

On the move? Exploring constraints to accessing urban mobility infrastructures

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ABSTRACT

Urban mobility infrastructures are crucial in connecting people to a city and the prospects it provides. Through a critical review of literature on growth of cities in South Asia, transport initiatives and policies, and the existing transport situation, this paper highlights barriers which impact accessibility to transport and thus, ridership. As Delhi gears up to become the world's most populated city, how does its transport infrastructure fare in enabling users' ease of movement and providing opportunities to access work, education, healthcare, and social life? The paper explores how challenges to access transport are a result of interactions between several inter-sectional factors. These include an individual's social and spatial position in the city, role of transport policies in shaping road-based transport, and Delhi's growth in the form of urban sprawls which has resulted in uneven distribution of and access to services. At the core of these inter-linked factors lie the users through whom the challenges or opportunities to access transport become operationalised. By highlighting transport-related constraints, including who is considered a user and who is not, this paper pushes for more inclusive discussions on the future of transport planning, and interventions for improving accessibility. Identifying opportunities for actions and addressing gaps is imperative as Delhi witness's continuous growth and migration. This review of existing transport literature is beneficial for policy recommendations and strategies for meaningful change.

1. Introduction

Globally, diverse groups of people, alone or with entire families, move to cities which are seen as centres of opportunities in terms of employment, social mobility, or a refuge from distress and violence (see for example Bhagat, 2017; World Economic Forum, 2017; Brian, 1990). A United Nations report projects that by 2050, 68% of the world's population will live in cities compared to the current 55% (United Nations, 2018). Much of this growth is happening across African and Asian cities. In India, over 30% of the population resides in urban areas. This will grow to 40% by 2030, and 58% by 2050 (United Nations, 2018). Cities are shaped by their own histories, local political and economic contexts, social and religious influences. This in turn impacts the creation and availability of services and infrastructures for different groups in the society. Urban mobility infrastructures reflect and are constitutive of how our cities live – who is included and who is not, and the

implications this has on different people's everyday lives. Delhi, India's capital, will take over Tokyo as the world's largest city in the next decade (United Nations, 2018). How does its transport infrastructure fare in enabling users' ease of movement and providing opportunities to access work, education, healthcare, and social life? This paper examines, step by step, the existing mobility infrastructures in Delhi and related barriers to accessibility. Addressing these is imperative for the framing of inclusive transport services and guidelines from users' perspectives. Through a critical analysis of existing literature on a) transport planning and land use, policies, and initiatives b) growth of cities in South Asia c) user experiences of existing mobility infrastructures, this paper highlights gaps and constraints which are consequences of our approach to transport planning. Overcoming such gaps aligns with Sustainable Development Goals (SDGs) which target inequalities through access to health (SDG 3), education (SDG 4), and work (SDG 8). Studies have shown how the ability to access transport is linked with opportunities to

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avail healthcare, education, leisure, and livelihood (Lucas, 2004, 2011, 2012; Mohan, 2013; Anand and Tiwari, 2007; Tiwari, 2002). By providing such access, inclusive transport measures will also target social and economic inequalities based on gender (SDG 5) and poverty (SDG 1).

Transport planning in India has focused on the expansion of physical infrastructure and a push towards newer technologies to manage congestion and pollution. This has included road widening, construction of flyovers, investment in rail-based infrastructure such as metro, promoting Electric Vehicles (EVs), and tying up the city's image as 'global' and 'modern' with infrastructure such as the metro (Transport Department, 2018; Institute of Urban Transport (India), 2014; UTTIPEC, 2012; Ministry of Urban Development, 2011; Delhi Development Authority, 1962; Delhi Development Authority, 1990; Delhi Development Authority, 2010;). In recent years, transport planning has encouraged non-motorised transport (NMT) and a greater use of public transport overall. But primarily these initiatives have revolved around infrastructure, technology, and movement of vehicles. This scenario has been reflected in the transport planning and outcomes of Delhi. Due to a majorly automobile-centric approach through the years, the city's road-based transport is a skewed story (Mohan, 2013; Reddy and Balachandra, 2012; RITES LTD et al., 2010).

About 94% of the registered vehicles on Delhi's roads are privately owned. Of the remaining, 3% are passenger vehicles including auto-rickshaws (motorised three-wheelers), taxis, buses, and other passenger vehicles¹ (Planning Department, 2019) on which a majority population of the city depends. The remainder vehicles include 'tractors, goods vehicles, and others' (see Fig. 3 for the road-based transport share in Delhi). The consequences of this have included limited road space for different transport modes. This slows traffic and increases travel time, congestion and pollution. Thus, the impetus of transport planning has been to combat pollution and congestion through introduction of cleaner fuel such as Compressed Natural Gas (CNG), investment in the Metro system, and road widening for easier vehicular movement (Planning Commission, 2001; Tiwari, 2001; Delhi Development Authority, 1990). In the period 1981–2001, compared to other major Indian cities with large populations and congestion issues such as Bengaluru, Mumbai and Kolkata, Delhi has recorded the highest decadal change in vehicular population (Reddy and Balachandra, 2012). By 2016, Delhi had recorded the highest number of registered motor vehicles (88.51 lakh) among 51 million-plus cities in the country (Road Transport Yearbook, 2015–16).

This paper urges a re-think in the planning and policies for sustainable and inclusive transport. It proceeds as follows: Section 2 presents an outline of Delhi's existing mobility infrastructures and ridership; Section 3 reviews key national and state-level transport initiatives. These together reveal how the city and its transport have grown. Based on a review of literature combining transport initiatives and studies on user experiences, Section 4 highlights prominent challenges in accessing mobility infrastructures. Interventions focused on these can assist in creating transport guidelines for a more inclusive city. Section 5 concludes the paper with policy recommendations.

2. An outline of Delhi and its transport modes: from the 20th century onwards

Delhi as a historical capital has grown from an area covering 43.25 sq. km. in 1901 with 400,000 people to 1483 sq. km with over 16 million people by 2011 (Census of India, 2011a,b). From a few settlements dating as far back as the 6th century BC, the city now comprises eleven administrative districts (see Map 1). Delhi or the National Capital

¹ There is a probability of error in the actual number of vehicles as several vehicles registered in Delhi are plying in the NCR region and vice-versa, or are not in active use (Planning Department, 2019).

Territory of Delhi is a city, a state, and a Union Territory simultaneously. Its administrative districts and services are the purview of different governing authorities² which leads to overlapping work areas and bodies functioning in-silos. Unlike western countries where the growth of a city has been tied to the impact of the Industrial Revolution and a core business district, Delhi has grown as multiple urban sprawls leading to the formation of relatively dense cities within cities (Roy, 2014; Mohan, 2013; Thynell et al., 2010).

Built and rebuilt several times by different dynasties, the precolonial Delhi was not considered as their capital by the British, resulting in the establishment of a new colonial city (Mohan, 2013). Where trade and commerce continued thriving in the old city, the colonial city or New Delhi became the political seat with government offices and accommodation of its employees. In the years following the colonial exit, decadal migrations of about 0.8 million people were recorded for 1961–1971, with 70,000 people from low income groups migrating into the city (Delhi Development Authority, 2006). For these new entrants, the older parts of the city did not provide the comfort of New Delhi, its colonial counterpart. New Delhi was only accessible to those who could afford to live and work there. This led to the formation of a new city from where expansion has continued, mostly uneven and unplanned (Auerbach et al., 2018; Mohan, 2013; Yeoh, 1999). For example, the New Delhi district (continuation of the colonial city) with its elaborate government buildings, housing, and well-maintained lawns has areas with a population density of 4000 persons per sq. km. On the other hand, the North-East district which shares a border with Uttar Pradesh state has a population density of 36,000 persons per sq. km. This is one of the highest population densities in the world (Census of India, 2011a,b).

Currently, over 75 per cent of Delhi's population lives in unplanned areas such as JJ Clusters (JJ denotes jhuggi jhopdi – a term referring to semi-permanent and makeshift shelters), urban and rural villages, resettlement colonies, as well as unauthorised colonies, where public transport service is limited (Gupta, 2019). Along with a chaotic expansion, these sprawls have led to an unequal development, characterised by unequal distribution of and access to services based on one's physical and social location (Shatkin, 2007). For example, public transport and private vehicles provide easier access from planned residential neighbourhoods to places of work and leisure compared to slums, thus demonstrating the inequality embedded (Tiwari, 2002).

From a historical capital to continuous sprawls, Delhi has been the location of several transport modes. The city has been connected to other regions via the Grand Trunk road. With five national highways traversing it, Delhi now has the most elaborate road network in the country. The road network covers 21% of the city area which limits further construction (RITES LTD et al., 2010). Fig. 1 below gives a timeline of road-based transport in Delhi. NMT modes were pre-dominant in the earlier part of the 20th century. These included walking, *taangas* (horse drawn carriages), cycle rickshaws, cycles. Trams and buses marked the entry of motorised transport (MT). Eventually, the city made way for increasing MT – *phat phatis* (four-seater motor rickshaws), auto-rickshaws, cars, scooters, motorcycles. The last two decades have seen the introduction of electrical modes such as the Metro, electric-rickshaws, and the use of phones for mobility through app-based

² For this paper, Delhi is used interchangeably with the National Capital Territory (NCT) of Delhi, as defined in the Census of India, 2011a,b). It is a Union Territory (UT) administered by the Union government and the NCT elected government. Spread over 1483 sq km, it earlier had 9 districts which were further divided into 11 districts under 3 local bodies – Municipal Corporation of Delhi (MCD; covering 96% area), New Delhi Municipal Corporation (NDMC; covering 3% area), Cantonment Board (CB; covering 1% area). Delhi or the NCT of Delhi is also part of the National Capital Region (NCR) which was created in 1985. This comprises Delhi and neighbouring satellite cities from the states of Haryana, Uttar Pradesh, and Rajasthan. In 1992, Delhi was also declared a State under the National Capital Territory Act, 1991 (NCRPB, 2016).



Map 1: Delhi with its administrative districts. Source: Census of India, 2011.

Map 1. Delhi with its administrative districts. Source: Census of India, 2011a,b).

transport services. An example of the city's growth through sprawls and resulting unequal service provision is the *Gramin Sewa* (six-seater). This shared mode was launched specifically to address the last mile connectivity issues in the unplanned areas of Delhi (Transport Department, NCT of Delhi, 2011). Public transport options and NMT including buses, trams, walking, and cycle-rickshaws have served the city's population for a much longer period compared to the entry and growth of private automobiles. It is only in the later part of the century that road-based transport has changed to accommodate the latter over the former. Such transport options in Delhi are an opportunity to explore who is using which mode and the possible reasons behind these choices.

2.1. Existing mobility infrastructures in the city

Currently with over 16 million people (Census of India, 2011a,b), Delhi is still growing with about 100,000 people in-migrating every year (Planning Department, 2019). More than 75% of Delhi's 16 million people undertake daily travels primarily for education and work purposes, with some traveling distances beyond 50 km (Agarwal, 2019; Census of India, 2011a,b). It is the nodal point for five national highways, three inter-state bus terminals, and intercity rail corridors (serving as the headquarters of the Northern Railways). In addition, travel is also undertaken to access healthcare facilities and for leisure. To serve these travel needs, transport in the city consists of a road network of ring and radial patterns, bus-fleets, metro rail system, motorised and non-motorised intermediate modes (such as auto-rickshaws, cycle-rickshaws, battery - powered/electronic-rickshaws, six-seaters called

Eco-Sewa or *Gramin Sewa*) and non-motorised modes (cycles and walking) which are under public, private, or public-private partnerships. These are a diverse mix of motorised and non-motorised modes, with a heavy reliance on road-based transport systems (Bhandari et al., 2009). All these together become primary or intermediary modes for intra- and intercity travel.

Everyday travel in Delhi can be undertaken by walking or by a bus, metro, car, cycle, 2-wheeler or 3-wheeler. Fig. 2 shows that the category of 'NMT and Others' has the highest share of trips in the city. Here, walking is combined with other NMT. But separately, it accounts for about 33% of the total trips in a day (Department of Urban Development, 2006). The remaining 67% are by MT or NMT. More frequently, different modes are combined for travel.

In the last twenty years, Delhi's urban area has more than doubled. One key consequence has been a rise in the average trip length from 8.5 km to 10.4 km (Pai, 2014). 45% of the city's population travels distances longer than 5 km (Census of India, 2011a,b; Sahai and Bishop, 2010). To undertake these travels, an average trip time is 49 min by public transport, and between 15 and 30 min by personal vehicle (Department of Urban Development, 2006). NMT and MT such as cycle-rickshaws, e-rickshaws, auto-rickshaws, informal car-pooling and walking comprise the Intermediate Public Transit Systems (IPT), crucial in providing first and last mile connectivity when not being used as primary modes for short-distance trips (Gadepalli, 2016). Although there is a great dependence on these modes in the city, private vehicles have a pre-dominant presence on the roads. Comparisons with other megacities (population over 10 million) such as Bengaluru and Mumbai which have

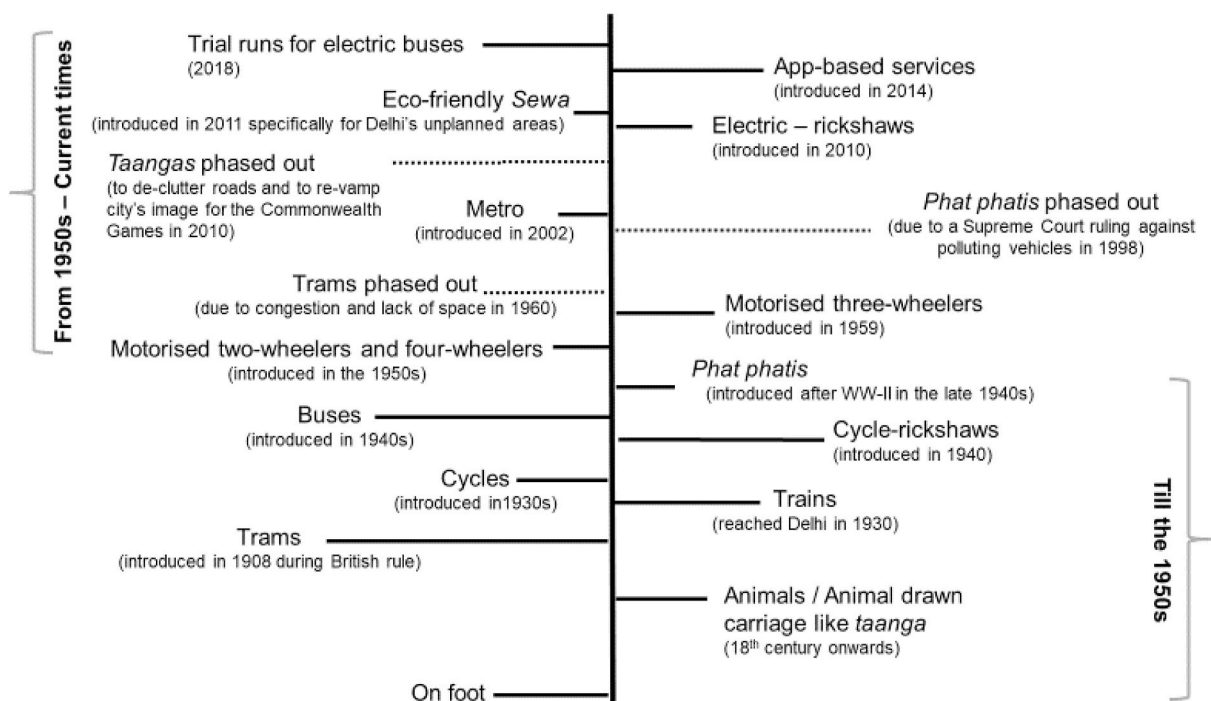


Fig. 1. A timeline of road-based mobility infrastructures in Delhi. Created by the authors. Data Sources: Shandilya et al. (2019); Transport Department, Government of NCT of Delhi, 2018; Mishra (2018); The Economic Times (2018); Delhi Metro, 2018; Sultan (2017); Manchanda (2016); Harding and Rojesh (2014); PT, 2013; Basu and Mahajan, 2011; RITES et al., 2010; Mohan and Roy (2003); Tiwari (2002); Jha (2001); Singh (1990).

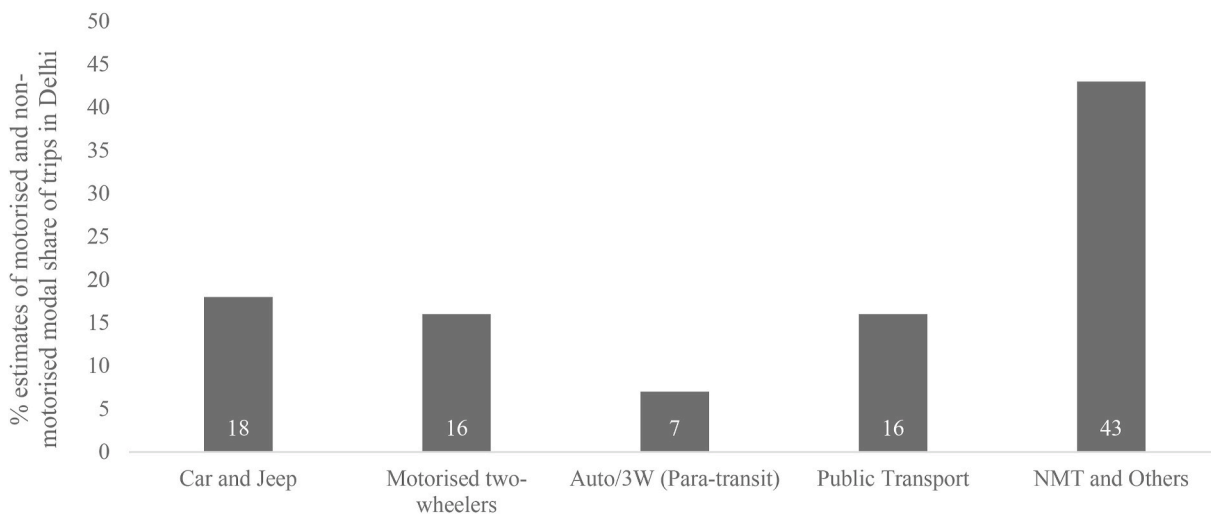


Fig. 2. Graph showing the percentage estimates of modal share of trips in Delhi. Data Source: Dinesh Mohan, 2013 (data for Delhi from 2012). (Category of 'NMT and others' comprises walk, cycles, and rickshaws).

some of the highest numbers of registered motorised vehicles along with Delhi (MORTH, 2019) reveal that the capital city has a greater presence of private vehicles than the other cities.

2.2. Modal share of road-based motorised transport in Delhi

Currently, the transport modes in Delhi are a diverse mix of motorised and non-motorised modes, with a heavy reliance on road-based transport systems. Private vehicles pre-dominantly occupy the road space (which does not have much scope to grow any further) while road-based public transport comprises 3% of the total vehicles. There is a heavy reliance on walking and IPT either as primary modes for short-distance travels (undertaken by 55% of the population) or for first and

last mile connectivity.

The road space in Delhi is shared by at least seven different types of vehicles, each with different characteristics (Tiwari, 2013). But the sharing of this existing road space is highly skewed as is depicted in Fig. 3. Private vehicles (4-wheelers and 2-wheelers combined) account for the largest share of motorised vehicles occupying roads in the city. Within these, two-wheelers account for almost 64% of the registered vehicles. Meanwhile, road-based public transport including buses, IPTs (auto-rickshaws and from 'other passenger vehicles'), and taxis depict an abysmal state. This is alarming because public transport along with the Metro cater to more than 60% of the city's population as direct or intermediate modes. To understand how the transport situation stands where it is today, the next section delves into relevant policies and

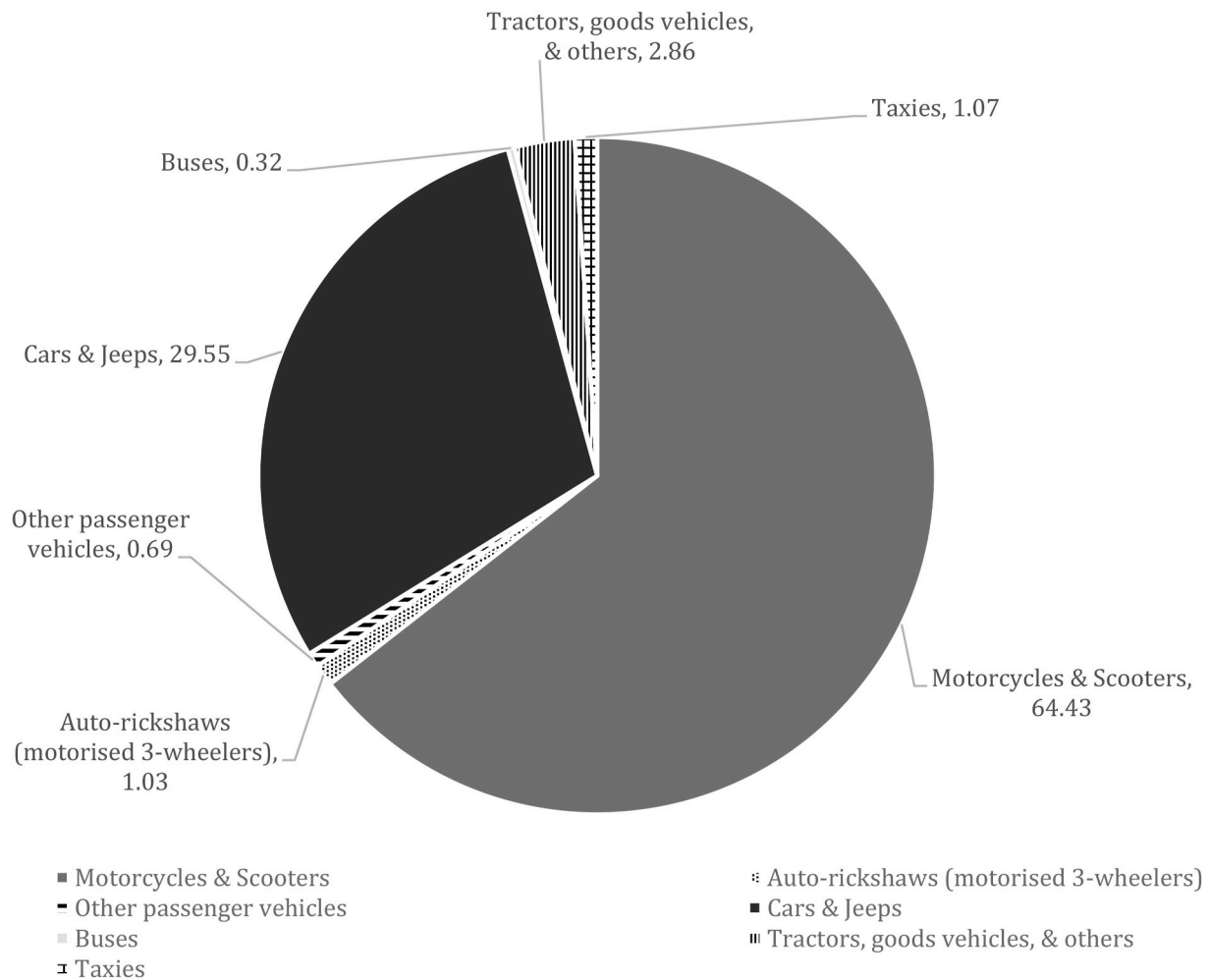


Fig. 3. Graph showing the percentage share of different motorised road-based transport modes in Delhi as of 2018. Data Source: [Planning Department \(2019\)](#).

initiatives chronologically.

3. Policies and initiatives: what shapes our mobility infrastructures?

In this section we examine initiatives which have shaped the city's transport since the 1950s. The following sub-sections are based on different times and changing focus of the initiatives.

3.1. From 1950s till the century's turn

To initiate planning of the city, the Delhi Municipal Committee was formed in 1874. This was followed by the formation of the Town Planning Committee to plan an imperial city in 1910 ([Tiwari, 2002](#)). After independence, the Town Planning Organisation was established in 1955 with the task of creating Delhi's first Master Plan ([Delhi Development Authority, 1962](#)). This focused on dealing with traffic congestion through the expansion of roads (widening and by-pass routes), rail networks for intracity movement of goods and people, creating cycle tracks, and envisioning an electrified sub-way for future mass-transit ([Delhi Development Authority, 1962](#)). In 1990, the DMP-2001 was published. The focus became three-pronged: re-structuring of and creating infrastructure for greater ease of vehicular movement; emphasising multimodal mass transport including rails, cycles, walking.

The transport system was to be 'comfortable and visually satisfying', reflecting the 'city's personality' ([Delhi Development Authority, 1990](#)). From roads being an 'amenity' in 1955, the urban transport

infrastructure became tied to innovations in technology and the city's image before the turn of the century ([Delhi Development Act, 1957](#)). [Fig. 4](#) below represents a timeline of transport initiatives from the 1950s onwards.

Delhi witnessed growing road presence, sales of personal automobiles, greater private sector investments and rising fuel fumes. With an 87% increase in vehicles between 1990 and 2001, compared to a 14% rise in the city's population during the same period, vehicular pollution could not be ignored ([Indian Institute of Human Settlements, 2015](#)). Addressing the link between increasing air pollution and traffic, the Ministry of Environment and Forests (MoEF), Government of India, released a white paper. It highlighted the cutting of fuel emissions, recommended the construction of faster motorways, and opting for cleaner fuels such as Compressed Natural Gas (CNG). It also emphasised the deficit in existing public transport by associating overcrowding of buses to higher smoke emissions ([MoEF, 1997](#)). In subsequent years, all DTC buses, auto-rickshaws, and some personal vehicles, switched to CNG. Monitoring of different sites in Delhi within the subsequent years showed negligible to marginal fall in air pollutants including gases and particulate matter following the transition to CNG ([Saxena et al., 2012](#); [Kathuria, 2005](#)). Along with fuel conversion, other measures such as phasing out of old taxis and sale of low speed diesel were also undertaken to reduce the pollution by private and commercial vehicles ([Kathuria, 2005](#)). Reasons for this lack of substantial change could be attributed to the increase in the number of on-road vehicles, worsening of the emission performance of in-use vehicles, and the poor conversion of vehicles from gasoline to CNG ([Kathuria, 2005](#); [World Bank, 2001](#)).

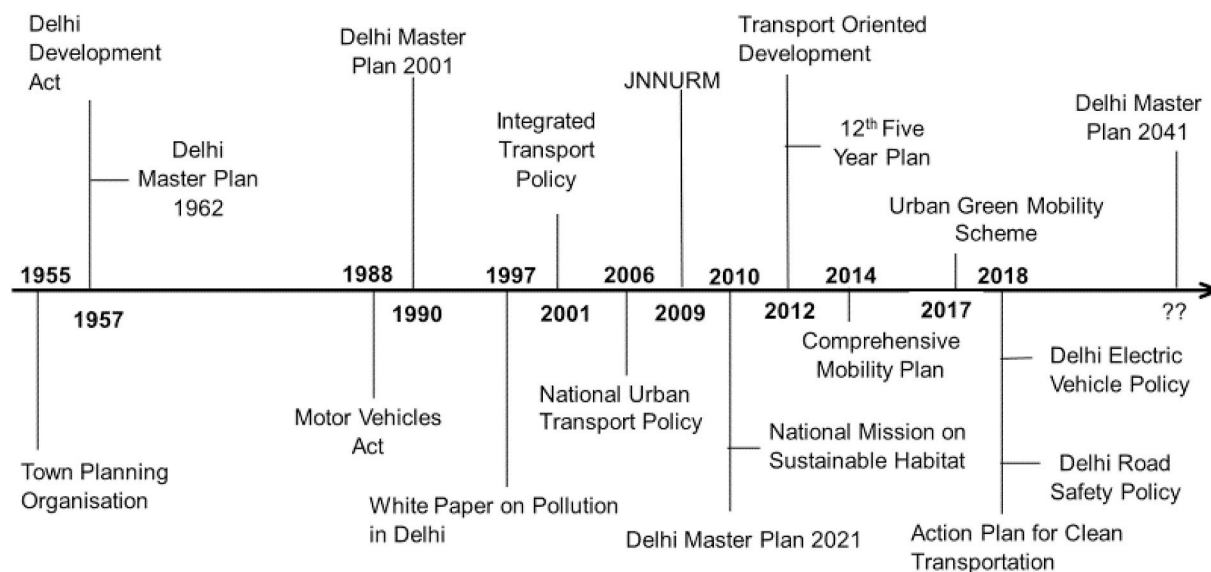


Fig. 4. Timeline of some key transport initiatives. Created by the authors. Data Source: Transport Department (2018); CII-NITI Aayog (2018); Ministry of Urban Development (2017); Institute of Urban Transport (India), 2014; UTTIPEC, 2012; Ministry of Urban Development, 2012; Ministry of Housing and Urban Affairs (2010); Ministry of Urban Employment and Poverty Alleviation (2010); Delhi Development Authority, 1962, 1990, 2010; Tiwari (2002); Ministry of Environment and Forests (1997).

3.2. Delhi's new millennium: mass transit and the Commonwealth Games

In 2001, the Planning Commission introduced a national level Integrated Transport Policy which linked transport with economic growth, encouraged competitive pricing of vehicles, emphasised energy efficiency, and discussed safety in terms of road accidents and fatalities (Planning Commission, 2001). The early 2000s saw a shift to cleaner fuels, and the operationalisation of an electric rail mass transit system – the Delhi Metro. As the city geared up to play host for the 2010 Commonwealth Games, there was an impetus in expansion of existing infrastructure. This included the roads (widening and building fly-overs), metro, and launching of the first phase of the Bus Rapid Transport System (BRTS). Sports events act as catalysts for the overall re-development of a city, including facilities such as transport. Major sporting events such as the Olympics and soccer World Cup have been used as drivers of urban transformation due to available funding and unavoidable public deadlines across the globe, including in cities such as Barcelona, Rio, London, and Shanghai (Azzali, 2015; Smith, 2009). Presented as an opportunity to revise the existing urban infrastructure, most initiatives have been short-lived and unsustainable. Studies carried out in cities including Delhi, which have hosted such events, highlight the negative after-effects of sports events. These include environmental problems caused by changes in land use, altering of ecosystems for developing infrastructure, widening socio-economic inequalities between different groups through loss of livelihood and evictions for infrastructure to be created (Maharaj, 2015; Leontidou et al., 2008).

This period also presented initiatives such as the National Urban Transport Policy (NUTP, Ministry of Urban Development, 2006), Jawaharlal Nehru National Urban Renewal Mission (JNNURM, Ministry of Urban Employment, 2010), and the National Mission on Sustainable Habitat (NMSH) under the Prime Minister's Action Plan for Climate Change (Ministry of Housing and Urban Affairs, 2010). These have acted as roadmaps for urban transport in the coming years. Earlier documents highlighted congestion and pollution with recommendations directed towards investments, infrastructure expansion, and newer technologies. The NUTP ushered in the involvement of people and their movement. It acknowledged links between people's mobility and the ability to access jobs, education, and recreational spaces. The document also emphasised NMT, connecting their safe usage to road accidents and fatalities. The JNNURM added to the NUTP by continuing to call for private sector

participation in urban transportation and by providing investments for the expansion of public transport infrastructure. Through its funding across 65 Indian cities, JNNURM aimed to improve urban infrastructure, reform urban governance, and provide services for the urban poor (Sadoway et al., 2018). But it fell short of meeting its promises due to several factors. These included a standardised approach across cities irrespective of their financial and personnel capacities, dependence on third-party consultants causing reduced decentralisation, and decreased spending for the lower income groups due to infrastructure directed at specific economic classes (Sadoway et al., 2018; Kundu, 2014; Nandi and Shama, 2013). The NMSH was one of the eight missions under the National Action Plan on Climate Change (NAPCC). It prioritised people over vehicles, equity in transport planning and growth, encouraged walking and cycling, and the use of fuel-efficient vehicles. The NAPCC has been critiqued for a lack of vision and no integration between the broader missions (Byravan and Rajan, 2012). The NMSH itself has been advisory in nature, with no clear targets (Rattani, 2018). Urban transport and planning within the document have neglected people from lower-income groups (Byravan and Rajan, 2012). Later initiatives such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart Cities Mission (SCM) overlapped with the NMSH in their objectives.

AMRUT was launched in 2015 to provide basic services and build amenities in cities. The underlying objective was to improve quality of life, especially of poor and disadvantaged people (MoHUA, Government of India, 2015a,b)³. Not an AMRUT mission priority,⁴ transport-related objectives focused on multi-level parking and a greater thrust to NMT, especially pedestrian infrastructure (MoHUA, Government of India, 2015a,b). It was simply a re-naming and replacing of the earlier JNNURM, covering more cities than the previous mission. The modifications included an increased emphasis on decentralisation with greater autonomy to states for sanctioning city-specific projects (Singh, 2016; Shiraz, 2015). In the same year, SCM was launched to drive economic growth through revamping cities' infrastructure and governance. Transport related objectives centered on infrastructure for walking and cycling, and promoting varied transport options (MoHUA, Government

³ Ministry of Housing and Urban Affairs.

⁴ Water supply and sewerage have been the priorities in AMRUT.

of India, 2015a,b). Due to their sector-specific scope, these drew more attention than the NMSH (Rattani, 2018). SCM has focused on physical infrastructures similar to earlier renewal schemes (Anand et al., 2018). The city-specific plans lack cohesion and conflict with statutory master plans (Praharaaj et al., 2017). Almost 40% of the transportation projects are directed at roads and parking lots. 20% of the budget focuses on public transport with only 2% of the entire transportation budget aimed at buses (Anand et al., 2018). As AMRUT and SMC targeted broader services and utilities, a separate scheme was launched to focus exclusively on sustainable mobility and accessibility of citizens (Ministry of Housing and Urban Affairs and Government of India, 2015a; Ministry of Housing and Urban Affairs and Government of India, 2015b).⁵ The Urban Green Mobility Scheme in 2017 focuses on sustainable urban mobility and sustainable vehicles. These objectives include development of infrastructure to promote NMT and buses, a shift to EVs for public transport, alternates to fossil-fuels for vehicles. The proposed plan includes a policy on encroachment to ensure a right of way for pedestrians and a policy for street vendors (Ministry of Housing and Urban Affairs and Government of India, 2015a; Ministry of Housing and Urban Affairs and Government of India, 2015b; The New Indian Express, 2017). The new mobility scheme is still in its early stages.

3.3. The last decade: recommendations for the future

There has been an attempt at a paradigm shift in approaching transport. This includes suggestions on putting people before automobiles; changing perceptions towards public transport use; and encouraging mixed-use areas interconnecting transport, work spaces and residences. In line with the SDGs, measures which are ‘sustainable’ in terms of technology, pricing, impact on environment; and incentivising public transport, disincentivising private vehicle use have also gained prominence (Transport Department, 2018; CII-NITI Aayog, 2018; Institute of Urban Transport (India), 2014; UTTIPEC, 2012; Ministry of Urban Development, 2011). Nonetheless, the paradigm to approach transport remains through tropes of infrastructure, greater private sector involvement, and not through prioritising different users’ experiences or improvements based upon a city’s own context and growth.

The third Delhi Development Authority (2010) discusses restructuring of the city around mass transport, acknowledging that congestion and pollution have been caused by the growth in automobiles (Delhi Development Authority, 2010). It encourages cycling and public transport systems, strengthening transport for economic development, and asks for pedestrian and disabled friendly features. The plan also suggests implementation of electric intermediate public transport systems such as the monorail and battery-operated high capacity buses. And for the first time, a city-level plan urges to do away with the multiple authorities currently responsible for transport. Presence of multiple authorities runs the risk of in-silos working or ineffective coordination.

In addition to asking for a single transport authority and encouraging mass transport based on newer technologies and NMT, the 12th Five Year Plan has some new additions: inclusion of ‘Urban Transport’ in the concurrent list of the Constitution of India; capacity building of officials and stakeholders; and ensuring ‘security’ of commuters, especially women (Ministry of Urban Development, 2011). The Transit Oriented Development (TOD) (UTTIPEC, 2012) begins by highlighting that Delhi has been unable to deliver efficient, comfortable, and affordable mobility options to its citizens. It urges for a change from auto-centric planning to low-cost and comfortable NMT and public transport (UTTIPEC, 2012). There has also been an enthusiastic push for

⁵ AMRUT has been extended by 2 more years since urban renewal targets were not achieved (Sharma, 2019). SMC, initially targeting 100 cities, will be extended to cover all the 4000 cities in the country. More private participation is being promoted for the next phase (Khan, 2019). Deadline of initial projects under SMC was set between 2019 and 2023.

incentivising the adoption of EVs from the government as a way to improve air quality, reduce congestion, pollution, mitigate climate change through an attempt to reduce greenhouse gas emissions and to ensure India’s fuel security and growth of the automotive industry (Transport Department, 2018; CII-NITI Aayog, 2018; Ministry of Heavy Industries and Public Enterprises, 2012). In this regard, the Delhi Electric Vehicles Policy, 2020 intends to reduce emissions by establishing Delhi as ‘the EV capital of India’ (Government of NCT of Delhi, 2020). It will focus on the rapid adoption and incentivising the purchase and use of EVs in passenger vehicles such as public/shared transport and two-wheelers (Government of NCT of Delhi, 2020).

The policy discusses measures for private and public charging infrastructure but challenges owing to pricing of private EVs, physical infrastructure such as charging stations and required technical know-how persist (Kumar and Padmanabhan, 2019; Kumar et al., 2018; Mohan, 2016; Kumar and Dash, 2013). In 2018, work on the DMP 2041 began (Sultan, 2019). In a departure from the earlier plans, it included greater citizen participation from the planning stage (Ramnani, 2019; Sinha and Narayan, 2019; Sultan, 2019). The draft was to be made available in the public domain by the end of 2019 for responses and feedback from citizens (Sultan, 2019). The intended plan focuses on walkability, street infrastructure, and quality public transport (NIUA, 2019; Ramnani, 2019). Unplanned settlements, a characteristic of the city’s urban sprawls, are a priority in the upcoming plan (NIUA, 2019).⁶

Broadly since the 1950s, approaches to urban transport based on these documents have been primarily concerned with combating congestion and pollution; highlighting citizens’ safety linked to road fatalities and crashes with safety of women commuters being mentioned in the last decade; and the representation of the city through infrastructure expansion, investment in physical infrastructure, and adoption of newer technologies. A consistent recommendation has been to increase EVs, public transport and NMT usage, including walking and cycling. Indian cities can exhibit extreme temperatures in different seasons. When suggesting walking, cycling, or other NMT, seasonal variations must be considered, and infrastructural support should be planned in accordance. ‘Encouraging’ cycling and walking as pursuits of leisure is discomforting when data show that these are already embedded in the daily travels for work and other commuting purposes (Census of India 2011; RITES et al., 2010; Tiwari, 2002). Quantitative evaluations of the initiatives have largely explored them through the lens of climate change and sustainability (Joshi et al., 2016; Bruun and Givoni, 2015; Mittal et al., 2015; Han et al., 2011). The focus in such studies has been on technology and green-house gas emissions. A few studies have explored the social impact of transport initiatives concerning gentrification and affordability (Padeiro et al., 2019; Chava et al., 2018; Serebrisky et al., 2009). But evaluations about user-experiences are mostly amiss, requiring future empirical research. In addition to these concerns, the transport initiatives do not probe further into the category of ‘user’ which is presented as constant and homogenous. For any successful change, understanding who a user is and their perception of transport must be a key for planning and implementation.

4. Constraints to transport accessibility and ridership

Earlier sections have given glimpses of the city’s uneven expansion along with the aims of transport initiatives through over half a century. These have resulted in unequal or selective provision of and access to services. Such city and national/global level concerns combine with an individual’s own circumstances. Fig. 5 below shows how these interact with one another. Together they provide degrees of transport access which impact transport experience and thus shape the everyday life of people in the city.

⁶ The draft is yet to be made public.

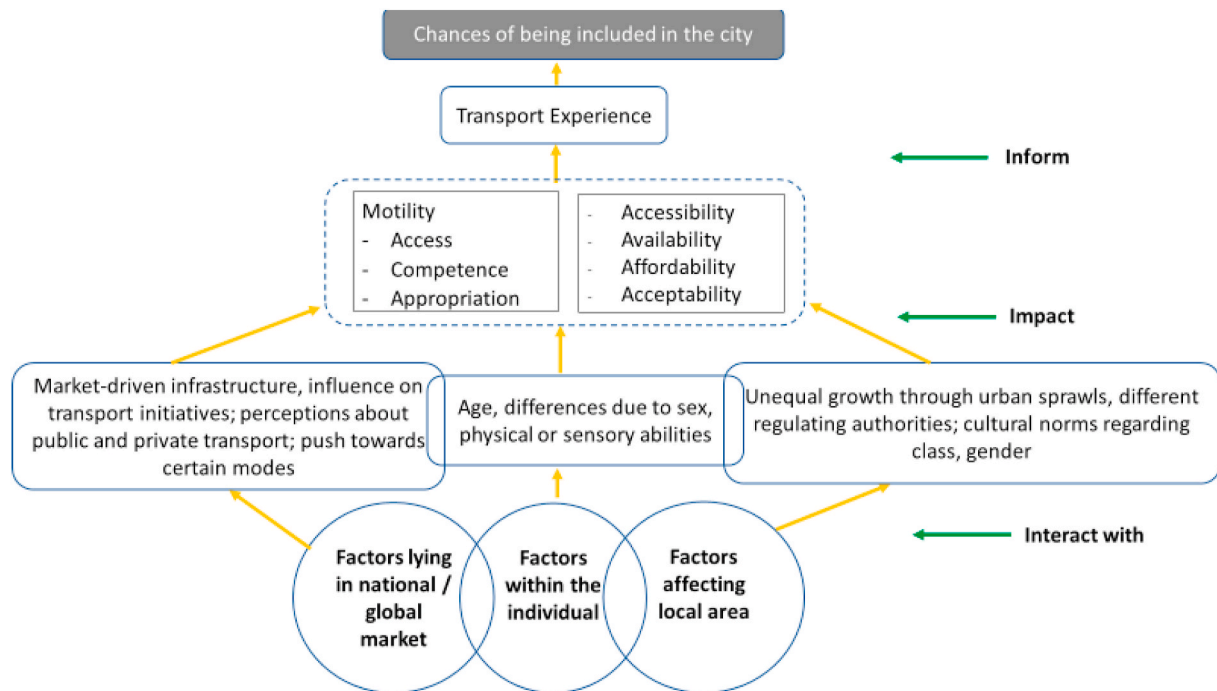


Fig. 5. Depiction of how different factors in tandem impact transport access and individuals' chances of being included in the city. Created by authors. Data Source: Lucas (2012); Cho et al. (2013); Carruthers et al. (2005); Kaufmann et al. (2004).

In transport literature, accessibility has come to mean the ease with which one can reach desired destinations by using a preferred mode within a chosen time, or the ease with which one can reach mobility infrastructures to undertake further journeys. Mobility has been defined through distance covered, amount of movement, the ability to move, or as socially constructed and produced within a context of asymmetric power relations (Bok and Kwon, 2016; Kalaanidhi and Gunasekaran, 2013; Kato and Hayashi, 2009; Cresswell, 2006; Litman, 2003; Vivier, 2001).

Fig. 5 uses key guiding concepts from transport literature (given below) discussing mobility and access to transport, to frame how user experiences and their inclusion in the city are shaped. Furthering these ideas, the concept of motility incorporates access as the entire range of possible transport services according to place and time with their constraints such as pricing or other logistics (Kaufmann et al., 2004). It also includes the aspects of competence and appropriation. The former constitutes user skills and abilities such as the physical ability to move about or the organisational skills to plan activities (Kaufmann et al., 2004, p. 750). Appropriation entails acting upon or making use of existing transport modes based on competence. The 4As framework elaborates on aspects which impact motility – Accessibility (ease with which all categories of passengers can use transport); Availability (route possibilities, timings and frequency); Affordability (ability to make journeys without giving up other essential activities); and Acceptability (personal perceptions about transport guided by several factors including staff behaviour, lack of waiting facilities and personal security, state of vehicles) (Carruthers et al., 2005).

These impact transport ridership when intersectional differences such as gender stereotypes, class, ageism, ableism, get coupled to create inequalities (Cho et al., 2013). These include factors such as age, or (physical/sensory) disabilities within an individual; failure of services or inadequate services which lie in the structure of the local area; cultural influences such as gender stereotypes or class, legislative frameworks, or migrations which lie within the national or global economy and shape a city (Lucas 2012, p.106). Based on the framework described above, the following sub-sections discuss key constraints due to interacting factors which prevent individuals from a sound transport experience.

4.1. Affordability and accessibility

The socio-economic fabric of Delhi, with unequal and unplanned growth, has led to different degrees of accessibilities for different kinds of users. For instance, about 33% of Delhi's working population travels by foot⁷ (Census of India, 2011a,b). This largely comprises people from low income households who are unable to afford personal (including cycles) or even public transport unless highly subsidised (Mohan, 2013; Tiwari, 2001). Within this, there are more women pedestrians than men. A key reason being that they opt for slower moving modes as faster or more flexible modes are more expensive and that generally, women have inferior access to public or private transport modes compared to men (Peters, 2013; Anand and Tiwari, 2007).

Based on National Sample Survey Office (NSSO) surveys on consumer expenditures, the monthly per capita expenditure (MPCE) in Delhi is Rs. 3726.66, with the MPCE of most non-salaried or regular wage workers up to Rs. 500, or between Rs. 500–1000 (Directorate of Economics and Statistics, 2012). Majority of the workers are under the category of 'other workers' (95.44%) which includes the informal work category,⁸ with unstable and comparatively low income, and negligible access to basic protections and services (NCRPB, 2016; Planning Department, 2019; Census of India, 2011a,b). Against this backdrop of

⁷ This is based on the work participation rate calculated as per the Census of India, 2011a,b figures. Thus, not all categories of workers are included and the actual number of workers across sectors and using different travel modes would be much higher.

⁸ This falls under the tertiary sector which employs over 80% of Delhi's workforce. It includes Information and Communication Technology, unorganised/informal sector workers, such as, vegetable sellers, hawkers, rickshaw pullers; industrial categories (Trade; Hotels and Restaurants; Transport; Storage; Communication; Financial Services; Real Estate, Ownership of Dwelling & Professional Services), Public Administration, and other services including Education, Medical and Health (Planning Department, 2019).

expenditure distribution, the MPCE on conveyance⁹ is Rs. 324.58 (Directorate of Economics and Statistics, 2012). Thus, for most workers in the informal category, almost 50% or more of their total monthly expenditures go into travel.

The share of scooters and motorcycles has increased from 28% in 2001 to 38.90% in 2011, four-wheelers have shown a decadal spike of 8% to reach 20.7%, and cycle share has declined from 37.6% to 30.6% (Planning Department, 2019). Studies point to a link between rising levels of literacy, income, greater purchase of motorised personal vehicles and reduced cycle ridership (Agarwal, 2019; CII-NITI Aayog, 2018; Reddy and Balachandra, 2012; Census of India, 2011a,b; Delhi Development Authority, 2010; Tiwari and Jain, 2008).

4.2. Perceptions around public and private transport

In addition to a greater spending capacity by mostly salaried and regular waged workers, a preference for private transport is also influenced by how private and public transport are perceived. People's perceptions about transportation are dependent on intersecting factors such as employment, age, gender and knowledge about different transport modes (Kumar et al., 2014; Belwal, 2013). Private transportation is preferred over public modes due to a perceived difference in their level of services (Ramos et al., 2019; Kumar et al., 2014; Belwal, 2013). These include factors such as response to users' needs, integration of different transport modes (Ramos et al., 2019), safety, convenience, reliability (Allopi and Sarkar, 1997), timings, frequency, travel duration, and overcrowding (Kumar et al., 2014). Private vehicles are also associated with ideas of prestige and status in the society; public transport is considered as the go-to for people who are unable to afford private vehicles (Agarwal, 2019; CII-NITI Aayog, 2018; Reddy and Balachandra, 2012; Delhi Development Authority, 2010). The association of transport modes with ideas of modernity has also been noticed within public transport in the city, especially the metro. It has been promoted as a system which is an alternate to the unreliable urban mobility infrastructures present in the city (Butcher, 2011; Bhandari et al., 2009; Siemiatycki, 2006). Thus, perceptions of different modes play a role in people's choice of modes depending on their own socio-economic backgrounds.

4.3. Defining a 'user': who is the transport for?

Where public transport caters to a majority of the population, census figures indicate that men, and primarily physically abled men, form the locus of this 'majority'. Spaces and infrastructure designed for the public usually aim for an abstract user who is able-bodied, heterosexual, and male (EPW, 2019; Sarkar, 2017; Phadke et al., 2013). Others using these same services have to adjust themselves and their mobility to these parameters. In the case of women, claiming access to public areas has often resulted in serious backlash with increasing violence against them being reported from the city¹⁰. These spaces, gender-blind in their creation and continuity, have been marked by daily violence against women in different forms (Datta, 2016). The city has seen measures

⁹ NSSO defines conveyance as 'expenditure incurred on account of journeys undertaken and/or transportation of goods made by any means of conveyance. The expenditure is the actual fare paid except in case of railway season tickets; journeys to commute to and from place of work are included here. In case of owned conveyance, the cost of fuel (petrol, mobile oil, diesel, etc.) for power-driven transport and animal feed for animal-drawn carriage is considered' (Directorate of Economics and Statistics, 2012). This definition does not include origin to destination costs.

¹⁰ This paper focuses on gender with respect to women. But it is not to disregard issues and challenges faced by transgenders in public spaces, including transport (please see International Commission of Jurists, 2019; Lubitow et al., 2017)

centering on providing safety to women in public spaces and transport through strategies of surveillance and protection (Gopala and Shin, 2019; Butcher, 2011; Tara, 2011; Sadana, 2010). These include initiatives such as reservation of coaches in the Delhi Metro for women, gender sensitisation programmes for the staff of DTC buses, self-defense classes organised by the Delhi Police, and recently, the free bus tickets for women to travel in public buses. Fig. 6 below shows the distribution of travel modes as used by women and men in Delhi (Census of India, 2011a,b). Men have a greater access to different transport options in comparison to women. Meanwhile, most women either do not travel or use buses for travel or walk.

Fig. 6 gives one part of the story by presenting the differences in the use of travel modes. Women's decisions to undertake travel, travel patterns (such as off-peak hour trips, trip-chaining and shorter commutes), and travel experiences are different than those of men, characterised by persistent inequalities (Agrawal and Sharma, 2015; Peters 2013; Jagori and UN Women, 2011; Ortoleva and Brenman, 2004). Where men are tasked with the primary responsibility to earn money and provide for their families, even making daily trips over 50 km for work (about 6.7% according to Census of India, 2011a,b); women's roles are largely within the domestic spheres involving reproductive and care-giving responsibilities, conforming to expected gender roles in this patriarchal society (Channa, 2013; Das, 1994; Dube, 1988). This leads to women making trips associated with economic activities, reproductive and caretaking responsibilities (Peters 2013; Anand and Tiwari, 2007).

Studies on women and public transport have explored themes around safety, ability to travel on one's own, women-focused transport initiatives, reasons for women's travel choices, and the role of existing transport infrastructure in contributing to women's travel experience (Ola Mobility Institute, 2019; Jagori and UN Women, 2011; Butcher, 2011; Tara, 2011; Sadana, 2010). These studies have shown links between gender, age, poverty, and disabilities in shaping access to transport (Ceccato, 2017; Shah et al., 2017; Loukaitou-Sideris, 2014; Agrawal and Sharma, 2015; Anand and Tiwari, 2007). Concerns about safety during travel emerges as a key issue. Irrespective of age, income, and disabilities, feelings of safety are perceived as intricately tied to harm in terms of harassment and proximity to unknown males, certain timings of the day and presence or absence of security personnel, with the fear heightening in women with disabilities (Iudici et al., 2017; Bhattacharyya, 2016; McQuoid and Dijst 2012).

Along with studies showing the need for gender-inclusive transport planning due to differences in gendered transport experiences, literature also discusses transport access shaped by experiences of older people and people with disabilities. Preference for or avoidance of any transport mode is dependent on affordability, adequacy of physical infrastructure including technologies used, feelings of comfort and safety, and behaviour of the staff. Physical infrastructures can include sidewalks, ramps, technologies used which require certain physical or sensory capabilities for usage, and designing of the transport mode and supporting services such as toilets. Comfort for the older population and people with disabilities is tied to the design of the infrastructure as well as aspects such as crowding and space, timings of the modes or how flexible these are (King et al., 2018; Ryan et al., 2015; Mohan, 2016; Kumar et al., 2011; Rantakokko et al., 2010). Safety and feelings of insecurity are tied with bodily harm, accidents, physical ailments and health issues, and the attitude of the staff such as friendly or unfriendly drivers (Luiu et al., 2018; Shrestha et al., 2017; UN Habitat, 2013). Thus, it has been demonstrated that there are a wide range of considerations different users have when using (or avoiding) transport modes. Yet these distinctions are not reflected in the implementation of transport initiatives. Explicit links between gender, poverty, age, and disability emerge from transport literature on user experiences. Yet, there has been no explicit correlation between caste/ethnicity/religion and access to public transport even though it is integral in the South Asian context determining people's social positions and access to resources. Some literature does mention caste when exploring women's access to public

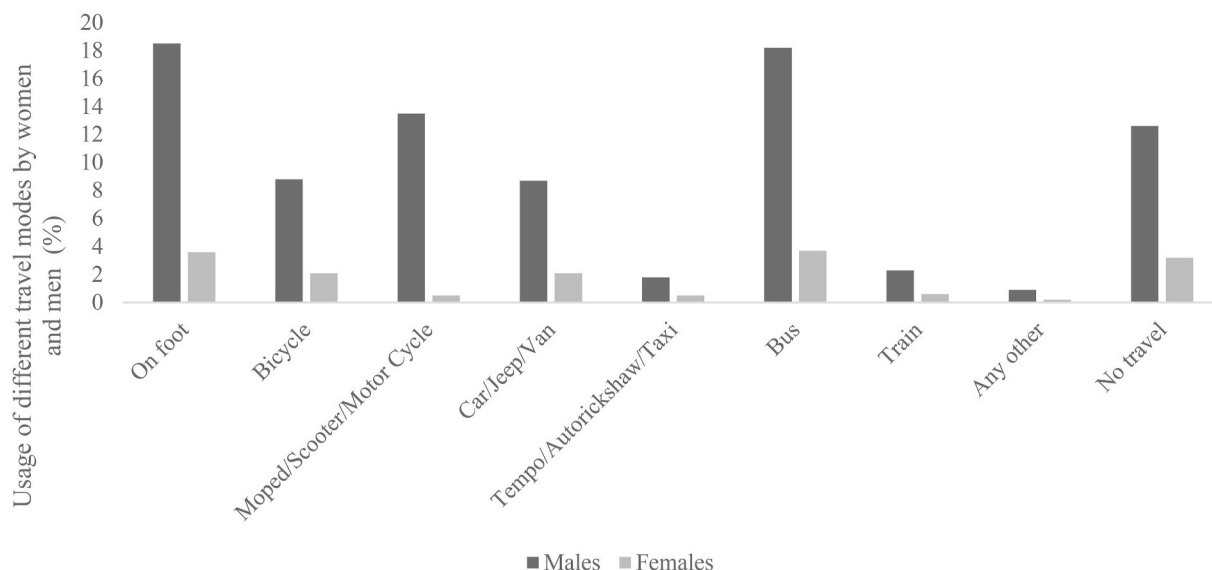


Fig. 6. Distribution of different travel modes as used by women and men in Delhi. Data source: Census of India, 2011a,b).

spaces where the women being referred to are mostly ‘Hindu, upper-caste’ (example Phadke, 2013, p.51), or the implicit co-relation of caste with access to public, private, and luxury goods and infrastructure (Sidhwani, 2015; Ministry of Minority Affairs, n.d.)¹¹

5. Discussion and conclusion: making everybody move

This paper has addressed key challenges which bar users from acting upon any form of choice to access transport modes within a South Asian city. To uncover these gaps, we undertook a literature review of research articles, initiatives, reports, and studies related to transport, growth of cities, land-use, mobility, and user experiences. For further context, this review was rooted within the expansion of Delhi as multiple urban sprawls where a large population lives in unplanned settlements resulting in low provision of and access to services. In addition, more than half of the city is heavily reliant on its existing public transport which consists of a mere 3% of the total road-based transport. The skewed road-based transport scenario in the city with a pre-dominance of private vehicles has been discussed in Section 2.

Driven by the key concepts as represented in Fig. 5, this paper has highlighted the barriers to transport access in Delhi. These include Delhi’s unequal growth in sprawls, transport initiatives as majorly automobile-centered, costing of different modes, and conceptualization of private and public transport which leads to their acceptance or avoidance. At the core lie the individuals who live in the city and travel for different purposes. This is where the most critical gap emerges - the abstract notion of a ‘user’ which excludes inter-sectional impacts of gender, age, income, or ability when it comes to designing, capacity building of transport staff, or the services provided by different modes (timings, routes, frequency, additional facilities like inclusive public toilets).

As the capital of India and the next most populous global city, Delhi will be home to continuous migrations and further expansions. By highlighting the constraints, we aim to contribute to a re-thinking of current transport planning practices with a focus on inter-sectional user experiences. If these are addressed and overcome by focusing on individual needs and perspectives, Delhi can set an example for other Indian cities in approaching their transport planning and providing inclusive transport for a diversity of users. Through the data presented here, our

intent has been to illustrate how the city’s growth and the evolution of transport initiatives set the stage for the existing gaps. An empirical measuring of the highlighted gaps was beyond the scope of this review. But its undertaking for future research will enrich transport literature further.

5.1. Policy recommendations

Timelines for Delhi’s transport use (Fig. 1) and initiatives (Fig. 4) provide a snapshot of the types of transport modes present over the years, and the focus of key measures. Fig. 1 showed immediately that public transport including NMT has been serving the needs of Delhi’s population for a much longer period than motorised private modes. Along with motorised IPTs, NMT serve as primary modes for short-distance trips and as feeder modes to avail longer-distance transport. This is significant in a city where over half the population travels less than 5 km. In addition, these modes are crucial for users such as women whose travel needs are different from those of men – including more frequent, shorter trips. As mentioned previously, public transport is the lifeline for most of the city’s population. Thus, improvement in existing public transport infrastructure, including NMT must be the primary objective. This needs to include the physical and social aspects of mobility infrastructures (such as designing, maintenance, use of space) arising from experiences of the users. By focusing on public transport which a majority of users depend on, Delhi can lead the way in sustainable transport use. The current circumstances of our city which is choking on traffic and air pollution make it imperative to pursue transport solutions which are sustainable.

From Section 3 which presents the evolution of transport initiatives, one infers that transport planning in India has focused on the expansion of physical infrastructure and a push towards newer technologies to manage congestion and pollution. A chronological documentation of transport initiatives from the 1950s onwards has shown that the approach to transport remains through tropes of infrastructure, greater private sector involvement, and economic growth. Prioritising different users’ experiences to combat issues or improvements based upon a city’s own context are largely amiss. While the focus of this section was to provide an overview of different measures and their aims overtime, we also addressed, briefly, how these unfolded. A future point of enquiry can be to explore a quantitative evaluation of existing policies and their on-ground impacts to guide policy recommendations. A review of the existing transport measures also highlighted an absence of regular

¹¹ Mosse (2018) mentions caste in India, statistically, to be among the most important determinants of life opportunity.

comprehensive data collection for all transport modes (MT and NMT) which contains service level attributes along with user-experiences of different modes. Availability of such data across states will help authorities grasp trends and prepare for short, medium, long-term strategies rather than relying on segregated data which might be dated.

It is commendable that transport planning has taken cognisance of users.¹² Transport initiatives must give prominent space and nuance to the category of ‘user’, specifying who all these do include - in terms of gender, age, abilities, income available for expenditure, know-how of different transport modes, and what different transport options are present for them to use. As discussed previously through the concept of motility, the movement across social and geographical space for these users is dependent on their social positions and the larger cultural contexts within which these movements are carried out. Elaborating upon ‘user’ opens ways for transport access and to public spaces.

For future strategies, transport needs to be understood as something more than a network of physical infrastructure providing movement. By doing so we are limiting a discussion which can elevate or obliterate an individual’s potential by helping them or holding them back from what the city can offer. Not token gestures of inclusion such as a ramp or two, we need to continuously engage with what our ideas of ‘everybody’ include and must include. And how these can be operationalised. If our transport can create operational guidelines with concrete action-plans, or retrofit infrastructures for the 33% pedestrians, for the 2.21% people with different disabilities, for the 45% women in Delhi, we would be on a path to a prudent and smart city. This would align with the SDGs aiming for cities which are truly inclusive for everyone, everywhere.

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Saakshi Joshi: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Roles/. **Ajay Bailey:** Conceptualization, Funding acquisition, Project administration, Supervision, Writing - review & editing. **Anindita Datta:** Conceptualization, Funding acquisition, Supervision, Writing - review & editing.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tranpol.2020.11.005>.

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¹² Although drivers have not been discussed, their needs and perspectives are crucial to transport planning too.

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