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Urban Rail and Sustainable Development Key Lessons from Hong Kong, New York, London and India for Emerging Cities

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Abstract

This paper discusses the significance of urban rail in sustainable development in the developing and developed world by examining the cases of Hong Kong, New York, London and Indian cities. The paper analyses the project structuring and financing of the urban rail system in these cities and its contribution to shaping sustainable urban growth and sustainable urban development in general. Observations from the case studies underscore the paper's main emphasis which is that both private and public funded urban rail require innovative financing mechanisms (specifically land based) to sustain or revive themselves financially and that urban rail lends itself to such innovation more than urban road projects as well as multiple other co-benefits. The paper reviews metro projects in several Indian cities and explores the applicability of innovative financing mechanisms and the challenges in adopting them in the Indian context to enable a sustainable urban development model for emerging cities.

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1. Introduction

The 21st century is characterised by extensive and rapid urbanisation in developing countries. UN Habitat (2008, p. xi) suggests that over the next four decades the urban population in developing countries would grow by five million per month on average, comprising 95% of the global urban growth. According to Glaeser (2011), urban development is essential for driving economic growth and that it can also contribute to broader sustainable

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development. The new sustainable development goals (SDG's) include a city goal as it is recognized that urbanization can play a critical role in addressing all the SDG's (Daniel, 2015).

India is set to witness peak urbanization in the next four decades (Heilig, 2012, p. 1). India's urban population is projected to increase from 377 million in 2011 to 600 million by 2031 (Ahluwalia, Kanbur, & Mohanty, 2014, p. 2). This frames a challenging scenario for Indian policy makers, but also provides opportunities to improve existing and furnish new sustainable urban development policies that could provide a model for emerging cities globally.

Newman & Kenworthy (2015) draw attention to decreased automobile dependence and increased economic growth across cities globally being synchronous with thriving urban rail and consequent revitalization of the urban fabric. This paper shows how such development that simultaneously reduces car dependence and increases economic growth can be a key tool for achieving sustainable development. Indian cities are in a position to leapfrog automobile dependence by packaging urban rail and land revitalization based on global best practice. Urban rail displayed its potential as an axis for sustainable urban development and economic growth in the early 20th century in New York and London. Hong Kong followed the same path in the latter half of the 20th century. These case studies will be examined before applying them to Indian cities.

Most sustainable development, specifically in cities, requires new infrastructure and this require investment. This paper will show that governments increasingly cannot provide such investment at the levels required and thus private investment through partnership projects are required. The case studies are on to show that urban rail is more likely to provide such investment opportunities than urban roads and achieve more sustainable outcomes.

The Government of India (GoI) has been financially supporting urban rail since 2011 in cities with population over two million (Ministry of Urban Development, 2012). Public acceptance of urban rail has enabled a cut-back of this population norm to one million to extend this benefit to medium size cities (Ministry of Urban Development, 2014a). Urban rail (metro) is currently being planned for over 50 Indian cities (Modi, 2015).

India, like all emerging nations, faces a critical investment gap in infrastructure so investing public funds in over 50 capital-intensive metro projects is impossible without new sources of investment. The situation demands that metro financing be looked at from a new perspective. This includes analysing the existing framework of governance, community participation, project structuring and implementation, learning from evolved urban rail systems and looking for improvised financing solutions.

Cervero and Duncan (2002), Cervero (2004) and McIntosh et al. (2017) demonstrate that increased transit accessibility uplifts the value of the accessible land market. This transit-linked shift in value can be captured through land value capture (LVC) mechanisms. According to Vadali, Aldrete and Kuhn (2013), LVC mechanisms provide a significant untapped resource for developing nations where the real-estate market is less rigid, more profitable and can sustain healthy population density and transit ridership. The National Urban Transport Policy (2014) and the 12th Five Year Plan (2012-2017) of India acknowledged the impact of urban rail on land and LVC as a possible financing mechanism to be used in Indian cities (Ministry of Urban Development, 2014b; Planning Commission, 2013).

This paper provides an overview of the development of urban rail systems using three global case studies, their evolving project structure and potential for innovative financing, especially LVC. It examines these three global urban rail systems first, and draws comparisons with them further to develop a way forward for Indian urban rail systems and hence any emerging urban area seeking greater sustainable urban development.

2. Global Case Studies

London, New York and Hong Kong have for long integrated land use with transit. This enabled distinctive and innovative methods of financing where LVC emerged as a source of finance to defray the urban rail project cost. Within these methods, private developers played a significant role in the financing and development of the New York and London rail systems in late 19th and early 20th centuries. In case of Hong Kong, the government only integrated transit and land use plans to finance their rail system. These cities provide lessons for the rapidly evolving urban rail sector in India and for other emerging systems around the globe.

2.1. *The Hong Kong Metro*

The Hong Kong Mass Transit Railway Corporation (MTRC) was set up by the government to implement and operate the metro system in Hong Kong under prudent commercial principles. The first line of around 8 km became operation in 1979 (Victor & Ponnuswamy, 2012, p. 113)

The Hong Kong government has enjoyed significant financial returns without subsidising their urban rail network. Their net financial returns in the period from 1980 to 2005 amounted to nearly USD 2.33 billion (Cervero & Murakami, 2008, p. 14). The Hong Kong government sold 23% of its capital share in MTRC to private investors in 2011 to increase private investment and capital flow (Suzuki, Murakami, Hong, & Tamayose, 2015, p. 77). According to Wong (2015), this restructuring improved the corporation's efficiency, competitiveness and profit. MTRC's market value rose significantly with its stock price doubling (in 2014) since restructuring (Verougstraete & Zeng, 2014, p. 3). It is one of the rare profit-making transit organizations in the world and recorded a net profit of about USD 2 billion in 2015 (Mass Transit Railway [MTR], 2016, p. 33). These facts render the case of Hong Kong a competent reference for innovative financing.

MTRC carries about 4.7 million passengers daily and its fare-box revenue covers 175% of its operating expenses despite having an economical fare structure (USD 0.50 to USD 7.50) and relatively shorter network (218 km) as opposed to London Underground (402 km) and New York Subway (373 km) (Transport Department, 2016). From 2000 to 2012, 38% of MTRC's revenue came from property development, 28% from commercial and property leases and 34% from transit operations (Suzuki, Murakami, Hong, & Tamayose, 2015, p. 83).

MTRC used the Rail plus Property development (R+P) program to integrate transit with land use. Under the R+P program, the government granted MTRC the exclusive air (development) rights of the land above transit stations and depots and that around stations, at the 'before-rail' market price (market value of the property before the construction of the metro) (Verougstraete & Zeng, 2014, p. 2). Development rights and land were the only form of subsidy provided by the local government (Tiry, 2003). Using these development rights MTRC partnered with private developers to jointly develop the land and to rent/sell the completed units under a revenue sharing model. This allowed it to capture the windfall gain of the 'after-rail' property value by sharing the profit with private developers rather than leasing the property for one-time lease money (Suzuki, Murakami, Hong, & Tamayose, 2015; Verougstraete & Zeng, 2014). Thus, MTRC could integrate and plan different phases of its rail and property development projects, ensuring smooth project implementation and reducing delays and transaction costs.

Apart from tangible financial benefits, MTRC's initiatives have also created intangible benefits to the city, such as Hong Kong's compact urban form, high population density and efficient transportation. The R+P program effectively guided the city's urban fabric through high-density development along metro corridors, promoting sustainable urban development. Land market's accessibility attracted people closer to the metro with 41% (in 2002) of Hong Kong's population residing within the catchment area (500m) of a metro station (Tang, Chiang, Baldwin, & Yeung, 2004, 8). Together these benefits led MTRC away from net loss in 1980s towards profit worth USD 2 billion in 2015 (Cervero & Murakami, 2008, p. 13; MTR, 2016, p. 33).

2.2. *New York Subway*

The New York state government approved the Rapid Transit Commission (RTC) in 1904 to administer urban rail for New York City (Hood, 1995). The construction and operation of the first corridor of this system (christened New York Subway) was leased to the Interborough Rapid Transit Company and the line opened in 1904, with investment from public and private partners (Cheape, 1980). Three separate companies—two owned privately and third by the City—expanded the subway throughout four of New York's five boroughs. These lines were planned and developed in densely populated areas (King, 2011) which ensured that towards the end of the decade public transit usage and automobiles for personal travel were competing at par (Schrag, 2000). Rising demand for transit was supplied through private investment allowing for ridership to boom for four decades and peak in 1947 (King, 2011; Metropolitan Transport Authority [MTA], 2016).

The two private operators were solely dependent on fare box revenues and were not allowed to increase the fixed nickel fare (USD 0.05) (King, 2011). The project lost its financial viability and the operators went bankrupt when the system peaked (1947). The City acquired their corridors and consolidated them with theirs. The City doubled the

fare in 1948 and imposed a tax for transit improvement to induce financial viability (Benjamin & Nathan, 2001, p. 140). In 1953 a separate body, the New York City Transit Authority (NYCTA)—a state authority headed by New York City—was created to operate the urban rail and cover operating costs from fare-box revenues, while the City continued to provide capital investment (King, 2013). In 1968 NYCTA was positioned under control of a state level Metropolitan Transportation Authority (MTA) (Sparberg, 2014).

Restructuring could not improve the financial condition as public ownership of the system adversely impacted its efficiency. In 1956, a policy of ‘deferred maintenance’ was adopted which entailed that brakes and signals be inspected less frequently, supplies of replacement assets such as signal bulbs be allowed to run down to zero, and electrical relays last 30 years whereas they require replacement every 5 years (Caro, 1975). Following these changes, annual ridership that had surpassed 2 billion in 1930’s dipped below 1 billion by the end of 1970’s (MTA, 2015).

The New York Subway was trapped in a vicious cycle of deteriorating system, lack of investment, falling ridership and continuous neglect by the authorities. Road based car-focused planning policies furthered drew attention away from the subway (Brown, 2003; Caro, 1974). Minimum parking requirements, parkways, investment in multiple lane highways, freeways and low-density suburbs were among the policies to accommodate cars (Altshuler, Womack, & Pucher, 1979; Ferguson, 2003; Shoup, 2011).

The subway’s revival began in 1982 with a public referendum on a ‘Capital Program’ for investment in the subway. The Capital Program referred to an investment pool legislated by the Transportation System Assistance and Financing Act of 1981 addressing the alarming situation of public transit in New York (Permanent Citizens Advisory Committee, 2012, p. i). It allowed MTA to issue bonds towards raising capital that is tied to the delivery of new assets and achievement of particular objectives related to upgradation of the subway (Allport, Brown, Glaister, & Travers, 2008, p. 104).

Under the Capital Program of 1982-1991, replacement and refurbishment of system components accounted for 70% of the expenditure on the subway (MTA, 2004, p. 73). This cut down the future (Capital Program of 2005-09) investment in maintenance to 27% (MTA, 2004, p. 13). The revival of the subway was rewarded with public acceptance for the system, which now reflects in an increased ridership level. The New York Subway recorded its highest annual ridership in 2016 since it peaked in 1948 (MTA, 2016). It is worth noting that the above-mentioned bonds and the system's continuing rehabilitation reflect a USD 32 billion long-term debt with MTA (PCAC, 2012, p. ii).

New York has been exploring and attempting ways to augment funds through financing mechanisms like the payroll mobility tax (PMT) and tax incremental financing (TIF). PMT refers to a tax on employees of all firms (above a certain size) within the public transport service area. TIF allows a local government to generate ‘incremental’ tax revenue from windfall increase in property values (within a prescribed development area or ‘TIF District’) and use it to fund infrastructure—like the subway—that led to the said increase in property values (Krogulecki, 2016). Generating additional tax revenue by TIF does not involve higher or additional taxes but expanding the base of taxpayers (International Council of Shopping Centers, 2012). Part of this additional revenue is directed from state’s treasury to TIF authority (PricewaterhouseCoopers, 2008). A USD 2 billion subway extension project (to Hudson Yards) in New York City is being financed by raising funds through municipal TIF bond sales (Demaese, 2015).

MTA receives a share of two state-wide non-fare box revenue namely ‘long lines tax’ (48%) and ‘petroleum business tax’ (55%) (UN Habitat 2013, p. 171). The former is a transportation-oriented tax levied on trucking, telegraph and telecommunications companies, and the latter is levied on refining or selling petroleum (Transportation Research Board, 2009). These regional level sources of finance provide assured funds to MTA and create agencies appetite for regular investment in the rail system.

MTA has planned station area development projects explicitly to integrate land use and transit. Residential and commercial towers are proposed over Hudson Yards (railyard). Another proposed project is the Penn station redevelopment (USD 14 billion) aimed at redeveloping the existing station and its surrounding area (Bagli, 2007). Plans include relocating the Madison Square Garden, demolishing Hotel Pennsylvania to accommodate two new towers one of which will be taller than the Empire State Building (Bagli & Fitzsimmons, 2016). These development projects and LVC mechanisms are proposed to repay the capital costs of the proposed subway extension-lines.

Over the years, the New York Subway has achieved one of the highest fare-box recovery ratios while maintaining low fares in comparison with other urban rail systems in America, like San Francisco's Bay Area Rapid Transit (Johnson, 2013). The comparative analysis of fare-box revenue and expenditure (operating and maintenance cost) of buses and the subway shows better financial performance of subway over the road-based bus service in New York, a significant consideration in determining the economically preferred public transport system.

The subway's cost per passenger is lower than that of bus (3:4 ratio) whereas revenue per passenger is higher (9:7 ratio), as shown in Table 1. This analysis displays the success of the subway's revival and justifies investment in rail based mass transit system.

Table 1: Cost and Revenue Comparison of Subway and Bus Service in New York

Mode	Financial Characteristics						Revenue per Passenger (R2/R1)
	Ridership (R1) (Million)	Revenue (R2) (fare-box)	Operation Cost (O)	Maintenance Cost (M)	O&M (O+M)	Cost per Passenger (O+M/R1)	
Train	1,735.6	\$3,111.9	\$10,367	\$16,186	\$26,553	\$15.3	\$1.8
Bus	688.9	\$964.0	\$10,475	\$3,735	\$14,210	\$20.6	\$1.4

Source: Data compiled from MTA Annual Report, 2014

Note: Financial figures in USD Million

The New York Subway has illustrated how alternative financing works effectively with referendum-backed (public participation) bond issues, TIF, air rights and developer contributions. These factors have been crucial for revival of the subway service and sustained financing for required upgradation. The New York Subway provides a noteworthy case of deliberative democracy and collaborative efforts at the city scale in favour of public transport. The tact to finance and upgrade subway infrastructure has enabled the city to integrate land use and transit to meet present day needs.

2.3. London Underground

London's population grew rapidly since the beginning of the 19th century. Around 200,000 people daily used the suburban railway system to visit London to pursue economic opportunities (Wolmar, 2004). The system was comprised of seven railway terminals with different private railway companies operating trains to the suburbs. In 1846, construction of new lines or stations in the central city was banned by a Royal Commission following issues of congestion (Simpson, 2003). Around the same time, Charles Pearson, Solicitor to the city introduced the idea of a central railway station to be used by all railway companies. After multiple rejections the scheme took shape partially in 1852 when the City Terminus Company was established to build the first line of the London Underground (Day & Reed, 2008). The company was restructured and renamed to Metropolitan Railway (the Met).

Lack of funds necessitated an agreement (1858) between the Met and City of London where the Met bought the required land from the City for USD 274,872 and the latter purchased USD 307,120 worth of the railway shares (Wolmar, 2004). With this public-private partnership, a 6 km long underground railway was opened (1863) to serve the city centre (Green, 1987; Day & Reed, 2008).

Ridership of 9.5 million in the first year and 12 million the following year marked the underground project a success (Simpson, 2003). The Met utilised the land stock in possession and promoted housing estates along the rail corridor in London anticipating additional income (Jackson, 1986). It then merged many private and public railway companies and expanded the network. These actions made private operators anxious and instilled fierce competition, which reflected through several marketing activities and ticket pricing (Horne, 2003). Most of the private companies started joint marketing which included maps, publicity and signs outside stations (Horne, 2003). Adoption of common ticketing system—and common logo—helped passengers embrace the system as one rather than separable lines and benefit from easy transfers across lines (Armstrong & Gourvish, 2000). By the time World War I broke, London had built an underground urban rail system (Armstrong & Gourvish, 2000).

Early 20th century marked the commencement of the electrification of the railway with the American financier Charles Yerkes investing in the system (Green, 1987). He later founded the Underground Electric Railways Company of London (UERL), a precursor to present day London Underground. UERL followed a policy of expansion by acquisition and took control over majority of the underground railway lines in and around London (Green, 1987). London's profitable bus and tram companies were also acquired. The UERL established virtual monopoly as a bus operator and eventually integrated its bus and rail services creating a new lifestyle for a large part of the London population (Green, 1987).

UERL faced fierce competition from private motorbus operators as the latter served on unregulated routes as large-scale people movers with unsafe, profit-seeking, unorganised and anti-social practices. The ensuing chaos on London streets called for a single body to coordinate the city's 5 railways, 14 tramways and 60 bus undertakings. Thus a 1933 Act of Parliament set up the London Passenger Transport Board which was one of the first quasi non-governmental and non-profit organisations in the world and remarkably successful (Armstrong & Gourvish, 2000). It was a move that integrated multi-modal mobility and removed any horizontal institutional conflicts.

The expansion of the Underground lines helped build the suburbs. Most of the railway companies had no authority to develop land but coordinated with developers in mutually beneficial deals. This allowed for the railway's expansion to become integrated with London's development. This co-development of land and rail continued through first half of the 20th century (Levinson, 2007).

In 1947, Britain nationalised all modes of mass transport (Mulley, 2009) and a separate executive institution called the London Transport. The 1950's through 1980's saw limited augmentation of the rail network in London owing to complete public ownership.

The Victoria line opened in 1971 was the first new line in over half a century. It was unprecedented on the service front for a line to be designed for riding comfort rather than purely financial considerations (Armstrong & Gourvish, 2000).

London Transport managed transport issues until 1969 when many of its policy-making roles were transferred to the Greater London Council (Armstrong & Gourvish, 2000), a move that helped better integrate transport and land use.

London's integrated transit agency called Transport for London (TfL) was established in 2000. TfL has under its jurisdiction the region's rail-based public transport infrastructure, bus service, streets infrastructure, bicycle routes and pathways. This institutional integration was followed by adoption of the London Plan (Greater London Authority, 2004) which provides a framework for integrated development of brownfield areas and accessibility of the public transport system.

TfL has undertaken various transit financing initiatives including value capture strategies, notable among them the Business Rates Supplement (BRS). An addition to a current property levy on commercial buildings, BRS is the largest locational value capture mechanism currently implemented in London (Greater London Authority, 2010). Revenue raised through BRS will partially fund the construction of the 21 km Crossrail line. Funds will also be raised through a spatially graduated tax—based on the property's proximity to the line—on new developments (Barone, Hsu, & Emily Roach, 2015). Crossrail line is currently under construction phase and has already uplifted house prices (Denham, 2017)

With a growing interest in sustainability, London became involved in brownfield redevelopment. The Kings Cross revitalization project spreads about 67 acres of brownfield land and redevelopment of three stations, the adjoining site are proposed to be developed as a mixed land use space with homes, serviced apartments, retail space, office space, a new university and a school (Tourism & Transport Forum, 2010). The project is focused to provide a walkable and open space environment to promote knowledge economy with engagement between residents, students and employees while being connected to key transit transport hubs in London.

David Levinson (2007) in his empirical study on co-development of land use and rail in London portrays that rail was a precursor to population growth which in turn was a precursor to rail deployment. The study concludes that the two systems, land development and rail networks, have co-developed gradually, circumstantially but in a noteworthy manner and contained the economic course of London for more than a century. The institutional framework for transit has alternated earlier between public and private control, rearranged later multiple times and upgraded itself with change in the scale of services. The transit has evolved institutionally without halting and so have the services.

3. Inferences from International Case Studies

The cases of New York and London urban rail systems suggest that urban rail can address the unsustainable characteristic of urban development trajectories caused by rapid motorization and automobile dependency. This requires public participation, political leadership and innovative financing. The city's indigenous leadership and innovation together can unlock unexplored funding sources (especially from land) to finance transit projects. Both cases provide a noteworthy example of evolution in urban rail system. New York case shows that the shift from road based policies to urban rail provides significant opportunity for sustainable growth and redevelopment.

Hong Kong Metro stands firm as the most efficient urban rail system in terms of revenue while maintaining a high ridership level. It follows a comprehensive approach to exploit the potential of integration of land and rail through innovative financing. Hong Kong presents a multi-directional solution to the issues much closer to the developing countries' context. China has chosen to follow this model for their new metro systems and is now building metros in 86 cities (Newman & Kenworthy, 2015).

4. Urban Rail Systems in India

The first urban rail (metro) project of independent India was implemented in Kolkata in 1984 (Metro Railway Kolkata, 2015). It is a public-owned indigenous system constructed by trial and error method with uncertain funds, court injunctions and an irregular supply of construction material. Kolkata Metro's first section (3 km) was completed in about 12 years. Currently the network stretches over 27 km. It has been incurring huge losses since the operations commenced. Recent years' increase in ridership has reduced the operating ratio from 311 in 2011-12 to 254 in 2014-15 (Metro Railway Kolkata, 2015).

India's second metro system the Delhi Metro became operational in 2002 setting into motion the development of metro in Indian cities (Delhi Metro Rail Corporation [DMRC], 2017). Eleven of these cities now boast of operational metro systems and another six are under construction. The following section discusses a government-funded Delhi Metro and a privately-funded Gurgaon Metro that together provide an appropriate reference to compare public and private urban rail systems.

4.1. Delhi Metro

Delhi Metro is a government-owned rail transit system with an assured revenue stream from government. It is equipped with modern technology, safety and security systems all of which the Kolkata Metro lacked. The first line (4 km) was completed in three and a half years and the system is now ranked second-best globally (DMRC, 2017; Times of India, 2014a). Delhi Metro Rail Corporation (DMRC) constructed Phase I and II without delay and cost overrun (Agarwal & Gomez-Ibanez, 2012; DMRC, 2017). The quality delivery of the project is credited to the ex-Managing Director, Sreedharan (1997-2011) (India Today, 2011), who gained the title of 'Metro Man' for his exemplary leadership, an inspiration for the sector. His background as a technocrat inspired a debate on the efficacy of the traditional choice of appointing a bureaucrat to manage public organizations mandated for infrastructure projects.

Delhi Metro as a transit system, has provided and will provide significant economic and environmental benefits to the city. It is estimated to save 16 million tonnes of emissions annually (Business as usual scenario) due to modal shift of 0.4 million private vehicles users by 2025 (RITES Ltd., 2011, p. 5.5). It targets cumulative CO2 emission reduction by 4.808 million tonnes in the lifetime (70 years) (RITES Ltd., 2011, p. 5.5).

With a focus on using renewable energy, DMRC plans to achieve carbon neutrality by purchasing power from solar energy providers. It has already commissioned implementation of solar power plants summing to a capacity of 3160 kW and plans capacity of 50 MW by 2021 (DMRC, 2016, as cited in Goswami, 2016). The primary reason for opting for solar over thermal power is the latter's higher tariff i.e. USD 0.11 per kilowatt-hour (Malik, 2015) while solar power's rate in India is down to USD 0.08 per kilowatt-hour (Times of India, 2014b).

Delhi Metro's existing network stretches over 213 km with a daily ridership of about 2.6 million (DMRC, 2016, p. 9). The network length is comparable to that of Hong Kong (another developing world city) but Delhi is way

behind in ridership and revenue. The fact reflects the system's failure to utilize innovative financing through land-use and transit integration.

Delhi Metro incurred net loss of USD 70 million in 2015-16 and has been operating in net loss since commencement (DMRC, 2016, p. 79). Revenue from fare-box contributed 79% and 3% was earned through leasing of real estate and 18% from rental income (advertisement and station space rental) in financial years 2015-16. The share of fare-box revenue was significantly lower in 2006-07 (41%) and 2007-08 (63%) due to higher share of revenue generated from one-time leasing of DMRC land to a private developer in order to reduce capital debt during the initial years' operations. This land was given by the GoI to DMRC at a nominal intergovernmental transfer rate. This was an opportunity lost for on-going LVC and capitalising on the metro-induced windfall gains in land values, as had happened in Hong Kong. In recent years, DMRC opted for aggressive advertisement strategy (sold naming right of stations) and extensively rented spaces in stations (space for kiosks, parking, shops, restaurants and malls) which has significantly improved their rental income.

JLL India speculates that more than 50% escalation in real estate can be expected following the launch of metro rail (Shankar, 2015). An empirical study by Singh and Sharma (2012, p. 7) based on simple comparison method (using 50 property samples) placed the windfall increase in property values at about 14.7% in a suburban area (Rohini) of Delhi following the opening of a metro line.

Delhi Metro's efforts to integrate land use with transit have been stifled by the multi-layered and overlapping nature of control in Delhi authorities. The Master Plan of Delhi 2021, notified in 2007, recommended demarcation of influence zones along metro corridors to be planned as intensive development zones, in other words transit-oriented development (ToD), but without any specific statutory guidelines for ToD (Sabikhi, 2016). Local government bodies (who are prepared Master Plan) responsible for land management have delayed DMRC's applications for modification in land use and floor area ratio (FAR) for property development which is a result of lack of institutional integration (Suzuki, Murakami, Hong, & Tamayose, 2015). After 12 years of metro operation, in 2015, the Master Plan was amended and a ToD policy was introduced (Delhi Development Authority [DDA], 2015). This integrates the land use and metro plan after the implementation of metro but without institutional integration which restricts DMRC for implementing LVC at a comprehensive scale.

An act that should have been anticipated before implementation of Delhi Metro comes as substantially less rewarding being made after operationalization of system. Post-operation application of TOD brings scope for spatial rearrangement but does not necessarily ease out the way for DMRC. The policy only states to benefit it with increased ridership and value capture in the longer term and does not outlay any action plan for the latter (DDA, 2015). Though this is an initiation of urban policies towards sustainable urban growth and recognizing metro as significant element for it by local development authorities. However the delay has put DMRC under heavy debt and is responsible for the financial burden the institution has been holding for years. The situation certainly holds lesson for the 50 Indian cities in-process and ready to implement metro.

4.2. Rapid Metro

Rapid Metro Gurgaon, operational since 2013, is a mass rail transit system (elevated) developed to provide transit facility in and around the commercial center of Gurgaon. The network (6 km) is integrated with the Delhi Metro by a pedestrian bridge (90m-long) (IL&FS, 2012). In contrast to the Delhi Metro, the Rapid Metro Gurgaon is a privately financed system on a Build Operate Transfer (BOT) basis, with a 99-year concession period. The private developer recovers fare box revenue, while advertisement revenue is shared with the State Government for the first five years (Seth, 2012).

Rapid Metro has adopted for aggressive advertisement strategy to augment revenue. Advertisement revenue amounted to 61% of the total revenue in 2014-16 through auctioning of naming rights of the stations (even before the stations were opened) and advertisement space inside and on the exterior of the train coaches (Deloitte Haskins & Sells, 2015, p. 20).

Ridership has significantly improved from 18,614 (March 2014) to 42,000 (Aug. 2015) and contributed 39% (fare-box revenue) to the total revenue in 2014-16 (Deloitte Haskins & Sells, 2015, p. 20; Rapid Metro Gurgaon Limited, 2014, as cited in Kumar, 2014). However, the existing ridership of the system remained at about 40% of the projected ridership. The less ridership is attributable to the delay in anticipated commercial land development

projects (private) along the corridor and intense competition with cheaper (by 50%) and highly available informal transport modes. The same situation occurred in London, where informal buses tapped on the ridership of formal sector. Based on the learning from case of London, Gurgaon being a new city with weak public transport, should explore modal and institutional integration.

4.3. Remarks for Delhi and Gurgaon cases

The difference in nature of ownerships of the two cases reflects significantly from the first stage of urban rail implementation i.e. land acquisition. Delhi Metro being a government agency faced little difficulties, referring to issues like legal and environmental clearances, in comparison with Rapid Metro Gurgaon. Moreover, Delhi Metro received land at a nominal inter-governmental transfer rate from the local government bodies, but Rapid Metro had to pay market value (sometimes even more). In this sense, Rapid Metro has a more sophisticated finance and project structure.

Although LVC approach is absent from the frameworks of both metro systems, Rapid Metro has effectively garnered considerable revenue through advertisements from its construction phase. Both the systems form lifeline of transportation in and around the National Capital of India and are significant for economic growth. DMRC and Rapid Metro have not been able to comprehensively tap on land-based finance initiatives. The government authorities should enable metro agencies to provide a distant vision and shift from piecemeal to strategic approach to financially sustain the metro systems using LVC mechanisms.

4.4. Evolving Project Structuring of Indian Metro

The Mumbai Metro started in 2014 is a notable public private partnership (PPP) project. A special purpose vehicle (SPV) was constituted to design, finance, build, operate, maintain and transfer the system at the end of a 35-year concession period to the state government. The selected concessionaire and local government agency hold 74% and 26% equity share in capital respectively (Reliance Mumbai Metro, 2013).

Mumbai Metro is hugely dependent on fare-box revenue and require government approval for fare revision. This condition has become ground for power struggle between the concessionaire and government. The Mumbai Metro concessionaire has filed a legal case for fare hike and threatened to exit the project. Over-reliance on fare-box revenue for sustaining the project in privately-funded metro is a critical issue, as was reflected in the case New York Subway.

An intrinsic challenge been faced in metro projects is that of project delays due to the lengthy and multi-layered bureaucratic process for obtaining approvals from different agencies for the project's implementation. This can significantly hinder private investment in urban rail projects. A case in point is of the Mumbai Metro where the 83% escalation in project costs is believed to have been caused by delays (Kulkarni & Shaikh, 2014).

Apart from Mumbai Metro and Rapid Metro, all operational Indian metro systems are funded by the public sector. The fiasco of delays and blowing out of project cost has occurred in public-financed metro systems too. Bangalore Metro project's costs escalated by 19.3% and with the existing project delays this number could rise to 60% (Ray, 2015). These delays and cost escalations are restraining economic benefits and value.

In case of the Delhi Airport Express Line, the PPP structure failed and the government had to take over operations. The public sector (DMRC) built and financed all civil works including viaduct, tunnels and stations. The private concessionaire's responsibilities included operation, and financing of the operating system (primarily the track, signals, power distribution system and rolling stock) in return for the operational revenue, both fare-box and non-fare box. The selected concessionaire began operations in 2011 with a 30-year concession period but in 2013 exited the project and terminated the Concession Agreement citing defects in the civil structure (Reliance Infrastructure Limited, 2013). It is believed that the concessionaire had been incurring huge losses and according to Pratap (2013, of the Planning Commission, GoI) the following reasons made it financially unviable to operate the system:

- Low ridership – While the projected daily ridership was 42,500, only 17,000 passengers used the system per day. This gap in ridership is attributable to inaccurate transportation modelling.

- Aggressive bidding – The concessionaire’s bid was on the higher side i.e. USD 7.7 million annual concession fee and a progressively increasing revenue share. The losing bidder on the other hand had asked for an annual subsidy of USD 5.2 million or a long-term interest-free loan of USD 217.4 million. Kumar Pratap of the Planning Commission of India speculated that the concessionaire followed India’s ‘jugaad’ (translating to makeshift) principle to bag the project through aggressive bidding and renegotiate the terms later.

Alternative project structuring models for metro projects are now being conceived in Indian cities, Noida city being the pioneer. Noida is a satellite city of Delhi, governed by another state government with different legislative and political framework. The first (2009) phase of metro in Noida was established as an extension of the Delhi Metro network by DMRC. The Noida Development Authority financed the civil works, construction and land (depot, office and station) while DMRC bears rolling stock and operating expenses and collects revenue. For the proposed second (2017) phase of the metro in Noida, the city will bear all civil works, construction and land (depot, office and station) expenses and will provide additional land to DMRC to develop towards generating revenue for the system. Additionally, DMRC would be reimbursed for operational losses and not be expected to furnish any operational revenue.

For the proposed third phase in Noida, the city has taken the lead to own and operate the system and has set up a separate company for planning, implementing and exploring various PPP options for the project. Noida Development Authority has raised the permissible FAR along the metro corridor (for a 500m radius) and estimates that it will generate a revenue of about USD 603.9 million by selling additional land and exploring other non-fare box revenue options (Keelor, 2015). This is of one the first line of metro in India to is integrating land use and transit to implement innovative financing mechanisms at the planning of metro.

4.5. Issues

Indian metro projects are not planned in integration with land use and lack institutional integration at city level, which has deterred them to strategize innovating financing mechanism and reduce dependence on conventional sources of finance.

A significant legal factor preventing the integration is that urban transport plans are not statutory in nature and are not prepared in concurrence with land use plans. Also, urban transport plans and land use plans are drafted by separate urban local bodies (ULB’s), and different agency implement and operate the metro system.

Local community has generally no role in the planning process of mobility plans and metro projects. The detailed project report (DPR) prepared for a metro project requires no mandatory local community inputs. The DPR (a traffic study) decides the metro alignment, and land use and community component is largely absent. This leads to the issues faced by implementing agencies, like land acquisition, which leads to project delays resulting in significant financial cost.

Lack of property mapping, updated land use maps and flawed property valuation procedures hinders to quantify the impact of metro, and strategize and implement LVC mechanisms. For example, Bangalore has 80% untapped built-up area (Ministry of Finance, 2017). These issues are reflected in the revenue estimation sections of DPR’s, which include simple calculations for fare-box and non-fare-box revenue.

These intrinsic issues have led to high dependence of both private and public metro projects on fare-box revenue. As the existing systems expand network and new ones are being planned it is essential to address these issues and explore alternative financing methods to keep pace with the rapidly growing demand.

5. Recommendation

Indian cities and other emerging cities can learn from these case studies and create a new historical process of sustainable urban development based on innovative funding. Key steps forward include:

- Urban rail needs to be prioritized over urban road.
- Community and local planning processes to be involved at very early stage and community participation to occur at every stage of the project.

- Structuring finance for project life cycle is needed to allow regular land based contribution to feed into infrastructure financing model.
- Finance needs to be sought from private investment at very early stage of project planning/ conceptualizing and given more significance than simply looking at transport objectives.
- Capacity building and urban governance reforms to enable local level planning to bring desired outcomes.
- Cities to invest in digitising land use maps and real estate valuation, and regularly update this data base to plan for LVC initiatives and other planning process. It is required for economically and financially establishing the notion that metro uplifts cities land market and these benefits can be quantified and captured judiciously.
- Integration between land use and transport policy with institutional integration between local governments and transit authorities would allow opportunities for sustainable urban development.

6. Conclusion

The significance of urban rail in economic growth has been established around the globe for more than a century now. Cities have revived and innovated urban rail projects due to the local demand and for broader economic objectives. This has never been more needed globally than now as cities in the emerging world face terrible congestion and yet have clear objectives to achieve the SDG's.

Indian cities and other emerging cities struggle with issues of pollution, congestion, increasing travel time and parking can be contained through integrated policies that are strategically planned around and executed in close link with urban rail systems, like development of active activity centres to promote knowledge economy (as done in the case of London), urban design and value capture to finance development. To implement this, community participation should be the center of urban policies in order to create sense of ownership of urban space and smooth implementation of projects.

The Indian urban rail sector is at nascent stage. The current plan to build metro systems in 50 cities, inspired by the political leadership, provides India the opportunity to shape its urban areas banking on the significance of urban rail. The sustainable urban development goals in Indian cities demand policymakers to be astute to facilitate innovative LVC financing. Collaborative effort by local governments, transit agencies, developers, landowners and communities can generate progressive investment for transit systems and steer for sustainable urban growth. These can realise economic agglomeration benefits.

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