



Study of Traffic Problems in Metro Cities: Review of Pune City

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Abstract : Rapid urbanization has caused tremendous increase in population of metro cities in India. This has led to ever increase in problems like demand for housing, traffic congestion creating adverse impact on the environment. Traffic congestion has also increased the travel time causing rise in stress levels of the commuters. The characteristic of City plays the important role to analyze the traffic congestion problems. The infrastructural development alone cannot solve the traffic problems in the metro cities with ever increasing travel demand. It is also required to strengthen the public transport system to achieve the modal shift from private to public transport. This paper reveals the study of characteristics and trip patterns of Pune City. Also, to study the existing public transport scenarios and the registered vehicles in the Pune city causing increase in traffic congestion.

Index Terms - Trip distribution, Traffic Intensity, Traffic Volume, Private modes, Priority to Public Transport, walking & Non-Motorized Transport, Modal shift, Modal Split.

I. INTRODUCTION

Metro Cities in India are facing various problems due to urban agglomeration. Due to increase in population, the demand for housing has extended the boundaries of urban areas. This has led to the increase in demand for transport and communication within the city. Traffic congestion in the metro cities is the major concern contributing to various problems like increase in pollution and increase in travel time leading to adverse health effects. It is necessary to identify the traffic problems in metro cities and study the cause for the same. The study of traffic problems will enable to identify the bottle necks in the transportation network. The character of the city defines the trips generated and its share in the transport network. The trips generated helps to know the travel demand of the metro cities. Pune is the eighth largest metropolis in India, second largest in the state of Maharashtra after Mumbai. PMC and PCMC are twin cities which are separated by Mula and Mutha River. The city is situated on the western margin of the Deccan Plateau at the confluence of the rivers Mula and Mutha. The centers of the twin cities are 15 km apart. Three rivers Pavana, Mula and Indrayani flow through the city. Pune is known for its educational facilities and its relative prosperity. It is the cultural capital of Maharashtra as well. These activities and job opportunities attract migrants and students from all over India and abroad. Thus, traffic in Pune has become a very serious problem due to ever increasing number of vehicles on roads. The characteristics and the economy of the Pune plays vital role in trip generation. This includes: 1) Large number of Industries and the employment opportunities 2) Large number of well known educational institutions 3) Being the historical place and natural beauty, large number of tourist spots.

II. ECONOMY OF PUNE

A. Industries and Employment

Pune has well-established industries and has a growing industrial hinterland, with many information technology and automotive companies setting up factories in Pune district. It is also a prominent location for IT and manufacturing companies. The Hinjewadi IT Park (officially called the Rajeev Gandhi IT Park) is developed by MIDC to house the IT sector in Pune. The IT sector employs more than 1.75 lakh people. Pune is the largest hub in India for German companies. According to the Indo-German Chamber of Commerce, Pune has been the single largest hub for German companies for the last 60 years. Over 225 German companies have set up their businesses in Pune. Many industrial areas (MIDC and Private Industrial areas) are located in Pune Metropolitan Region which employs large number people. Industrial areas generate large number of commercial and passenger trips.

Table 1- Industrial Areas in Pune Metropolitan Area

Sr. No.	Name of Industrial Areas	Type of Industries
1	Chakan	Engineering, Auto, Auto ancillary
2	Hadapsar	Engineering, Auto ancillary, Food,
3	Hinjewadi	IT, Pharmaceutical, Auto ancillary
4	Jejuri	Pharmaceutical, Textile, Engineering
5	Kharadi	IT, Engineering
6	PimpriChinchwad	Engineering, Auto,Engineering, Auto,
7	Pirangut	FMCG, Pharmaceutical, Engineering
8	Ranjangaon	White goods, FMCG, Auto, Engineering, Electronics
9	Talewadi Software Park	IT
10	Talegaon	Engineering, Auto, ICD
11	Talegaon Floriculture Park	Floriculture, Inland Container Deport
12	Sanaswadi	Steel, Engineering, Auto, Auto Ancillary
13	UraliKanchan	Engineering, Paper, Agricultural Research

B. Education and Research Centers

Pune is known as "Oxford of the East" due to the presence of several well-known educational institutions in the city. The city has emerged as a major educational hub in recent decades, with nearly half of the total international students in the country studying in Pune. Pune has over a hundred educational institutes and more than nine deemed universities apart from the University of Pune, which is the second largest University in the country. The College of Engineering Pune, now an autonomous institute of the government of Maharashtra, founded in 1854, is the third oldest engineering college in Asia. A total of 156 and 1810 colleges and schools exist within the PMC and PCMC.

C. Tourism

Pune is known as the Queen of the Deccan, surrounded with green hills and placid lakes and having a salubrious climate. The cultural capital of Maharashtra is among the greenest urban areas in India. Pune Metropolitan Region is house to various kinds of tourist locations like historical, spiritual and religious, hill stations, trekking spots, museums, amusement parks, waterfalls etc., which will entertain tourist of all age groups. Pune is visited by vast number of domestic and international tourists every year. Pune is most preferred destination for foreign tourists in Maharashtra after Mumbai. Around 1.3 crore tourists visited Pune during 2014-15; in which about 95% were domestic and 5% are international tourists.

Table 2: Tourist Locations in Study Area

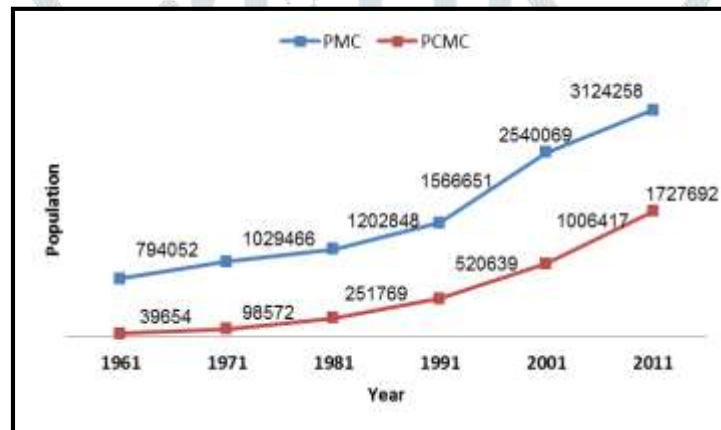
Sr. No.	Name	Type
1	Shaniwar Wada	Historic
2	Aga Khan Palace	Historic
3	Sinhagad	Historic
4	Bund Garden	Historic
5	LalMahal	Historic
6	Raja DinkarKelkar Museum	Historic
7	Parvati Hill	Historic
8	MahadjiShindeChhatri	Historic
9	National War Memorial Southern Command	Historic
10	Mahatma Phule Museum	Historic
11	Pataleshwar Cave Temples	Historic
12	VishramBaug Wada	Historic
13	Tribal Research and Training Institute	Historic
14	Sarasbaug Ganesh Temple	Leisure
15	Rajiv Gandhi Zoological Park	Leisure

16	Khadakwasla Dam	Leisure
17	Osho International Meditation Resort	Leisure
18	Pu La Deshpande Garden	Leisure
19	MorayaGosavi Temple	Religious
20	SantDyaneshwarMandir	Religious
21	SantTularamMaharaj Temple	Religious
22	ShreemantDagdushethGanpati Temple	Religious
23	St. Mary's Church	Religious
24	Chattushringi Temple	Religious
25	ShriMahalaxmiMandir	Religious
26	TulsiBaug	Religious
27	Ohel David Synagogue	Religious
28	Shree ChintamaniVinayaka Temple Theur	Religious
29	PratiShirdi	Religious

III. DEMOGRAPHIC DETAILS

A. Population Growth Trends in PMC and PCMC

The population of Pune is 59.91 lakhs as per 2011 census and the estimated population of 2018 is about 77.5 lakhs. Out of 77.5 lakhs, it is estimated that PMC contributes to 37.13 lakhs, PCMC with 22.73 lakhs, cantonment areas with 2 lakhs and rest of PMR with 15.62 lakhs. It can be observed that in the last decade PMC has added 5.76 lakh people whereas PCMC has added 7.22 lakhs recording a decadal growth rate of 23% and 72% respectively. The overall population growth rate in the study area in the last decade has been 42%.



Graph 1: Population growth trends in PMC and PCMC

Pune is among Maharashtra’s developed Industrial, Educational and IT hub; this makes Pune one of the fastest growing populations. Pune contains highly populated area and development around it, which is increasing with every passing day, which increases the need of transformation and travel.

B. Employment

Employment data as per 2011 Census for PMC and PCMC is summarized below.

Table 3: Working Population in PMC & PCMC

Year	PMC	PCMC
1991	531493	166833
2001	865150	350260
2011	1203153	676832

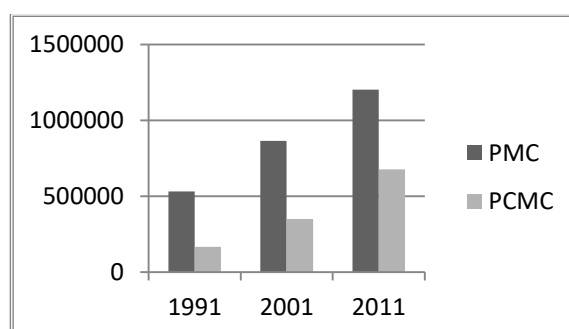


Chart 1: Bar Chart of working population in PMC and PCMC

The share of Pune population engaged in Agricultural and household industries is only 4% and rest is categorized as other workers. In addition to 11.29 lakhs main workers, there are around 73,765 marginal workers who are engaged in employment activity less than 6 months in a year. Further, the share of male and female working population is 73% and 27%, respectively. The distribution of population by employment sector for PMC and PCMC area is presented in Table below.

Table 4: Distribution of Population by Employment

Employment Sector	PMC	PCMC
Agro base / Farming	1.5%	1.0%
Construction / Mining	8.4%	10.7%
Manufacturing (Household)	2.6%	0.9%
Manufacturing (Other)	2.6%	2.3%
Service Sector (Govt.)	5.5%	5.6%
Service Sector (Pvt.)	36.2%	58.2%
Retail / Whole sale Trade	10.0%	6.3%
Transport / Communication / Utilities	7.9%	3.2%
Finance / Insurance / Real Estate	2.3%	1.2%
Educational	4.7%	1.9%
Informal Employment	14.0%	7.7%
Tourism	0.4%	0.7%
Information Technology / Information Technology Enabled Service	4.0%	0.3%
Total	100%	100%

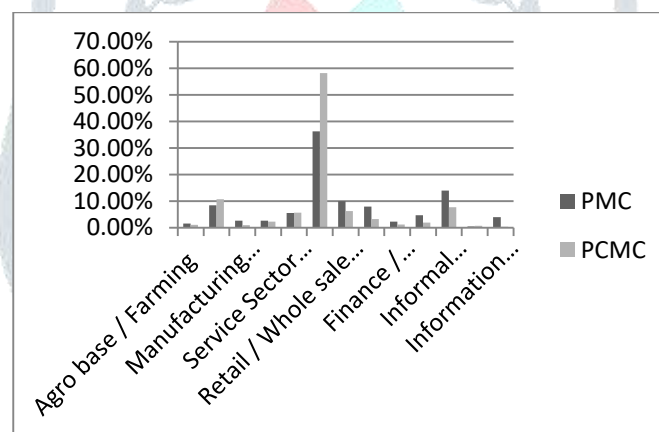


Chart 2: Bar chart of population distribution by employment

It can be observed that Service Sector (private) employment has the highest share with around 36.2% of the total employment in PMC and 58.2% in the PCMC area.

C. REGISTERED VEHICLES

In recent years, the total number of vehicles here has surpassed the human population of Pune, which is 3.5 million, considered a first for any urban area in India. There are 3.627 million registered vehicles under the Regional Traffic Office MH-2712 till March 31 2018. In 2016-2017, it was 3.337 million. In year 2017-18, the RTO has registered total of 280000 vehicles in which Two wheelers and Four wheelers has largest share. There are 6.45 lakh Four wheelers and 27.03 lakh Two wheeler vehicles, which has 9.75% and 8.24% increment over 2017 respectively.

In 2018, the highest growth of 25% was seen in the taxicab segment with a total of 28,344 cabs registered against 22,696 in 2016-2017. This growth to the increased acceptance of cabs as a mode of conveyance over self-owned or self-driven vehicles by the growing industrial, IT, educational sectors, and upcoming residential complexes in and around Pune. This had created massive traffic management issues in most parts of the city and increase in pollution. It also leads to traffic rule violations. However, there is hope with the upcoming Metro, the new Ring Road and other infrastructure projects within and outside the city; traffic may experience some relief despite the growing number of vehicles being registered every year. Out of the total vehicle ownership, the mode wise distribution of vehicles in PMC and PCMC area is given in table below.

Table 5: Vehicle Ownership in PMC and PCMC

Mode	PMC	PCMC
Cycle	2.8%	2.3%
Two wheeler	57.7%	61.5%
Car	0.9%	1.0%
Two wheeler & Cycle	6.6%	3.7%
Car & Two wheeler	12.5%	12.8%
Car, Two wheeler & Cycle	2.4%	1.8%
Others	4.2%	3.4%
No Vehicle	12.9%	13.5%
Total	100%	100%

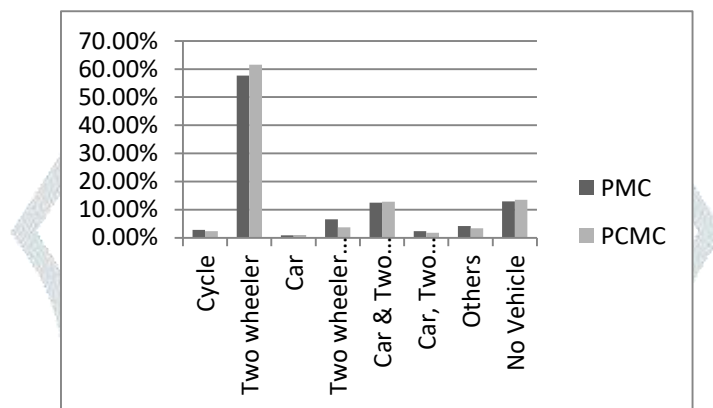


Chart 3: Bar chart showing vehicle ownership in PMC and PCMC

It is observed that 2-wheelers share is high for both PMC (57.7%) and PCMC (61.5%) followed by both car and two wheeler ownership which is 12.5% in PMC and 12.8% in PCMC.

IV. DISTRIBUTION OF TRIPS

A. Trips by Purpose

Trip distribution by purpose of travel reveals that work/business trips accounts to 50.05% in PMC and 54.18% in PCMC area. Education trips are around 37.67% in PMC and 41.55% in PCMC area. The details of purpose-wise distribution of trips for PMC and PCMC area are given in the table below.

Table 6: Distribution of Trips by Purpose in the study area

Sr. No.	Purpose	PMC	PCMC
1	Work	50.05 %	54.18%
2	Business	5.18%	1.67%
3	Education	31.67%	41.55%
4	Shopping	3.62%	0.31%
5	Social / Religious / Recreational	0.57%	0.02%
6	Health / Hospital	0.34%	0.04%
7	Tourism	0.23%	0.01%
8	Other Purpose	2.35%	2.23%
Total	100%	100%	100%

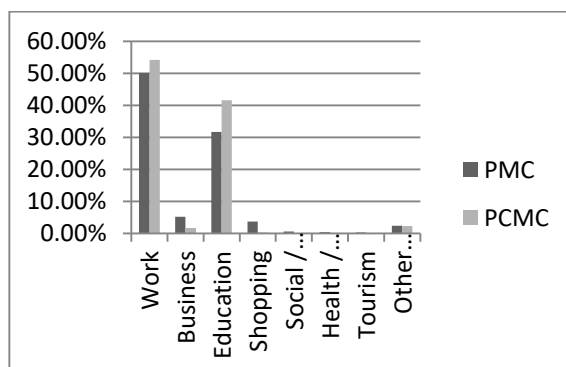


Chart 4: Bar chart showing distribution of trips by purpose

B. Distribution by Mode

The study shows that the work trips contribute more than 50% of all the trips in Pune. Thus, it is priority to solve the traffic problems of work trips. The employment data shows that the maximum population is working in Private Service sector out of all employment sectors. The private sector industries and IT Parks are located at Chakan, Hadapsar, Hinjewadi, Jejuri, Kharadi, Pimpri Chinchwad, Pirangut, Ranjangaon, Talewadi Software Park, Sanaswadi, Urali Knachan etc. The mode-wise distribution of trip purpose is presented in table below.

Table 7: Mode Wise distribution of trip purpose

Sr. No.	Trip Purpose	Car	Taxi	Two Wheeler	Auto-Rickshaw
1	Work	55.70%	46.61%	54.58%	49.57%
2	Business	20.05%	25.43%	18.19%	17.54%
3	Education	5.70%	6.74%	11.27%	7.18%
4	Shopping	6.39%	8.83%	7.46%	15.13%
5	Social / Religious / Recreational	3.32%	3.02%	3.26%	3.28%
6	Health / Hospital	2.12%	2.01%	1.19%	2.94%
7	Tourism	3.72%	5.15%	1.97%	2.97%
8	Other Purpose	3.00%	2.21%	2.10%	1.39%
Total		100%	100%	100%	100%

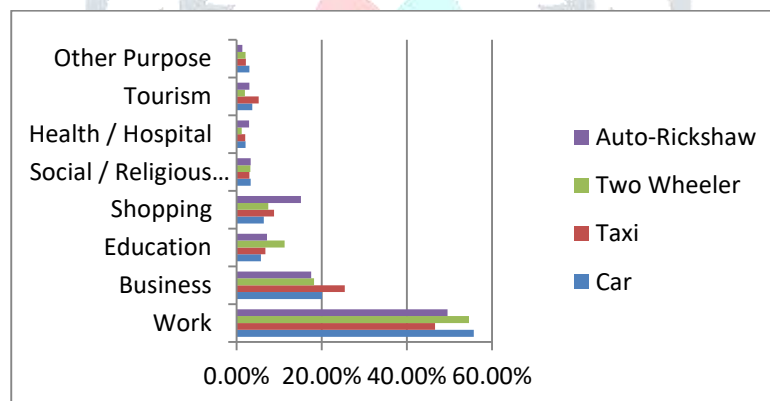


Chart 5: Bar chart showing mode wise distribution of trips

V. EXISTING PUBLIC TRANSPORT

Pune has well developed public transport system, which spread all over pune, but some areas has poor infrastructure development in road sector. The total length of roads in the city is 1800 km. including about 50 km. of National Highways and State Highways.

A. Intercity Bus Service

Maharashtra State Road Transport Corporation (MSRTC) is the state run bus service of Maharashtra having fleet of over 18,000 buses and operating over 1,05,000 bus trips daily covering 5.8 million km with a total staff of 1.07 lakh employees. MSRTC runs various kinds of buses providing passengers mobility covering Intra-state and Inter-state: i) Volvo buses ii) AC buses, iii) Semi-Luxury, iv) Ordinary, v) Medi buses; etc. Over 7 million passengers are availing our services daily. MSRTC operates buses from Pune to all major parts of the state from four bus terminals: Swargate, Shivaji Nagar, Pune Railway Station and Vallabh Nagar. Buses to Mumbai, Solapur, Nasik, Shiridi etc, are plying at regular intervals from Pune. Wide range of services is operated by MSRTC which includes Ordinary, Asiad, Hirkani, Ashwamed, Shivneri and Shivshahi. Apart from MSRTC, state transport corporations of neighboring states such as Gujarat, Karnataka and Telangana also operate bus services to Pune. The trends of passengers travelling by ST bus in Pune District are presented in table.

Table 8: Trends of Passengers travelling by State Transport Buses

Year	Bus Passengers (in lakhs)	
	Per Day	Per Annum
2011-12	3.82	1395.19
2012-13	3.70	1352.30
2013-14	3.52	1284.43
2014-15	3.20	1167.58
2015-16	3.23	1181.15
2016-17	3.04	1108.93

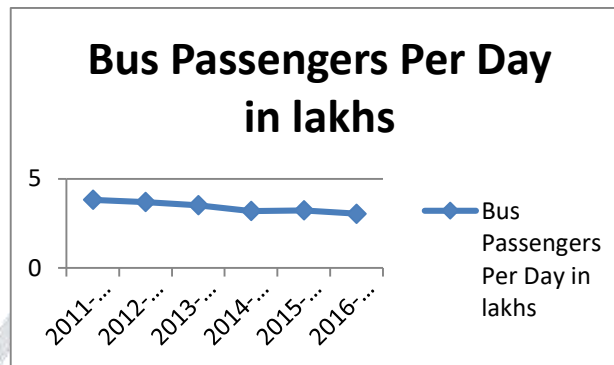


Chart 6: Bar chart showing Intercity bus passengers per day

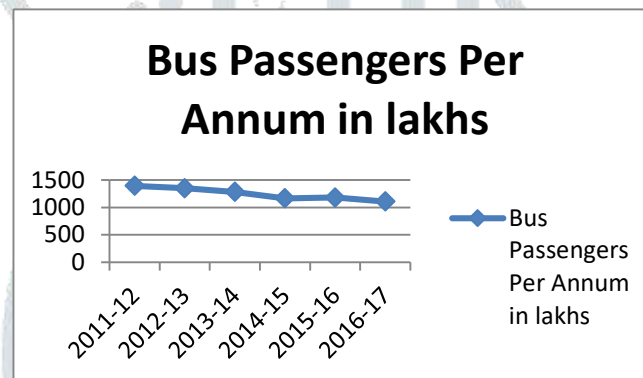


Chart 7: Bar chart showing Intercity bus passengers per Annum

It can be noted that there is a decline in passengers travelling by MSRTC bus over the last five years. This may be due to the shift to other modes such as private bus services, rail and increasing use of car for intercity travel.

B. City Bus Service

PMPML is responsible for operating the bus service in the city and its suburbs. The fleet size of PMPML is about 1,500. The average life of fleet is about 8 years. Average number of buses on road per day is 1,382 operating on 371 routes. On an average, 17,000 trips are made and PMPML carries around 10.65 lakh trip passengers per day. The average number of passengers per bus per day is about 770. PMPML operates various services like Regular Service, Rainbow Buses, Night Buses, Pune Darshan, Ladies Special and Airport Buses.

At present, PMPML has 13 bus depots and 2392 bus stops. 13 bus depots are located at Swargate, Shivaji Nagar, Kothrud, Katraj, Hadpasar, Market Yard, Upper Depot, Pune Railway Station, Nigdi, Pimpri, Bhosari, Wagholi, Bhekrai Nagar. Apart from these the other major bus stands are Deccan Gymkhana PMT Bus Stand, Mahatma Gandhi Bus Stand at Pulgate, Bhakti Shakti Bus Stand in Nigdi and Chinchwad Bus Stand. The historical trend of passengers travelled on PMPML is presented in the table. It clearly shows that the ridership is declining due to increased preference for personal vehicles.

Table 9: Trends of PMPML Passengers

Year	Total Passengers	Daily Passengers
2013 – 14	424894432	1164094
2014 – 15	444357132	1217417
2015 – 16	411503942	1124328
2016 – 17	393916615	1079224

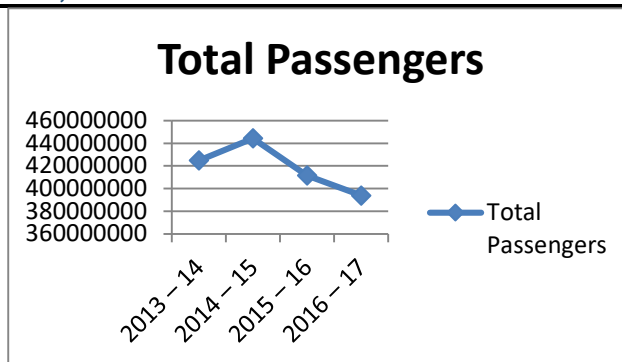


Chart 8: Bar chart showing yearly total passengers of PMPML

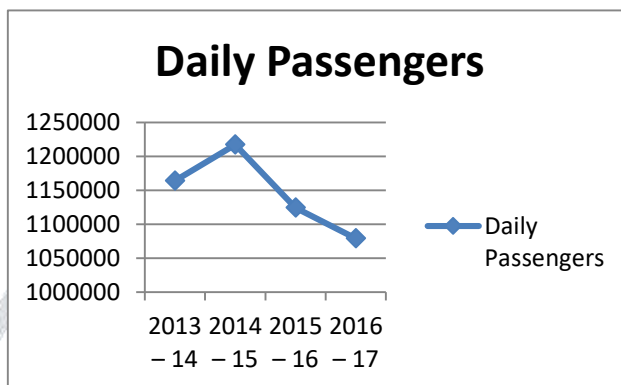


Chart 9: Bar chart showing daily passengers of PMPML

C. Suburban Railways

Pune Suburban Railway between Pune to Lonavala is operated by Central Railway (CR). It runs on double line electrified broad gauge section of 63.84 km. In a day, 18 trains are being operated from Pune to Lonavala and 5 trains between Pune and Talegaon. The minimum headway of the trains is 30 minutes and frequency is observed to be low, which makes the system heavily crowded during peak hours.

Table 10: Railway Commuters in Pune

Year	Railway Passengers (in Lakhs)	
	Per Day	Per Annum
2016 - 17	1.15	282.62
2017 - 18	1.11	273.17

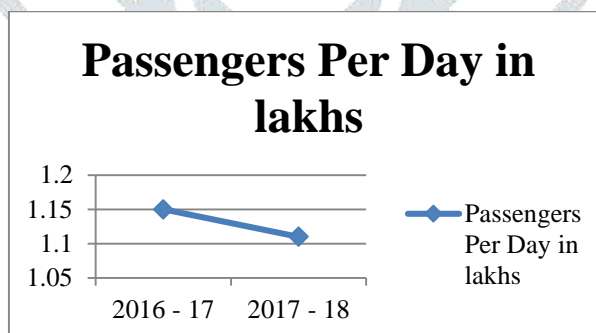


Chart 10: Passengers travelling Daily by Railway

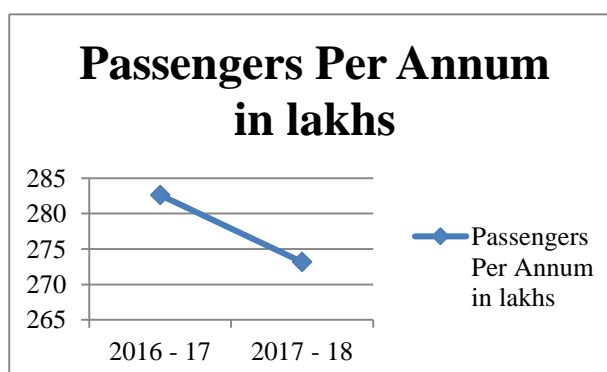


Chart 11: Passengers travelling per Annum by Railway

VI. RESULT AND DISCUSSION

This paper reveals that Pune city has large number of industries having 13 industrial areas in Pune metropolitan region. The industries are of various fields like Engineering, Auto, Pharmaceutical, IT, Electronics, Textile Engineering, Floriculture, Steel, Paper, Food, Agricultural Research etc. So, there are large number of Employment opportunities. The Employment data shows, there is continuous increase in working population of PMC and PCMC as per 1991, 2001 & 2011 census.

Pune, “Oxford of East” has many well known universities and educational institutions. There are 156 colleges and 1810 schools in and around Pune.

- 1) Technical papers submitted for publication must advance the state of knowledge and must cite relevant prior work.
- 2) The length of a submitted paper should be commensurate with the importance, or appropriate to the complexity, of the work. For example, an obvious extension of previously published work might not be appropriate for publication or might be adequately treated in just a few pages.
- 3) Authors must convince both peer reviewers and the editors of the scientific and technical merit of a paper; the standards of proof are higher when extraordinary or unexpected results are reported.
- 4) Because replication is required for scientific progress, papers submitted for publication must provide sufficient information to allow readers to perform similar experiments or calculations and use the reported results. Although not everything need be disclosed, a paper must contain new, useable, and fully described information. For example, a specimen's chemical composition need not be reported if the main purpose of a paper is to introduce a new measurement technique. Authors should expect to be challenged by reviewers if the results are not supported by adequate data and critical details.

VII. CONCLUSION

The solution for these challenges can be - Priority to Public Transport, Promoting walking & Non-Motorized Transport, Integrated land use and transport facility, Integration of different modes of transport and Transit oriented Development. Efficient interchange points will make the commuter decide to use the public transport network as a matter of choice.

The public transport network should be citywide so that the commuter is assured that he can complete his journey all the way by using public transport. Transport demand varies from corridor to corridor and so does the capacity of various modes. For an economic public transport network, the mode for a corridor should suit the demand level on that corridor. Before doing transportation planning of any city, it is necessary to know the choice of mode that is used by the people of any particular area. Travel Demand Management aims to maximize the efficiency of urban transport system by discouraging unnecessary private vehicle use and promoting more effective, healthy and environment friendly modes of transport like Bicycle, NMT, Car-pool, Van – pool and Transit.

Modal split represents the ratio of different transport modes in the total journey from the origin (O) to the destination (D). Journey is considered to be a transport of people (including walking) from O-D with the exact purpose. A Journey can consist of several trips depending on number of transport modes used. To be able to include the usage of different modes in one journey a multimodal journey approach must be applied; otherwise some modes are being neglected.

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