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Smart Growth and Transit Oriented Development: Financing and Execution Challenges in India

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Abstract

Cities today face burgeoning personalized vehicles as a consequence of neglected public transport and a spatial planning model isolated from transport planning. Transportation planning has been accorded a residual rank post spatial planning. This has prompted dispersed and automobile-centric growth of cities. The pursuit of more sustainable, liveable, congestion and pollution free cities resulted in the paradigm of New Urbanism and Smart Growth. Transit-oriented Development (TOD), an integral part of Smart Growth, has emerged as a paradigm in urban design. It aims at the concentration of development in or around a transit station or along a transit corridor. TOD could be a befitting reply to sprawl, congestion, pollution and provide an effective way to restructure existing cities. By integrating public transport and land use planning TOD provides ways to intensify agglomeration economies and weaken congestion diseconomies. TOD has several socio-economic and environmental benefits to its credit. The chapter looks at the various advantages of TOD and the challenges faced in its execution and financing. Further, several successful TOD practices from around the globe have been discussed to draw lessons for replication in India.

Keywords: new urbanism, smart growth, transit oriented development, agglomeration economies, congestion diseconomies

1. Introduction

In the urban context, the importance of transport stems from the fact that it contributes to the productivity of workers and competitiveness of firms. It widens labour markets and makes them inclusive. It saves travel time and costs to reach valued destinations – for work, education, shopping and leisure. Urban transport investments augment agglomeration economies by enhancing access to the economic mass, reducing congestion and channelizing residential and non-residential development in desired directions. They balance the location of jobs, housing and common facilities. Urban transport plays an important role in the working of cities, enhancing their efficiency, facilitating economic growth, generating value enhancements to finance planned urban development, and creating livable, competitive and sustainable cities.

In the last four decades, the issues of urban transport have come into sharp focus in many developed countries around the world due to the problems of their

automobile-dependent model of urban development. They have been subject to high levels of traffic congestion, air pollution, accidents, damages to ecosystems and neighborhoods, segregation and adverse impacts on the quality of life in cities.

Rapid motorization has worsened traffic conditions, aggravated congestion and pollution levels in several cities around the globe. Apart from environmental concerns, traffic congestion is also detrimental to the economic health of cities by adding to the wastage of time and fuel and increasing the levels of emissions. It hampers productivity by delaying and hindering the movement of goods, raw materials as well as people.

The proliferation of personalized vehicles, lack of investment in public transport and implementation of a spatial planning model that promoted dispersed, automobile-centric development have been the primary factors behind the urban transport problems in countries. The search for ways of making urban communities provide a better quality of life and promoting sustainable cities led to the emergence of an urban design paradigm called 'New Urbanism' in North America and Western Europe in the 1970s and 1980s. This was followed by a theory of urban planning and transportation called 'Smart Growth'. This theory is founded on the following principles of urban design: (i) mixed land use; (ii) compact design; (iii) increased densities; (iv) housing opportunities and choices; (v) walkable and accessible neighborhoods; (vi) multiple transportation mode choices; (vii) neighborhood centres to foster social interaction; (viii) preservation of open space, farm land, natural beauty and critical environmental areas; (ix) strengthening of and directing development towards existing communities; (x) making development decisions predictable, fair, and cost-effective; and (xi) community and stakeholders' consultation in development decisions [1]. Transit-oriented Development (TOD), a key element of Smart Growth, aims at concentrating development around one or more transit stations or within a transit corridor.

TOD aims at compact, high density and mixed use development within easy walking or biking distance from a transit station, typically about 1 kilometer. Focused around a transit node, TOD facilitates access to public transit, thereby inducing people to walk, cycle and use public transport rather than personal vehicles. The selective concentration of development acts against sprawl, promotes agglomeration economies and mitigates congestion diseconomies. It also leads to increase in property values, reflecting the benefits to residents and businesses of diverse transportation options, and resultant automobile and parking cost savings [2]. Thus, TOD assists in the mobilization of value capture finance by harnessing the windfall gains accruing to land and property-owners. The key factors that support TOD include: land use and development policies promoting dense and compact development around transit nodes and discouraging such development in the areas without good access to public transport; development of public transit and provision of quality transit services; integration of transportation and land use; and application of other mobility management strategies. These factors jointly increase the cost-effectiveness and utility of TOD for consumers as well as businesses. TOD has the potential of becoming a powerful tool for planned development of cities and rural areas in developing countries. It not only improves connectivity between regions, but also saves a lot of time and costs of workers. It augments productivity and efficiency of economic agents. The case for transit-oriented development is well-argued in research [3].

The motivation behind this research is the need for India to move from an automobile-dependent to a public transportation-led and transit-oriented model of planned urban development. The current practice of master planning in India, rooted in the 1947 Town and Country Planning Act in the United Kingdom, has neglected urban transport. The model has not facilitated transportation-land use

integration, transit-oriented development and value capture financing. Land use planning and transportation planning have been pursued as independent exercises, a prime example being Delhi. Cities have thus not been able to benefit from the interaction of transport and land use for sustainable urban development and adopt a robust mechanism of financing public transit. In this context, this paper explores the theory and international practice of New Urbanism, Smart Growth and TOD. It also examines the potential of TOD to raise revenues towards financing public transportation. The objective is to draw lessons from successful practices to strategize TOD policy for cities in India. Finally, the paper analyses the existing practices in Indian cities, identifies its inadequacies and suggests corrective measures.

The study is organized as follows. Section 2 deals with the challenges of urban mobility in India. Referring to the trends of urbanization, metropolitanization and motorization, it highlights the imperative for a public transportation-based strategy of urban development in the country. Section 3 discusses the paradigm Transit Oriented Development (TOD), adopted by several developed countries to address their problems of sprawl, inefficient urban form, excessive energy consumption, greenhouse gas emission, and environmental degradation. It makes a strong case for TOD as a dominant paradigm of urban planning and development in India. Section 4 presents some examples of successful TOD strategies practiced world-wide and draws lessons for urban transport development and land use planning, in general and TOD, in particular. Section 5 focuses on financing and execution practices of TOD internationally in the overall context of urban transport development to present a range of financing instruments that Indian cities could consider to promote TOD. Section 6 presents the emerging approaches towards TOD in India, referring to case studies, including projects, policies and plans in the offing. We specially focus on financing issues. Section 7 brings out the challenges of implementing TOD in India and indicates some directions for the design of a public transportation-led, transit-oriented and value increment financing-based strategy to address India's urbanization challenges. It also calls for an effective institutional structure for the implementation of TOD and suggests reforms in the regional and urban planning model being followed. Section 8 concludes.

2. India's urban mobility challenges

Bourgeoning travel demand, rapid motorization, rise in personalized vehicles, dwindling share of public transport, congestion, degradation environmental quality, rising number of road accidents and fatalities, fragmented institutional arrangements and chronic under-investment in transport infrastructure pose major hindrances to urban mobility. These are linked to the trends and patterns of urbanization, concentration of productive economic activity, income distribution structure in cities and motorization.

2.1 Urbanization trends and patterns

Urbanization in India is characterized by rising urban population and increased density in large cities. This has led to a rapid growth in travel demand. **Tables 1–4** present the trends and patterns of urbanization in India.

While the number of cities/towns in India increased by 3 times, urban population rose by 13 times between 1901 and 2011. This reflects the concentrated pattern of urbanization. In 2011, the number of urban agglomerations (UAs) /towns was 7935 as against 5161 in 2001. While the number of statutory towns rose from 3799 to 4041 between 2001 and 2011, the number of census towns experienced a

Year	Total Population	Rural Population	Percentage Rural	No of Cities / Towns	Urban Population	Percentage Urban
1901	238.4	212.5	89.2	1916	25.9	10.8
1911	252.1	226.2	89.7	1908	25.9	10.3
1921	251.3	223.2	88.8	2048	28.1	11.2
1931	279.0	245.5	88.0	2220	33.5	12.0
1941	318.7	274.5	86.1	2427	44.2	13.9
1951	361.1	298.6	82.7	3060	62.4	17.3
1961	439.2	360.3	82.0	2700	78.9	18.0
1971	548.2	439.0	80.1	3126	109.1	19.9
1981	683.3	523.9	76.7	4029	159.5	23.3
1991	846.3	628.7	74.3	4689	217.6	25.7
2001	1028.7	742.5	72.2	5161	286.1	27.8
2011	1210.7	833.5	68.8	7935	377.1	31.2

Source: *Census of India for different years* [4].

Table 1.

India: Total, rural and urban population (in million) and level of urbanization (percentage) 1901–2011.

phenomenal jump from 1362 to 3894. About 30 percent of urban population growth in the last decade is accounted for by census towns.

Table 2 presents the distribution of urban population between size classes of towns in India from 1901 to 2011. It reflects a top-heavy urban structure, highlighting the increasing density of large cities. **Table 3** presents the trends in metropolitan population in India and reflects a similar trend.

There are large interstate variations in urbanization patterns in India, having differential implications for urban transport demand and strategy. Among the states, Delhi was the most urbanized in 2011, with 97.5 percent urbanization level, followed by Goa (62.2 percent), Mizoram (52.1 percent) and Tamil Nadu (48.4 percent). **Table 4** presents the percentage of urban population in 1971, 1981, 1991, 2001 and 2011, and decadal annual exponential growth in urban population for 1971–81, 1981–91, 1991–2001 and 2001–11.

India's urban population is projected to more than double between 2011 and 2050 – from 377 million to 814 million. With an estimated rural population of 860 million in 2014, the country would still have 810 million in villages in 2050 [5]. Thus, India would confront the dual challenges of urban and rural development for many decades. The country has to address not only the problems of transportation within cities, it will have to connect villages to cities and towns providing efficient transport services to rural areas.

2.2 Population density in urban areas

Census of India 2011 data reveals that not only many cities, but also urban agglomerations or regions in India have a population density of more than 10,000 – with central city areas being denser than peripheries. **Table 5** provides data on densities of 10 urban districts in India with the highest population density. A simple conclusion from international comparisons relating to population densities of urban regions is that the density patterns of many cities and urban districts in India overwhelmingly support a public transport-led urban development strategy.

Census Year	Number of Agglomerations/Towns						Percentage of Urban Population					
	Class I	Class II	Class III	Class IV	Class V	Class VI	Class I	Class II	Class III	Class IV	Class V	Class VI
1901	24	43	130	391	744	479	26.00	11.29	15.64	20.83	20.14	6.10
1911	23	40	135	364	707	485	27.48	10.51	16.40	19.73	19.31	6.57
1921	29	45	145	370	734	571	29.70	10.39	15.92	18.29	18.67	7.03
1931	35	56	183	434	800	509	31.20	11.65	16.80	18.00	17.14	5.21
1941	49	74	242	498	920	407	38.23	11.42	16.35	15.78	15.08	3.14
1951	76	91	327	608	1124	569	44.63	9.96	15.72	13.63	12.97	3.09
1961	102	129	437	719	711	172	51.42	11.23	16.94	12.77	6.87	0.77
1971	148	173	558	827	623	147	57.24	10.92	16.01	10.94	4.45	0.44
1981	218	270	743	1059	758	253	60.37	11.63	14.33	9.54	3.58	0.50
1991	300	345	947	1167	740	197	65.20	10.95	13.19	7.77	2.60	0.29
2001	393	401	1151	1344	888	191	68.67	9.67	12.23	6.84	2.36	0.23
2011	468	474	1373	1686	1748	424	70.15	8.54	11.11	6.39	3.36	0.45

Note: Class I: 100,000 or more, Class II: 50,000 – 99,999, Class III: 20,000 – 49,999; Class IV: 10,000 – 19,999, Class V: 5000–9999 and Class VI: Below 5000.

Each urban agglomeration, comprising generally a number of cities, towns and outgrowths is considered as one unit.

Source: Census of India for different years [4].

Table 2.

India: Number of agglomerations/towns and percentage of urban population by size classes of towns 1901–2011.

Census year	Number	Population (in Million)	Population per city (in Million)	Percentage of urban population
1901	1	1.51	1.51	5.84
1911	2	2.76	1.38	10.65
1921	2	3.13	1.56	11.14
1931	2	3.41	1.70	10.18
1941	2	5.31	2.65	12.23
1951	5	11.75	2.35	18.81
1961	7	18.10	2.58	22.93
1971	9	27.83	3.09	25.51
1981	12	42.12	3.51	26.41
1991	23	70.66	3.07	32.54
2001	35	108.29	3.09	37.85
2011	53	160.70	3.03	42.61

Source: *Census of India for different years [4]*.

Table 3.

India: Number of metropolitan cities and their share in urban population 1901–2011.

Sl No	States	Percentage of Urban Population					Annual Exponential Growth Rate			
		1971	1981	1991	2001	2011	1971–1981	1981–1991	1991–2001	2001–2011
1	Andhra Pradesh	19.3	23.3	26.8	27.3	33.4	3.9	3.6	1.4	3.04
2	Arunachal Pradesh	3.7	6.3	12.2	20.4	22.9	8.3	9.3	7.0	3.31
3	Assam	8.8	9.9	11.1	12.7	14.1	3.3	3.3	3.1	2.46
4	Bihar	10.0	12.5	13.2	10.5	11.3	4.3	2.7	2.6	3.03
5	Chhattisgarh	NA	NA	NA	20.1	23.2	NA	NA	3.1	3.49
6	Delhi	89.7	92.8	89.9	93.0	97.5	4.6	3.8	4.1	2.37
7	Goa	26.4	32.5	41.0	49.8	62.2	4.4	4.0	3.3	3.01
8	Gujarat	28.1	31.1	34.4	37.4	42.6	3.4	2.9	2.8	3.07
9	Haryana	17.7	22.0	24.8	29.0	34.9	4.7	3.6	4.1	3.68
10	Himachal Pradesh	7.0	7.7	8.7	9.8	10.0	3.0	3.1	2.8	1.45
11	Jammu & Kashmir	18.6	21.1	22.8	24.9	27.4	3.8	3.4	3.4	3.10
12	Jharkhand	NA	NA	NA	22.3	24.0	NA	NA	2.6	2.80
13	Karnataka	24.3	28.9	30.9	34.0	38.7	4.1	2.6	2.5	2.74
14	Kerala	16.2	18.8	26.4	26.0	47.7	3.2	4.8	0.7	6.56
15	Madhya Pradesh	16.3	20.3	23.2	26.7	27.6	4.5	3.7	2.7	2.28
16	Maharashtra	31.2	35.0	38.7	42.4	45.2	3.4	3.3	3.0	2.12
17	Manipur	13.2	26.4	27.7	23.9	32.5	9.7	3.0	1.2	3.70
18	Meghalaya	14.6	18.0	18.7	19.6	20.1	4.9	3.1	3.2	2.70
19	Mizoram	11.4	25.2	46.2	49.5	52.1	11.8	9.6	3.3	2.59
20	Nagaland	10.0	15.5	17.3	17.7	28.9	8.5	5.6	5.3	5.10

Sl No	States	Percentage of Urban Population					Annual Exponential Growth Rate			
		1971	1981	1991	2001	2011	1971–1981	1981–1991	1991–2001	2001–2011
21	Odisha	8.4	11.8	13.4	15.0	16.7	5.2	3.1	2.6	2.38
22	Punjab	23.7	27.7	29.7	34.0	37.5	3.6	2.6	3.2	2.29
23	Rajasthan	17.6	20.9	22.9	23.4	24.9	4.5	3.3	2.7	2.54
24	Sikkim	9.4	16.2	9.1	11.1	25.2	9.6	–3.2	4.8	9.42
25	Tamil Nadu	30.3	33.0	34.2	43.9	48.4	2.5	1.8	3.6	2.39
26	Tripura	10.4	11.0	15.3	17.0	26.2	3.3	6.2	2.5	5.66
27	Uttar Pradesh	14.0	18.0	19.9	20.8	22.3	4.8	3.3	2.8	2.53
28	Uttaranchal	NA	NA	NA	25.6	30.2	NA	NA	2.8	3.36
29	West Bengal	24.8	26.5	27.4	28.0	31.9	2.8	2.5	1.8	2.60
Union Territories										
1	Andaman & Nicobar Islands.	22.8	26.4	26.8	32.7	37.7	6.4	4.1	4.4	2.10
2	Chandigarh	90.6	93.6	89.7	89.8	97.3	5.9	3.1	3.4	2.38
3	Dadra & Nagar Haveli	0.0	6.7	8.5	22.9	46.7	—	5.3	14.6	11.57
4	Daman & Diu	—	—	46.9	36.3	75.2	—	4.9	1.9	11.59
5	Lakshadweep	0.0	46.3	56.3	44.5	78.1	—	4.5	–0.8	6.24
6	Pondicherry	42.0	52.3	64.1	66.6	68.3	4.7	4.9	2.3	2.73
	All India	20.2	23.7	25.7	27.8	31.2	3.8	3.1	2.7	2.76

Note: a) The figures for the states of Uttar Pradesh, Bihar and Madhya Pradesh for the 1970s and 1980s pertain to the undivided states as existed during that time. The figures for the 1990s are, however, for the new states and hence these figures are not temporally comparable.

b) In the absence of the Census data for total and urban population for the year 1981 in case of Assam, the urban and total population growth rates have been assumed to be constant during 1970s and 1980s. The same has been assumed for 1980s and 1990s for Jammu and Kashmir. The percentage of urban population has been arrived for Assam (1981) and Jammu and Kashmir (1991) based on these assumptions.

c) Goa in 1971 and 1981 corresponds to Goa, Daman and Diu.

Source: Census of India for different years [4].

Table 4. India: Level of urbanization and growth in urban population across states and union territories 1971–2011.

2.3 Composition of urban population

Apart from the trends and patterns of urbanization and population density, the composition of population and income distribution structure in urban India also favors the use of public transport for living and working. An overwhelming majority in cities belongs to the poor, low and lower-middle income groups. The Global Wealth Report 2015 published by Credit Suisse suggests that more than 90 percent of the adult population in India fall below the bottom of the wealth pyramid (less than \$10,000). The middle class population in India, defined as those with annual wealth of about Rs.61,480 or \$13,662 is estimated at 23.6 million [6]. About one-fourth of urbanites have been identified to be below the poverty line. An equivalent number are slum dwellers. More than 65 percent of urban households lives in two rooms or less.

Table 6 presents a picture of urban poverty vis-à-vis rural poverty in India based on the Rangarajan Committee report. According to the Committee, a person spending less than Rs.1407 per month or Rs.47 a day was considered poor in cities in

Rank	Urban District	Area (Sq. Kms)	2001 Census		2011 Census	
			Population (In Lakhs)	Density	Population (In Lakhs)	Density
1	North East Delhi	56	17.68	31,573	22.42	36,155
2	Central Delhi	23	6.46	28,104	5.82	27,730
3	East Delhi	49	14.64	29,869	17.09	27,132
4	Chennai	174	43.44	24,963	46.47	26,553
5	Kolkata	185	45.72	24,718	44.97	24,306
6	Mumbai Suburban	446	86.40	19,373	93.57	20,980
7	Mumbai City	157	33.38	21,261	30.85	19,652
8	West Delhi	131	21.29	16,251	25.43	19,563
9	Hyderabad	217	38.30	17,649	39.43	18,172
10	North Delhi	59	7.82	13,256	8.88	14,557

Source: *Census of India 2001, 2011* [4].

Table 5.
Most densely populated districts of India 2011.

Year	Poverty ratio (%)			No. of poor (million)		
	Rural	Urban	Total	Rural	Urban	Total
1. 2009–10	39.6	35.1	38.2	325.9	128.7	454.6
2. 2011–12	30.9	26.4	29.5	260.5	102.5	363.0
3. Reduction	8.7	8.7	8.7	65.4	26.2	91.6

Source: *Planning Commission (2014)* [7].

Table 6.
India: Rural and urban poverty estimates 2009–10 and 2011–12.

2011–12. The number of urban poor was estimated at 102.5 million, accounting for 26 percent of the urban population in the same year.

Census 2001 estimated the urban slum population in India at 42.6 million. It reported that 41.6 percent of slum population in the country lived in metropolitan cities. Mumbai had the largest number of slum dwellers, accounting for 54 percent of the population. Census 2011 has placed the number of slum-dwellers in India at 65.5 million. It further reveals that 46 million-plus cities contain 38 percent of the slum households. 9 metropolitan cities have more than 30 percent of households in slums, with Visakhapatnam topping the list at 44.1 percent, followed by Jabalpur Cantonment Board (43.1 percent) and Greater Mumbai (41.3 percent). Among the largest municipal corporations, apart from Greater Mumbai, Kolkata and Chennai have reported more than 25 percent of households living in slums.

The trends of urbanization, patterns of population density and state of slums, poverty and housing in cities suggest that the demographic and income distribution structures of urban India are overwhelmingly suitable for a public transportation-led model of urban development. Transportation planners and traffic engineers advocate the following strategies for urban transportation depending on their peak hour per direction traffic (PHPDT) that significantly depend upon the density of commuters:

PHPDT Recommended strategy

10,000 - 15,000 Bus and Dedicated Busways

- 15,000 - 30,000 Light Rail Transit
- > 30,000 Heavy Rail Mass Transit

Based on the above criteria and other factors, many cities in India qualify for light rail transit and heavy rail transit. The largest metropolitan cities also need high speed rail connecting them to sub-urban centres and regional towns.

2.4 Trends in motorization

The number of registered motor vehicles in India increased from 0.3 million in 1951 to 55 million in 2001 and 210 million in 2015. While the share of two wheelers rose from 8.8 percent in 1951 to 73.5 percent in 2015, the share of busses declined from 11 percent to 1 percent. **Table 7** presents the trends in the number of motor vehicles and the composition of the vehicular population for the period 1951–2015.

The population of motor vehicles reported by million-plus cities in India in 2015 was 66.24 million. Among these, Delhi had the highest number at 88.51 lakhs, followed by Bengaluru (55.60 lakhs), Chennai (49.34 lakhs), Ahmedabad (34.20 lakhs), Greater Mumbai (25.71 lakhs), Surat (24.59 lakhs), Hyderabad (23.69 lakhs), Pune (23.37 lakhs), and Jaipur (22.49 lakhs). The largest number of two-wheelers in 2015 was in Delhi at 56.98 lakhs, followed by Bengaluru (38.41 lakhs), Chennai (35.16 lakhs), Ahmedabad (24.32 lakhs), Surat (19.13 lakhs); Pune (17.65 lakhs); Hyderabad (17.08 lakhs); Jaipur (16.58 lakhs) and Greater Mumbai (14.70 lakhs). Considering the quantum of cars in 2015, Delhi had 27.30 lakhs, followed by Bengaluru (10.89 lakhs), Chennai (8.60 lakhs), Greater Mumbai (7.97 lakhs), Kolkata (5.41 lakhs), Ahmedabad (5.26 lakhs), Hyderabad (4.02 lakhs) and Pune (3.75 lakhs). **Table 8** shows the number and share of two wheelers and cars in the population of motor vehicles for metropolitan cities as of 31st March 2015.

Table 9 presents the growth of motor vehicle population in 22 metropolitan cities in India over the period 2005–15 for which data are available. As the table

Year	Number in Million	Composition (% of Total Vehicle Population)				
		Two Wheelers	Cars, Jeeps and Taxis	Busses	Goods vehicles	Other vehicles
1951	0.3	8.8	52.0	11.0	26.8	1.3
1961	0.7	13.2	46.6	8.6	25.3	6.3
1971	1.9	30.9	36.6	5.0	18.4	9.1
1981	5.4	48.6	21.5	3.0	10.3	16.6
1991	21.4	66.4	13.8	1.5	6.3	11.9
2001	55.0	70.1	12.8	1.2	5.4	10.5
2006	89.6	72.2	12.9	1.1	4.9	8.8
2011	141.8	71.8	13.6	1.1	5.0	8.5
2012	159.5	72.4	13.5	1.0	4.8	8.3
2013	176.0	72.7	13.6	1.0	4.7	8.0
2014	190.7	73.1	13.6	1.0	4.6	7.7
2015	210.0	73.5	13.6	1.0	4.4	7.5

Source: Government of India, Ministry of Road Transport & Highways, New Delhi: Road Transport Year Book (2013–14 and 2014–15) [8].

Table 7.

Total number of registered motor vehicles in India (in million) 1951–2015.

Million Plus Cities	Total Number of Registered Motor Vehicles	Two Wheeler		Cars	
		Number	% of Total	Number	% of Total
Agra	9,05,023	7,41,778	81.96	76,107	8.41
Ahmedabad	34,19,828	24,31,839	71.11	5,25,891	15.38
Allahabad	8,97,035	7,30,758	81.46	72,779	8.11
Aurangabad	4,26,246	3,35,725	78.76	19,591	4.60
Bengaluru	55,59,730	38,41,139	69.09	10,88,587	19.58
Bhopal	10,80,477	8,47,334	78.42	1,36,627	12.65
Chandigarh	7,45,520	3,95,565	53.06	2,61,752	35.11
Chennai	49,34,412	35,16,062	71.26	8,60,932	17.45
Coimbatore	19,01,277	15,47,395	81.39	2,32,751	12.24
Delhi	88,50,720	56,98,242	64.38	27,30,071	30.85
Dhanbad	5,63,426	4,27,714	75.91	58,836	10.44
Durg-Bhillai	7,68,922	6,44,138	83.77	49,569	6.45
Ghaziabad	7,51,603	5,33,808	71.02	1,52,256	20.26
Greater Mumbai	25,71,204	14,70,175	57.18	7,97,267	31.01
Gwalior	6,17,681	4,87,259	78.89	52,685	8.53
Hyderabad	23,68,818	17,07,714	72.09	4,02,334	16.98
Indore	17,12,702	13,01,383	75.98	2,08,005	12.14
Jabalpur	6,38,219	4,93,633	77.35	67,445	10.57
Jaipur	22,49,240	16,58,006	73.71	3,05,445	13.58
Jamshedpur	4,72,051	3,51,696	74.50	55,020	11.66
Jodhpur	9,16,172	6,50,097	70.96	71,972	7.86
Kannur	1,88,497	1,12,851	59.87	43,920	23.30
Kanpur	14,61,530	11,72,577	80.23	1,47,072	10.06
Kochi	6,05,689	3,36,316	55.53	1,71,063	28.24
Kolkata	14,01,638	6,00,156	42.82	5,41,432	38.63
Kollam	2,74,006	1,75,528	64.06	58,097	21.20
Kota	6,54,041	5,12,740	78.40	51,749	7.91
Kozhikode	4,12,304	2,89,801	70.29	70,539	17.11
Lucknow	17,09,662	13,61,787	79.65	2,44,121	14.28
Madurai	9,54,893	7,93,510	83.10	68,804	7.21
Malappuram	2,76,765	1,51,351	54.69	59,297	21.43
Meerut	5,25,235	4,24,975	80.91	63,148	12.02
Nagpur	12,75,575	10,67,160	83.66	1,08,951	8.54
Nashik	6,22,206	4,61,628	74.19	62,473	10.04
Patna	10,18,798	7,05,298	69.23	1,35,638	13.31
Pune	23,37,085	17,65,172	75.53	3,75,267	16.06
Raipur	11,11,745	8,45,861	76.08	84,377	7.59
Rajkot	9,79,423	7,87,608	80.42	93,185	9.51
Ranchi	5,47,036	3,56,067	65.09	65,434	11.96

Million Plus Cities	Total Number of Registered Motor Vehicles	Two Wheeler		Cars	
		Number	% of Total	Number	% of Total
Srinagar	2,35,614	1,00,291	42.57	77,043	32.70
Surat	24,59,111	19,12,715	77.78	3,07,540	12.51
Trichy	7,63,396	6,36,961	83.44	58,712	7.69
Thiruvananthapuram	5,71,956	3,49,657	61.13	1,53,674	26.87
Thrissur	3,55,491	2,26,285	63.65	72,994	20.53
Varanasi	7,68,769	6,09,656	79.30	55,727	7.25
Vijayawada	6,10,321	4,52,403	74.13	53,755	8.81
Vadodara	10,41,818	8,03,969	77.17	1,23,509	11.86
Visakhapatnam	7,30,872	5,74,135	78.55	79,592	10.89
Total	6,62,43,782	4,73,97,918	71.55	1,16,53,035	17.59

Source: Ministry of Road Transport and Highways, Government of India, New Delhi: Road Transport Year Book (2013–2014 and 2014–2015) [8].

Table 8.

Share of two wheelers and cars in total number of registered motor vehicles in million plus cities of India as on 31st March 2015.

Metropolitan City	No. of Motor Vehicles (in Thousands)		Average Annual Growth (%)
	2005	2015	
Ahmedabad	1632	3420	10.96
Bengaluru	2232	5560	14.91
Bhopal	428	1080	15.23
Chennai	2167	4934	12.77
Coimbatore	682	1901	17.87
Delhi	4186	8851	11.14
Greater Mumbai	1295	2571	9.85
Hyderabad	1433	2369	6.53
Indore	705	1713	14.30
Jaipur	923	2249	14.37
Kanpur	425	1462	24.40
Kochi	166	606	26.51
Kolkata	911	1402	5.39
Lucknow	615	1710	17.80
Madurai	330	955	18.94
Nagpur	770	1276	6.57
Patna	378	1019	16.96
Pune	827	2337	18.26
Surat	692	2459	25.53
Varanasi	366	769	11.01

Metropolitan City	No. of Motor Vehicles (in Thousands)		Average Annual Growth (%)
	2005	2015	
Vadodara	586	1042	7.78
Visakhapatnam	435	731	6.80

Source: Ministry of Road Transport and Highways, Government of India, New Delhi: Road Transport Year Book (2013–2014 and 2014–2015) [8].

Table 9.

Growth in number of registered motor vehicles in select metropolitan cities 2005–2015.

shows 16 out of 22 metropolitan cities recorded more than 10 percent annual growth over the period; 3 cities had an annual growth rate exceeding 20 percent.

The car-penetration rate defined as the number of cars per 1000 persons is very small in India compared to that in developed countries and several developing countries. **Table 10** compares data on Gross National Income (GNI) and vehicular penetration rates for select countries with those for India.

The data in the above table suggest that with the rise in GNI, following structural transformation and economic growth, the vehicular penetration rate, with attendant problems of congestion, pollution, noise and carbon emissions in cities, will lead to increased demand for road space and public transport, including rail-based transit.

Ironically, many of India's urban mobility problems can be traced to the lack of an appropriate planning model and public transport development strategy rooted in the economics of cities. In particular, cities have not exploited the links between

Country	GNI per capita (US\$) for 2013	Number per 1000 persons		
		Passengers Cars	Total Vehicles	Two-wheelers
Developed Countries				
United States	53,470	360	783	27
United Kingdom	41,680	455	517	19
Japan	46,330	466	598	81
Germany	47,270	544	603	50
Australia	63,390	562	711	32
Developing Countries				
Mexico	9940	203	285	15
Malaysia	10,430	358*	396*	356
South Africa	7190	110**	162**	6
Brazil	11,690	227	290	108
China	6560	76	93	70
South Korea	25,920	300	386	42
India	1570	19	167	123

*Data relates to 2012.

**Date relates to 2011.

Source: Ministry of Road Transport & Highways, Government of India, New Delhi: Road Transport Year Book (2013–2014 and 2014–2015) [8].

Table 10.

Vehicular penetration rates in select developed and developing countries 2013.

agglomeration externalities and transportation in their spatial planning and development models. Land use planning and transportation planning have been pursued as disjointed exercises in India. Cities had land use planners, but no transport planners. As a result, they have not been able to harness the power of city externalities to guide transport-land use integration and local economic development, address congestion and raise resources to finance public transport. The trends of urbanization, metropolitanization and motorization; patterns of population composition and densities in cities; abysmal state of urban transport with no robust model of financing in sight; emerging energy security and environmental concerns; and the demands of inclusive economic growth in India call for exploring the principles of New Urbanism, Smart Growth and TOD for restructuring urban planning.

3. New urbanism, smart growth and TOD

New Urbanism and Smart Growth emerged in the last four decades in the United States, Europe and other developed countries in response to their problems of urban sprawl, a consequence of automobile-dependency. They are rooted in a search for alternatives to low-density, single-use and spread-out patterns of urban expansion, increasing traffic congestion and air pollution, and adversely impacting the environment and quality of life.

New Urbanism is a design-oriented with architectural roots. Promoted by architects, it is focused on neighborhood design. Smart Growth is policy-oriented with environmental roots. Spearheaded by planners, it is centered on promoting guided development. Smart Growth is not so much concerned with urban design as it is with growth promotion. It elevates the discourse on urban planning from growth control to issues of how and where growth should be accommodated. It calls for public subsidies for growth, such as infrastructure facilities and land use incentives. Both New Urbanism and Smart Growth advocate TOD.

Transit Oriented Development (TOD) owes its origin to the paradigms of New Urbanism and Smart Growth. It is an urban planning and development approach aimed at creating vibrant, livable and sustainable communities by concentrating growth around one or more transit stations or within a transit corridor. It emphasizes compact, walkable, mixed-use communities with access to high quality transit services within a walking distance. TOD principles are not new; they were introduced by many cities in North America and Australia into their planning models after World War II. However, TOD as a specific policy paradigm has taken root only in the last twenty years.

The concentration of development based on a TOD approach acts against urban sprawl and uneconomic extension of costly infrastructure, catalyzes external economies of agglomeration, mitigates congestion diseconomies, and assists in the mobilization of resources through increases in land and property values and other tax bases. TOD enables lower-stress living without complete dependence on a car for mobility. It is environment-friendly and inclusive. The poor, who do not own automobiles benefit significantly when included under a TOD scheme. As an instrument of inclusive regional and urban planning, TOD promotes the inclusion of the poor in the urban development process. The economic, social and environmental benefits of TOD are briefly presented below:

TOD: Economic Benefits:

The economic benefits of TOD include reduced congestion, agglomeration economies, resource mobilization for financing infrastructure, reduced costs of development, efficiency of investment, etc.

Reduced Congestion: TOD reduces the need to travel and, thus, reduces congestion and stress levels.

Agglomeration Economies: TOD, if designed properly, can augment agglomeration economies by enhancing access to the economic mass and facilitating the collocation of productive economic activities in nodes with potential to engineer growth. These economies lead to benefits of backward and forward linkages, market access, sharing of common infrastructure facilities and resources, specialized labour pooling, human capital accumulation, knowledge spillovers and networking. They lead to economies of sharing, matching and learning; they promote specialization, diversity and competition.

Increased Revenue Yields: Properties around transit hubs are accorded higher values. These higher property values could be converted into revenue for the government through value capture levies.

Efficiency of Investment: TOD directly fosters patronage for growth and helps to optimize existing transit and connectivity infrastructure. It maximizes the efficiency and carrying capacity of the transportation network.

TOD: Social Benefits.

Affordable housing and public transport are key enablers of social inclusion. They increase the accessibility to jobs, health care, education, recreation and socio-cultural interactions.

TOD: Environmental Benefits.

Public transport can help to reduce the proliferation of personal vehicles and thus, reduce the level of emissions. This reduction could be quite significant, especially during the peak hours.

The success of TOD depends on its design. **Box 1** presents some key principles to guide TOD designing.

1. Multimodal Transit Station.

Transit is the focus of TOD. Transit facilities should not be designed in isolation, rather it should connect the neighborhoods. Further, it should include a mix of modes like two wheelers, car, bicycles, BRT, LRT and NMT.

2. Interconnected Streets.

Such a pattern not only decreases congestion but also encourages mixed use development along with enhanced travel choices.

3. Mixed Use Development.

A compact structure involving diverse land use pattern can benefit residents as well as workers to meet their daily requirements including work, shopping and leisure.

4. Walkability.

In order to encourage walking it is important to design a pedestrian-friendly structure. Such a structure must include sidewalks, shaded pedestrian routes, benches to rest and safe crossing points at transit stations.

5. Compact Development.

In order to be successful, the structure needs to be compact. The extent of neighborhoods around transit nodes is based on a comfortable walking distance from edge to centre (approximately 400 to 800 meters in radius).

6. Street-facing Buildings.

Streets can be better defined by placing the buildings near them. Street front retail should be provided to humanize the building wall and activate the sidewalk.

7. Urban Place-making.

A successful TOD design works on developing public spaces in the neighborhood. It is important for improving social interaction and strengthening community bonds and participation.

8. Neighborhood High Street.

Retail streets provide the goods and services of daily life, activate the street, reduce auto reliance, and increase ownership and safety of the pedestrian realm.

9. Streetscape Design.

A beautified street pattern equipped with pedestrian utilities improves the desire to walk and makes it pleasant while shortening the sense of distance.

10. Bicycle-friendly Streets / Parking.

Bicycles are environment friendly and efficient alternatives to automobiles. Bike lanes, bike routes, and secure parking make the bicycle an easy option.

11. Urban Parks & Plazas with Minimized Ecological Footprint.

Open spaces enable public interaction and promote healthy communities.

12. A Well-designed Transit Station for a High Quality User Experience.

The design of the transit station is at the heart of a successful TOD structure. Its design is critical for enhancing customer attraction and ensuring seamless and efficient accessibility to consumers.

13. Reduced Parking Standards.

Reducing parking standards provides increased site area for alternative public amenities.

14. Safety & Security.

Ensuring safety and security of transit users especially pedestrians, not only improves the transit experience but also enhances transit ridership.

15. Market Acceptance and Successful Implementation.

A vibrant and transit supportive space which attracts several jobs and residents is critical for a TOD programme. Flexible strategies along with designs which cater to the needs of the surrounding neighborhood can ensure a successful TOD.

Source: UNDP 2012 [9].

Box 1.

Transit-oriented development: design principles.

While the principles of Smart Growth and TOD originated in developed countries in response to their problems of sprawl, the paradigms make good sense for developing countries like India. However, TOD policies have not been implemented in an appreciable way in India. Only recently Delhi and Haryana have brought out planning guidelines for TOD, calling for the integration of transportation and land use. Bengaluru, Mumbai, Pimpri-Chinchwad, Ahmedabad, Hyderabad, Naya Raipur and Bhubaneswar have embarked on programmes to promote transit-oriented planning and development. TOD presents significant opportunities to India to make the country's urbanization process efficient, inclusive and sustainable. However, the execution of TOD and financing of transit investments are key challenges for Indian cities. Apart from the principles of sustainable development, successful international practices of transport-land use and integration approaches to financing public transport investments can guide the design of TOD in India. Section 4 refers to some oft-cited examples of successful international practices of TOD. Section 5 presents the broad approaches to financing of public transport, including transit to guide Indian cities to draw lessons for TOD.

4. Transit oriented development: international practices

TOD is emerging as a preferred paradigm to plan cities, localities and urban extensions and renew old cities and derelict areas within cities in many countries. Some of the successful TOD models practiced internationally that can provide lessons for Indian cities for the integration of transportation and land use are discussed in this section.

4.1 Hong Kong SAR

Hong Kong is internationally known for its successful integration of rail transit investments and urban development. The integrated "rail-property" development model (R + P), plays a vital role in managing and financing railway expansion,

advancing high-quality urban designs, creating “one-stop” settings for “live-work--shop-play”, guiding regional urban growth, and more. As with all good public-private partnerships, this occurs in a win-win fashion – i.e., the railway corporation reaps financial benefits and society at-large benefits from more sustainable, transit-oriented patterns of development. Maritime Square Residential-Retail Development atop Tsing Yi Station provides a good example of Hong Kong TOD. Maritime Square features hierarchically integrated uses. Shopping mall extends from the ground floor to the 3rd level. Station concourse sits on the 1st floor, with rail lines and platforms above and ancillary/logistical functions (like public transport/bus interchange and parking) at or below. Above the 4th and 5th floor residential parking lies a podium garden and above this, high-rise, luxury residential towers [10].

The Hong Kong Government derives a major proportion of its revenues from land, including premium on new land and modification of existing leases, property taxes, stamp duty, rents, etc. [11]. The Hong Kong MTR has generated many benefits to the community. These include travel time saving, employment gains, environmental health benefits, property value increases and so on. The network obviously generates enormous external benefits as it passes through the densely populated districts, commercial and employment centres and carries large passenger loads.

4.2 Bogota

Bogota, the capital of Colombia, has some of the most progressive public investment initiatives in developing countries, including the first-class TransMilenio BRT; integrated TDM measures; the transit-linked social housing Metrovivienda program; the Alameda Porvenir, the world’s longest pedestrian way; and other public projects that incorporate good urban design and innovative financing schemes [12]. Bogota’s TransMilenio is one of the world’s most successful examples of Bus Rapid Transit (BRT) [13]. It is characterized by dedicated main trunk routes for high speed busses, physically separated from the rest of traffic [14]. The bus stations are well-connected with systematic feeder services. The integrated approach of Bogota addressing affordable housing and affordable transport simultaneously, has improved the access to work, leisure, recreation, shopping.

4.3 Curitiba

Curitiba’s bus system is composed of a hierarchical system of services. Minibusses routed through residential neighborhoods feed passengers to conventional busses on circumferential routes around the central city and on inter-district routes. The backbone of the system is composed of the Bus Rapid Transit, operating on the five main arteries leading into the centre of the city like spokes on a wheel hub [15]. Along each of the five arteries there is a trinary road system, comprised of middle express bus lane with vehicle lanes on each side for local auto traffic and parking.

Curitiba’s Master Plan integrated transportation with land use planning. It limited central area growth, while encouraging commercial growth along the transport arteries radiating out from the city centre. The city centre was partly closed to vehicular traffic, and pedestrian streets were created. Rush hour in Curitiba has heavy commuter movements in both directions along the public transportation arteries.

4.4 Copenhagen

Danish Town Planning Institute created the “Egnsplan” or the Finger Plan in 1947. It was based on a TOD principle, with mixed land use and high-density areas

around the centre [16]. Shopping malls, offices, recreational centres and housing were all planned in pedestrian areas with good bicycle facilities such as cycle lanes and parking and a good connection to public transport. The design includes five fingers or corridors of urban development along the suburban areas which are connected through railway lines and would directly connect the areas to Copenhagen Central Business District (CBD). The neighborhoods around the transit stations were planned to be developed in a TOD fashion with high density housing and amenities. The approach aimed at an ordered and integrated 'green' growth and was developed at the time of extensive and rapid urban development. There were spaces left for the use of farmland and recreational purposes between each finger, known as "green wedges". A ring road was planned at the end of each finger which linked the Copenhagen harbor and inner city to industrial locations. Most of the land was developed by the end of the 1960s and the two southern-most fingers were extended.

Orestadtowship is one of the best examples of successful TOD following the Finger Plan. It combines economic activities, housing and amenities – jobs, housing, retail, leisure and education – all based on TOD. It helped Copenhagen to remain competitive and release pressure on CBD.

Unlike the international cities with global best practices on TOD, Indian cities have grossly neglected transportation planning, public transport investments and transport-land use integration for long. Key issues of financing public transit and development integrated with such transit are typically ignored in public discourses. As a result, a coherent strategy for financing public transport has not emerged in India. Section 5 refers to international practices for financing of transit oriented development in the broader concept of financing public transport to guide Indian cities.

5. Financing transit oriented development

The financing of TOD cannot be artificially divorced from the broader issues of financing urban transport and cities. Both planning and economic considerations are important for designing a financing strategy. The approaches to financing of various types of public transport infrastructure, including TOD internationally include the following methods:

- Equity, including public-private partnerships (PPP), special purpose vehicles, infrastructure debt funds, investment funds, infrastructure financing companies.
- Debt tools, including private debt, commercial bank debt, take-out financing, bond financing – infrastructure bonds, municipal bonds (revenue and general obligation), green bonds, etc.
- Foreign Direct Investment and Foreign Portfolio Investment.
- Grant financing, combining central and state grants with local government resource mobilization and using public funds to leverage market resources and PPP.
- Direct fees, including user fees, utility fees, benefit charges and congestion pricing.
- Using land as a resource - value capture and impact instruments such as land and property taxes, land value tax, land value increment tax, betterment levy, developer exactions, impact fees, special assessment districts, land

Sl. No.	Name	Description	Advantages	Disadvantages
1.	Fare increases	Increase fares or change fare structure to increase revenues	Widely applied. Is a user fee (considered equitable)	Discourage transit use. Is regressive.
2.	Discounted bulk passes	Discounted passes sold to groups based on their ridership	Increases revenue and transit ridership	Increases transit service costs and so may provide little net revenue
3.	Property taxes	Increase local property taxes	Widely applied. Distributes burden widely.	Supports no other objectives. Is considered regressive.
4.	Sales taxes	A special local sales tax	Distributes burden widely.	Supports no other objectives. Is regressive.
5.	Income tax	Special income tax for transit or transportation	Progressive with respect to income. Relatively stable.	May be difficult to implement.
6.	Fuel taxes	An additional fuel tax in the region	Widely Applied. Reduces vehicle traffic and fuel use	Is considered regressive.
7.	Vehicle fees	An additional fee for vehicles registered in the region	Applied in some jurisdictions. Charges motorists for costs.	Does not affect vehicle use.
8.	Utility levy	A levy to all utility accounts in the region	Easy to apply. Distributes burden widely.	Is small, regressive and support no other objectives.
9.	Employee levy	A levy on each employee within a designated area or jurisdiction	Charges for commuters.	Requires administration. Encourage sprawl if in city centers.
10.	Road tolls	Tolls on some roads or bridges	Reduces traffic congestion.	Costly to implement. Can encourage sprawl if only applied in city centers.
11.	Vehicle-Km tax	A distance-based fee on vehicles registered in the region	Reduces vehicle traffic.	Costly to implement.
12.	Parking taxes	Special tax on commercial parking transactions	Is applied in other cities.	Discourages parking pricing and downtown development.
13.	Parking levy	Special property tax on parking spaces throughout the region.	Large potential. Distributes burden widely supports strategic goals.	Costly to implement. Opposed by suburban property owners.
14.	Expanded parking pricing	Increase when and where public parking facilities (e.g. on-street parking) are priced	Moderate to large potential. Distributes burden widely. Reduces parking & traffic problems.	Requires parking meters and enforcement, and imposes transaction costs.
15.	Development or transport impact fees	A fee on new development to help finance infrastructure, including transit improvements.	Charges beneficiaries.	Limited potential.
16.	Land value capture	Special taxes on property that benefit from the transit service	Large potential. Charges beneficiaries.	May be costly to implement. May discourage TOD.

Sl. No.	Name	Description	Advantages	Disadvantages
17.	Station rents	Collect revenues from public private development at stations	Charges beneficiaries.	Limited potential.
18.	Station air rights	Sell the rights to build over transit stations.	Charges beneficiaries.	Limited potential.
19.	Advertising	Additional advertising on vehicles and stations.	Already used.	Limited potential. Sometimes unattractive.

Source: Todd Litman 2016 [18].

Table 11.
Potential public transport funding options.

readjustment, town planning scheme, joint development, land monetization including the lease and sale of land and air rights with enhanced Floor Space Index and value-enhancing land use changes in TOD zones, tax increment financing, etc.

- Bullet Bonds and Pooled Finance Fund Scheme.

Land value capture (LVC) instruments take many forms and can be classified into two major types: (i) tax- or fee-based and (ii) non-tax- or non-fee-based, also called “development-based LVC.” Tax- or fee-based instruments capture land value increases through, for example, land and property taxes, betterment charges, special assessments, and tax increment financing. In contrast, development-based LVC instruments capture these increments through land-related transactions such as selling or leasing land, development rights and air rights; making land readjustments; and redeveloping urban areas [17]. If adapted well to local contexts, development-based LVC instruments can be an effective finance and planning mechanism for cities in India.

The issues of financing public transit and TOD are intricately connected. However, as Indian cities are struggling to finance the development of mass rapid transit and bus rapid transit systems, not many have focused on TOD funding linked to LVC and non-LVC instruments. Based on international experience, a combination of financing instruments needs to be considered for adoption in India. These have to be suitably customized to fit the context of cities. A summary of various potential options for funding public transport, including transit is presented in the table below (**Table 11**).

International experience suggests that no one size fits all. But it makes clear that public transit and TOD impact on local, regional and national economies and lead to enhanced tax bases of all governments. Thus, if they are financed by borrowed funds with repayment linked to a value creation, capture and recycling strategy, cities in India can hope to get out of their vicious circles and traverse on a path of planned development. Future tax increments can finance current investment programmes which augments tax bases.

6. Towards TOD in India: case studies

Some state governments and urban local bodies in India have resorted to novel initiatives to plan and implement projects aimed at improving urban mobility

following the TOD principle and Smart Growth framework. Some case studies are presented below.

6.1 Janmarg: Ahmedabad

The city has decided to develop and implement an integrated public transit system including:

- A Suburban Rail Transit System to connect the city with its industrial suburbs such as Kalol, Naroda, Mehmedabad, etc.
- A Metro Rail System to cater to the high intensity movement between Ahmedabad and Gandhinagar.
- A Bus Rapid Transit System (BRTS) to cater to major mobility needs of the city.
- A regular bus system to support BRTS.
- Decentralized Regional Bus & Rail Terminal.
- Integrate different form of transport, i.e., BRT with other regional and urban transport systems, with bicycles and pedestrian facilities.
- Integration of Land Use -Transport elements like increased FSI along BRTS corridor.

The primary objective of the integrated public transit initiative in Ahmedabad is to make the city more accessible – with physical, social and economic accessibility.

Ahmedabad city has developed a Bus Rapid Transit System under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) with the name “Janmarg” or “the people’s way” and the slogan ‘Accessible Ahmedabad’. Janmarg boasts of an innovative plan and design which includes pedestrian only sections and one-way bus lane etc.

6.2 “Namma” metro: Bengaluru

Bangalore Metro Rail Corporation Limited (BMRCL), a joint venture of Government of India and Government of Karnataka is a Special Purpose Vehicle entrusted with the responsibility of implementation of the Bengaluru Metro Rail Project. “Namma Metro” is an environment friendly initiative as it aims at reducing carbon emissions in the city. The project has an East–West corridor - 18.10 km long, starting from Baiyappanahalli in the East and terminating at Mysore Road terminal in the West and a 24.20 km North–South corridor commencing at Nagasandra in the North and terminating at Puttenahalli in the South.

In connection with the construction of Bengaluru Mass Rapid Transit System, the Government of Karnataka has introduced a number of innovative measures to create a dedicated resource pool, including special cess to capture land value increments due to transit [19]. The Government has taken up several value capture instruments like development ceases, chess on additional FAR, Transferable Development Right (TDR) etc. to finance Bengaluru mass rapid transit system.

6.3 Delhi MRTS

The Delhi Metro system serves Delhi and its satellite cities of Faridabad, Gurgaon, Noida and Ghaziabad in National Capital Region in India. Delhi Metro is the world's 12th largest metro system in terms of both length and number of stations. The network consists of five color-coded regular lines and the faster Airport Express line, with a total length of 213 kilometers serving 160 stations (including 6 on Airport Express line) [20]. The system has a mix of underground, at-grade, and elevated stations using both broad-gauge and standard-gauge. The metro generated an average daily ridership of 2.661 million passengers.

Delhi Metro has been instrumental in reducing vehicular congestion on the roads. According to a study, Delhi Metro has helped in removing about 3.9 lakh vehicles from the streets of Delhi. The Delhi Metro Rail Corporation has been certified by the United Nations as the first metro rail and rail-based system in the world to get "carbon credits for reducing greenhouse gas emissions" and helping in reducing pollution levels in the city by 630,000 tonnes every year, thus helping in reducing global warming [21].

The Delhi TOD Policy 2013 has provided for significant increases in FSI in transit influence zones to promote intensive development so that TOD can be self-financing adopting a land value capture method and even be surplus-generating. The Delhi Development Authority has proposed to take up TOD to build the East Delhi Hub as a signature destination. This includes the development of 75 acres of land in Karkardooma with FSI raised to a maximum of 4 and maximum density of 2000 persons per hectare on the basis of a TOD model. The project is being taken up on a partnership with the National Building Construction Company (NBCC). Some parcels of land are under development, but Delhi is far from achieving the TOD Policy objectives of inclusive development.

6.4 Delhi TOD policy

The salient features of the Delhi TOD Policy are:

- Development/redevelopment in TOD zone will be incentivized by providing significantly higher FAR of 4.0 on the entire amalgamated plot being developed/redeveloped.
- Additional FAR may be availed only through Transferable Development Rights (TDR), for schemes larger than 1 hectare.
- Entire approved layout plan of a scheme will be included in the influence zone if more than 50 percent of the plan area falls in the influence zone.
- It will be mandatory to use a minimum of 30 percent of overall FAR for residential use, a minimum of 10 percent of FAR for commercial use and a minimum of 10 percent of FAR for community facilities. Utilization of the remaining 50 percent FAR shall be as per the land use category designated in the Zonal Plan.
- There shall be a mix of housing types for a wide range of income brackets within communities with shared public spaces/greens/recreational facilities/amenities, which will minimize gentrification and create more community-oriented developments.

- The mandatory residential component covering 30 percent FAR shall wholly comprise of units of 65 m² area or less. Out of the half of the FAR, i.e. 15 percent of the total FAR, has to be used for units of size ranging between 32 and 40 m². Over and above this, an additional mandatory FAR of 15 percent, i.e. FAR of 0.6 (out of 4.0) has to be utilized for Economically Weaker Sections (EWS). The size of EWS units will range between 32 and 40 m².
- 20 percent of land shall be used for roads/circulation areas. 20 percent area for green open space shall be kept open for general public use at all times. Further, 10 percent of green area may be for exclusive use.
- MRTS agencies are exempted from providing the mandatory 30 percent residential component which is part of the TOD norms applicable to all other developer entities (DEs).

6.5 Hyderabad elevated metro rail

Hyderabad has gone for a metro rail transit based on project report prepared by Delhi Metro Rail Corporation (DMRC) which identified 269 acres of land requirement. Originally the project was conceived as a government-funded project. However, subsequently the city went for a metro based on a PPP mode, adopting a Design, Build, Finance, Operate and Transfer (DBFOT) format. Hyderabad is currently implementing the world's largest elevated metro rail project in PPP mode with L&T as concessionaire.

The revenue model of the concessionaire is: 55 percent passenger fare, 40 percent property development and 5 percent advertisement and parking fees. Thus, the project's revenue is partially fare based. But, a significant portion of the revenue is also non-fare based. The concessionaire hugely relied on the potential of development of property or air space above and around transit stations. It has been provided with some valuable government land at vantage transit stations and is undertaking commercial exploitation of property with engineering innovations. It cannot sell property but can enjoy the rentals during the concession period of 35 years.

6.6 Mumbai metro

Mumbai Metro Line 1 – Versova-Andheri-Ghatkopar Mass Rapid Transit System is the first metro project awarded in the country on a PPP basis. It has provided the much needed connectivity in the financial capital of India linking the East and the West. It has ensured connectivity to Western and Central Railways. Providing modern, fast, clean and caring infrastructure, the Line has carried 100 million commuters in the first year of operation. It has reduced the journey time between Versova and Ghatkopar from 71 minutes to 21 minutes.

While Indian cities have making efforts to promote TOD with new policies, projects and plans emerging, especially in the context of Smart Cities Mission, a study of the Indian initiatives so far suggests robust approaches to financing and execution of TOD have not emerged. The approaches to financing transit also vary considerably as shown in **Table 12** below.

A key lesson from the initiatives of Indian cities towards financing transit and TOD, when compared to international best cases, is that urban policy, spatial planning, city development strategy, city financing framework, transit orientation, zoning, land use and development control regulations and institutional framework to integrate land use and transportation planning, raise resources and execute TOD

Funding Approach	Financing Pattern	Practicing Metro Rail
Government-funded	50–50 Central Government: State Government	Delhi, Bengaluru, Chennai, Kochi, Nagpur
	100 percent State Government	Jaipur, Lucknow (initially)
	100 percent Central Government	Kolkata (North –South) Kolkata (East–West)
Public-Private Partnerships	Private provisioning of operation and maintenance	Delhi Airport Express (initially) – Reliance Infra
	PPP-BOT model (Design, Build, Finance, Operate, Transfer)	Hyderabad Metro (Government of India Viability Gap Funding – 10%, L&T – 20% equity and 70% debt) Mumbai Metro Line 1 (RInfra – 69% MMRDA – 26%, Veolia – 5%)
Private Funding	Complete private funding	Gurgaon Rapid Metro Phase I – Equity 75%, DLF 25% Phase II – Senior Debt from Banks/ Financial Institutions – 70%, Sponsor’s Contribution – 30%

Table 12.
Emerging approaches to financing public transit in India.

need to be part of a holistic model of integrated urban development and should not be undertaken disjointedly.

7. Implementing TOD in India: issues and directions

The existing institutional framework in Indian cities is not adequate to tackle the issues associated with planning, financing and implementing TOD. The starting point for successfully implementing TOD in India is to devise an appropriate institutional framework along with clarity in financing mechanisms. Considering the investment and planning efforts demanded by TOD, an effective, extensive and robust institutional framework needs to be put in place. This framework is required at all three levels of governance: centre, state and local. The design, implementation of TOD and enforcement of urban transport pricing and regulatory measures require special attention. Proper co-ordination must be ensured between the several agencies involved at the different levels in order to prevent potential conflicts and delays.

The draft National Transit Oriented Development Policy paper takes into account the above internationally recognized principles and implementation guidelines for TOD. Keeping in view the international best practices and national debate and discussion on TOD as an instrument of sustainable and planned urban development, **Box 2** provides some broad directions for executing TOD in cities and towns of India.

TOD focuses on compact, mixed use development around transit corridors - metro rail, BRTS etc. International best practices have demonstrated that though transit system facilitates transit-oriented development, improving accessibility and creating walkable communities is equally important. Thus, to achieve the goals of TOD, the planning and development principles mentioned earlier in the study need to be adopted. The principles should also be supported by TOD-support policy tools such as right size infrastructure, technology integration, station area planning, land value capture, safety and security, universal accessibility etc. The following key aspects need to be considered for translating TOD principles and policies into practice in India:

1. Approach for TOD Implementation:

1.1 Influence Zone:

Influence zone of any transit corridor or station is the area in its immediate surrounding. It is intended to be developed into a compact, high density structure with mixed land use to cater to the residents' basic needs. It is generally up to a radius of nearly 500–1000 mt of the transit station.

1.2 High Density Compact Development:

TOD calls for the densification of the influence zone. This can be done by providing higher Floor Area Ratio (FAR)/ Floor Space Index (FSI) and higher job and population density in the influence areas. To ensure sustainable and financially viable development, the minimum FAR should be 300–500 percent, and can be higher, depending on the city size.

1.3 Mixed Use Development:

Mixed land use in the TOD zone reduces the need to travel for work, shopping, leisure, education etc. The basic necessities of the residents can be provided within walking distance.

1.4 Mandatory and Inclusive Housing:

The cities should have minimum percentage (30 percent or higher) of allowed FAR for affordable housing in all development/ redevelopment in the influence zones. Housing in the influence zones should have a mix of all economic groups/ sections. The development control regulation should cater housing for EWS as well as LIG and MIG to give an opportunity to the people who depend on public transport for daily commuting to live in walkable neighborhoods.

1.5 Multimodal Integration:

An integrated multimodal network is required for availing various facilities in the influence zone. Seamless physical connectivity, integrated information system and fare integration can provide easy first and last mile connectivity.

1.6 Focus on pedestrians, cyclists and NMT users:

The influence zone should address the needs of pedestrians and NMT users. Sidewalks and amenities like benches, lighting, shops and information signage etc. should be developed.

1.7 Street Oriented Buildings and Vibrant Public Spaces:

Buildings should face the streets so as to define them better. Buildings should be oriented towards facing the pedestrian facilities. Public spaces should be developed to improve social interaction and strengthen community bonds and participation.

1.8 Managed Parking:

Use of private vehicles can be discouraged by reducing availability of parking spaces in influence zones and making it expensive. On-street parking should be prohibited within 100 mt of the transit station, except for freight delivery and pick-up or drop-off of the differently abled.

2. Value Capture Financing (VCF) for TOD:

The investment in the transit system as well as increase in FAR and provision for mixed use development would result in increase in value of land within the influence zone. Land Value Capture can be used as a mechanism to finance the required upgradation of infrastructure and amenities within the influence zone and expansion of the public transport system.

3. Statutory Framework:

TOD policy should be notified as part of the Master Plan/ Development Plan of the city whose vision should be resonated by all the stakeholders, especially those involved in infrastructure development and preparation of development plans. The policy document should clearly outline the importance of the high capacity transit network in the city's development.

4. Coordination and Implementation:

Successful implementation of TOD requires the various agencies involved in planning, design and financing to work in coordination with each other. UMTAs need to be operationalized and strengthened.

5. Communication and Outreach:

It is important to create awareness about TOD so as to increase its use. Multiple agencies including both private and public stakeholders must have a collective approach for successful implementation of TOD.

Source: National Transit Oriented Development Policy [22].

Box 2.

Implementing TOD in India.

Table 13 presents a summary of steps to convert the concepts of TOD to micro level implementation and undertake rapid transit station area and transit corridor development in India:

Existing Land Use	
a. Existing Land Use	<ul style="list-style-type: none"> • Development of existing corridor and station-area. • Making existing station-area pedestrian friendly, including access for persons with disabilities. • Improving parking supply in existing corridor and station-areas.
Transit Supportive Plans and Policies	
a. Growth Management	<ul style="list-style-type: none"> • Concentration of development around established activity centres and regional transit. • Greater employment opportunities should be provided close to transit stations. • Managing and conserving land.
b. Transit Supportive Corridor Policies	<ul style="list-style-type: none"> • Development of station-area and increasing transit corridor. • Plans and policies aiming to increase transit-friendliness of transit stations, corridors and areas. • Designs to improve pedestrian amenities, including facilities for the differently abled commuters. • Parking policies.
c. Supportive Zoning Regulations near Transit Stations	<ul style="list-style-type: none"> • Policies and regulations which encourage development around transit stations. • Zoning ordinances that provide enhanced accessibility to pedestrians and encourage transit-oriented characteristics of stations. • Zoning allowances to mitigate traffic and reduce parking. • Ensuring provision of affordable housing units close to transit stations.
d. Tools to implement land use policies	<ul style="list-style-type: none"> • Outreach to government agencies and the community in support of land use planning. • Regulatory and financial incentives to promote transit supportive development. • Higher FSI should be allowed along transit corridors. • Efforts to engage the development community in station area planning and transit-supportive development.

Table 13.
 Summary of steps to execute TOD: station area and corridor development.

8. Conclusions

India is going to experience a multifold rise in the demand for urban transport in the coming years. A strategic approach is required to ensure that the growth momentum is maintained without adversely impacting the quality of environment to urban dwellers. A holistic planning mechanism consolidating urban transport and land use planning is essential for Indian cities, especially metropolitan cities, so that synergies between urban form and functions can be channelized. This will further augment the productivity and efficiency of cities. The present challenges of congestion, pollution, accidents, sprawl etc. can be mitigated by investing in public modes of transport and optimizing multimodal mobility patterns. Urban transport influences the spatial organization of cities. So, urban transport must be approached in a holistic manner integrating pricing, financing regulation and comprehensive land use.

This chapter suggests that TOD is a necessity in India in view of the urbanization, metropolitanization and motorization trends in cities, the numbers and densities therein, income distribution patterns and considerations of sustainability. The

country cannot afford auto-centric, sprawling, energy-intensive and an expensive process of urbanization. India needs to move to a public-transportation led, transit-oriented, mixed use, and value capture financing-focused strategy of planned urban development with public transportation investment and transport-land use integration as the key drivers. This also calls for a robust financing strategy. Successful TOD policy requires a robust and integrated framework bestowed with financial independence, responsiveness and competence. TOD policy can be successful by ensuring transparency and accountability towards the users while augmenting the accessibility of Indian cities.

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Conflict of interest

The authors declare no conflict of interest.

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