) presents unique opportunities for Indian cities to meet the challenges of rapid motorization, rising inequity, deteriorating quality of the urban realm and climate change. This paper explores the case of TODs – planned or underway – in three Indian cities and examines if the international experiences of TOD have enriched our understanding of TOD. It critiques these attempts and presents suggestions for Indian cities to achieve a development that is more oriented to transit than being adjacent to it.

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1. Introduction

Transit Oriented Development (TOD) has been the buzzword in planning circles internationally since the nineties. Calthorpe (Calthorpe 1993) and Cervero (Cervero and Kockelman 1997) were able to capture American policymakers' attention through their writings and advocated the adoption along transit of a model of development that was already prevalent in the inner cities. In the Indian context, some of our cities already had the features which came to be associated with TOD at a later stage. It is only much later in the early 2000s when cities started investing in big budget projects like metro-rail that TOD started to be imposed on cities demanding transit. While progress has been patchy, efforts have involved adopting TOD concepts and replicating them in the Indian context. In 2017, as the Delhi Metro completes fifteen years of operations and other cities like Bengaluru have one or more phases of their metro-rail commencing operations, there is a need to address the attempts made by Indian cities at achieving TOD. International literature presents several critiques of TODs in American, European and Australian contexts, harping on how in the absence of enabling circumstances, these have turned into Transit Adjacent Development (TAD).

This paper is a response to the need for an evaluation of Indian attempts at producing TOD. It traces the advent of TOD in India and its progress over the years. It evaluates TOD plans, either standalone or as part of the development plan, focusing on the case cities of Delhi, Ahmedabad and Bengaluru. The framework developed for evaluating these TOD plans is developed after a comprehensive literature review, drawing especially on the work of Singh et al. (2015). The first section consists of a comprehensive review of literature on TOD from global experiences with identification of indicators on which the TODs can be evaluated on their TODness and the current debates of urban planning on land use and transport integration. We consequently evaluate the 3 Indian case studies with respect to the identified indicators to understand the current scenario of TOD ness in India.

2. Literature review

2.1. What is TOD or TOD-ness?

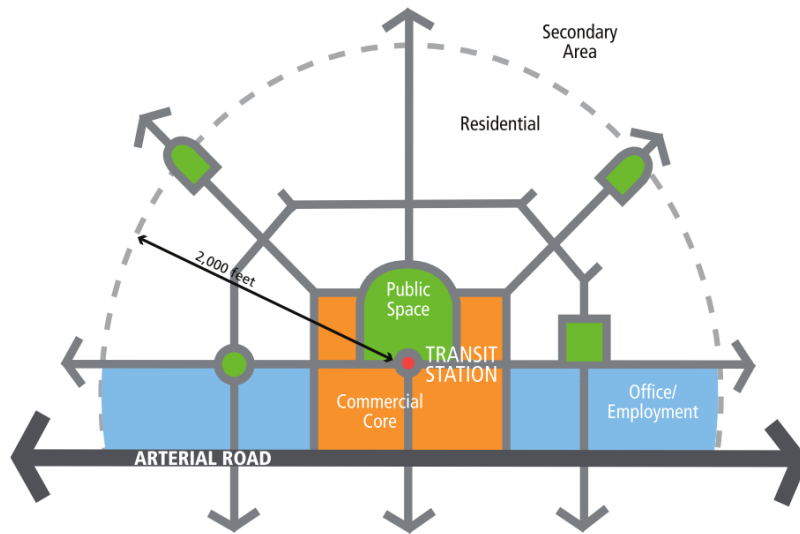
There are multiple definitions of TOD which lies within the concept of new urbanism. New urbanist theory suggests that compact, mixed-use communities are the answer to the suburban problem. Several academics have adopted their own explanations of this new paradigm. One of the original and most popular definitions of the transit-oriented concept came from Peter Calthorpe, an architect and proclaimed urbanist. According to Calthorpe (Calthorpe 1993), TODs are:

Mixed-use communit[ies] within an average 2,000-foot walking distance of a transit stop and a core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot or car (p. 56).

In addition, the transportation hub should be located in the heart of the neighbourhood, within a 400 metre, or 10 minute walk from residents. This central location reflects the importance of transit in the community and in the region as a whole (Picture 1). TOD comprises a mix of commercial, residential, and institutional developments built to support a transportation hub and to encourage non-motor vehicle mobility options, such as biking and walking, within the

community. A TOD area could encompass a radius of as little as 0.5 miles or as much as 1 mile from a transit station (Cervero 2002).

Picture 1: Transit-Oriented Development as explained by Calthorpe



Source: Adapted from (Brinklow 2010)

Table 1: Definitions of Transit-Oriented Development (TOD) according to authors

Authors	Definition
Calthorpe (1993)	Mixed-use community within an average 2,000-foot walking distance of a transit stop and a core commercial area that mixes residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot or car.
Cervero et al. (2004)	TOD is a tool for promoting smart growth, leveraging economic development, and catering for shifting housing market demands and lifestyle preferences.
Still (2002)	A mixed-use community that encourages people to live near transit services and to decrease their dependence on driving
Maryland Department of Transportation	A place of relatively higher density that includes a mixture of residential, employment, shopping and civic uses and types located within an easy walk of a bus or rail transit centre.
Bernick and Cervero (1997)	A compact, mixed-use community, centred on a transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more.

Source: As indicated.

Carlton (Carlton 2007) presents a rich history of the evolution of TOD tracing it back to as far as Ebenezer Howard’s seminal work “Tomorrow: a Peaceful Path to Real Reform” (Howard 1898) and “Garden Cities of Tomorrow” (Howard 1965). In the succeeding decades, American cities like Boston witnessed what may be called as Development-Oriented Transit (DOT) with cities increasingly getting divided into areas of work and stay. The rise of the motor car aided this form of development. As cities grew larger by the 1970s, streetcars came into being which expected suburban dwellers to “park-and-ride.” Systems like the Bay Area Rapid Transit (BART) were a product of these times and were called as Auto-Oriented Transit (AOT). Since these were not able to achieve the kind of ridership that were originally envisaged, the government started funding research, which demonstrated that transit ridership was dependent on the intensity of development near transit stations.

Cervero and Zupan (1996) demonstrate that localized densities around transit systems could produce positive synergies. Also, office uses generally attracted high numbers of transit users while housing near transit, both affordable and high-end, also offered synergies. Transit

authorities began to see that they could take up the role of land developers and guide the type and scale of development on land near stations to increase ridership. This was called Transit-Supportive Development (TSD) and paved the way for TOD later.

Transit-oriented development was a response to current conditions, a) rising energy prices, b) road congestion, c) climate change, d) shrinking household sizes, e) increasing demand for urban living, f) interest in green building and walkable neighbourhoods. Homebuyers, renters and employers are drawn to areas with convenient access to transit and other urban amenities such as neighbourhood shopping and services. At least a quarter of all housing demand in the next 20 years will be for homes and apartments within half a mile of rail transit stations (Austin et al. 2010). This high level of demand is reflected in the prevalence of higher rents and land values near transit across the country.

2.2. Measuring TOD-ness

As mentioned earlier, there are multiple definitions of TODs and no umbrella strategy works for all cities. Every city is different in nature and hence to make a successful strategy for TOD it is important to list out indicators or key components for measuring TOD ness.

Calthorpe (1993) lists the key components of TOD as follows:

- Growth organized on a regional level to be compact and transit-supportive
- Commercial, housing, jobs parks, and civic uses within walking distance of transit stops
- Pedestrian-friendly street networks that directly connect local destinations
- A mix of housing types, densities, and costs
- Preservation of sensitive habitat, riparian zones, and high-quality open space
- Public spaces become the focus of building orientation and neighbourhood activity.

Additionally, Transit Oriented Development Institute adds the following to that list:

- Walkable design with pedestrian as the highest priority
- Transit station as prominent feature of town centre
- Public square fronting [transit] station
- Nodes containing a mixture of uses in close proximity (office, residential, retail, civic)
- High density, walkable district within 10-minute walk circle surrounding [transit] station
- Collector support transit systems including streetcar, light rail, and buses, etc
- Designed to include the easy use of bicycles as daily support transport
- Large ride-in bicycle parking areas within stations
- Bikeshare rental system integrated into stations
- Reduced and managed parking inside 10-minute walk circle around [transit] station
- Specialized retail at stations serving commuters and locals including cafes, grocery, dry cleaners

Cervero (1997; Ewing and Cervero 2010) lists five Ds in the form of a) density, b) diversity, c) distance to transit, d) design, and e) destination access as key to ensuring lower Vehicle Kilometres Travelled (VKT) and higher trips on the transit system. Others argue that it makes sense to categorise TODs into typologies as similar sets of strategies may be adopted for TODs of a certain type. It supports the identification of development potentials and future adaptations of TODs. Each TOD type has a desired density, land-use mix, connectivity, and transit system function which can be ascribed to a typology (Zemp et al. 2011). Therefore,

TOD typology helps answer questions such as “what mixtures of uses will optimize effective mixed-use development and support location efficiency under specific conditions (for example, in areas with different levels of density)?” or “what densities and level of transit service are necessary?” (Kamruzzaman et al. 2014). These questions not only help design better TODs but also help in evaluating them on set parameters. For example, while increased density has the potential to increase ridership, scholars argue that it may result in negative implications on the twin fronts of social equity and quality of living. As a result, a balance between these factors are important for a successful TOD (Lin and Gau 2006). It also opens up avenues for creation of parameters against which TODs may be evaluated, answering questions like what makes a TOD successful. Recent research in this direction has been encouraging and will be covered in the following section.

Prominent among such research is that by Center for Transit-Oriented Development (Austin et al. 2010) which proposed normative measures for typifying examples of TOD. Performance measures use data on existing conditions to compare station areas to predetermined outcomes of what TOD was expected to bring. Performance measures can be reviewed over time to gauge whether station areas are moving towards ideal conditions or away from them. The CTOD research aims at answering questions like, a) what outcomes can we expect from investments in transit and TOD?, b) what differentiates transit-oriented development from transit-adjacent development?, and c) what standards should be utilized in evaluating zoning for TOD or other policy interventions? Vehicle Miles Travelled (VMT) or Vehicle Kilometres Travelled (VKT, in the Indian context) is used as a performance measure. The logic being that people tend to use transit, walk and cycle more in places with lower VKT in accordance with one of the stated goals of TOD. The study puts normative measures in place and evaluates the case cities against these measures. It must be conceded that given the rich tradition of collection of data in the West, it becomes possible to carry out such analysis which may be difficult in Indian conditions.

Another example of an attempt at measuring TOD ness is by Singh et al. (Singh et al. 2014) who proposed a TOD index that measures multiple spatial indicators and aggregates them under a Spatial Multi Criteria Assessment (SMCA) framework to arrive at a comprehensive value depicting the existing levels of TOD at an area. The study was carried out in the cities of Arnhem and Nijmegen in The Netherlands. The criteria used as part of the TOD index is presented in Table 2. It uses indicators based on a) density, b) land use diversity, c) land use mixed ness, and d) number of business establishments as parameters of evaluation.

Table 2: Criteria used as part of TOD index developed by Singh et al.

Criteria	Rank order	Resulting weights	Indicator	Contribution to criterion's weight	Description
Level of density	1	0.35	Residential density Commercial density	50% 50%	Higher residential and commercial densities are required for more efficient public transport
Level of land use diversity	1	0.35	Land use diversity	100%	Higher diversity of land uses reduces vehicular trips and enhances the liveliness and safety of a place where people socialize
Level of mixed use	2	0.20	Mixed use	100%	Higher mixed-ness of land uses (w.r.t residential land use) encourages higher degree of walk and cycle for non-work trips
Level of economic development	3	0.10	Number of business establishments	100%	The higher number of business establishments represents higher level of economic development and hence higher TOD levels

Source: (Singh et al. 2014)

This index was proposed to be used for recommending hotspots for transit connectivity. It helped identify and map those particular areas in the study area, where urban development had high TOD levels, but poor transit connections. Availability of data is again a major component of this approach.

2.3. Benefits of TOD

The benefits of transit oriented development have been extensively written about and endorsed by planners worldwide. The pursuit of sustainability includes a wide range of policy goals that address environmental, equity, and economic conditions. The transportation sector is frequently seen as a place ripe for helping regions meet their sustainability goals because of its relationship to global warming, pollution, employment access, and household costs. To address global warming and pollution especially, policy makers use a three-pronged approach, with the first two prongs focusing on improving fuel efficiency and vehicle efficiency to address transportation's role in increased emissions and travel. The third prong, the built environment, has been linked by numerous studies to vehicle miles travelled and greenhouse gas emissions (GHGs) (Austin et al. 2010). Through this lens, one of the greatest benefits of transit oriented development is reduced greenhouse gas emissions. This is a result of less cars on the road, which leads also to the benefit of less air pollution and smog. With a reduced number of cars on the road, a wave of other benefits emerges including reduced transportation costs for individuals and families, expanded mobility choices, and increased transit ridership that in turn increases revenue for the city. The money saved by not having a car also benefits people as there is more money to spend elsewhere than a car. With cars gone, communities also become more walkable and therefore more active and healthy.

Ranked high among social benefits is the reduction in commuting time and stress that results when transit users can depend on a high quality service characterised by frequent, dependable arrivals and departures, clean, safe and attractive carriages and an appealing station environment. However, a service needs to compete favourably with the private vehicle in trip time, convenience and cost to attract a level of ridership which ensures the financial sustainability of commercial enterprises near the station. Of even greater value to TOD residents is 'the trip not taken', when local employment, services and facilities reduce the need to travel. Another drawcard of a well-designed TOD is the high level of amenity within a comfortable walking distance. Successful TODs integrate quality retail, community facilities and other services which ensure commuters and residents of nearby suburbs utilise local services as they walk, cycle or arrive by feeder transport. Transit riders are pedestrians as they enter and depart from stations. A well-conceived station precinct not only ensures that commercial enterprises prosper but, importantly, the investment in place making attracts people and encourages them to linger, leading to a sense of familiarity, safety and engagement which helps a community to grow. Living near good public transport can reduce the proportion of household income spent on travel which indirectly makes housing more affordable.

Table 3: Benefits of Transit-Oriented Development (TOD)

Class	Public sector benefits	Private sector benefits
Primary	Increase ridership and farebox revenues	Increase land values and rents
	Provide joint development opportunities	Increase affordable-housing opportunities
	Revitalize neighbourhoods	
	Economic development	

Secondary/ Collateral	Less traffic congestion and VKT-related costs, like pollution and fuel consumption	Increase access to labour pools
	Increase property and sales tax revenues	Increased physical activity
	Reduce sprawl/conservate open space	
	Reduce road expenditures, infrastructure outlays	
	Reduce crime	
	Increased social capital and public involvement	

Source: Adapted from (Cervero et al. 2004).

3. Challenges of TOD

One of the biggest challenges is that the regulatory framework of most municipalities is not supportive of TOD. It is common for cities to have zoning ordinances and land development codes designed for automobile-oriented, single-purpose, suburban-scale development. The physical requirements of zoning ordinances often prohibit the development density necessary for TOD, through such provisions as maximums on floor area ratio (building floor area divided by lot area), height limitations, and minimum front setback of buildings, landscaping requirements, lot coverage maximums, and minimum parking requirements.

3.1. Resolving the conflict between transit node and desirable place

Issues such as increased residential densities or changes to neighbourhood character may provoke strong opposition to a proposed development, the ‘Not in My Backyard’ or NIMBY reaction, unless predicted and catered for with careful education and promotion backed up by genuine and extensive community consultation processes. The tension between node and place refers to a station’s dual role as a node in a regional transportation system and its role as a neighbourhood. The key to balancing the development mix is in understanding the station’s role in the transit network and metropolitan economy. Stations in predominantly residential neighbourhoods will require a different mix of uses from those that are at transit interchanges or major employment centres. The imperative for successful TOD of any size or location remains ensuring the walker has precedence (Curtis 2008).

3.2. Parking

Developments where car parking ratios for residents, shoppers and commuters remain generous, and private car use continues at former levels, will struggle to develop the sense of place and community to which genuine TOD aspires. Research results show that TOD parking supply and pricing policy seldom are structured to support transit ridership goals (Willson 2005). Parking policy is an important determinant of travel behavior, regardless of proximity to transit (Hess 2001). Critics argue that parking is generally oversupplied and underpriced. Researchers have called for reforms in minimum parking requirements and the cashing out of parking subsidies (Shoup 2005; Willson 2000).

3.3. TODs degenerating into TAD

Development close to transit which is not pedestrian and cyclist friendly, fails the walkability test (destinations within a 10 minute walk), does not include a rich mix of uses appropriate to the population it is supposed to serve, is not well served by feeder services or connected to larger regional transport networks, fails to conform to the expectations from a TOD. A development which does not achieve a balance between residential and commercial uses or utilise and expand on existing employment, facilities and social capital is likely to not meet its potential (Irvine 2012).

3.4. Gentrification

The general consensus lately has been that even as most cities continue to sprawl, many young families especially from the middle class prefer returning to the central city resulting in an increase in demand for housing in upmarket neighbourhoods which are usually located around newly ordained public transit projects (Garrett and Taylor 1999). Scholars agree on the problematic shifting of the geography of wealth and employment from the suburbs to the core city. It is generally agreed that in the American context, average prices for homes near transit may be at least 10 per cent costlier than in the suburbs. In the resultant competition for housing limited by development regulations, invariably those with poor purchasing power may get replaced by the newly arrived richer households through the process of gentrification (Davis et al. 2012; Dutzik et al. 2014). This exacerbated imbalances in spatial distribution of wealth and concentrations of poverty. This flies in the face of those who advocate for spatial and social equity.

As a result of the above reasons, the low-carbon objective of TODs may not be met. Additionally, it may also result in the exclusion of the low-mobility, low-income groups that were located on the TOD corridor who may be considered captive groups for public transit. These groups may then be replaced by middle-income or high-income groups that already own cars and would be reluctant to use public transit in the absence of adequate push factors in the form of high taxation and fuel prices.

3.5. Willingness from stakeholders

One of the major components in making a TOD successful is the ‘economic condition, political will and capacity among stakeholders’ (WRI India, 2016) It is imperative for stakeholders to actively take part and integrate between various departments within a city to make a TOD successful. In the Indian context, political will acts as a major factor in the completion of TOD projects because of the age-old discussions and policies mostly leading into private vehicle oriented policies, it is a shift which needs to be backed by willingness from the citizens as well as the government.

4. TOD in India

Indian cities face a multitude of issues such as severe congestion; deteriorating air quality; increasing greenhouse gas (GHG) emissions from the transport sector; increasing road accidents; and an exploding growth in the number of private vehicles (largely motorcycles). With the urban population projected to more than double in the next generation, the situation could easily get out of control and thwart India’s economic development efforts unless remedial measures are soon taken. The state of public transport in the majority of Indian cities has degraded over the years. Rising population and underdeveloped mass transport has led to a rapid rise of personal vehicles, traffic congestion and an increase in pollution levels. Moreover, the majority of people do not use public transport simply because of the lack of it and inaccessibility to the transit. Therefore, while augmenting public transport, planning for accessibility is the need of the hour. Increased density and improved connectivity through TOD can help achieve that. But, one of the most important reasons for thinking about TOD for Indian cities is the recent emphasis on public transport at all levels of government (EPC 2012).

Scholars have argued that transport sector in India is extremely energy intensive and needs massive investments in mass transit to quell the rise of private motorised mobility (Rizvi

2013; Yedla 2015). Post the announcement of mission based programs like Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2005, Atal Mission for Rejuvenation, and Urban Transformation (AMRUT) and Smart Cities in 2015, there has been huge emphasis on investments in public transport. Transit systems like metro rail and Bus Rapid Transit (BRT) have found their way into many cities including Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Rajkot, Surat, Pune, Pimpri-Chinchwad, Hubli-Dharwad, Lucknow, Kochi, Jaipur, Bhopal and Indore among many others. Some of these cities have gone on to leverage the huge potential accorded by the massive investments in public transit and prepared TOD plans for their cities. In western countries, TOD was used for densifying certain areas but in India the cities already have higher densities. Hence TOD in Indian cities should be looked at as a tool for improving quality of life and financial means to provide infrastructure facilities (Petkar and Hamand 2013). India is taking steps towards achieving the TOD guidelines and designing a well-planned city for its people, making itself sustained and pedestrian friendly.

4.1. Current debate on TOD in India

There are several debates surrounding the adoption of TOD in India. Indian cities have always had high densities, especially in the inner core areas. Additionally, the level of diversity of use in these areas is also high, presenting an ideal case for TOD (Munshi 2013). Many of the mainstream debates around TOD have centred on the development potential of the areas along transit corridors. Aspects such as equity and sustainability are unfortunately late entrants to the debate. The National Urban Transport Policy (NUTP) of 2006 was a response to the massive issues of congestion and resultant loss of productivity in Indian cities. While it mentioned progressive concepts like “cities for people” and “encouraging greater use of public transport and non-motorized modes,” it also talked of mass transit systems only in the context of using “land as a resource for financing investments” (Ministry of Urban Development 2006). It also encouraged cities to pursue the integration of land use and transport plans. It must be noted that the draft NUTP (Ministry of Urban Development 2014) stresses on TOD as means to bring about high density urban growth with a view to promoting high levels of accessibility and shortening trip lengths.

“The Government of India would encourage Transit Oriented Development (TOD) with increased [Floor Area Ratio]FAR along transit corridors with high density of population should form a part of planning” (Ministry of Urban Development 2014).

The report lists TOD as a congregation of housing, jobs, shops and other activities around PT stations. It exhorts the city planners to “[revise] building bye-laws and planning norms... so as to encourage high FAR and ground coverage along major PT corridors (Ministry of Urban Development 2014).” Additionally, the reports recognises the need for Transportation Demand Management (TDM) and controlling the use of personal vehicles in line with the philosophy behind TOD. These are indeed progressive indications of the mainstreaming of the concept. The National Mission for Sustainable Habitat (Ministry of Urban Development 2011) and Sustainable Urban Transport Project (COE-UT-CEPT University 2013) also stress on the need for greater integration of land use and transport towards achieving sustainability and signal the government’s keen resolve in this direction. The Detailed Project Reports (DPR) for metro rail in cities like Kochi (DMRC 2011), Jaipur (DMRC 2012) and Pune (DMRC 2013) take inspiration from national policy only sparingly as only integration of different modes with the metro rail is proposed. Since these reports were produced by Delhi

Metro Rail Corporation (DMRC), the shared emphasis on integration may have been common. It is however unclear if planning in these cities allows for preparation of TOD plans.

Cities like Delhi have had the lead in the adoption of mass transit from the early 2000s. There are several publications by Institute for Transportation and Development Policy (ITDP), Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre UTTIPEC, Institute for Urban Transport (IUT), Environment Planning Collaborative (EPC) that discuss inclusive street design in line with the requirements of TOD (EPC 2012; ITDP and EPC 2011; UTTIPEC 2009). These studies were undertaken in the light of the massive investments in urban transport that followed the JNNURM funding. Overall, the debates have largely centred on realising the value of land through which the metro rail corridor runs and integration of private modes with metro stations. Concrete attempts towards preparation of TOD plans through development plans or standalone local area plans has not been explored in most cities. Among the cities where some amount of progress has been achieved are Delhi, Ahmedabad and Bengaluru. These cases will be explored in detail in the following section.

By means of the key components mentioned by Cervero, we began de novo and guided our research in the direction of these elements which we configured by keeping in mind the relevance of these elements in the Indian context. They are namely a) Density, b) Diversity, c) Design, d) Housing, e) Accessibility, and f) Funding.

5. Comparison of TOD attempts in India: Ahmedabad, Delhi, Bangalore

As mentioned earlier, while many Indian cities have invested in mass transit systems like BRT and metro rail, not many have adapted the concept of TOD. This, despite the presence of enabling factors like density and diversity of activities, especially in the inner core areas of cities. Even in the cities where there has been talk of TOD, progress has been tardy. Delhi has made some progress and its master plan has an entire section dealing with TOD provisions (UTTIPEC 2012). Ahmedabad has delineated Transit Oriented Zones (TOZ) as part of the development plan and is in the process of preparing detailed Local Area Plans (LAP). Bengaluru has prepared some and is in the process of preparation of Station Area Plans (SAP). The following section describes and presents a comparison between the TOD attempts in these cities. Table 4 presents the population and density details while Table 5 presents an introduction to the development planning and TOD in the case cities.

Table 4: Population, area and density of case cities in 2011

City	Population (millions)		Area (square kilometers)		Density (ppHa)	
	Core city	Metropolitan	Core city	Metropolitan	Core city	Metropolitan
Delhi	16.32	45.20	1,483	33,578	110	13
Ahmedabad	5.57	6.35	450	2,433	124	26
Bengaluru	8.43	10.70	741	8,005	134	11

Source: (Registrar General of India 2013)

Table 5: An introduction to development planning processes in case cities

City	Delhi	Ahmedabad	Bengaluru
Plan making authority	DDA	AUDA	BDA
ULB or parastatal	Parastatal	Parastatal	Parastatal
Constituted in	1957	1978	1961
Enabling legislation	DD Act, 1957	GTPUDA, 1976	BDA Act, 1976

Current plan in force	2021 Master Plan for Delhi	2021 Comprehensive Development Plan (Second Revised)	2015 Revised Master Plan for Bangalore
Horizon period	20 years	20 [^] years	20 years
Nature of TOD plans	TOD regulations prepared	TOD LAPs being prepared	SAPs being prepared

Source: Adapted from (Munshi et al. 2015)

5.1. Overview of TOD case study cities

5.1.1. Delhi

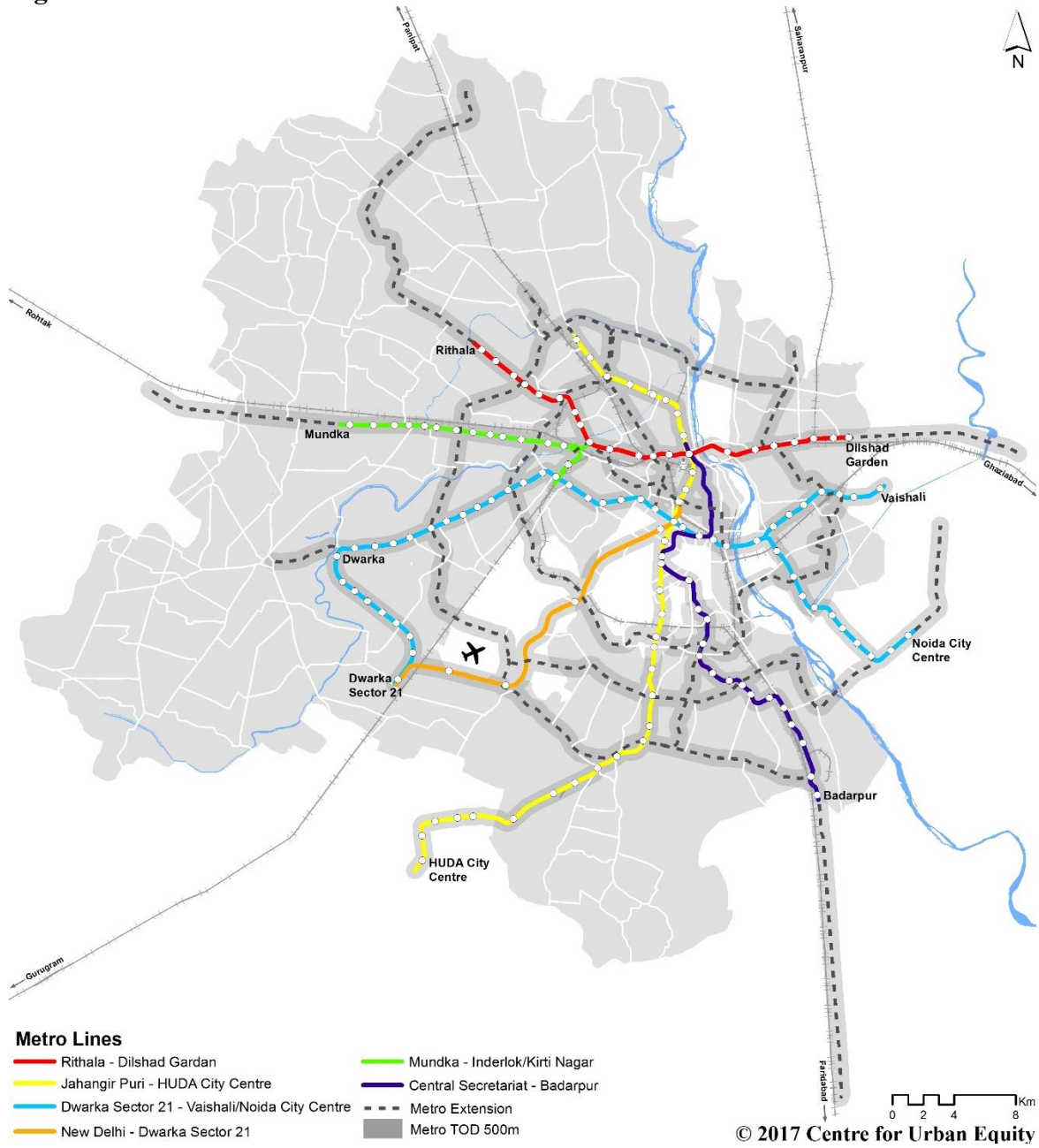
The National Capital Territory (NCT) is located at the core of the National Capital Region (NCR). It has a population of 16.32 million within the NCR which has a population of 45.2 million (Registrar General of India 2011). NCT Delhi is highly urbanized with 93.18 percent of its population living in urban areas as against the national average of 27.81 percent. During 1991-2001, the urban population of Delhi increased at 3.87 percent annual growth rate. This rate of growth of population stabilized to around 1.8 percent in the next decade. The 2021 Master Plan for Delhi (Delhi Development Authority 2005) is currently in force. It was prepared by the Delhi Development Authority (DDA) under the provisions of the Delhi Development Act 1957. It sits within the larger context of the 2021 National Capital Region Plan (National Capital Region Planning Board 2013) prepared by the National Capital Region Planning Board (NCRPB) which was formed under the NCRPB act of 1985. As indicated in Table 5, the DDA is in charge of the preparation of the master plan and TOD plans. DDA identifies TOD as

“Key for low-carbon, compact development with mixed land use that allows for optimized development along transit corridor. TOD increases densities and places high-rises along the transit corridors to accommodate a wide variety of uses. It is an ideal tool for governments to address inclusivity by citing minimum caps for housing for various segments. With the policy capturing the essential elements of mixed-use development, non-motorized transport and pedestrian priority, and encouraging a walk-to-work culture, Delhi in particular is looking at TOD as a solution to its mobility and air quality challenges by developing the areas around metro stations.” (WRI 2014)

Apart from a dedicated chapter in the master plan for TOD, a TOD manual that looks at the Delhi TOD policy¹ and helps in the interpretation of regulations was developed by UTTIPEC and WRI (UTTIPEC 2012; WRI 2014). The TOD policy exempts the following areas, namely a) Lutyen’s Delhi and Chanakya Puri, b) Civil Lines area, c) Areas under ASI, d) Zone-O, and e) Low-density residential areas notified by DDA. The picture below shows the metro rail network in Delhi and TOD zones around the transit stations.

¹ The TOD Policy was created and approved by the Ministry of Urban Development on July 14, 2015. Subsequently, there have been modifications in the master plan notified in the Gazette of India on July 14, 2016 and a series of public notices that notified the draft TOD regulations on February 2 and April 24, 2016.

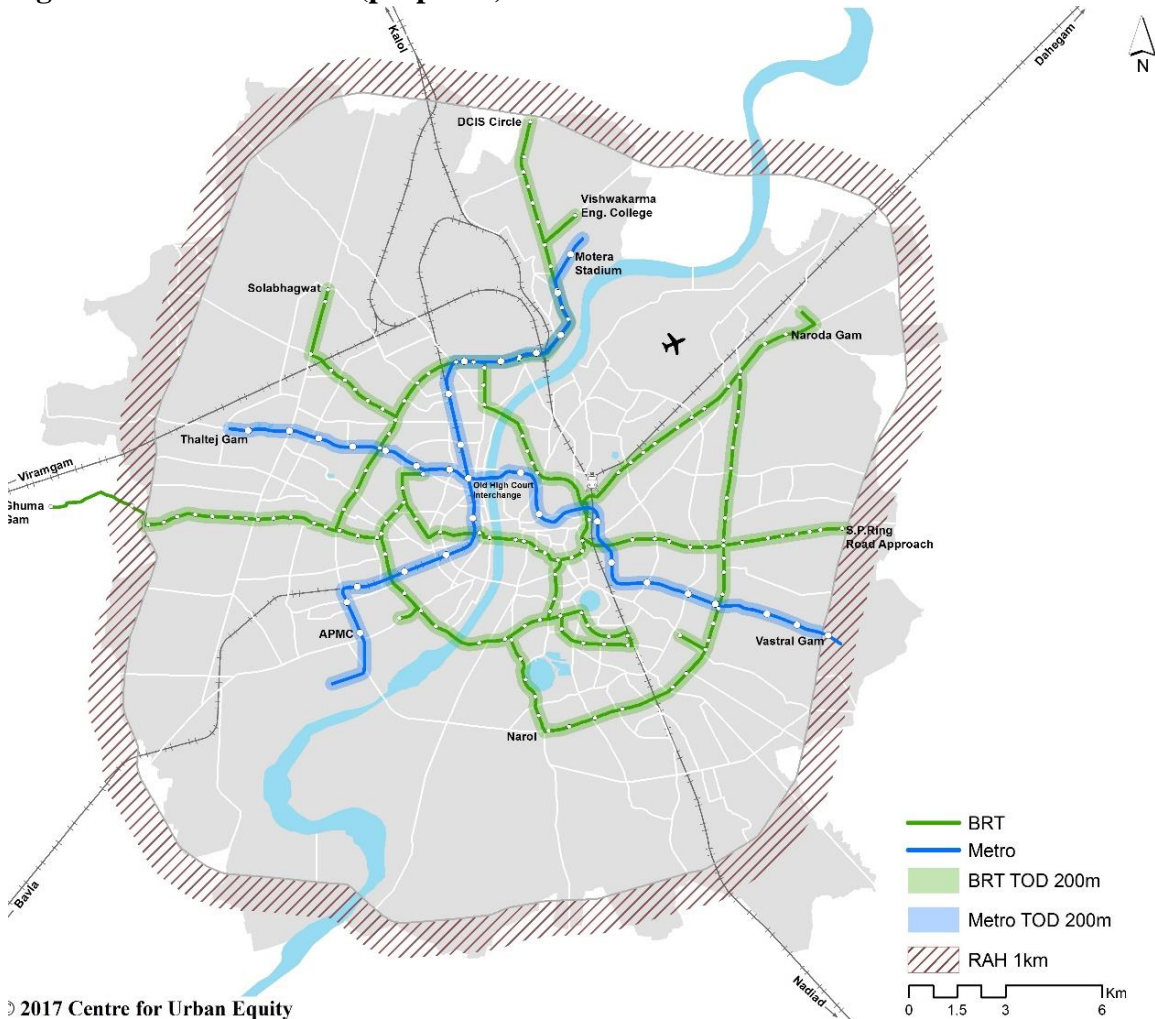
Figure 1: MRT network of Delhi



5.1.2. Ahmedabad

Ahmedabad is the largest city in Gujarat with a population of 5.57 million in an area of 450 square kilometres (Registrar General of India 2011). The Ahmedabad Municipal Corporation (AMC) was established in 1950 under the Bombay Provincial Municipal Corporation (BPMC) Act, 1949. In the year 2008, around 180 square kilometres in the west and 80 square kilometres in the east were added to the city, bringing the total area of the city to 450 square kilometres. Apart from the area under AMC, growth centres of Kalol, Dehgam, Sanand, Mehmedabad and Bareja, 169 villages fall within the jurisdiction of Ahmedabad Urban Development Authority (AUDA) which is responsible for planning and development functions in its jurisdiction. As of 2011, the area within AUDA’s jurisdiction has a population of 6.35 million in an area of 2,433 square kilometres. Currently, the 2021 Comprehensive Development Plan (Second Revised) (Ahmedabad Urban Development Authority 2013; AUDA 2013a, 2013b) is in force. It presents immense opportunities for inner city densification and compact development centred on the BRT network in place and proposed metro rail alignment.

Figure 2: BRT and MRT (proposed) network in Ahmedabad

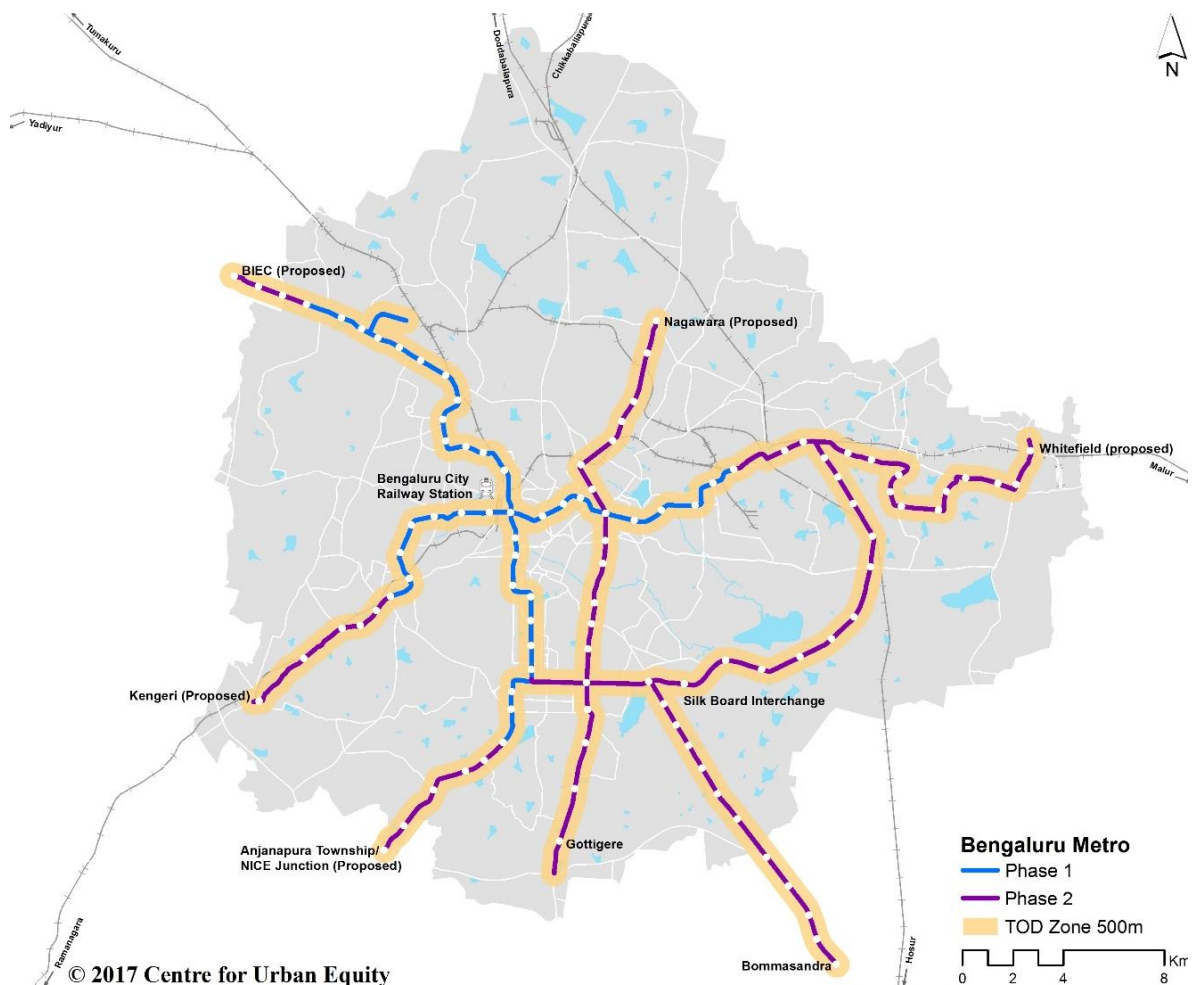


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5.1.3. Bengaluru

Bengaluru is the largest city in Karnataka and is the fourth most populous city in India with a population of 8.43 million and area of 741 square kilometres. It is administered by the Bruhat Bengaluru Mahanagara Palike (BBMP). It forms part of the Bangalore Metropolitan Area (BMA) which has a combined population of 8.49 million and area of 1,320 square kilometres. The Bangalore Development Authority (BDA) is responsible for planning and development functions in BMA. Its stated vision is to ‘plan, regulate, control, monitor and facilitate urban development in BMA, to ensure sustainable and orderly growth’ (Bangalore Development Authority 2015). The BDA uses the 2015 Revised Master Plan for Bangalore (Bangalore Development Authority 2007) to regulate and facilitate urban development in the area under its jurisdiction. In addition, the Bengaluru Metropolitan Region Development Authority (BMRDA) plans and coordinates development in the Bengaluru Metropolitan Region (BMR) measuring 8,005 square kilometres comprised of Bengaluru urban, Bengaluru rural and Ramanagara districts. As of 2011, some 10.70 million people live in the BMR. The BMRDA aims at integrating development in the BMR through the 2031 Revised Structure Plan (Groupe SCE India Pvt. Ltd. 2013). Planning in areas outside the BMA is undertaken in accordance with the provisions of the Karnataka Town & Country Planning Act, 1961.

Figure 3: MRT network in Bengaluru

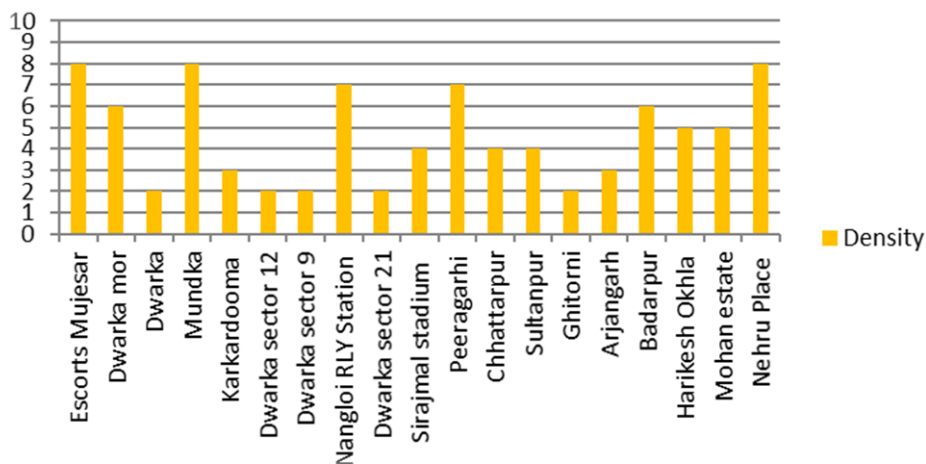


5.2. Comparison of TOD attempts with respect to factors

5.2.1. Density

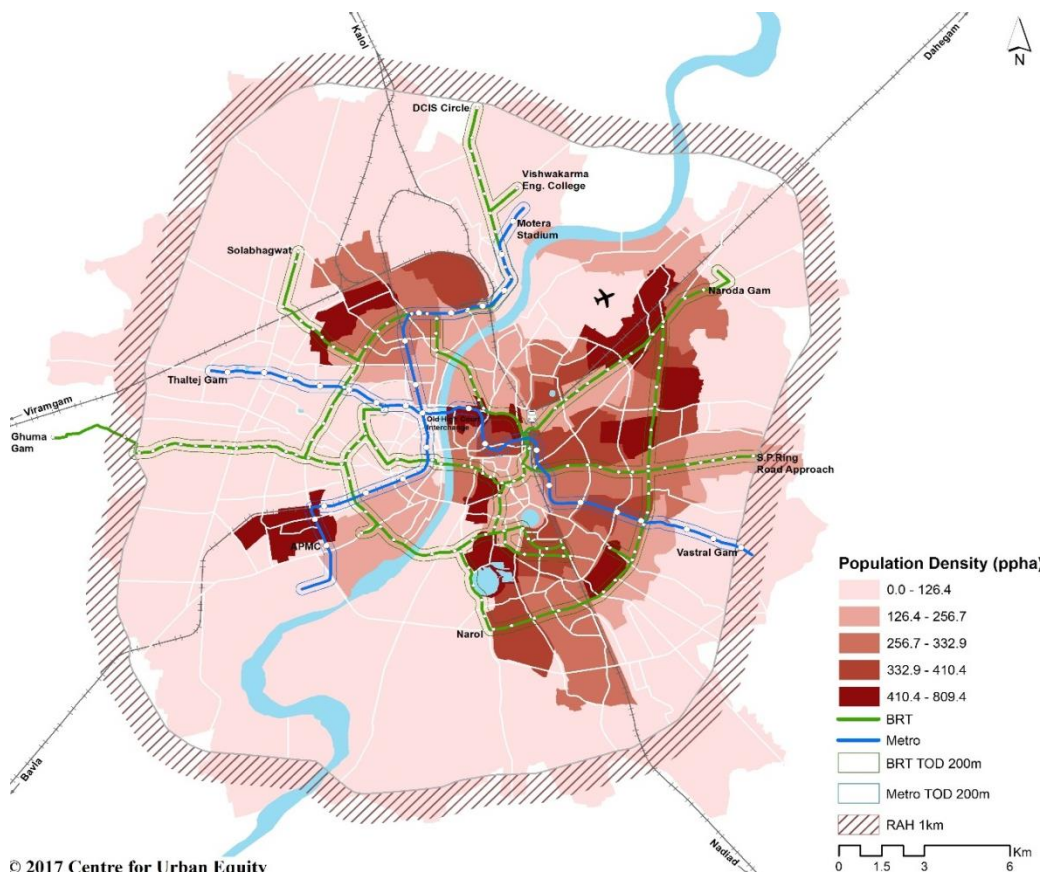
Density is one of the most essential factors for the success of a TOD. “Density is a key determinant for modal choice: High densities tend to be associated with lower average trip distances for all modes” In the case of Delhi, about 500 m wide belt on both sides of centre line of the existing and planned/approved MRTS Corridors is designated as Influence Zone which has been identified in the respective Zonal Development Plans, along with stations. Entire approved plan of a TOD integrated scheme will be included in the zone if more that 50% of the plan area falls inside the influence zone. Higher FAR and height can be availed through the preparation and approval of comprehensive TOD integrated scheme. Wherever height is restricted by any regulatory authorities like AAI, NMA; in order to enable the DE to utilize the permissible FAR, a relaxation in ground coverage and setbacks, without compromising the green public open space of 20%, in such TOD integrated scheme shall be allowed (WRI 2014). Amalgamation and reconstitution of the plots for planning purpose is permitted in all redevelopment schemes, including TOD. In terms of redevelopment, the policy advocates the redensification of low density areas and redevelopment of other developed areas in addition to the influence zone along MRTS corridor shown in (Picture 3) In order to participate in TOD, individual/ group of owners may need to partner with other adjoining land owners/ property owners to form a Developer Entity (DE), and prepare a single contiguous scheme of minimum 1 Ha. For any integrated scheme, a max. FAR of 400 and a maximum density of 2000 persons per hectare (ppHa) i.e. approx. 450 du/ha is permissible. The entire amalgamated plot will be considered for calculating the FAR and density. FAR utilization shall not be less than 200.

Figure 4: Relative densities along Delhi Metro corridor, 2017



Source: Survey by Centre for Urban Equity

The Delhi Metro has been running for over a decade, but the adoption of policies for TOD implementation in its masterplan is quite recent. The current scenario of Delhi in terms of density is quite low on the end of the transit lines. During our study on 3 different lines of Delhi metro, the maximum density we found were Nehru place, Escorts Mujesar and Mundka which have high commercial areas and are booming business areas. Out of all the stations we studied, only a few were high density areas around the metro stations.

Figure 5: Densities in Ahmedabad, 2011

In Ahmedabad, while the base FSI is 1.8, a 400m wide band around the BRT network and proposed metro rail is termed as Transit-Oriented Zone (TOZ) and allowed higher FSI of 4 and the central business district in close proximity to the two networks is allowed a much higher FSI of 5.4 (Picture 6). These areas currently consume an FSI of less than one on an average (Ballaney et al. 2013). In order to realise an FSI of 4 or 5.4, these areas will require rapid infill development. Gujarat has already in place a progressive land pooling mechanism in the form of Town Planning Schemes (TPS) through the landmark Gujarat Town Planning and Urban Development Act, 1976 (Ballaney 2008; Ballaney and Patel 2009; Deuskar 2011; Nallathiga 2010). The TPS mechanism has been used in the provision of serviced land for development, especially in the urban periphery of Ahmedabad and other towns of Gujarat. While this mechanism has largely worked in the peripheral area, there has been some criticism on the socio-political dimensions of this mechanism especially when seen in the context of realization of new ventures like smart cities (Datta 2015). The concern here is the already unutilised FSI in the current scenario and now with the increase in the permitted FSI, would the building density increase on ground?

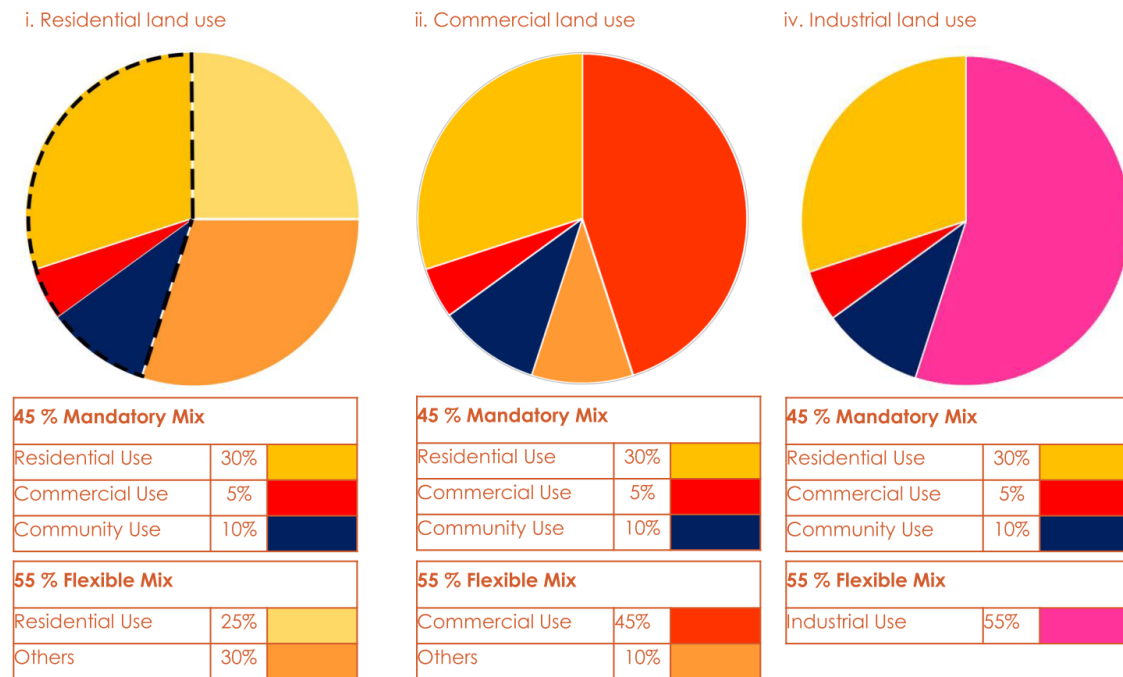
The new master plan of Bangalore is under revision and is said to have provisions in the form of TOD policies. However, these are not yet in the public domain. Till the new plan comes into fruition, the Revised Master Plan of 2015 is in play. A notification from the Karnataka Urban Development Department (No.UDD 93 MNJ 2008) was passed in 2009 stating that the maximum permissible FAR is increased to 4 for all land uses with the exception of Traffic and Transportation Zone within a distance of 150m from the outer edges of the Metro Station. However, it does not prescribe any change to the other regulations of the RMP 2015. The

current regulations fail to address the issues that accompany the transformations brought on by the introduction of the metro system and the UDD notification itself. Since each of the areas through which the metro line passes differ from the rest in many aspects, they have responded differently to the transformations triggered by these developments. Hence a blanket rule cannot be applied to all areas without assessing their potential and limitations in supporting these new developments (Embarq 2014). In all the three cases, densities have been increased quite a lot within a certain range of the mass transit corridors or stations but have not been regulated or supported by other infrastructure.

5.2.2. Diversity

“The availability of a wide range of amenities and activities within a given area is one of the main aspects that underpin successful TODs” (Ogra & Ndebele, 2014). DDA’s definition of TOD as mentioned above in the overview section of Delhi, stresses on inclusivity, sustainability and public health as evident in the quote. In detail, the TOD policy mentions a mixed use, mixed income development near stations with residential, commercial and civic uses as desirable uses around the MRT corridor. In all integrated schemes, a minimum of 30% of overall FAR shall be mandatory for Residential use, a minimum 5% of FAR for commercial use and minimum 10% of FAR for community facilities. At least 50% of the total FAR shall be as per ZDP use. See graphic for proposed and use mix above.

Figure 6: Proposed land use break up in Delhi in TOD zone



Source: Delhi Development Authority, 2007

This clearly shows diverse land uses around MRT at the policy level however the current situation does have various uses in some of the stations, but a lot needs to be improved in terms of diversity and inclusivity in most of the stations.

Figure 7: Areas around metro stations in Delhi



Source: Survey by CUE, 2017

The Ahmedabad Urban Development Authority (AUDA) has commissioned planning firms to prepare Local Area Plans (LAPs) for the areas that come under the TOZ. Some of these plans have been prepared and public opinion sought on them. These are currently pending with the state-level planning agency for approval. The LAPs mention the use of mixed development in buildings along the transit corridor with residential and commercial uses. Not much has been analysed in terms of the LAP as they are still under scrutiny with the state. As of now, the corridor along the BRT has various uses like big institutions and universities, residential and commercial as well as civic uses. There is a fair mix of uses, although inclusivity is a persistent issue as well because of the high land prices along the corridor.

Figure 8: TOD areas in Western Ahmedabad

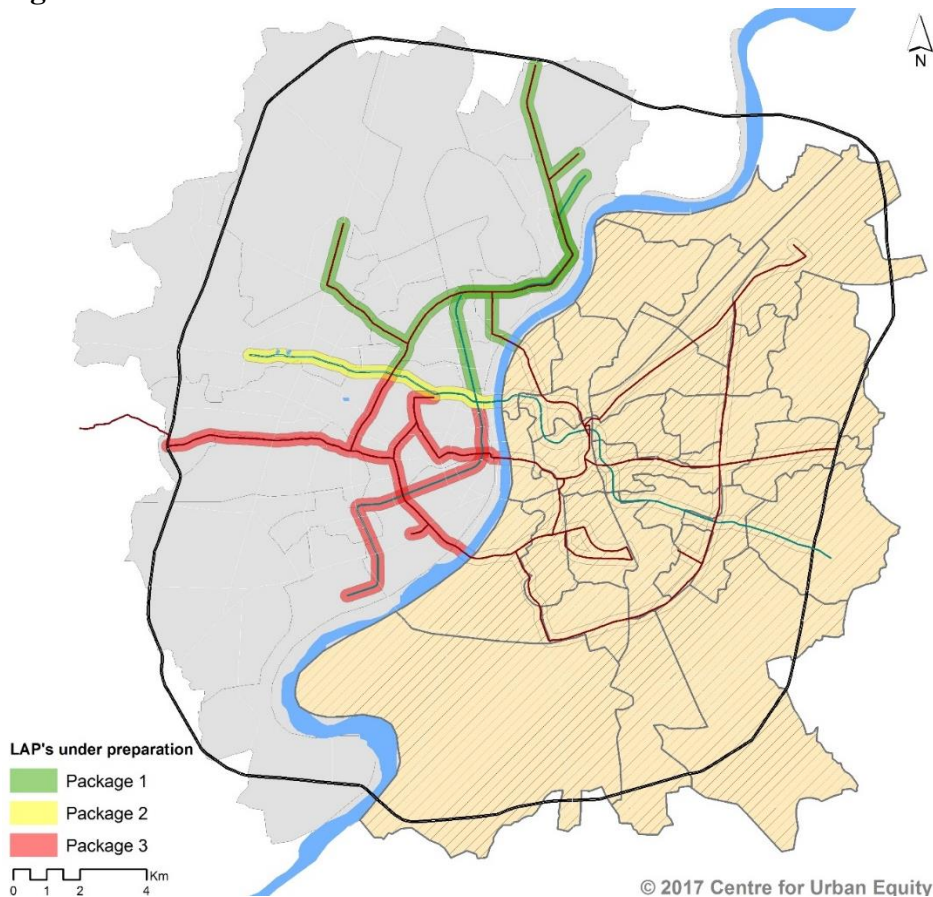
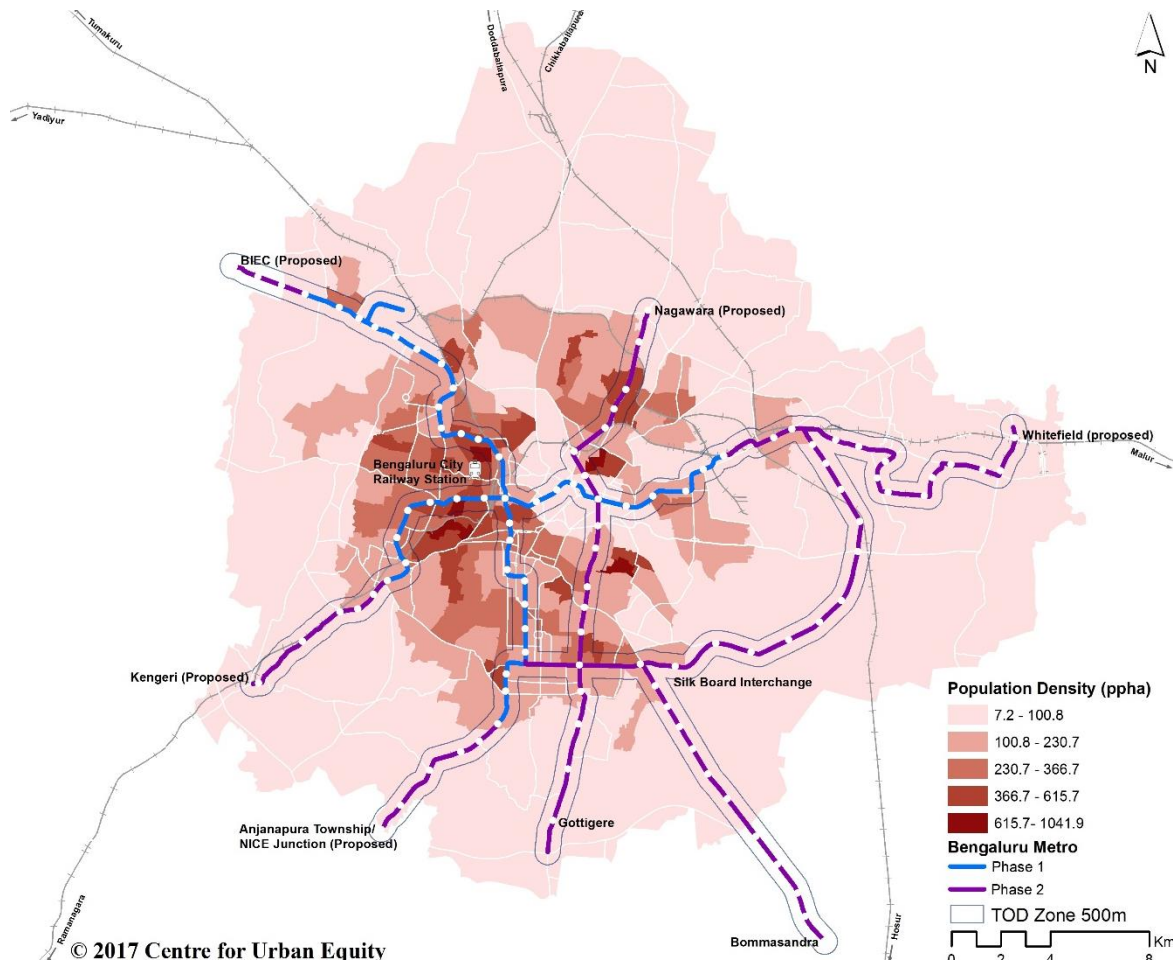


Figure 9: TOD areas in Bangalore overlapped with population density

The existing uses around the metro stations in Bangalore are diverse and of varying densities. Very few stations will be able to accommodate additional density. Institutional uses, large commercial uses, large industrial uses and existing older commercial areas will remain. Depending on the station, the opportunities for densification of land uses and transportation connectivity will vary and in some cases, will be very limited.

5.2.3. Design

Design is an important aspect of TOD with 'carefully articulated land-use mixtures; safe and smooth accessibility to transit stations (enabled by foot paths, cycle paths, and street lights, for example); and amenities such as benches, parks, landscaping, and libraries - which all contribute to the development of a good built environment" (Suzuki, et al., 2013). The UTTPEC document on TOD policy for Delhi advocates the adoption of TOD through its principles of a NMT friendly environment, connectivity and network density and placemaking and ensuring safety. The main building facade shall face the public street without setback and an active frontage to facilitate visual surveillance of streets. There is no minimum active frontage requirement when RoW is ≤ 12 m. Active frontages include arcades, shopfronts, entrance doorways, access points, entry/exits and transparent windows of active areas facing the main street. Commercial frontages shall have minimum 50% transparency at ground floor level. As of now, in the area of our study on ground, we could hardly find any

active frontages in most of the stations but a lot of informal stalls around a few of the stations showing a demand for smaller food stops as shown below.

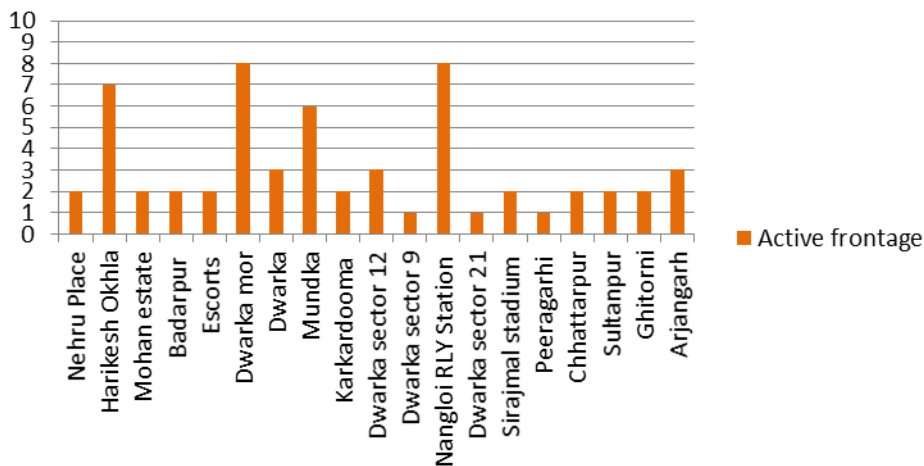
Figure 10: TOD areas around Delhi Metro station: Nehru Place



Source: Survey by CUE, 2017

In the case of Ahmedabad, the authorities seek the implementation of LAPs with part of the front margin used for pedestrian movement as part of the public domain. Connectivity within two buildings in the same block is sought to be enhanced by making more roads publicly accessible. New pedestrian walkways are allowed within the block. Sharing of underground parking facilities is encouraged. The front margins have been increased with active building frontages for more pedestrian or NMT activity especially around transit stations. In the existing scenario, not much has changed after the launch of BRT in terms of the frontages of buildings or NMT infrastructure (see picture below) although, the new LAPs are still under approval and seem to present a better future in terms of design in Ahmedabad.

Figure 11: Frontages rated through perception study on active frontages on various stations in Delhi



Source: Survey by CUE, 2017

Figure 12: Area along BRT corridor in Ahmedabad



Source: Survey by CUE, 2017

The current policies of Bangalore do not have any separate all-inclusive policy on TOD, although the Directorate of Urban Land Transport and Embarq India have come out with development control regulations for station areas, an example being the one for Indiranagar Metro Station area from which we can understand that they aim to nurture an “environment to allow for comfortable, efficient and easy access to the metro station” (Embarq India, 2014). The design proposals of Embarq state that the street and pavement space should respond well to the needs of the transforming neighbourhoods around the metro station (Embarq India, 2014). Pedestrian infrastructure and lack of ventilation and light are some of the current issues around Indiranagar. In the absence of any regulations, mix of building frontages have come up, with little concern for the users of the public spaces.

Figure 13: Area around Indiranagar metro station, Bangalore



Source: Survey by CUE, 2017

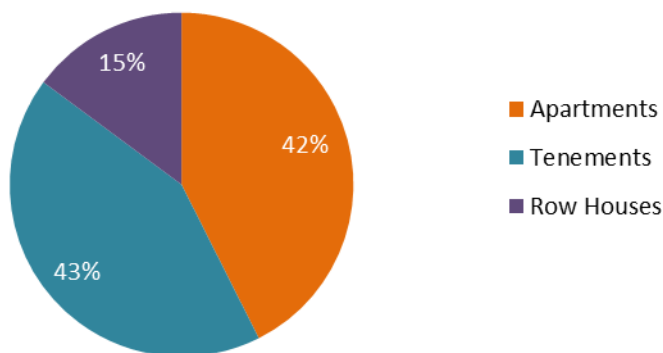
5.2.4. Housing

It is essential for TODs to have housing as they “preserve, enhance, or contribute to creating active pedestrian districts within walking distance of transit system”(NC State Design n.d.). In the case of Delhi, at the policy level a mix of uses with residential percentage of 30% is included in the total FAR with a mandatory EWS FAR of 15% over and above the permissible FAR. This is a great start towards inclusivity within the TOD zones with affordable housing as a part of the mandates. On ground, in the area of study, we saw high end residential housing (see picture below) and commercial buildings in the more developed and developing areas around the station, but on the other side a lot of slums and EWS housing were already present around a few metro stations. It is important to take them into consideration while redeveloping the area according to the new TOD policies. To make the area more inclusive and safe it is important to have a good balance between residential, commercials and other amenities within the area.

Figure 14: Housing near one metro station in Delhi



Figure 15: Residential break up of TOD areas in Delhi



Source: Survey by CUE, 2017

Many of the policies in Ahmedabad are focusing on the public spaces around transit stations and building use break up is left to the market to decide, although the LAPs are still under approval and may make additional changes in the policy in its final form. As mentioned before, the stations have varied type of building diversity and residential also make up a significant amount of the building within the TOD zone although most of the stations have middle income or high income group residing near the BRT corridor because of the high land rates around it.

Figure 16: Areas around BRT stations in Ahmedabad

Source: Survey by CUE, 2017

The existing uses around metro stations in Bangalore, is mostly institutional uses, large industrial uses and older commercial areas. Most of the stations need to have more residential, although this can only happen if redevelopment process commences as the existing situation cannot take any additional density. As of now in the Indiranagar metro station plan, incentives will be given for affordable housing around the metro corridor. This however pertains to a particular station but we can grasp the idea of inclusion of housing in the policies.

5.2.5. Funding

The concept of value capture finance in TODs is essential in funding and maintaining transit quality. Various instruments exist to capture the land value around TOD and cities try to leverage that opportunity and get funds out of the increased land prices. In Delhi, FAR over and above the permissible FAR is charged and used towards improvement of public transit. This is one mechanism mentioned in the TOD document of Delhi to capture land value. Ahmedabad and Bangalore have similar policies in terms of land value capture wherein premium FAR is charged and funds used towards the improvement in infrastructure of public transport. They also have a mechanism called Transfer of Development Rights (TDR) or Heritage TDR where unutilised FAR can be sold off and utilized' in other parts of the city.

5.2.6. Accessibility

Accessibility and safety for all modes of transport to reach the mass transit station is essential in increasing transit ridership with convenience. In TOD zones of Delhi, the permissible ECS² (Permissible Equivalent Car Spaces) per 100 sq m of floor area is 1.33. Additional parking may be created within integrated schemes only as paid, shared parking facilities accessible to general public at all times. 20% of the area of the amalgamated plot in TOD integrated scheme (TODIS) of 4 Ha and above, shall be designated as green Public Open Space which shall be designed, developed and maintained by the DE/agency and will remain un gated and open for general public at all times, failing which it will be taken over by Public agency. In addition to the above, at least 10% of plot area shall be in the form of Green/

² ECS is the land required to park a car including the space occupied by the vehicle as well as the minimum space needed to move it into and out of the space.

Recreational area for the exclusive use that includes circulation and common areas. The proposed scenario is quite ambitious and aims to increase NMT infrastructure over park and ride mode contrary to the current scenario where most of the stations had huge parking lots next to the metro stations although many options for feeder services are provided like e-rickshaws, cycle-rickshaws, feeder buses and auto-rickshaws as shown below. NMT infrastructure was in shambles in most of the stations which was either encroached by informals (see picture 9) or it was not built completely without obstacles or with shade where it would be convenient for people to access the stations.

Figure 17: Availability of cycling paths along metro stations, Delhi 2017

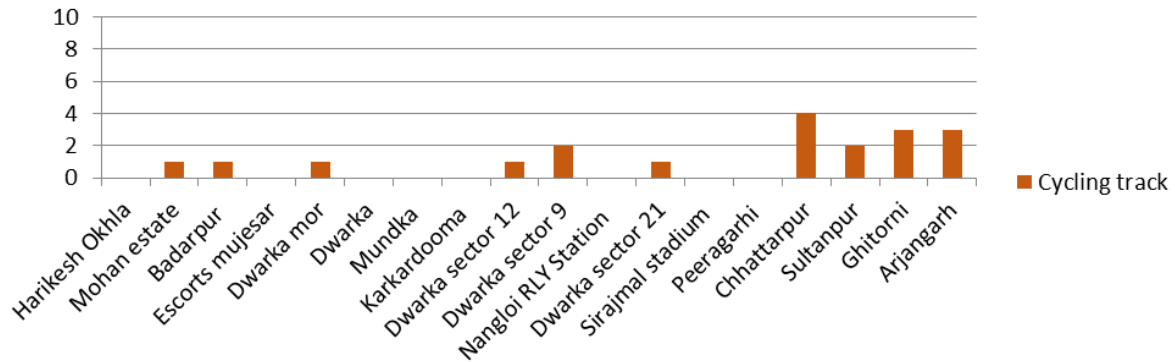
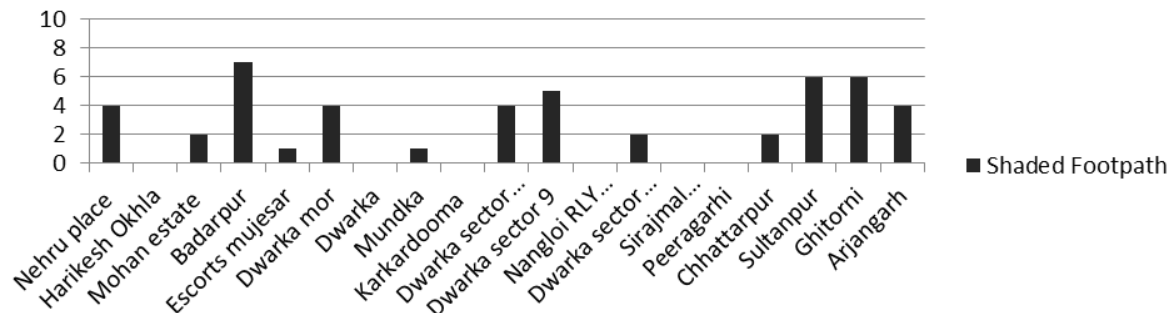


Figure 18: Availability of shaded footpaths along metro stations, Delhi 2017



Source: Survey by CUE, 2017

In the case of Ahmedabad last mile connectivity is not addressed, and most of the focus has been on the provision of the dedicated routes for the buses to run. There are hardly any shaded pedestrian footpaths without obstacles and wherever few locations the cycle routes were made are being demolished now to increase the ROW. Although, some of these issues are being tackled with in the proposed LAPS where part of the front margin will be used for pedestrian movement as part of the public domain. Connectivity within two buildings in the same block is sought to be enhanced. New pedestrian walkways are allowed within the block. Sharing of underground parking facilities is encouraged. The public transport, feeder services, walkability and accessibility around the metro stations are yet to be developed for overall transportation connectivity in Bangalore (Nagaraj 2013). As of now near major commercial areas, the pedestrian network is laid out really well, although it does not hold true for all the stations and accessibility needs to be increased in areas around metro stations. Although these are addressed in the station area plans wherein more pedestrian and cycling tracks are to be increased within 500m of the metro stations to increase pedestrian connectivity for metro users as well as adjoining neighbourhoods.

5.3. Inferences from TOD in Delhi, Ahmedabad and Bangalore

5.3.1. Delhi

TOD policy and EIA provision do not harmonize with each other. Green areas for 1 hectare plots falling in TOD zones, Parking ECS for TOD plots is less compared to the provisions prescribed in construction manual of EIA. EIA provisions need amendment for incorporating TOD concept provisions so that TOD projects can be facilitated for implementation. Though it is mentioned in the policy that adequate space for IPT, Bus, private bus, truck and commercial parking must be provided for all layout plans, the policy does not provide for or mention any standards that may be referred for making such provisions. The policy does not specify that the social infrastructure ought to compliment the larger catchment area or neighbourhood and the missing services need to be provided. Setback: Of the area taken up for development as integrated scheme, at least 20% of land shall be used as ungated constructed roads/ circulation areas for common use versus Setback to be handed back to local body as public roads (at least 20% of plot/scheme area): should this 20% public road area be restricted to the setbacks only. To what extent can the basement be utilized for parking purposes when there is zero setback (WRI 2016).

5.3.2. Ahmedabad

BRT in Ahmedabad has been running for 8 years now but development around the BRT corridor has not been much affected specifically by the BRT. Ahmedabad has proposed LAPS in western Ahmedabad and aim to increase FSI and other NMT infrastructure around the BRT corridor. One critique of TOD in Ahmedabad is the lack of NMT infrastructure around the BRT corridor hampering last mile connectivity. Very few stations have footpaths, although not shaded and most of the stations do not have cycling tracks altogether failing one of the major aspects of TOD to increase transit ridership. In the existing situation, the density is quite low even when FSI is permitted although at a premium. It is essential to address these issues as higher densities with inclusivity are one of the major factors indicating the success of TOD.

5.3.3. Bengaluru

The TOD policy in Bengaluru mainly focuses on higher densities around the metro stations and there is still scope for improvement for TOD implementation around the metro corridor.

Incompatibility with smaller plots: An FAR of 4 translates to a building height of at least 5 floors (15m). As per existing regulations, for buildings taller than 11.5m, the setback increases with the addition of every floor. This results either in the decrease of the building footprint to impractical extents or under-utilization of the FAR due to the restricted height the building should be limited to in order to avoid reducing its ground coverage. This issue is faced by 92% of the plots in Indiranagar which are smaller than 1000sqm (Embarq 2014).

Lack of light and ventilation: While the maximum FAR limit of 4 can be achieved by most plots by adding two or more floors and maintaining the existing setbacks, it will create a series of tall structures with very little space between the buildings due to which sufficient natural light and ventilation cannot reach the lower floors (Picture 14 **Error! Reference source not found.**). This is applicable to at least 75% of plots that currently have a maximum FAR of 1.75 and setback of approximately 1.4m on all sides (Embarq 2014).

Figure 19: MG road metro station, Bengaluru

Source: CUE, 2017

Insufficient pedestrian infrastructure like pavements to support increased densities:

Application of 4 FAR to the 150m zone results in a 95% increase in built-up area and an equivalent increase in the number of households and hence number of vehicles. With most roads having width lesser than 15m and the wider roads already being congested with traffic, the increased demand for parking and road space cannot be accommodated on the existing streets. A 95% increase in built-up area also translates to a near doubling of the population and pedestrian volumes within the 150m zone. This makes it imperative to address issues pertaining to walkability and easy access around the metro station; including effective design of building facades, creation of more pedestrian-friendly streets and zones and ensuring a safe environment for pedestrians at all times of the day (Embarq 2014).

Area Character: The constraints placed by the existing regulations on the smaller plots forces them to either amalgamate or forego the additional FAR they are entitled to. Due to the high real estate values in Indiranagar and proximity to the Metro, amalgamation is more likely to take place across the 150m zone, whereby independent homes cannot be maintained on amalgamated plots and will have to give way to either multi-storeyed apartments or commercial structures. Since, currently, in this zone 89% of residential plots have independent homes, such a transformation will completely change the scale and function of buildings in the neighbourhood. The increased rate of commercialization taking place in close proximity to the Metro may result in the creation of mono-functional commercial areas that are dead spaces beyond working hours and hence unsafe for pedestrians (Embarq 2014).

Concentration of densities: The UDD notification concentrates all the development within 150m of the metro station. The proposed incentive will result in a 95% increase in density when the 4FAR is completely achieved. This doubles the load on the infrastructure within this limited area. On the other hand, a number of activity generators that make Indiranagar a city level destination for high-end retail and commercial activities are located beyond the 150m zone but within walking distance of the Metro Station. These areas have high potential for growth but are underutilized due to the limited FAR they are entitled to (Embarq 2014).

Figure 20: Newly developing commercial in residential areas around Indiranagar station, Bengaluru



Source: CUE, 2017

Other opportunities in Indiranagar: Indiranagar is a city level destination for high end commercial and retail activity as well as a much sought after location for residential properties. A study of the real estate market indicates that the property rates in Indiranagar are one of the highest in the city. This is further expected to rise with the completion of the metro lines which will provide better connectivity to all parts of the city. Hence, the development in this area must be planned to make best use of the Metro system and the supporting incentives while ensuring that a safe and attractive environment is created for the residents, visitors and users of the public transportation systems (Embarq 2014).

Parking: Indiranagar presents huge challenges in terms of availability of free parking. Our discussions with stakeholders presents a clear picture of how the arrival of new developments, esp. commercial land use has put immense pressure on the available streetscape. The huge spurt for parking that cannot be met within the premises of these commercial developments spills over on the streets making it difficult for those living in the area to use the streets safely for walking and cycling. Our surveys present the encroachment of footpaths by motorbikes and cars (**Error! Reference source not found.**). This has had a debilitating effect on the accessibility to the metro station itself, putting pedestrians and cyclists at risk.

Visual aesthetics: Indiranagar, in the absence of any regulations on the nature of development coming in the area has become a mishmash of all kinds of buildings with little concern for the users of the public spaces. In becoming so, Indiranagar presents itself as an eyesore than a planned urban space.

Figure 21: Parking spillover on the narrow inner streets around Indiranagar station

Source: CUE

6. Discussions

While DDA has gone on to produce TOD policies and has prepared manuals for practitioners to engage with the TOD regulations, Ahmedabad has recently amended their town planning legislation to allow the preparation of local area plans. The Delhi experience has enabling regulations to encourage the development of a TOD friendly built form. There are some internal contradictions in the TOD policy regarding the provision of inclusive housing. The Ahmedabad local area plans subscribe to the new urbanism principles of improving accessibility, walkable environments, high density-high quality development, mixed use activities, transit friendly design and alternative modes of transportation. The plans are still not concrete. In Bengaluru, development plan which addresses the city at an aggregate scale does not address the ‘nitty-gritties’ of street design and accessibility but rather deals with land utilisation and its related regulations within plots. This is often a challenge in the Indian context wherein the use of private land has city level regulations and restrictions but regulations for the public realm however are neither comprehensive nor binding on any particular government agency. This is a scenario when more than 45% of the city’s land is publicly owned such as highways, urban roads, street networks, parks, water bodies, beaches etc. Also since a plethora of agencies act in this public realm no single agency can be assigned the onus of its design and upkeep (Rangwala et al. 2014).

This section presents a discussion on what needs to be done to improve TOD plans in India. Indian cities need to explore Station Area Planning (SAP) to achieve densification. Additionally, special overlay zones may be provided to supplement existing regulations. Differential FSI may be explored to adjust for variations in context. For densification and redevelopment, especially in the inner city, land-pooling may be explored. Incremental addition of FSI and promotion of mixed-use development is recommended. Parking reform is also essential in order to encourage walkable TOD neighbourhoods. Parking needs to be controlled through effective parking management. Areas around transit stations must be made parking unfriendly to discourage the “park and ride” experience. It would also help reclaim more public space. Parking must not come attached with residential space and should be sold at high rates. TOD policies must deal with parking specifically and discouraged along transit corridors, especially around stations. Overall, policymakers must realise that unlike housing,

parking need not be thought of as an unalienable right but a commodity that can be bought, albeit at high prices.

An essential element in the fundamentals of achieving TOD or initiating TOD elements needs the basis of scientific hard core data. A lot of current transit corridors have come up in a haphazard manner without any planned development and with the speculation of land prices around TOD by the private players. It is extremely essential that development of areas around TOD be planned or at least scientifically speculated as this would eventually increase transit ridership. On the basis of our first working paper we analysed that a lot of elements of TOD work on real estate speculation and demand and supply without really digging deeper on the facts rather focusing on actual ridership. In continuation, we would be digging deeper and though ground truthing methods develop models and statistics which can be used for creating models which are hard facts on what can be further prepared for making current TADs into essentially TODS.

Table 6 presents a comparison of various indices in the case cities of Delhi, Ahmedabad and Bengaluru. Cities must commission studies of their mode shares and identify the factors that lead to higher ridership on the transit systems. Studies such as ours can help reinforce the link between built-form and travel behaviour. This is the first in a series of papers that explores questions related to low-carbon TOD. The second paper in the series will discuss the methodological aspects of a model that demonstrates that while conventional planning may lead to a high-carbon scenario, the right interventions made through TOD plans could lead to a low-carbon scenario. The third paper synthesises best practices from international experiences to help achieve the low-carbon scenario in the case city of Ahmedabad.

Table 6: Comparison of various indices of the case cities

Parameters/City	Delhi				Ahmedabad				Bengaluru			
PT accessibility index ³	1.09				2.49				1.01			
Service accessibility index	16.36				21.54				13.00			
Congestion index	0.47				0.30				0.40			
Walkability index	0.87				0.85				0.63			
City bus transport index	43.86				12.99				39.22			
Safety index	0.32				0.14				0.11			
Paratransit index	75.60				73.90				89.70			
On-street parking interference index	2.82				2.03				1.28			
Mode split (NMT:PT:IPT:M2W+4W) [§]	33	43	5	19	36	16	6	42	33	35	7	25
Type of transit	Metrorail				BRT				Metrorail			
Operational since	2002				2009				-			
Extent (km) (2015-16)	213				89				39.2*			
Number of stations	160				150				32			
Ridership (lakhs) (2015-16)	25.6				1.32				5.0*			
Transit agency	DMRC				Janmarg				MEGA			
UMTA function performed by	DMRC				AUDA				DULT			
FSI/FAR along transit	4.0 (max); 2.0 (min)				4.0				4.0 (in 150 m radius)			
FSI/FAR elsewhere (base:paid)	1.20	3.50			1.80	2.25			1.75	3.25		
Densities along transit	450 DU/Ha (max)				-				-			
Mix of land-use proposed in TOZ	30% ^R , 20% ^{C+} , 15% ^{EWS}								Specifics unclear			
Unbundling of parking	No				No				No			
Limits on unpaid parking	Yes				Yes				Yes			

Note: [§] Data for the year 2008 * Planned for 2018; [^] Planned for Phase-I

Source: (Wilbur Smith Associates Ltd. 2008)

³ See Wilbur Smith Associates Ltd. (Wilbur Smith Associates Ltd. 2008) for details of these indices.

7. Conclusion

The second working paper (introduced below) in this series presents the methodological framework for testing and identifying the carbon-benefits of various scenarios that the future could hold for areas adjacent to transit. This paper discusses the need for an evaluation of Indian attempts at producing TOD. It traces the advent of TOD in India and its progress over the years. It presents a comprehensive review of literature on TOD and identifies good practices. The current debates on TOD in India are presented as being centred on the use of land as a financing mechanism for development. TOD plans in Delhi, Ahmedabad and Bengaluru are evaluated. While the right keywords are used in most TOD plans, not much is done to ensure the right mix of lands use and built form. Finally, the paper ends with suggestions to make TODs more inclusive.

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