

PAPER • OPEN ACCESS

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To cite this article: S Rajesh *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **297** 012025

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Sustainable Transportation in Metropolitan Cities; Berlin, Helsinki, New Delhi and Pune

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Abstract. If one comprehends a city as a human body, then transportation would be its arteries and veins. It makes mobilization possible. In the age of rapid globalization transportation does not only concern itself with a single city but transportation deals with a global scale today. This paper focuses on a comparative analysis of transportation methods for four cities in terms of how new sustainable transportation concepts can be applied to make our future better. The discussion includes a vast range of possibilities of our future sustainable cities in transportation. Environmental and technological aspects as well as politics and policies are inspected. Cities flourish, develop and revolve around transportation. Our future sustainable cities would be no different. We need to approach transportation from all the three aspects of sustainability e.g. social, ecological, and environmental. We have chosen our cities for case studies on a broad range from low-density in Helsinki to very high population in Delhi. The rapid growth in transportation has remarkably increased the carbon footprints of our cities. While planning for our future cities making transportation sustainable is of paramount importance. To understand the issue of transportation for our sustainable cities we discuss the present state of transportation globally and analyse transportation in major cities such as Berlin, Delhi, Helsinki and Pune.

Keywords: Berlin, Helsinki, Delhi, Pune, Transportation Policy and Sustainable Transportation.

1. Introduction

A majority of the world's population is living in urban areas today. We already have a world urban population more than ever before. It is inevitable that transportation is going to grow more critical in our future sustainable cities. Looking at history we would find the major cities on the face of earth have developed around mobility routes. Urban transportation is the single most important component instrumental in shaping urban development and urban living. While urban areas may be viewed as engines of growth, urban transport is, figuratively and literally, the wheel of that engine. The test of urban governance depends upon the quality of life the city or town offers. Since transport is one of the prime determinants of quality of life, it is for the government to articulate the need for mobility and facilitate it through an appropriate mechanism. In fact, the efficiency of cities greatly depends on the development of transport systems; as urban transport is a catalyst for overall development. All these have very heavy economic, social and environmental costs. The need of the hour is therefore a sound urban transport policy. The major thrust of such an urban transport policy should include integrated planning, an optimum share between public and private modes, the choice of relevant technology for public transport systems, optimal use and management of available resources, restructuring of monetary and fiscal policy to encourage and promote public transport and establishment of institutional arrangements, at all levels of governance, particularly at the city level, for planning, development, operation, management and coordination of urban transport systems. Much of the confusion in these matters is due to a lack of professional expertise. [1]

Although policy measures that involve restraining the use of private cars and two-wheelers are likely to be unpopular, a gradualist approach of progressively introducing restraints on road use, while at the same time improving public transport, is more likely to lead to greater acceptance. It is believed that improved public transport and more efficient management of demand would help to combat the trend away from public transport vehicles towards greater use of personalized modes. The application of Transport System Management (TSM) strategy such as one-way systems, improvement of signals, traffic engineering improvement measures for road network, intersections, bus priority lanes and



suitable policies and development of intermediate passenger transport as a short-term measure should be introduced in all cities especially in metropolitan cities so that the existing road capacity and road user safety is increased. [1]

2. Berlin

Berlin is divided into three Fare zones A, B and C. Area A is based on a variety of aspects. They represent the area in the middle of the city. Area B represents the city and Area C boundaries representing the airport and the surrounding areas of Berlin. The main reason for this division is to know the ticket prices. There are also trains. For example, trains run continuously in the city center. Berlin is divided into three tariff zones: AB, BC und ABC. Tariff zone AB includes the urban area to the city boundary. Zone ABC additionally includes Berlin's surrounding area and Potsdam main railway station. [2]



Figure 1: Travel Zone Berlin, (Visit Berlin, 2018)

The Berlin S-Bahn is faster and easier to use, especially through the Ringbahn route, which is a great way to travel around the city in a circular and very fast pace. It consists of 15 lines and 166 stations. On weekdays, the S-Bahn starts running around 4.30 a.m. and stops service at 1.30 a.m. Depending on the time of day the trains run in five-, ten- or 20-minute intervals. On weekends, S-Bahn trains run 24 hours, at night in 30-minute intervals. The eastern line of the city is the central axis of the transport system which connects the stations Westkreuz and Ostkreuz. The most important are peak periods where the S-5, S-7 and S-75 lines operate in standard time periods of three minutes, making it easier to navigate throughout the city. This is where the most beautiful features such as stations Zoo and Alexanderplatz are especially worth seeing. There, the S-Bahn passes landmarks like the Victory Column, Central Station, Museum Island and HackescherMarkt. [2]

The link line between the north and south of the city is represented by the S2 and S1 which connects Oranienburg and Wannsee Bernau and Blankenfelde. The so-called Ringbahn runs around Berlin's city centre on a route of about 37 kilometres. It stops at 27 stations and needs approximately 60 minutes to circle around the city. Many stations of the Ringbahn have links to S-and U-Bahn lines running to the city centre or outskirts of Berlin. Important junctions of the Ringbahn are the stations Westkreuz, GesundbrunnenOstkreuz and Südkreuz. The Ringbahn consists of the S-Bahn lines S41 and S42: S41 moves clockwise, the S42 anticlockwise. The trains run throughout the day, during the rush hour in five-minute intervals, in the evening in ten-minute intervals.

The Underground (U-Bahn) and S-Bahn operate on weekends and holidays throughout the night, ensuring that late-night travellers are safely home. On regular days of the week, trains operate daily from 4 am to 1 am. In addition, buses continue to link stations throughout the night. During the day the train arrives at each station for 5 minutes. At night, the train arrives at any station every ten minutes. At weekends, trains operate nonstop throughout the day. The Berlin trams are very much available in East

Berlin. Consisting of 22 lines 9 of them operate 24 hours and the remainder only works at regular times. Tram and Metro lines run on different schedules. Furthermore, Metro tram lines operate during the night even on weekdays. The BVG Metro has nine lines (1 to 17) which are supplemented by 13 tram lines (12 to 68). The lines of the Metro are marked with an "M". During the day these lines run at least every ten minutes, and at night (from 0.30 a.m.) they run in 30-minute intervals. [2]

The very sophisticated system of buses in Berlin serve roads that are not covered by other means of transport. It also acts as a link between train stations. In Berlin, buses do not operate from one area to another within the city. For buses, it is the slowest public transport but it is a sufficient way to take you to almost any area in Berlin. The double-decker busses stop in each lane, while the express buses stop at the main stations only. You can visit many of Berlin's tourist attractions through a few bus routes, something every tourist should do. Most buses in Berlin run throughout the day nonstop. The distinguishing feature of these buses is the letter N located at the front of the bus. These buses operate at night where they connect the metro stations when the trains are not operating.

3. Delhi

Delhi is an ancient city situated on the banks of river Yamuna, founding its first mention in mythologies of Mahabharata, as the capital city of Pandavas then known as Indraprastha dating 3000 BC. It has an area of 1483 km² and has a radius of approximately 50 km. Delhi has one of the robust transport systems among Indian cities. Derived from the town plan of Architect Edward Lutyens, Delhi has radial road networks. Being an ancient Mughal capital, it has a rich cultural heritage to bestow. [3]

In terms of the transport system, there are several high points which the city feels proud of, but still it lacks on certain grounds which give scope for ample improvement in the future. Delhi transport includes the Delhi Metro (DMRC), the Delhi EMU ring rail network (Indian Railways), the buses, auto-rickshaws, taxis and cycle-rickshaws and battery-operated rickshaws. [3]



Figure 2: Delhi Ring Railway, (Delhi United, 2018)

It is said that "If you have a car, you are treated like a king. If you come by bus or metro, then you are a second-grade citizen." Despite Delhi's evolving transport system, the financially affluent classes are reluctant to use public transport like in other parts of the world. Although Delhi metro only accounts for 2.76 million riders per day, but this basically consists of people earning less than 1200 Euro per month (98% of the total ridership). Travelling by personal car or taxis gives people last mile connectivity which is often found missing with a metro ride. Harsh extreme climate, pollution worries and safety concerns also play a role in people opting for car rides. But lately, government as well as private institutions have been working hard to spread awareness regarding need for acceptance of public mode of transport system. Car free week was largely advertised in recent year as part of this campaign.

Real estate around metro stations has primarily two models of metro and real estate relationships. For instance, in Mumbai, metro stations were built first and extensive markets started to build up on both sides of the stations. The station became the focal point of any sub-region in the city. The influence is so large that for example areas got named as Malad (east) and Malad (west) owing to its direction on the either side of the rail station. And this phenomenon is seen in all stations of Mumbai city. On the other hand, city of Delhi got Metro rail installed way after the establishment of core areas be it retail or residential in nature. The last 15 years of metro engagements has greatly influenced the real estate market of the nodal areas. There has been a sharp increase in property prices in vicinity as well as notable distances of the metro stations. It has not been restricted to commercial or retail sector but also impacted the residential commodities. [3]

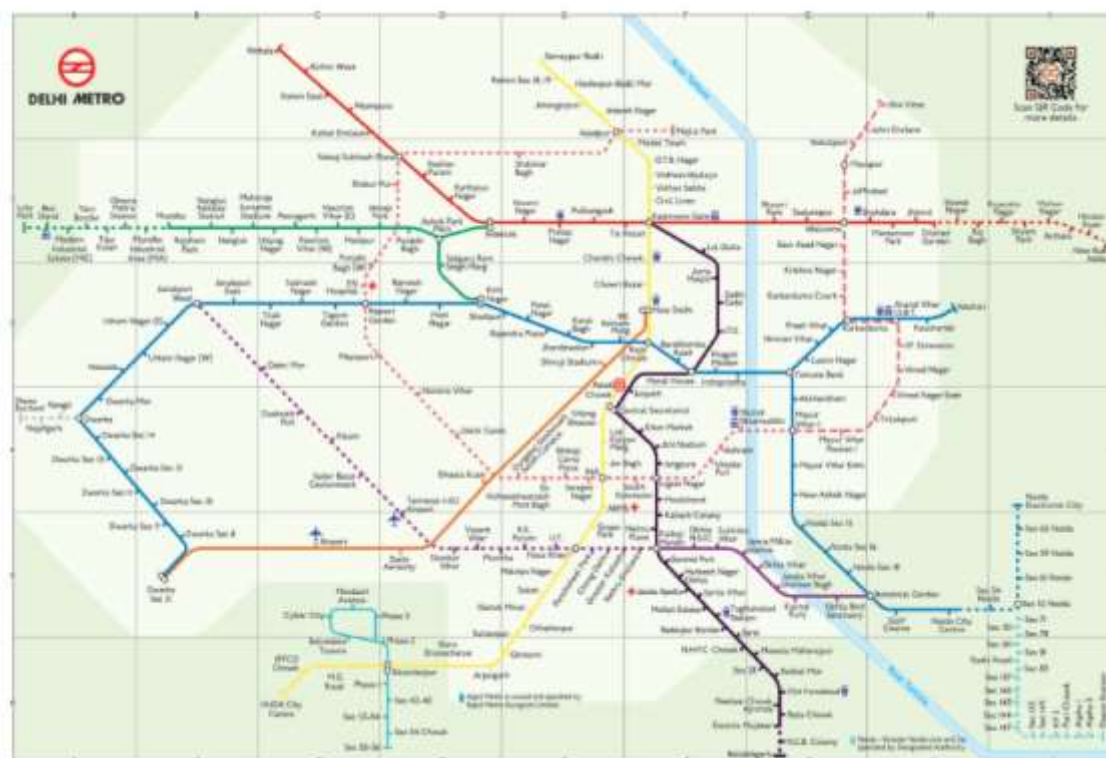


Figure 3: Delhi Ring Railway, (Delhi United, 2011)

Due to better connectivity, employment in all areas has thrived giving way to a demand for housing. This has seen positive developments in the residential sector. FAR (floor area ratio) also has been increased in transit corridors. This paved the way to new developments over the existing structures as well as vacant lands. Property prices in western areas of Dwarka almost doubled from 2009 to 2017. This kind of rise was seen in all areas of Delhi as well as its satellite towns. Due to better connectivity, employment in all areas has thrived giving way to a demand for housing. This has seen positive developments in the residential sector. FAR (floor area ratio) also has been increased in transit corridors. This paved the way to new developments over the existing structures as well as vacant lands. Property prices in western areas of Dwarka almost doubled from 2009 to 2017. This kind of rise was seen in all areas of Delhi as well as its satellite towns.

Ownership of land in Delhi is a mix of private and central government. For the development of infrastructure and transport, the government acquires land using the “Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR)” which has

recently replaced redundant “Land Acquisition Act of 1894.” In Delhi all auto rickshaws have been converted into CNG fuel-operated mode. This has helped in the reduction of PM10 emissions. Recently battery-powered rickshaws serve as feeder for last mile transport from metro stations. They contribute to low emissions operating with 250W battery which runs for 50 kms on charging it for 4-5 hours. Despite various public transport options, most of Delhi’s population still prefers to travel in their personal vehicles such as a car, taxi, auto-rickshaw and two wheelers. These roads are also instrumental in carrying freight on a daily basis.



Figure 4: Delhi Major National Highways, (Google Maps, 2018)

The class system in railways are inherited from the British colonial mind-set. There have been several voices suggesting the unification of varied classes in the railways, but this will mean adopting a common rail fare that will be average of existing fare systems. This might not be necessarily acceptable to the masses especially the weaker sections.

S. No.	Class	Reservation	AC/Non - AC	Type
01	General class	Non-reserved	Non-AC	Sitting
02	Sleeper class	Reserved	Non-AC	Sleeper
03	3 tier AC	Reserved	AC	Sleeper
04	2 tier AC	Reserved	AC	Sleeper
05	1 tier AC	Reserved	AC	Sleeper
06	Chair car 01	Reserved	Non-AC	Sitting
07	Chair car 02	Reserved	AC	Sitting

Figure 5: Class System in Delhi

The Inter-State bus depots are in Maharana Pratap ISBT in Kashmiri Gate (North Delhi), Swami Vivekananda ISBT in Anand Vihar (East Delhi), Vir Hakikat Rai ISBT in Sarai Kale Khan (South/East Delhi) and Dwarka ISBT (West Delhi).

The Delhi airports are Indira Gandhi Airport, Indira Gandhi International Airport, Safdarjung Airport for government use and Palam Airport, used by the Indian Air Force.

Delhi's transport system has evolved over the years trying to meet up with its ever-increasing demographic structure. The Influx of population from other states burdens the transport system. Although there have been fewer success stories like Delhi Metro, still a lot needs to be done in Delhi Metro and especially so in other sectors of transportation. The roads of Delhi are primarily good only for use of cars. It has almost no consideration for pedestrians, bicycle users and even motor bike users. In most places there are no separate lanes for each and non-car users struggle to find their voices heard. Bicycles and motor cycles also run in highly vulnerable circumstances and often meet fatal accidents. The Delhi bus rapid transport system (BRT) inaugurated in 2008 ahead of 2010 commonwealth games failed to live up to its expectations. It was scrapped and dismantled in 2016 by the state government. The BRT failed due to poor implementation, people violated the lane system by entering into bus lanes thereby defeating the purpose of the system.

The flyovers built in last three decades have started to wear down and major faults are being observed in a few of the flyovers due to soil settlement and temperature variations. Pressure on Airport infrastructure has increasing ridership. Air ridership has seen a sharp increase due to cheap flight tickets and rising middle classes. However, the airport infrastructure has not been able to keep up with the same pace. Major airports and the state government are facing this challenge to upgrade the infrastructure as per recent demands of the consumers. Transport all over India and especially in Delhi finds the challenge to provide adequate safety for women. Although in Delhi metro condition has seen improvement, still teasing and groping are major challenges in buses and pedestrian areas. The Delhi government promised to install cameras in all buses and provide marshals but the concept is still in the pipeline even after 3 years. CNG vehicles and the Delhi metro helped in curbing city's pollution to a certain extent but due to ever increasing number of private vehicles pollution due to transport is increasing.

4. Helsinki

Helsinki is a compact, well-planned city and it grows due to internal and external immigration which cause its metropolitan area to extend rapidly; currently it covers 14 municipalities, spread over a total area of 3700 km². With 1.8 million inhabitants, the main problem in transportation system is the low density of people. [6]

Helsinki Region Transport Authority (HSL) was found on 2010 and since that it takes responsibility of managing the transportation system and this include developing transport plans (short and long term). HSL service covers cities of: Helsinki, Espoo, and Vantaa, Kerava and Kauniainen and the municipalities Kirkkonummi, Sipoo, Tuusula and Siuntio. [6]



Figure 6: Helsinki Metropolitan Area, (HSL, 2016)

Integrity and good public transport connections are the main goals of HSL policy, so the various transport means operates to insure seamless journey. HSL transport management system based on hiring contractors to operate the various public transport means.

There are three types of tickets: single ticket, day ticket and travel card, you can issue or recharge your ticket via ticket machine, sms, mobile ticket or direct payment. No gates in ferry, metro or commuter train stations; that means the rider does not need to show ticket unless required by spot checkers, which may result in a fine. In buses the ticket must be shown to the driver. HSL provides a comprehensive IT

solution that works on electronic devices to facilitate the journey. The trip planner tool enables the user to determine nearest point to reach public transport and guide him/her to the next means of transport, until the rider reaches the destination. [6]

Helsinki Metro consists of 25 stations (six stations lie in Espoo), six of these stations runs below ground, while others are at street level. All the stations aligned in two lines: M1 (Vuosaari – Matinkylä) and M2 (Mellunmäki – Tapiola). Tracks - of total length equal to 35 km - run in two directions - east to west and vice versa. Construction of the metro started on 1969 and the first official service operation was in August 2, 1982 and metro trains ran from Itäkeskus to Hakaniemi. From that time until now the line extended to the east and west. The last extension was to the west towards Espoo and opened to the public in 2017, final route as shown the figure below. The figure shows the metro stations in Helsinki before the last extension in the orange colour and last extension in green colour and the future planned stations in light green colour. Importance of metro line comes as it is the main public transportation mean that crosses Helsinki from east to west. The fact that metro is the fastest means to transport inside Helsinki [3] metro has many other features that attracted more than 127 million passengers in 2015[4]. The most important feature is the connectivity of metro station to other transportation means, for instant there is bus station or at least bus stop at each metro station which enable passengers to continue their trips smoothly. Other features are that metro allows bicycles and pets in its trains and it offers continuous free Wi-Fi internet in the stations and in the trains. Metro starts first journey at 05:00 am and last one at 23:20 pm with headways varying from 2.5 min. to 10 min. [6]



Figure 7: Helsinki Metropolitan Route Map, (Yle, 2018)

Most of Helsinki streets have a bike lane, and there are several bike stations attached to metro stations and many other places, bikes also allowed in metro and commuter trains. HSL has its city bikes, which are available for common share during summer period and can be borrowed by residents or visitors via special ticketing system. These bikes are in 225 bike stations, 150 stations in Helsinki and 105 in Espoo. [4] HSL policy aims to increase the use of bikes and for a lifestyle for those who care about their health and travel time, also to benefit from bikes rides with neither carbon emissions nor noise. [8]

5. Pune

The city of Pune is the second most growing metropolis in the state of Maharashtra after Mumbai. The urban sprawl of the core city is situated on the Deccan plateau on the banks of river Mula and Mutha. It has an area of almost 243.84 square kilometres. This city has been the land of administration since its establishment in 18th century by the great Maratha warrior “Chhatrapati Shivaji Maharaj”. The land has been the political centre and was ruled back then by the “Peshwas”. So, the city has a strong influence of planning and administration over the last four centuries. However, with the increasing footprint is not able to cater the norms. Mumbai is the economic and financial capital of India situated 150 Km apart, this makes the city of Pune more commutable and accessible. The city is a major contributor to economy, which is western part of the state. It is one of the most populated cities of India, with over 8 million residents. The rapid modernization, setting up of international IT companies, migration of skilled labour from other states, world-class educational institutions and a good standard of living are among few factors, which make Pune a preferred city to live. The city is transcending from last decade to achieve this kind of world-class amenities and status. [1]

There is a proportionate growth of sectors in infrastructure, business and transportation. Hence, there is an increasing demand for public transport for the mobility of people, which is termed as inter-city and intra-city connection. However, the research areas for this report are only focused on intercity transport and would be focusing more on latest updates and changes in transportation policy in the city of Pune. This research focuses only on three public transportation sectors. They are as follows:

“Streets of Aundh, Pune” – An Initiative to promote cycle and pathways.

“Feasibility study of Hyperloop One” – Case Pune and Mumbai in 20 minutes”

“Pune Metro Rail – “Maha Metro”

We are already in the age of revolution of the transportation industry. One such example is Hyperloop One. Although the concept has reached only testing of wind tunnels the start-up which was founded by visionary “Mr. Elon Musk” has taken a sudden take off in the last two years. The company has gone from 3 people to 100 people working on the design and feasibility study. The company has made so far eight MOU (Memorandum of understanding with the specific country’s Governments) for understanding the feasibility of the project. One of the routes on which it focuses is Pune – Mumbai in 20 minutes. This is a revolutionary idea in the field of transportation and if implemented for these two cities then it changes the concept of commute time for every transport. The feasibility study is being carried out by Indian railway ministry and the company.

The much-awaited Pune metro has begun its construction (excavation and foundation phase) from last two years, since its’ beginning in 2000. The metro suits the city since the average travel time in city is more than 100 min per person. The proposal has 3 metro lines two in PMC area and one in PMRDA region. Total numbers of stations proposed are 53. The metro is being elevated at 23 stations and will go underground at 5 stations. Since land acquisition is a critical part for setup the metro got escalated for the city of Pune. The estimated date of completion for line 1 and line 2 is around the year 2021. The total area covered would be 54.58km. The PMC region is 31.25 km long while the PMRDA is 23.33 km long. The total estimate for the project is 845 million Euros. Table 3 explain the demand of metro for the city.[7]

The fare collection would be done on an automated system which would have a smart application. The estimated service of day is around 19 hours/day. The estimated travel speed would be 31-33 Km/h. The maps developed for the routes relate to the main stops and a comprehensive mobility plan has been developed for the same. According to surveys and urban experts the TOD (Transit oriented development area) would boost the real-estate sector since there are high chances of FSI (Floor space index) to be raised to 4.

CRITERIA	EXISTING SCENARIO	WITH METRO SCENARIO
1. Traffic Congestion	Bumper to Bumper Traffic In peak hours	No congestion of roads in peak hours
2. Pollution	Air quality is going down	Will improve as vehicles will start getting low in number
3. Road Accidents	High rate of accidents	Will drastically reduce due to less commute time
4. Convenience	Traffic jams	Highly comfortable and reliable
5. Weather Extremities	Affecting Drivers Health	Distraction free environment
6. Travel Time Cost	Excessive more than 100 min average	Travel time reduction by 50 %
7. Energy Savings	High due to Fuel consumption	Use only 1/5 th of the energy according to DPR

Table 1: Transportation Scenario in Pune, (Pune Metro Rail, 2018)

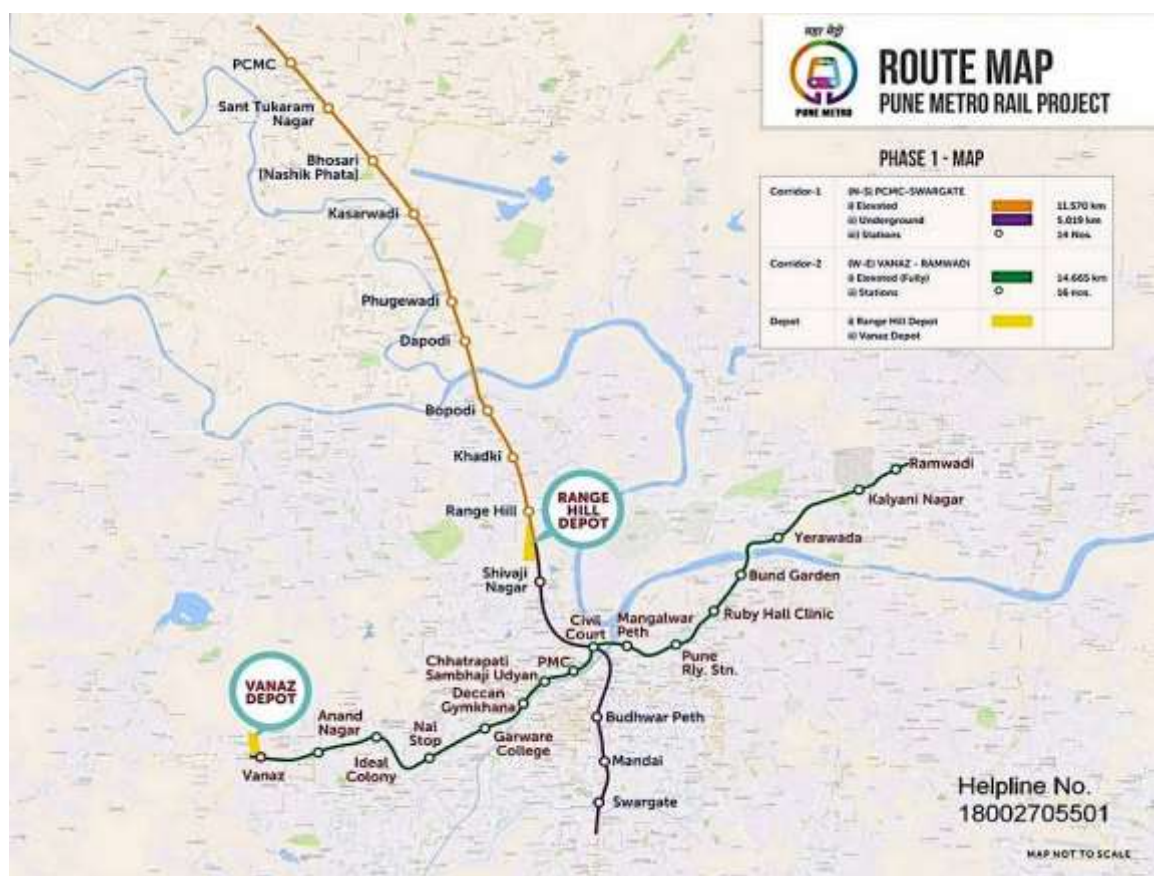


Figure 8: Pune Metro Map (Pune Metro Rail, 2018)

This figure is lucrative and a lot of debate is happening around the urban policy makers on what could be the solution. The metro is to be built on BOT (Build operate and transfer) basis, with a maintenance contract of 35 years. The success of the metro will be determined based on the users experience in terms of commute time and fair prices. A comprehensive report for mobility has been developed by the regional municipal authorities for efficient implementation of systems of transport. [7]

Another project which recently got appreciated related to street development in an urban setting is the streets of Aundh; Pune, Maharashtra, India. It was developed with the help of public participation and was designed by urban designer “Architect Prof. Prasanna Desai”. The project aimed at developing a breather space on the heavily occupied traffic region for the residents. The pedestrian walkway stretches to 3M in length having cycle tracks of 1.5M. The street has an end to end connection, hence is used to full potential by residents. “The public transport plan is supplemented with an extensive bicycle network that is both interconnected and continuous that reinforces and feeds into the public transport corridors. To improve the mobility of the corridors and pave way for the public transport corridors an effective parking management plan that complements the corridor plan is identified. The parking plan in addition to freeing the right of way for the public and non-motorized transport would also act as a demand management tool. A strong and reformed institutional framework is identified to help achieve the mobility plan and the vision”.

These individual plan elements are detailed in the subsequent sections”. (Pune Municipal Corporation, 2018). Additionally, there has been initiative of strongly promoting bicycling in city. An association with a car rental company “Zoom car” and PEDL have made it possible to rent bicycles on hourly basis. There are cycling hot spots set around the areas of city. It’s just 15 cents per hour thus by promoting the cycling experience in city. [8]



Figure 9: Cycle and Pedestrian Pathways (ITDP, 2016)

The increase of the population in the 20th century past to 220 million to 2.8 billion. According to the UN statistic, by 2050 6.9 billion people will be living in the urban areas, almost the 70% of the global population. By the hand of this increase of population, the number travels inside the cities also increase. The transportation systems in all urban cities must grow in a sustainable and responsible way. But, for the transportation system work efficiently, other actors must be involved. The planning of the cities, the policies, and the new technology must work together.

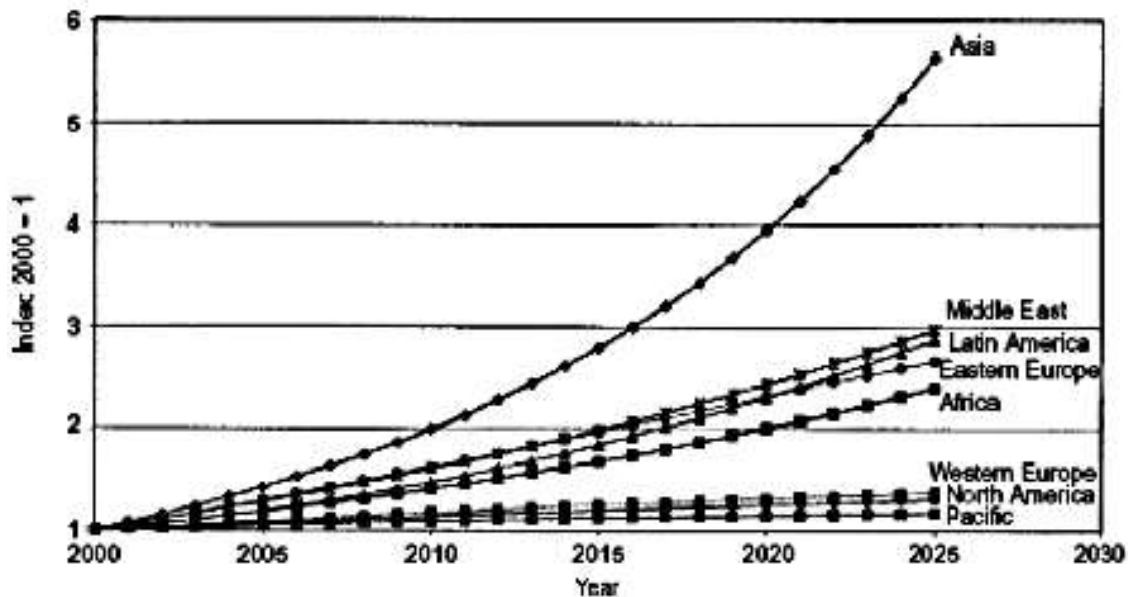


Figure 10: Estimated changes in road traffic levels relative to year 2000, (Dargay, 2002)

Asia will be the continent with the major increase in the road traffic levels and it is also the one who has 1/3 of the global population. Nevertheless, the increase will be considered around the world and its one of the problems that every citizens suffer every day. Six cases or stages were presented to a city to be considered friendly to the environment based on the United Nations Reports of Sustainable Development:

1. Reducing greenhouse gas emissions
2. Improving air quality / reducing noise
3. Improving transport safety
4. improving Access / Reducing exclusion
5. Reducing Congestion
6. Crafting wealth / supporting the economy

6. Comparison Delhi vs. Berlin and Pune vs. Helsinki

The population of Delhi has 4.3 times the population and 2.75 more density than that of Berlin. In the airport Cargo Tonnage, Delhi has 18 times more than Berlin. In trains, both cities have almost the same number of stations; Berlin has more lines (15 to 6) and the system length is longer (327 km to 213). Both have the same number of metro stations, almost same lines, but in length, Delhi has 80 km more than Berlin. Only Berlin has a tram. Delhi has more trips per day than Berlin.

The population of Pune has 3 times the population and 2.4 more density than that of Helsinki. At the airports, the passenger movement in Helsinki is 2.65 times faster than in Pune. In Cargo Tonnage it is a big contrast, Helsinki has 5.44 times more than Pune and 3.52 more aircraft movements. In trains, Helsinki has 15 lines and Pune only 2; Helsinki has 70 stations and Pune only 17. Daily ridership in Helsinki move 2 times faster than in Pune; Helsinki has Metro and Tram systems. The Pune Bus rapid transit has 6 lines, but unfortunately, the project has been a disaster.

	Delhi - India	Berlin - Germany
Population	26,454,000	6,000,000
Area (km ²)	1,483	892
Density (hab/km ²)	11,312	4,100
Airport		
Passenger Movements	35 millions	29.5 millions
Aircraft Movements	397,799	254,952
Cargo Tonnage	857,419	48,000
Train Sub-Urban		
Number Lines	6	15
Number Station	160	166
System Length (km)	213	327
Daily ridership	3,000,000	1,142,465
Metro		
Lines	7	10
Length (km)	231	146
Number of station	173	173
Daily Ridership	2,760,000	1,389,041
Tram		
Lines	-	22
Length	-	189
Number of station	-	404
Daily Ridership	-	495,890
Bus Service		
Bus Rapid Transit	No	No
Public and Private Bus	Urban and InterCitys	Urban and InterCitys
Taxi Services		
Taxi	Yes	Yes
Three Wheeler Motorcycle	Most Popular transport	No
Uber and Apps	Yes	Yes

	Pune - India	Helsinki - Finland
Population	4,600,000	1,500,000
Area (km ²)	1,109	3,697
Density (hab/km ²)	7,214	3,003
Airport		
Passenger Movements	6,787,391	18,000,000
Aircraft Movements	46,932	165,330
Cargo Tonnage	35,312	192,204
Train Sub-Urban		
Number Lines	2	15
Number Station	17	70
System Length (km)	63	99
Daily ridership	100,000	194,500
Metro		
Lines	-	2
Length (km)	-	35
Number of station	-	25
Daily Ridership	-	201,400
Tram		
Lines	-	11
Length	-	39
Number of station	-	293
Daily Ridership	-	156,164
Bus Service		
Bus Rapid Transit	6 Lines	No
Public and Private Bus	Urban and InterCitys	Urban and InterCitys
Taxi Services		
Taxi	Yes	Yes
Three Wheeler Motorcycle	Yes	Yes
Uber and Apps	Yes	No

Table 2: Data Delhi vs. Berlin and Data Pune vs. Helsinki

7. Conclusions

A modern city runs on its mobility. In today's world, railways are essential in the daily life of citizens. Metro is one of those basic infrastructures on which common people heavily depend. The Delhi Metro is the lifeline of the citizens. The basic purpose of public infrastructure like Metro is to serve the public a safe and convenient transport. The policy makers must not forget that Delhi metro is also keeping the pollution and the traffic of the city in control. The management of transportation systems is of high importance in cities like Delhi and Berlin. In smaller cities like Helsinki, a nice modular mix of transportation without dedicated lanes for pedestrians and bicycles works. In Delhi, auto-rickshaws are widely used. The accident rates are also high among people travelling in these transportation modes where the traffic density is not accommodated at all by the road lanes. There is a need for remarkable improvement and proper integration of mixed transportation in Delhi. The Delhi Metro is one of the few good examples the city provides for future sustainable cities.

The Pedestrian safety should be given priority in the sustainable development of transportation. In older cities pedestrian lanes can be narrow. On the other hand, for the making of future sustainable cities the transportation planning should have emphasis on pedestrian mobility. No matter how much technology develops in transportation systems pedestrians will always be prime in sustainability of future cities.

Berlin is an economic and transportation centre in Europe. Berlin transportation has witnessed change from old slow cars to modern fashioned high-speed commuter trains. Compared to the increasing population Berlin is coping well in its transportation services. The development of technology and sensible implementation is critical for sustainable transportation. The aspects of renewable energy and tech- savvy transportation systems such as hyperloop should be considered carefully for our future sustainable cities.

Although policy measures that involve restraining the use of private cars and two-wheelers are likely to be unpopular, a gradualist approach of progressively introducing restraints on road use, while at the same time improving public transport, is more likely to lead to greater acceptance. It is believed that improved public transport and more efficient management of demand would help to combat the trend away from public transport vehicles towards greater use of personalized modes. The central government should assist local governments for effective implementation of such measures. In fact, there is pressing need to strengthen institutions in the transport sector. Central government should provide training and technical assistance to local governments to prepare and implement sound policies and programs. The implementation methods, proper monitoring is equally important as the policy making.

Transportation development largely depends on policy and budgeting. There should be proper structure of transportation budget which is essential for structural development of sustainable cities. In a country like India, where policy making depends and changes on electoral polling, construction and implementation of transportation policy suffer greatly from the shift of power among political parties. Also, the industry, housing, and jobs will increase. To reduce the pollution and the CO₂ in these cities, the government is planning to invest in green technology for the public transportation. For example, Helsinki is planning to change the diesel of the buses for new biodiesel, gas and electric. A more radical solution is Berlin that is planning to get free the public transportation for the population. According to the United Nations, 66% of the global population will live in cities by 2050 (UN, 2014). It is important to create urban plans that are “green cities”. The new ideas, new technologies must be implemented and grow “shoulder to shoulder” with the cities.

The infrastructure of the cities must change to improve the public transportation and break the walls and the belief that the public transportation is for “Poor” people. The private car will never disappear, but with political laws, the used of them can be reduced by investing in public transportation.

Helsinki is a well-planned city and it has strong transportation infrastructure represented by the streets, highways, foot paths, bike lanes, metro, and commuter trains. All these means form together a solid integrated mobility network that gives the residents a wide range of travel options and this lead to more reliability on public transport system. Helsinki has developed short-term and long-term strategic planning for the present and future aims mainly to increase the sustainable journeys. Some goals are to maximize the cycling, offer car parking close to metro and train stations, utilize IT solution to facilitate journeys via trip-planner tool, use e-tickets and mobile apps.

Urban transport policies should encourage the need for developing ‘green’ modes like bicycling and walking with pedestrian paths and cycle tracks especially in new development areas of larger cities and small and medium towns which should be integrated with the transport network. The application of Transport System Management (TSM) strategy such as one-way systems, improvement of signals, traffic engineering improvement for road network, intersections, bus priority lanes and suitable policies and development of intermediate passenger transport as a short-term measure should be introduced in all cities especially in metropolitan cities so that the existing road capacity and road user safety is increased.

Acknowledgments

Authors wishing to acknowledge assistance or encouragement from the Professor Eric Pollock, and our classmates for their cooperation in the development of this paper which is based on the book *Sustainable Cities* developed for the Master's Programme in Construction and Real Estate Management (ConREM).

References

- [1] Urbanisation and Urban transport in India: the sketch for a policy, S Padam and S Singh, www.deas.harvard.edu/TransportAsia/workshop
- [2] Travel Zone Berlin, <https://www.berlin-welcomecard.de/en>
- [3] <https://www.quora.com/What-are-some-lesser-known-interesting-facts-about-Delhi-Metro>
- [4] Touru, T. (2016). Helsinki region transport system. Urban node concluding workshop (p. 26). Helsinki: hsl.
- [5] HSL (2018, N.D. N.D.). City Bikes. Retrieved from HSL: <https://kaupunkipyorat.hsl.fi/en>
- [6] HSL (2018, N.D. N.D.). Commuter Train Services. Retrieved from HSL: https://www.hsl.fi/sites/default/files/uploads/hsl_lahiliikennelinjat_pysty_700x1000_2017_v04_esikatselu_0.pdf
- [7] Pune Municipal Corporation. (2018, 03 27). PMC. Retrieved from www.pmc.gov.in: <https://pmc.gov.in/en/comprehensive-mobility-plan>
- [8] The Times of India. (2016, December 8). Pune metro rail project gets go-ahead from Centre. Retrieved from Pune metro rail project gets go-ahead from Centre: <https://timesofindia.indiatimes.com/city/pune/Pune-metro-rail-project-gets-go-ahead-from-Centre/articleshow/55865879.cms>
- [9] Shivatare, C. D. (2017, October N.D.). Pune Traffic Problems & Control Measures. Editor in chief Dr. G.R. Kulkarni: <http://www.ejournal.aessangli.in/ASEEJournals/CIVIL86.pdf>