



Transportation Status Report by Citizens of Pune 2012-13

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2012-13

Compiled by "Save Pune Traffic Movement" and "Parisar"

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- "Save Pune Traffic Movement" and "Parisar".

Preface

The deteriorating traffic situation of Pune has become a regular topic of conversation right from office pantries to seminars and meetings. Though opinions may vary about the reasons, it is generally agreed that the transportation is indeed deteriorating.

But what do we mean by "good transportation", after all? We generally call it good or bad depending on our personal experience. Once "personal experience" comes into picture, it becomes the same as the story of an elephant and six blind men. Everyone describes it by his or her experience, and that too in subjective terms like "so so, very bad". If that is how we describe it, how can we tell whether transportation is really becoming worse?

Instead, how about quantifying various attributes of transportation, annually? Then we could not only describe the exact status of transportation, but also identify in which aspect our city is improving or becoming worse. Not only that, we could identify exactly the aspects where we need improvement and how much, and design projects, allocate budgets accordingly.

Various official entities do have the information we need for this purpose, but it is scattered across various departments. And what they have is "information", not "evaluation". What we need is an annual "Report Card" that compiles and evaluates all this information. Such a report card would tell us how many marks the city gets in various subjects related to transportation. That will tell us in which subjects our city's transportation does not fare well, and needs extra "coaching" - i.e., special projects or initiatives.

Which are these "subjects"? The Ministry of Urban Development, Government of India has stated some such subjects or parameters. They have also specified how one should evaluate transportation with respect to those parameters and give marks to your city. Some of these are: Public transportation system, facilities for pedestrians and cyclists, traffic accident fatalities etc. They have stated a system of awarding marks depending on how many buses your city has, how crowded they are, for how long pedestrians have to wait for crossing a road at a signal, etc.

Additionally our city has a "Comprehensive Mobility Plan", or the CMP. The CMP has specific transportation objectives for our city, projects needed to achieve those objectives, investment needed and approximate timeline. These objectives and associated plans are very important for our city and we should continuously track whether our city is on track with those plans and objectives. This report does exactly that job.

We would like to stress one point here. The objective of this report is not to evaluate anyone's performance, but to prepare a benchmark for transportation in our city. Therefore we have only mentioned information in this report and refrained from analyzing

its causes. It is up to the citizens, corporators and administration to make the best use of this information. This benchmark will help us determine next year whether we have made any progress in transportation.

What is important is not the points scored by various parameters this year, but whether these points increase next year.

We think that the PMC should come up with such a "Transportation Status Report" every year that crosschecks today's status with targets in the CMP. The PMC publishes an "Environment Status Report" with a similar philosophy. We hope that this report prepared by citizens encourages not only the PMC but also other municipal corporations to prepare such a report.

Till that happens, we intend to publish such a report "by the citizens, for the citizens". This report will help us understand whether the transportation system of our city is really improving, whether it is convenient, reliable, safe and sustainable to not just vehicles, but also all citizens, as documented in the CMP.

Effort of five months for collecting and analyzing information has culminated in this TSR for 2012-13. PMC, Traffic Police, PMPML, transportation experts in the city, NGOs, common citizens ... all have helped in this effort. This report does not belong to one or two organizations, but all of us. All information collected during this effort will be available on the website mentioned herein. Since this is public information, anyone can use this information freely, as long as its source is quoted.

The report and all associated information is available on the following website:

- <http://tsrpune.wikispaces.com>

We propose that the character of this report is somewhat like "Wikipedia". Your comments, suggestions - and yes, appreciation and financial support - are most welcome. We would like this report to be supported in all ways by citizens instead of finding "sponsors" for the same.

For comments and suggestions and also for offering financial support for the next year, please write to us at:

- tsrpune@gmail.com

Donors can avail of income tax benefits under Section 80(G).

This report is the first of its kind, not only for Pune, but also for any city in India. All residents of Pune are proud of it.

This report is being presented in 3 formats:

1. This document is the original and detailed Transportation Status Report. It is available only in electronic format (soft copy) on the website mentioned above, along with all raw data collected for preparing this report.
2. We have created an abstracted Marathi version of this report. A limited number of hard copies are available. Please email us at tsrpune@gmail.com if you need one.
3. An English translation of the abstracted version is also available on the website mentioned above.

- The Editorial Board,

Transportation Status Report by citizens of Pune, 2012-13.

Parameters for benchmarking status of transportation

The Ministry of Urban Transportation, Government of India, has suggested some parameters for benchmarking urban transportation. (More information on these is available in the "Service Level Benchmarks" they have defined in the document "http://moud.gov.in/sites/upload_files/moud/files/pdf/Service_level.pdf"). As much as possible, we have used these parameters and the method to determine their value as stated in that document. However, the main objective of these benchmarks is to determine whether cities receiving funds from the Government of India are using them wisely, which does not apply to this TSR. Therefore we have made some changes in some of the benchmarks they have suggested and have replaced some parameters with others more appropriate for this purpose.

Transportation is a facility for going from one place to another. Modes of transportation include public transportation (bus, BRT, trains, metro, monorail etc), auto rickshaws, school buses, company buses, motorized personal vehicles (cars, motorcycles etc), bicycles and walking. When we think of what aspects we must take care of while providing facilities for all these modes of transportation, the following four turn out to be the main aspects:

1. Safety
2. Mobility for all sections of society
3. Transportation in a reasonable amount of time
4. Transportation that does not adversely affect health

In addition, the Comprehensive Mobility Plan accepted by Pune Municipal Corporation has stated some objectives for our city's transportation system. considering all this, the following 10 "subjects" have been chosen for the TSR and points have been awarded based on these subjects.

Sr No	Subject	Details
1	Safety	Statistics of fatalities in accidents in Pune city
2	Modal share	How many trips are undertaken by which mode
3	Facilities for pedestrians	Facilities for walking along the road as well as for crossing the road
4	Public transportation	No of buses, quality of buses, time needed to get a bus
5	Facilities for bicycles	Facilities for riding as well as parking bicycles

Sr No	Subject	Details
6	Time to commute	How much time does it need to commute by various modes?
7	Pollution	Pollution caused by vehicles
8	Parking on arterial roads	Our objective is to use arterial roads for transportation, not for parking. What is the actual situation?
9	Public opinion	What do people think about our city's transportation?

The method used for awarding marks is provided in the respective chapter. Some may think that the method is subjective. However, the same method will be used for subsequent TSRs. Please note that it is important to understand whether our city has made progress in the last year in a given parameter, rather than the marks received.

In addition, the following information provided in the appendices would also be useful.

Sr No.	Subject	Details
A	Analysis of PMC budget	Mapping provisions in budget on objectives stated in the CMP
B	Initiatives by Pune Traffic Police	Information on special initiatives taken up with interests of pedestrians, buses, cycles, personal vehicles in mind
C	Traffic discipline	Details of violations caught by traffic police and their effects
E	Driving licenses	How many candidates apply for driving tests, how many pass?
F	Number of vehicles	Figures about number of vehicles in Pune
F	PUC Checks	Coverage of PUC checks
G	Affordability	Cost of transportation by various modes
H	Fuel consumption	Amount of fuel used for transportation in the city

Transportation Status Report of Pune, 2012-13

Before we benchmark the transportation of Pune, it is imperative that we understand the important objectives stated in Pune's Comprehensive Mobility Plan, approved and accepted by PMC.

Sr No	Parameter	Objective	Remarks
1	Modal share of non-motorized transport (bicycles and walking) in overall transportation, minimum	50%	The CMP does not separate objectives for bicycling and walking. One can say that bicycling trips should be 30% and walking trips should be 20%.
2	Share of public transport system in motorized transportation, minimum	80%	This implies that 40% of all trips should be with public transportation. Since the modal share of auto rickshaws is about 5-10%, modal share of PMP (plus Metro in future) should be about 30-35%.
3	Modal share of personal vehicles, maximum	10%	Inference from the 2 objectives above.
4	Number of buses per lakh population	55	
5	Cycle tracks and footpaths	100%	Every road should have a cycle track and a footpath.
6	Parking along arterial roads	0%	All space of important roads should be used for actual transportation.
7	Road accident fatalities	0	

1. Safety

1.1. Why was this parameter selected

Although the main objective of transportation is to be able to go from one place to another, an implicit objective is to be able to do it safely.

The World Health Organization's (WHO) report on Road Safety (2013) states that the estimated GDP loss due to road traffic crashes is about 3% for India. Our country ranks number one in road accident fatalities. Road accidents in India kill twice as many people as they do in China. Accidents annually killed about 8 people in 100,000 in both countries in 2001. While China has brought that rate down to about 5 by 2010, in India it had increased to almost 12 in the same period.

The "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India, also include "Road Safety" as a parameter. We are using the method stated in this benchmark for the TSR of Pune.

1.2. What data was collected

The method stated in "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India, needs the following data:

- Population of the city,
- Number of fatalities in road accidents,
- Number of fatalities of users of non-motorized transport, viz. pedestrians and cyclists.

Therefore the TSR collected the following data:

- Number of traffic fatalities in Pune during the period 1st April 2012 - 31st March 2013.
- Distribution of the above with respect to the following:
 - Modes: Pedestrians, cyclists, drivers and riders of 2-wheelers, 3-wheelers and 4-wheelers, buses and other vehicles.
 - Ages: 0-9 years, 10-17 years, 18-29 years, 30-59 years, 60 years and above.
 - Reasons:
 - For pedestrians: While crossing a road and other reasons,
 - For cyclists: Vehicles colliding from behind, from any other direction,
 - For 2-wheelers: Collisions with light vehicles , heavy vehicles, slippage,
 - For 2-wheelers: How many of the dead were wearing a helmet.

1.3. How was the data collected

The data was collected by submitting an application under the RTI act to the Traffic Branch of Pune Police.

The following information was sought in the application:

१. माहितीचा विषय पुणे शहरातील रस्त्यावरच्या अपघातातील मृत्यू

२. कोणत्या कालावधीसाठी माहिती हवी आहे: १ एप्रिल २०१२ ते ३१ मार्च २०१३

३. माहितीचे विवरण कृपया खालील प्रश्न पाहावेत.

१ एप्रिल २०१२ ते ३१ मार्च २०१३ ह्या वर्षामध्ये रस्त्यावर, वाहतुकीमध्ये झालेल्या अपघाती मृत्यूंविषयी माहिती पुढील तक्त्यांमध्ये भरून द्यावी. ही माहिती पुणे वाहतूक पोलिसांच्या पुणे महापालिका क्षेत्रातील विभागांसाठी एकत्रितपणे द्यावी ही विनंती- (भारती विद्यापीठ, बंड गार्डन, चतुःशृंगी, दत्तवाडी, डेक्कन, फरासखाना, हडपसर, खडक, खडकी, कौढवा, कोथरूड, मुंढवा, सहकार नगर, समर्थ, शिवाजी नगर, स्वारगेट, विमानतळ, विश्रान्तवाडी, विश्रामबाग, वानवडी, वारजे, येरवडा)

१. सर्व मृतांचे वाहनानुसार पृथक्करण

	१ एप्रिल २०१२ ते ३१ मार्च २०१३
एकूण अपघाती मृत्यू	
पादचारी मृत्यू	
सायकलस्वारांचे मृत्यू	
दुचाकी वाहन चालक व वाहनावरील इतर व्यक्ती	
तीनचाकी वाहन चालक व वाहनामधील इतर व्यक्ती	
चारचाकी वाहन चालक व वाहनामधील इतर व्यक्ती	
बस चालक व बसमधील इतर व्यक्ती	
इतर वाहन चालक व वाहनामधील इतर व्यक्ती	

२. सर्व मृतांचे वयोगटानुसार पृथक्करण

	१ एप्रिल २०१२ ते ३१ मार्च २०१३
--	--------------------------------

एकूण अपघाती मृत्यू	
वय ० ते ९	
वय १० ते १७	
वय १८ ते २९	
वय ३० ते ५९	
वय ६० आणि त्यापेक्षा जास्त	

३. मृतांचे कारणानुसार पृथक्करण

पादचारी मृत्यू- एकूण		
	रस्ता ओलांडताना	
	नियंत्रण सुटलेले वाहन पदपथावर अथवा रस्त्याच्या कडेला आल्याने	
सायकलस्वारांचे मृत्यू- एकूण		
	एखाद्या वाहनाने मागून धडक दिल्याने	
	एखाद्या वाहनाने इतर दिशेने धडक दिल्याने	
दुचाकीस्वारांचे मृत्यू- एकूण		
	रिक्षा/ इतर दुचाकी/ चारचाकी ह्यांच्याशी टक्कर झाल्याने	
	बस/ ट्रक अशा अवजड वाहनांशी टक्कर झाल्याने	
	वाहनाशी टक्कर न होता दुचाकी घसरल्याने	
	किती मृत दुचाकीस्वारांनी हेल्मेट घातले होते?	

1.4. How was the data processed

No special processing was needed as the data is very simple.

It is to be noted that the divisions of Pune Traffic Police listed above may not strictly reflect the Pune Municipal area. In particular, please note the following:

- The "Lashkar" division, though not considered above, may not strictly overlap the Pune Cantonment Board area.
- The area along Sinhgad Road beyond Rajaram Bridge does not fall under Pune Police but under Pune Rural Police.

However, these differences are minor in nature and may be ignored, especially while comparing the same data year over year.

1.4.1. Scoring system

The scoring system for this parameter is exactly as stated in the "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India.

1.4.1.1. Fatality rate per lakh population

- a = Record of fatalities from police records.
- b = Population of the urban agglomeration in that year, projected to arrive at current population, taking into account the projected growth rate.
- c = Fatality rate per 100,000 = $[(a * 100,000) / b]$.

The level of service is calculated as

- 1 if c is ≤ 2 persons
- 2 if c is 2-4 persons
- 3 if c is 4- 6 persons
- 4 if c is >6 persons

1.4.1.2. Fatality rate for pedestrian and NMT (%)

- a = From 'a' above, who were pedestrians or on non-motorized vehicles
- b = Record of fatalities from police records.
- c = $[(a / b) * 100]$.

The level of service is calculated as

- 1 if c is $\leq 20\%$
- 2 if c is 20%-40%
- 3 if c is 40-60%
- 4 if c is $>60\%$

1.4.1.3. Score out of 100

The SLB determines the "Overall LoS" from the "calculated LoS". "Calculated LoS" is addition of the two LoS figures above, and can have values from 2 to 8, where 2 indicates "very good" and 8 indicates "very bad". Overall LoS is determined from the following table:

Calculated LoS	2	3, 4	5, 6	7, 8
Overall LoS	1	2	3	4

For the purpose of arriving at a score out of 100, these 7 values are mapped to the range 1-100 using the following formula:

$$\text{Score} = 15 * (9 - \text{Calculated LoS}) - 5.$$

Thus if LoS = 8, Score = 10 and if LoS = 2, Score = 100.

1.5. Inferences drawn from data processing

1.5.1. Data collected

The following tables show the data provided by the traffic Branch of Pune Police in response to the application.

Categorization of fatalities as per mode of transportation

	1 st April 2012 to 31 st March 2013
Total number of fatalities	256
Pedestrians	84
Cyclists	16
2-wheelers: Drivers and riders	129
3-wheelers: Drivers and riders	3
4-wheelers: Drivers and riders	7
Buses: Drivers and riders	5
Other modes: Drivers and riders	12

Categorization of fatalities by age

	1st April 2012 to 31st March 2013
Total number of fatalities	256
0-9 years	11
10-17 years	5
18-29 years	84
30-59 years	113
60 years and above	37

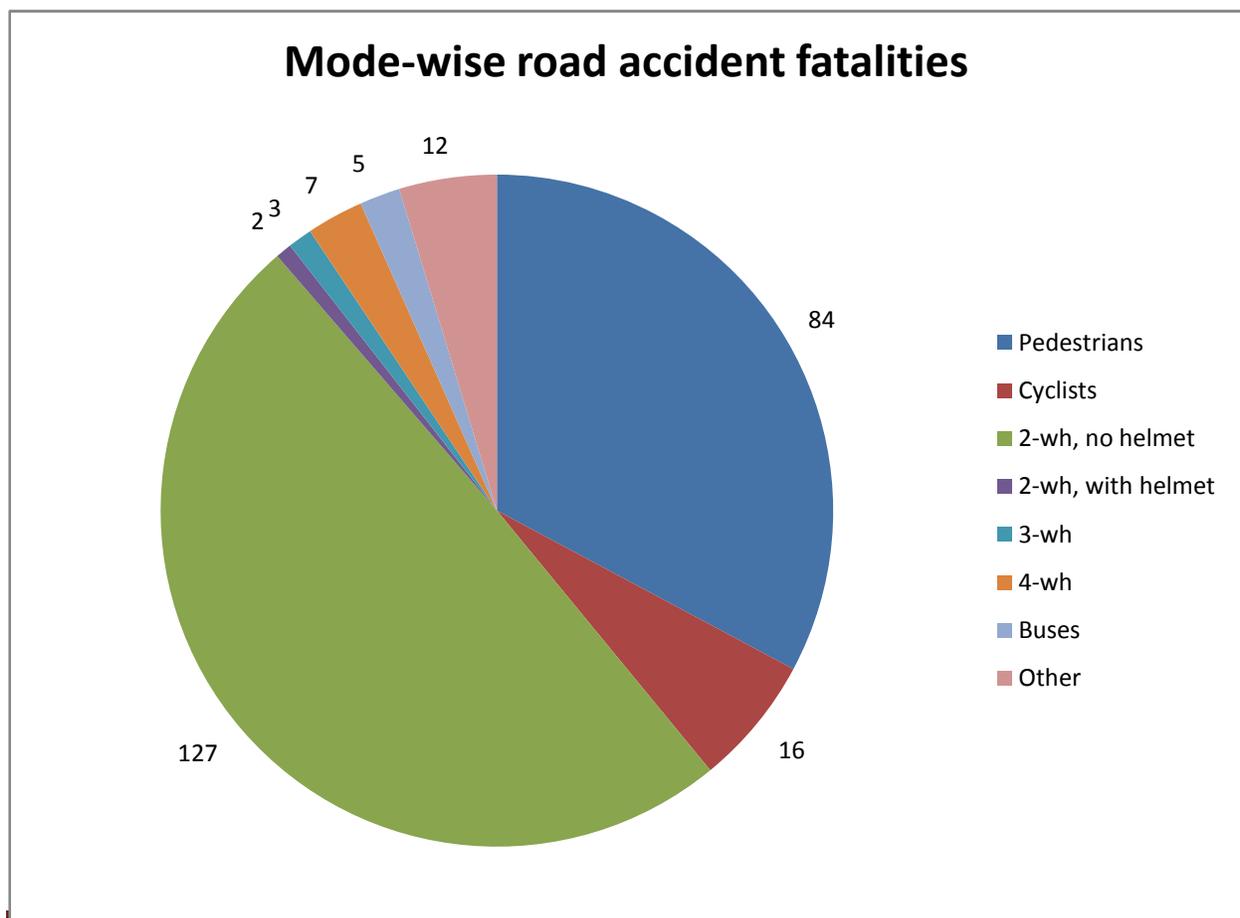
Categorization of fatalities by reason

Pedestrians' fatalities- total	83
---------------------------------------	-----------

	While crossing a road	83
	Another vehicle lost control and came on the footpath/ edge of the road where the pedestrian was walking	0
<u>Cyclists' fatalities- total</u>		16
	Dashed by a vehicle from behind	4
	Dashed by a vehicle from any other direction	12
<u>2-wheelers' fatalities- total</u>		125
	Collision with rickshaw/ other 2-wheeler/ 4-wheeler	37
	Collision with heavy vehicles like bus, truck	53
	No collision with another vehicle, but the 2-wheeler slipped	7
	How many of the deceased were wearing a helmet?	2

1.5.2. Key observations

The following chart shows the road accident fatalities in Pune for various modes in a pictorial format:



The following chart shows the road accident fatalities in Pune for various age groups in a pictorial format:



1.5.3. Calculating Pune's score

1.5.3.1. Fatality rate per lakh population

The fatality rate per 100,000 is $[(\text{no of fatalities} * 100,000) / \text{population}]$.

No of fatalities in Pune in 2012-13 = 256.

Pune population as per 2011 census = 31,15,431.

Pune population as per 2001 census = 25,38,473.

Annual growth = 2.07%

Estimated 2012 population = 31,80,181.

Therefore fatality rate per 100,000 population = 8.05.

"Level of Service" for fatality rate = 4.

1.5.3.2. Fatality rate for pedestrian and NMT (%)

The fatality rate for pedestrians and NMT = [(Pedestrian and NMT fatalities / Total fatalities) * 100].

Pedestrian and NMT fatalities in Pune in 2012-13 = 84 + 16 = 100.

Total fatalities in Pune in 2012-13 = 256.

Therefore fatality rate for pedestrians and NMT = 39%.

"Level of Service" for fatality rate for pedestrians and NMT = 2.

1.5.3.3. Pune's score

Calculated LoS = 4 + 2 = 6.

Overall LoS = 3.

According to the SLB, Pune's road safety can be described as "Needs considerable improvements in road design and available road infrastructure, traffic management and in other such reasons which significantly contribute to road safety."

Score = 15 * (9 - Calculated LoS) - 5 = 40 out of 100.

2. Modal Share

2.1. Why was this parameter selected

The main objectives of any city's transportation system is to provide mobility to people. Considering that people may choose a variety of modes of transportation depending on various parameters like the distance they need to travel, their physical and financial capability, affinity to a particular mode - or whatever the reason may be, the city should provide facilities for a variety of modes, e.g. walking, public transportation, bicycles, rickshaws and taxies, personal vehicles etc.

Some of these modes cannot be used by some people. For example, physically weaker people cannot use a bicycle. People younger than a certain age cannot legally drive a motorized vehicle. Physically challenged people have certain specific needs. Poor people heavily depend

on walking, cycling and public transport to earn a living, and insufficient facilities for these modes could effectively deprive them of even the basic needs. Therefore the objective of a city's transportation system should be to provide mobility to all people.

Considering that the resources a city has at its disposal to provide facilities for all of these modes are limited, it should strive to use these resources as optimally as possible, yet provide a reasonably uniform commuting experience to all modes. To achieve that, various cities decide a target "modal split", or a distribution of which modes should carry how much load of transportation. This target modal split depends largely on the character and needs of the city.

Pune has set such a target "modal split" for itself in the "Comprehensive Mobility Plan", which was drafted in 2008 and approved by the Pune Municipal Corporation in 2012. Achieving the target modal split is one of the most important objectives of the CMP.

A lot of characteristics of traffic, e.g. congestion, pollution, level of satisfaction, access to livelihood etc. depend on the city's "modal split", either directly or indirectly.

It is therefore essential to see what Pune's modal split today is, and whether we are moving in the right direction.

2.2. What data was collected

The parameter "Modal split" is about finding how much of transportation is carried by different modes. This data can be gathered only by conducting a survey of a sample of Pune population.

Such a survey was conducted to understand what modes people use for their transportation needs during a typical working day. The following sample form describes what data was collected.

1. Survey was conducted in all 76 electoral wards, or "prabhags" of PMC. Since all 76 electoral wards have approximately the same population, this ensured that Pune was uniformly represented.
2. The Housing Report by "Mashaal", from which data is taken for the Pune Development Plan (draft) of 2007-2027, was studied. It was found that the distribution of population in Pune according to types of housing is approximately as follows:
 - a. 10% in bungalows, row houses and very high end flats,
 - b. 20% in 2 or 3 BHK, high end flats,
 - c. 40% in 1 BHK or 1 room kitchen, low end dwellings or chawls,
 - d. 30% in slums.

The target for total number of people to be surveyed from all PMC area was set as 6,000. Thus the target for total number of people to be surveyed from any ward was set as 80. Accordingly, the following number of people were surveyed from each electoral ward:

- a. 7-8 from very affluent households,
 - b. 15-16 from well-to-do households,
 - c. 30-32 from relatively cheaper but "pucca" types of households,
 - d. 25 from cheapest, "kuchcha" types of households.
3. In order to ensure that the people surveyed reflect the demographic distribution with respect to age and gender, volunteers were instructed to interview all people in a household.
4. The principal information gathered in the survey focused on how people travel on a typical work day. The above method also ensured that since some people do not venture out of the home even on working days, that information will also be captured.

2.3.2. Ensuring consistency of the survey

The volunteers who executed the survey were provided extensive training that covered the following:

1. How to identify the geographical area to be surveyed
2. How to identify the households to be surveyed
3. How to approach the people to be surveyed
4. What information is to be gathered from them
5. What are the possible exceptional or corner cases and how to address them
6. How to record the information in the forms
7. How to keep track of the progress of their survey

An on-line form was devised to help the volunteers keep track of their survey. A survey coordinator was assigned the task of keeping track of all volunteers, to ensure that the survey as a whole followed the city's demographics.

2.3.2.1. Contents of the training and terminology used

The document "modal-split-survey-training.docx" describes the contents of the training and the terminology used. In particular, it is important to note the definitions of some terms.

Trip

A trip is characterized by an origin, a destination and a purpose. There is some specific activity to be done at the destination, be it for work or pleasure.

Stage

A trip could consist of multiple stages. A stage uses only one mode of transportation.

For example, a person may walk to the nearest bus stop from home, then board a PMPML bus, get down and take a rickshaw to his office. There are 3 stages involved in this trip. First is the walking stage, second is the bus stage and third is the rickshaw stage. All three stages have the same purpose, which is "going to office" in this case, therefore they collectively form a trip.

2.3.2.2. Special conditions and corner cases

Summer vacation

This survey was conducted from 5th May to 24th May 2013. Since this was the summer vacation time for schools, it was difficult to capture trips to school and back from school. In an attempt to capture what this data could have been, two special rows were added in the form. Volunteers were instructed to capture how the children typically travel to and from school, and also whether their parents escort them either way.

Special trips

Some persons like milk vendors, newspaper distributors, sales persons etc typically undertake a large number of trips. This data was captured with help of specially designed fields in the form.

2.4. How was the data processed

2.4.1. Tools and mechanism

The data was captured in machine readable forms. The forms were scanned using Optical Mark Recognition (OMR) software, which generated an MS Excel file from the data.

This data was then processed using MS Excel features like filters, as well as Visual Basic scripts.

2.4.2. Sanity checks and corrections

An initial, "sanity check" was performed to verify whether the collected data followed the target distribution. As explained above, each volunteer was given a target of number of individuals to survey from various kinds of households that reflected Pune's demographic distribution. The following table describes the target distribution and the actual distribution by household types.

Household type	Bungalows, row houses, very high end flats	2, 3 BHK high end flats	1 BHK or 1 room kitchen, low end dwellings or chawls	Slums
Target	10%	20%	40%	30%
Actual	11.0%	21.9%	37.5%	29.6%

It was observed that data for some stages was filled erroneously in some of the forms. For example, two modes of transport were marked for the same stage.

Such data was corrected where appropriate, using Visual Basic scripts. Some data was discarded where correction was not possible. The volume of discarded data is estimated at less than 2.5% stages.

2.4.3. Combining stages to form trips

Since transportation planning literature considers trips and not stages, it is important to figure out trip data from stages data.

Given the time taken and distance traveled for individual stages, it is trivial to find out the time and distance for the entire trip. However, since the objective is to find out trips conducted by various modes, and not stages, we need to assign a single mode to the entire trip. The following reasoning was used for this purpose.

As an example, let us consider that a person either walked to a bus stop or was dropped at a bus stop by a family member from home and then took a bus to his office. However, since he took a bus for his main stage, it can be said that he really wanted to do the home to office trip by a bus. Therefore, any trips with multiple stages in which at least one stage is by bus can be considered to be a bus trip. Here the "bus" can be considered as the "ruling mode" of the trip.

The following modes were considered as "ruling modes", in the order given below:

Bus (implying a PMPML bus), private bus, 4wh, 2wh, rickshaw, bicycle, walk, "other".

2.4.4. Scoring system

2.4.4.1. Interpretation of modes of transportation

The survey considered the following 8 modes of transportation:

Walking, cycling, PMPML bus, private (e.g. company provided) buses, rickshaws, 2-wheelers, 4-wheelers, other.

PMPML buses, private buses and rickshaws were clubbed together in the broad category of "public transportation". Taxis were considered in the same category as rickshaws. Rickshaws, or "intermediate public transport (IPT)" in general, was also included in this category because the CMP does not provide a separate category for IPT.

2- and 4-wheelers were clubbed together in the category "personal (motorized) vehicles".

The category "other" might include the local trains, or even animal drawn carriage. The number of stages or trips by this category was found to be very small.

2.4.4.2. Target modal split

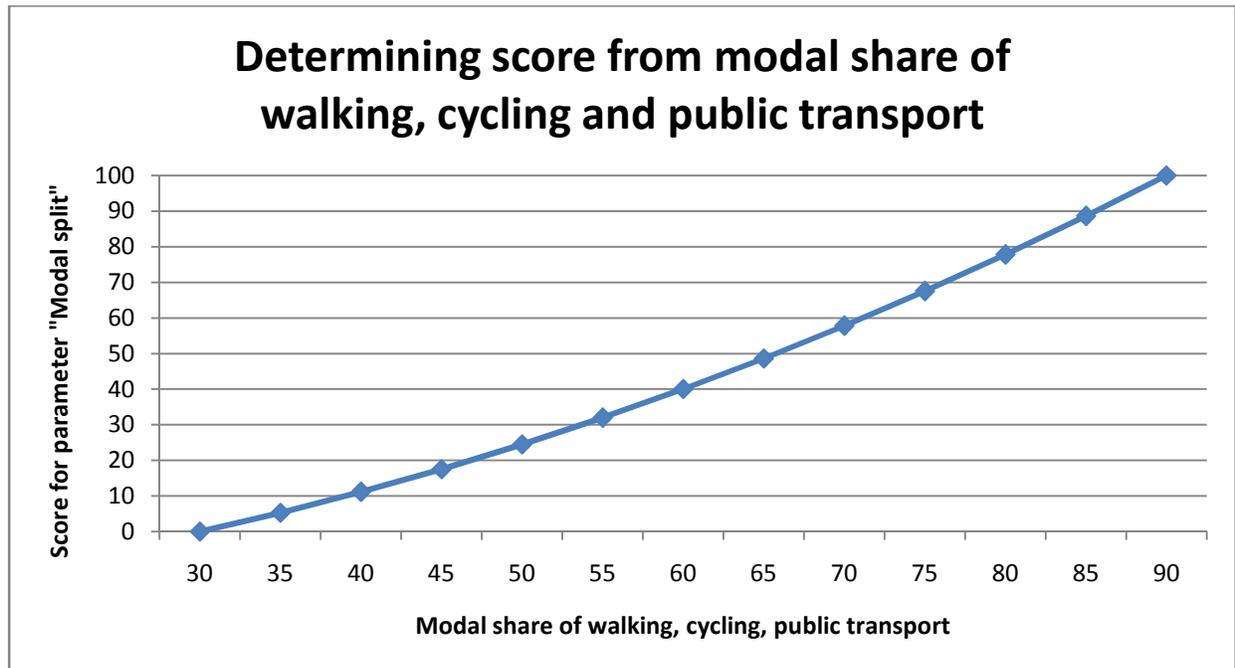
The target modal split for Pune is expressed in Pune's Comprehensive Mobility Plan as follows:

1. It is desired that 50% of all trips be conducted with non-motorized modes. This includes walking and cycling trips.
2. 80% of all motorized trips should be done by public transportation. Thus it is desired that 40% of all trips should be by public transportation.
3. No 1 and 2 above accounts for 90% of all trips.
4. Trips to be conducted by rickshaws and taxis ("intermediate public transport") are not specified. Likewise, trips to be conducted by personal vehicles are also not specified.
5. Since it is unreasonable to assume that trips by rickshaws and taxis as well as personal vehicles should be 10%, it may be inferred that trips to be done by intermediate public transport are clubbed with no. 2 above.
6. Therefore we arrive at the following target "modal split":
 - A. Walking and cycling: 50%
 - B. Public and Intermediate public transport: 40%
 - C. Personal vehicles: 10%

- The overall tone of the CMP is to encourage walking, cycling and public transport and to discourage the use of personal vehicles. Therefore the modes in 6A and 6B above can together be considered as encouraged modes, with a combined target of 90% trips.

2.4.4.3. Score out of 100

A formula is devised to determine a score out of 100 from the following graph:



This graph is devised from the following reasoning:

Since the combined target modal share of the encouraged modes is 90% as per the CMP, achieving this target is assigned a score of 100.

It is generally found that the modal share walking does not drop below about 20% trips irrespective of the nature of transportation. It follows that the modal share of walking, public transport and cycling would not go below about 30%. This situation is assigned a score of 0.

This fixes the end points of the intended graph. One option was to let the graph be a straight line. However, since it is increasingly difficult to incrementally improve the modal share of cycling and public transportation, every incremental improvement in the modal share of these modes should be awarded more points. Therefore the intended locus should have a slight "curvature".

Considering all these factors, the combined modal share of walking, public transport, cycling is CMS, the score is defined by the equation $(CMS - 30) + (CMS - 30)^2 / 90$.

The following table makes this clearer.

Combined modal share of walking, cycling and public transport	Score (rounded off)	Incremental increase in score
30	0	
35	5	5.3
40	11	5.8
45	18	6.4
50	24	6.9
55	32	7.5
60	40	8.1
65	49	8.6
70	58	9.2
75	68	9.7
80	78	10.3
85	89	10.8
90	100	11.4

2.5. Inferences drawn

2.5.1. Things to keep in mind

The following things must be kept in mind while understanding and interpreting the modal split data.

1. Pune being a large city draws a considerable floating population for work every day. Pune's transportation system should be designed to cater to transportation needs of not only the resident population but also the floating population. The survey did **not** take this population into account. It could be said that most of the trips conducted by the floating population would be by public transportation and personal vehicles rather than the non-motorized modes.
2. The survey was conducted during summer vacations. Although an attempt has been made to capture the trips that would be usually made for educational purposes, both by

students and their escorts, the actual data could have been different, had the survey been conducted before the vacations began.

2.5.2. Data collected

The following table summarizes the data collected from the modal split survey.

Sr No	Description	Number
1	Number of individuals surveyed Males Females	3608 54% 46%
2	Number of wards surveyed	48 out of 76
3	Number of "trips" on which data was collected	10,197
4	Number of "stages" that make these trips	10,870

Scans of survey forms of all 3,608 individuals are available upon request.

Note

The number of stages per trip is noticeably lower than the generally observed values. This can be attributed to possible differences in the way the terms "stage" and a "trip" are interpreted.

The following logic was used to correct some of the data and also to achieve consistency in data collected by all volunteers:

- If a stage had a different purpose than the previous stage, it was marked as a new trip.
- If a stage started after a large gap in time (at least one clear time slot between two stages), it was marked as a new trip.

In our opinion this reasoning can identify stages erroneously marked as a continuation stage and can correct them as new trips. Yet, there is a very slight, though theoretical, possibility that some trips remain marked as new trips when they should have been marked as continuation stages. This might lead to a slightly higher number of trips than there actually are.

Interpretations that could be affected because of this error:

- Number of stages per trip
- Length of each trip
- Distance of each trip

- Number of trips per person

The following interpretations are unlikely to be affected because of this error:

- Modal split by number of trips
- Modal split by time spent and distance covered by various modes
- Modal split by demographics: Earning levels, gender, age etc.

In other words, this error may affect interpretations where one is concerned about the absolute time and distance of the trip but not where one is concerned about distribution by various modes.

Number of stages per trip

Number of stages = 10,870.

These stages were "stitched" to form 10,197 trips.

Number of stages per trip = 1.07.

2.5.2.1. Actual sample size

Although the size of the sample was targeted at about 6,000, lack of sufficient number of volunteers led to a survey of 48 wards out of 76. Some wards were surveyed only partially. Still, the total number of individuals surveyed is 3,608, which is about 60% of the target.

The following map depicts which parts of Pune were surveyed. A green 'pin' indicates a ward that was surveyed.

2.5.3. Observed modal split

The number of trips observed by various modes is given in the table below. The target modal split for 2028 as stated in the CMP is provided for comparison.

Mode	No of trips	Modal split	Aggregated mode	Modal split	Target (2028) Modal split
Walking	2,761	28.0%	Non-motorized modes	33.2%	50%
Cycling	511	5.2%			
PMPML bus	807	8.2%	Public transportation	18.8%	40%
Private bus	269	2.7%			
Rickshaws	778	7.9%			
2-wheelers	3,455	35%	Personal vehicles	46.9%	10%
4-wheelers	1,165	11.8%			
Other	114	1.1%	Other	1.1%	
TOTAL	9,680				

Note:

Although the total number of trips observed in the survey is 10,197, the modal data was not noted for some trips. The analysis above considers only those trips for which modal data was available.

Estimate of total number of trips

Pune's population for 2013 is estimated to be 32,46,011. Number of people surveyed were 3,608. From these figures, the total number of trips with various modes is estimated as follows:

Mode	No of stages
Walking	2,483,990
Cycling	459,732
PMPML bus	726,034
Private bus	242,011
Rickshaws	699,944
2-wheelers	3,108,361
4-wheelers	1,048,116
Other	102,562
TOTAL	8,870,750

It is to be noted that this estimate is for area within Pune Municipal Corporation limits.

2.5.4. Other key observations

The table above summarizes all trips by all kinds of people. It is interesting to see how demographical considerations affect the modal split as well as other characteristics of the daily commute of Pune residents. The data gathered from this survey was analyzed to find answers to the following questions also, apart from merely the modal split of Pune's transportation.

Modal split by stages

Mode	No of stages	Modal split	Aggregated mode	Modal split	Target Modal split
Walking	3,229	30.8%	Non-motorized modes	35.8%	50%
Cycling	526	5.0%			
PMPML bus	821	7.8%	Public transportation	18.0%	40%
Private bus	269	2.6%			
Rickshaws	796	7.6%			
2-wheelers	3,538	33.7%	Personal vehicles	45.0%	10%
4-wheelers	1,183	11.3%			
Other	136	1.3%	Other	1.3%	

TOTAL	10,498				
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Note: Although the total number of stages observed in the survey is 10,870, the modal data was not noted for some stages. The analysis above considers only those stages for which modal data was available.

Modal split by time and distance

For this purpose, each **stage** was considered by itself. The following table indicates split of the time Pune-kars spend by each mode and split of the distance travelled by that mode.

The "distance/ time benefit" is an indication of how fast that mode could be perceived in Pune's traffic.

Mode	Time spent	Distance travelled	Distance/ time "benefit"
Walking	22.2%	4.2%	0.19
Cycling	4.2%	2.5%	0.60
PMPML bus	10.8%	9.0%	0.83
Private bus	4.2%	4.3%	1.04
Rickshaws	5.9%	5.9%	1.00
2-wheelers	37.7%	57.4%	1.52
4-wheelers	13.4%	16.5%	1.23
Other	1.6%	0.2%	0.13

Modal split only by number of trips is considered for the rest of the analysis below.

Modal split by time of the day

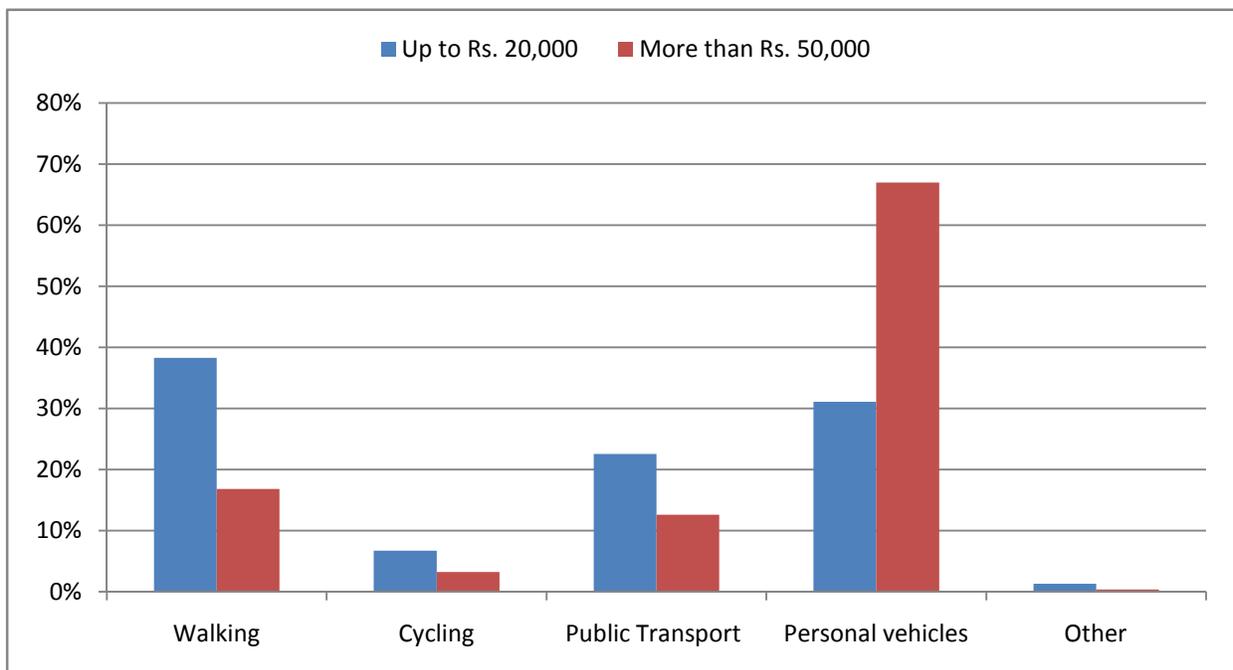
Mode	Before 8 am	8 - 11 am	11 am - 5 pm	5 - 8 pm	After 8 pm
Walking	37.5%	23.6%	26.8%	34.5%	26.3%
Cycling	8.0%	4.9%	5.4%	3.0%	3.5%
PMPML bus	10.2%	10.0%	9.7%	8.5%	6.1%
Private bus	7.1%	2.4%	3.2%	2.4%	1.5%
Rickshaws	5.0%	4.6%	7.7%	4.0%	4.8%
2-wheelers	25.0%	42.8%	36.7%	37.8%	41.5%
4-wheelers	6.5%	11.0%	9.7%	9.4%	15.4%
Other	0.6%	0.7%	0.8%	0.4%	1.0%
Total trips	11.3%	26.6%	22.8%	29.8%	9.5%

Modal split by earning levels

Mode	Less than Rs. 10,000	Rs. 10,000 - 20,000	Rs. 20,000 - 50,000	Rs. 50,000 - 1,00,000	More than Rs. 1,00,000
Walking	48.1%	31.5%	26.6%	14.4%	22.9%
Cycling	7.7%	6.0%	3.7%	3.8%	1.7%
PMPML bus	12.2%	15.8%	10.2%	3.9%	2.6%
Private bus	1.8%	2.4%	3.3%	5.3%	1.3%
Rickshaws	5.5%	6.5%	4.3%	5.4%	3.9%
2-wheelers	20.2%	34.1%	44.3%	47.2%	40.0%
4-wheelers	2.4%	3.0%	6.8%	19.5%	27.6%
Other	2.2%	0.7%	0.6%	0.5%	0.0%
Number of respondents	17.1%	23.9%	27.4%	23.0%	8.6%

The table above deserves some commentary.

- The table above shows modal split of only about 60.5% respondents who disclosed the band in which their family income falls. Therefore the row "number of respondents" may not reflect the demographic distribution.
- The share of walking trips declines predictably up to the income group of Rs. 50,000 - Rs. 1,00,000 p.m. but then increases suddenly. This phenomenon might need further investigation.
- The modal share of PMPML for the poorest group is lower than that for the income group of Rs. 10,000 - Rs. 20,000 pm. The table above might suggest that PMPML is not affordable for this group and they prefer to walk instead.
- The following chart shows the modal split of the lower two and upper two income groups. Bus, private bus and rickshaw are combined in the category "public transport", while 2 and 4 wheelers are combined in the category "personal vehicles".



Modal split by gender

Mode	Females	Males
Walking	39.9%	21.2%
Cycling	2.6%	6.3%
PMPML bus	11.1%	7.6%
Private bus	2.5%	3.3%

Rickshaws	6.6%	4.1%
2-wheelers	30.0%	43.6%
4-wheelers	6.8%	12.9%
Other	0.4%	0.9%

Modal split by age

Mode	< 10 years	10-17 years	18-29 years	30-59 years	> 60 years
Walking	43.1%	37.1%	21.6%	24.5%	51.7%
Cycling	2.1%	15.5%	3.5%	4.6%	2.3%
PMPML bus	4.5%	11.1%	11.0%	6.6%	7.2%
Private bus	9.2%	7.5%	2.5%	1.7%	0.0%
Rickshaws	15.5%	9.1%	2.6%	9.0%	9.8%
2-wheelers	18.4%	15.0%	50.6%	36.4%	16.7%
4-wheelers	5.4%	3.8%	7.2%	15.7%	11.8%
Other	1.9%	0.8%	1.0%	1.4%	0.5%
Total no of trips	425	1,073	2,550	4,775	824

Modal split for educational trips

Mode	%
Walking	40.0
Cycling	13.4
PMPML Bus	8.7
Private bus	8.9
Rickshaw	12.1
2 wheeler	10.3
4 Wheeler	5.1

Other	1.5
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Distribution of time taken for trips

Time taken for each stage of a trip was added to determine the time taken for the trip.

Time in minutes	% of trips	Time in minutes	% of trips under that time
Less than 15	36.3%	15	36.3%
16 to 30	40.9%	30	77.2%
31 to 45	20.5%	45	97.8%
46 to 60	1.1%	60	98.9%
More than 60	1.1%		

Note

Information on time taken for some of the stages was not provided by the people, yet the stages are added to form a trip. For example, time taken for a walking stage might be missing but a subsequent bus stage might have been recorded to take 20 minutes. In such a case, although the actual time taken for the trip could be about 30 minutes, it might have been recorded as a 20 minute trip. The table above should be interpreted accordingly.

Please see the note in the paragraph "2.5.2. Data collected".

Distribution of length of trips

The survey did not ask people to mention the distance of their trips as many people cannot estimate distances with reasonable accuracy. Therefore it was derived from the time taken for each stage and the mode used for that stage.

The following average speeds were assumed in calculating the distance for each stage:

Walking: 3.5 kmph, cycle: 12 kmph, PMPML bus: 16 kmph, private bus: 20 kmph, rickshaws: 20 kmph, 2-wheelers: 30 kmph, 4-wheelers: 25 kmph.

Length of each stage was calculated from the assumed speeds and the time taken for each stage. Lengths of all stages that constitute a trip were added to arrive at the length of each trip.

Length in km	% of trips	Length in km	% of trips shorter than that length
Less than 5	52.3%	5	52.3%
5 to 10	29.5%	10	81.8%
10 to 15	5.7%	15	87.5%
15 to 20	4.1%	20	91.6%
20 to 25	8.1%	25	99.7%
More than 25	0.3%		

Please also see the note in section "Distribution of time taken for trips" above.

2.5.5. Perception of Pune's transportation

The survey also included questions that could throw some light on how people perceive the city's transport system.

Women's safety

These questions were asked only to women above 12 years.

Do women face incidents of eve teasing while in traffic?

Never	Rarely	Frequently	No response
64.8%	15.2%	2.6%	17.4%

For women who faced incidents of eve teasing, with which modes of transport did they encounter such incidents? (As multiple modes could be cited, the total may exceed 100%)

Mode	Percentage of incidents of eve teasing
Walking	9.1
Cycling	1.4
PMPML Bus	14.7
Private bus	0.9
Rickshaw	3.1

2 wheeler	9.3
4 Wheeler	3.4
Other	0.4
No specific mode mentioned	71.8

Accidents

The survey asked people whether they have encountered any small or big accident in the last year or so. They were asked to consider even minor incidents as accidents, because even minor incidents have a potential of turning into a bad accident. The decision of whether an incident should be counted as accident was left to people.

About 9.5% people said that they have encountered one or more accident in the last year, whether major or minor.

No accident	One accident	Two or more accidents	No response
80.0%	8.3%	1.2%	10.4%

People were also asked to state which mode they were using when they had the accident. However, it looks like this question was not understood properly, so we are not including any outcome in this report.

Unused modes

Which modes were virtually never used by some people in the last one year?

Mode	% of respondents
Walk	2.8
Cycle	42.1
PMPML bus	23.3
Private bus	37.0
Rickshaw	9.8
2 wheeler	10.7
4 Wheeler	24.9

It is difficult to imagine that 2.8% people never walked (outside their home or society) in the last year or so, but the other numbers seem to follow the general impression.

Vehicle ownership per household

How many households have a bicycle? How many have a 2-wheeler? How many have a 4-wheeler?

How many households don't have a 2-wheeler or a 4-wheeler? How many don't have even a bicycle?

Have	Bicycle	38.6%
	2-wheeler	78.2%
	4-wheeler	42.0%
Don't have	Neither a 4-wheeler, nor a 2-wheeler	18.7%
	Neither a 4-wheeler, nor a 2-wheeler, nor even a bicycle	12.4%

2.5.6. Pune's score

As described in the paragraph "Method of Scoring", the score is determined as follows:

CMS = combined modal share of walking, public transport, cycling = 33.2% + 18.8% = 52%.

Score = $(CMS - 30) + (CMS - 30)^2 / 90 = 27$ out of 100.

3. Facilities for pedestrians

3.1. Why was this parameter selected

Walking is the only mode of transportation that can be used by almost everyone irrespective of age, gender and income level. Everyone rightfully deserves a safe and convenient walking infrastructure.

If good walking infrastructure is not available, people are forced to walk on road and cross the roads in an unsafe manner. This results in increased accidents.

3.2. What data was collected

Walking on the roads consists of primarily two activities: walking on one side of the road and crossing the road to get to the other side.

Therefore the TSR collected data for the most common and universal infrastructure associated with these two activities, namely the footpaths and pedestrian crossings.

Only at-grade crossings at road junctions were considered for this report to keep the scope manageable. Mid-block crossings (raised non-signalized / raised signalized / regular zebra stripes) were not considered, as these are not consistently present on all roads in the city. Pedestrian over-bridges and pedestrian subways were not considered as these are present at very few locations and are mostly unused.

3.2.1. Footpaths

Four parameters were considered regarding footpaths, namely:

- Width of the footpath
- Surface of the footpath
- Obstructions to walking on the footpath
- Bollards

Width

According to Indian Road Congress (IRC) norms, a footpath needs have a continuous minimum width of 1.8m. In areas of higher pedestrian concentration (like commercial areas and near transit stations), it needs to be even wider. Since many footpaths in Pune are not of uniform width, the width available for majority of the footpath length was considered.

Surface

The surface of the footpath needs to be even (unbroken and non-undulating) and non-slippery. Since slipperiness can be subjective, only the evenness of the surface was considered.

Obstructions

In Pune, many kinds of obstructions are observed to be present on the footpath. These include permanent obstructions like junction boxes, electric poles, signposts, garbage cans, bus stops, trees, etc. as well as transient obstructions like street vendors, flex boards, advertising boards, construction material, etc.

Bollards

It is not uncommon to see motorcycles ride on the footpath to get ahead of traffic jammed on the road. It is also fairly common to see motorcycles and cars parked on the footpaths, blocking the way of the pedestrians. Bollards are typically used to prevent the motorized vehicles from getting on to the footpath. The presence/absence of the bollards at both ends of the footpath and their ability to meet the stated goal were surveyed.

3.2.2. Pedestrian crossings

For **pedestrian crossings**, three parameters were considered, namely:

- Presence and condition of zebra stripes
- Pedestrian phase in the signal cycle (in case signalized junctions)
- Presence and condition of pedestrian signals (in case of signalized junctions)

Zebra Stripes

The zebra stripes are the primary road-crossing infrastructure and are expected to be present at all road junctions.

Pedestrian Phase

As currently implemented in Pune, the pedestrian phase of the signal cycle is the duration for which ALL vehicular signals show RED. This allows pedestrians to cross any segment of the road.

Pedestrian Signals

The green and red pedestrians signals indicate when it is safe for pedestrians to cross a particular segment of the road. Minimum two sets (one set consisting of green and red aspect, either separate or integrated into a single multi-purpose aspect) are needed for each road meeting in the junction.

3.3. How was the data collected

The data was collected through an on-site survey conducted by volunteers at representative random sample locations and scores were assigned for each of the parameters. For the purpose of the data collection, 50 locations were surveyed, consisting of 35 crossings and 15 footpaths. For this exercise, a footpath means a one-kilometer stretch of a footpath on one side of the given road.

The crossings include a mix of large junctions (signalized), medium junctions (signalized), small junctions (signalized), small junctions (non-signalized), and transit hubs (bus stations / train stations / local bus stands).

3.4. How was the data processed

Frequency of each score for each category was determined.

3.4.1. Scoring system

Scoring for Footpath stretches

Footpath Width (excluding cycle track, if any)

0	Footpath absent
1	Width < 2m
2	Width >= 2m
4	Width >= 3m

Footpath Surface

0	Mostly uneven / broken / up-and-down surface
1	Some uneven / broken / up-and-down surface
2	Even / non-slippery surface throughout the stretch

Encroachment per km

0	7 or more encroachments
1	Between 3 and 6 encroachments
2	2 or less encroachments

Bollards

0	No bollards allowing motorcycles / cars to get on the footpath
1	Bad / broken / widely-spaced bollards that allow motorcycles / cars to get on the footpath
2	Good bollards that prevent motorcycles from traveling on footpath

What constitutes an encroachment?

Permanent obstructions like electric and telephone poles, support wires for poles, telephone junction boxes, electrical DP boxes, garbage bins, raised manhole covers, any step taller than 6", bus shelters, etc.

Temporary obstructions like street vendors, hoardings (that are lower than 7' height), advertisements, construction material, merchandise and anything that gets in the way of walking.

Scoring for Signalized Intersection:

Zebra Crossing

0	No markings are present or only faint markings are present
1	Some visible markings are present OR duplicate zebra stripes
2	Acceptable markings on most road segments
4	Bright & clear markings present on ALL road segments

Pedestrian phase

0	< 10 seconds
1	Between 10 and 15 seconds
2	>= 16 seconds

(The IRC guidelines prescribe a duration for the pedestrian phase. This duration depends on the width of the widest road to be crossed. For most roads in Pune, this duration would be very close to 16 seconds. To keep the process simple for the surveyors, 16 seconds was used as the desired pedestrian phase for all intersections surveyed.)

Working pedestrian lights

0	No pedestrian signals are present or none are in working condition
1	Some pedestrian signals needed are absent
2	All pedestrian signals needed are present, but some are not working
4	All pedestrian signals needed are present and working.

Scoring for Non-signalized Intersection

Zebra Crossing

0	No markings are present
3	Some visible markings are present OR duplicate zebra stripes
6	Acceptable markings on most road segments
10	Bright & clear markings present on all road segments

3.4.1.1. Score out of 100

For each junction and footpath stretch, a maximum of 10 points can be awarded. The total of 500 points (50 location x 10 points each) are represented as a percentage between 0 and 100 in the TSR.

3.5. Inferences drawn from data processing

State a question. Provide data: direct or processed. Data can be provided in tables/ graphs/ charts. If providing graphs/ charts, display data labels. e.g. reader should not have to guess whether it is "between 60-70%". Label should say "64%".

The owner should decide whether to use pie charts/ bar graphs/ simple tables/ whatever. The Editorial Board will decide which of these data/ inferences will be included in the hard copy version.

3.5.1. Data collected

The data collected is shown in the tables in the following two sections ("3.5.1.1. Footpath survey" and "3.5.1.2. Junction survey") along with the points awarded to the respective footpaths and junctions as per the scoring system described above.

3.5.1.1. Footpath survey

Road Name	Footpath From - To	Side of Road	Footpath Width	Footpath Surface	Obstructions	Bollards	Score
Anant Kanhere Path	Indradhanushya, towards LBS Road	Right	1	2	1	0	4
Bajirao Road	Belbaug towards Shanipar	Right	1	2	1	0	4
Bibwewadi – Kondhwa Road	Bibwewadi Road, towards Lulla Nagar	Right	2	2	1	0	5
Handewadi Road	Jain Township, towards Saswad Road	Right	0	0	0	0	0
Jawaharlal Nehru Road	Seven Loves Chowk towards Market Yard	Left	2	1	0	0	3
Karve Road	Paud Phata, towards Karve Putala	Left	2	2	1	1	6
Katraj – Kondhwa Road	Undri Junction, towards Satara Road	Left	0	0	0	0	0
Kelkar Road	Baba Bhide Bridge junction, towards Appa Balwant Chowk	Left	0	0	0	0	0
Kondhwa Road	Gera Junction, towards Saswad	Left	1	1	1	0	3

Road Name	Footpath From - To	Side of Road	Footpath Width	Footpath Surface	Obstructions	Bollards	Score
Kumthekar Road	Vishrambaug Wada, towards Alka Talkies	Left	1	1	0	0	2
Law College Road	Kanchan Galli, towards Nal Stop	Left	2	1	1	1	5
Laxmi Road	Vijay Talkies towards Belbaug	Left	2	2	0	0	4
Mohammadwadi Road	Railway crossing, towards Mohammadwadi	Right	0	0	0	0	0
Satara Road	Laxminarayan towards City Pride	Left	1	1	1	1	4
Swami Vivekanand Road	N Road junction, towards Upper Indira Nagar	Right	2	1	1	0	4
Total points obtained			17	16	8	3	44
Total points possible			60	30	30	30	150

3.5.1.2. Junction survey

Junction Name	Junction Type	Scores			
		Zebra	Pedestrian Phase Time	Pedestrian signals	Total
Ashish Garden Chowk (Kothrud)	Small non-signalized	3	-	-	3
Bhide Bridge / Kelkar Road	Small non-signalized	10	-	-	10
Dr Ketkar Road / Bhandarkar Road	Small non-signalized	0	-	-	0
Gujarat Colony Chowk	Small non-signalized	0	-	-	0
Nagnath Par Chowk	Small non-signalized	0	-	-	0
NIBM Road / Hadapsar Road	Small non-signalized	0	-	-	0
Saswad-Pune Road / Phursungi Bhekrai Road	Small non-signalized	0	-	-	0
Vijay Talkies (Laxmi Road)	Small non-signalized	0	-	-	0

Junction Name	Junction Type	Scores			
Omkareshwar Mandir	Small non-signalized	6	-	-	6
Hadapsar PMPML Depot	Transit Hub	6	-	-	6
Kothrud PMPML Depot	Transit Hub	1	1	1	3
Anant Kanhere Path / Datta Wadi Road Junction	Small signalized	2	1	2	5
Appa Balwant Chowk	Small signalized	4	2	1	7
Athavale Chowk (Law College Road)	Small signalized	1	2	2	5
Belbaug Chowk	Small signalized	4	2	2	8
Karnatak High School (Gulawani Maharaj Road)	Small signalized	4	0	0	4
Neelayam Chowk	Small signalized	4	1	1	6
NIBM Chowk	Small signalized	2	0	0	2
Ogale Chowk (Paud Road)	Small signalized	2	1	1	4
Senadatt Police Chowky	Small signalized	2	1	2	5
Vasant Baug Chowk	Medium signalized	2	1	1	4
Gangadham Chowk	Medium signalized	0	1	2	3
Golibar Maidan Chowk	Medium signalized	1	0	2	3
Hutatma Rajguru Chowk	Medium signalized	2	2	2	6
Lulla Nagar Chowk	Medium signalized	2	0	4	6
Panchami Chowk	Medium signalized	2	0	0	2
Satara Road (Market Yard)	Medium signalized	2	1	4	7
Seven Loves Chowk	Medium signalized	2	1	4	7
Shanipar Chowk	Medium signalized	4	2	1	7
Karve Nagar Chowk	Large signalized	1	0	1	2
Katraj-Kondhwa Road / Satara Road	Large signalized	2	1	4	7
Khandujibaba Chowk	Large signalized	4	1	1	6
Nal Stop	Large signalized	1	1	1	3
Tilak Chowk	Large signalized	2	1	1	4
Warje Highway Chowk	Large signalized	1	0	1	2
Total points obtained		79	23	41	143
Total points possible		200	50	100	350

3.5.2. Key observations

3.5.2.1. Regarding footpaths

Footpath Width

The following table shows the percentages of footpaths in Pune having different widths.

No Footpath	Width < 2m	Width >= 2m	Width >= 3m
27%	33%	40%	0%

Footpath surface

The following table shows the percentages of footpaths in Pune having different surface quality.

Mostly uneven surface	Partly uneven surface	Even surface
27%	40%	33%

Obstructions on footpath

The following table shows the percentages of footpaths in Pune having different number of obstructions.

>7 obstructions per footpath km	3-6 obstructions per footpath km	<2 obstructions per footpath km
47%	53%	0%

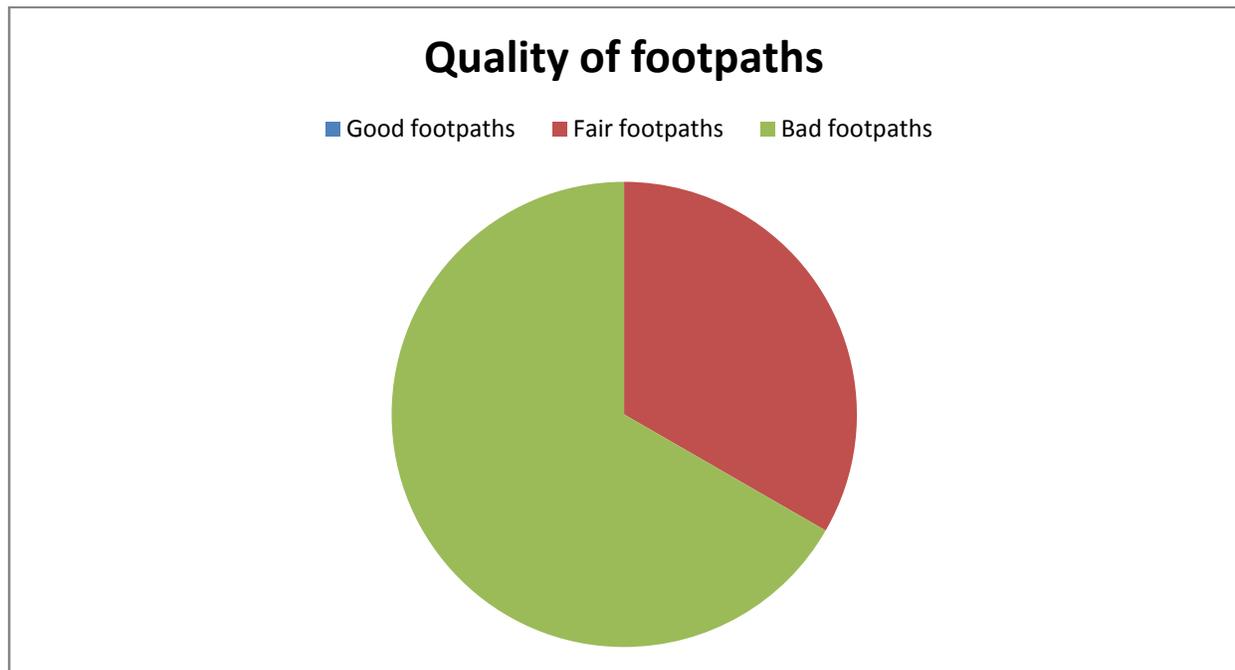
Presence of bollards

The following table shows the percentages of footpaths in Pune having no / bad / good bollards, to deter vehicles from coming on to footpaths.

No bollards	Bad bollards	Good bollards
80%	20%	0%

“Good” footpaths

The following chart shows the percentage of footpaths in Pune that can be classified as “good”, “fair” and “bad”. “Good” indicates a footpath that is at least 2m wide, has even surface and less than 2 obstructions per km. “Fair” indicates a footpath that is at least 2m wide, has even or somewhat uneven surface and less than 6 obstructions per km. “Bad” indicates all other footpaths.



3.5.2.2. Regarding junctions

Visibility of zebra stripes

The following table indicates the percentages of zebra stripes in Pune that are absent or poor / acceptable / good.

Absent or poor zebra stripes	Acceptable zebra stripes	Good zebra stripes
40%	40%	20%

Duration of pedestrian phase in signal cycles

The following table shows the percentages of signals in Pune having non-adequate / barely adequate / adequate time for pedestrians to cross the road.

No or insufficient pedestrian time	Barely adequate pedestrian time	Sufficient time for pedestrians
28%	52%	20%

Presence of working pedestrian signals

The following table shows the percentages of chowks in Pune where pedestrian signals are working.

Pedestrian signals absent or not working	Pedestrian signals partially working	Pedestrian signals fully working
56%	28%	16%

Pedestrian signal visibility

The following chart shows the percentages of chowks in Pune where pedestrian phase is adequate and is visible to the pedestrians and motorists alike.

Pedestrian phase inadequate or non working ped signals	Pedestrian phase adequate and working ped signals
64%	36%

“Good” Junctions

The following chart shows the percentage of junctions in Pune that can be classified as “good”, “fair” and “bad”. “Good” indicates a junction that has adequate or good zebra stripes, adequate pedestrian phase and fully working pedestrian signals. “Fair” indicates a junction that has adequate or good zebra stripes, barely adequate or adequate pedestrian phase and partially / fully working pedestrian signals. “Bad” indicates all other junctions.



3.5.3. Pune's score out of 100

As per the data collected in footpath and junction surveys:

About footpaths	Footpath Width	Footpath Surface	Obstructions	Bollards	Total score
Total Points obtained	17	16	8	3	44
Total Points possible	60	30	30	30	150
About junctions		Zebra	Pedestrian Phase Time	Pedestrian signals	Total score
Total points obtained		79	23	41	143
Total points possible		200	50	100	350

Total score = 44 + 143 = 187 out of 500,

or 37 out of 100.

4. Quality of Public Transportation

4.1. Why was this parameter selected

Among all modes of transportation, public transportation is the only one that provides all of the following advantages:

- Flexibility:
 - It can provide mobility over short as well as long distances.
- Socio-economic equitability:
 - People of all ages can use it.
 - People of all economical strata can use it.
 - If designed properly, it also enables persons with disabilities to be independently mobile.

In addition, public transportation generally uses the land most efficiently in terms of land used per person. If maintained well, it also uses less fuel per person and causes less pollution per person compared to motorized personal vehicles. Therefore public transport is a more sustainable form of transportation. The National Urban Transport Policy of India¹ explicitly mentions its support and encouragement to public transport system in cities of India. It spells out that, 'Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes' should be the goal of all cities in India.

It is because all of these and such reasons that cities try to increase the modal share of public transportation. It is therefore the second most important mode that cities should cater to, after walking. "Public transport facilities" is hence an important benchmark in the SLBs published by MoUD.

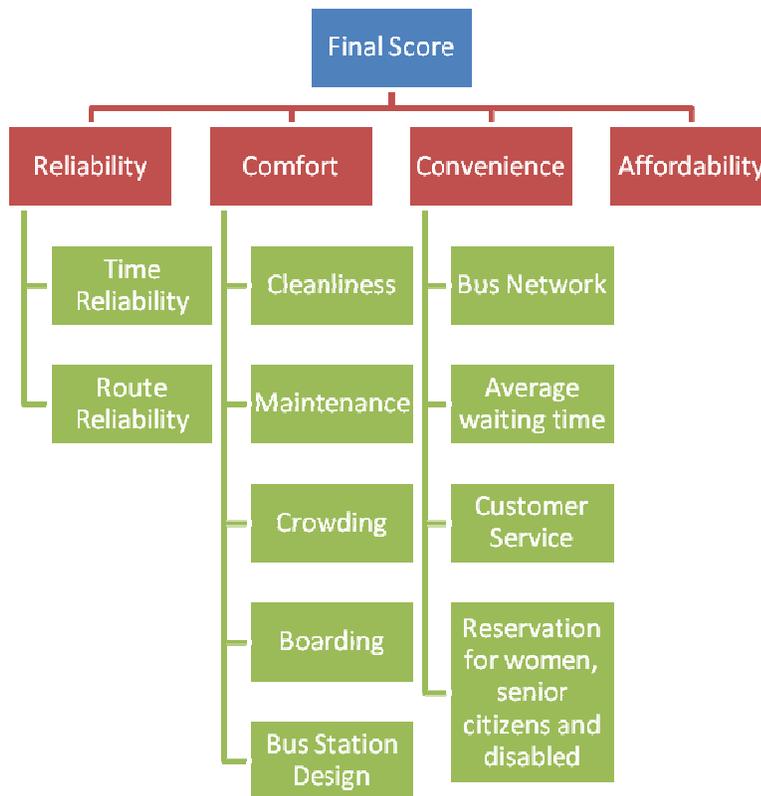
4.2. What data was collected

As of today, there are only two means of public transportation in Pune:

- The local railway trains and
- PMPML

Out of these two, the local trains do not really have a network within Pune. The modal share of the local trains is expected to be about 1% or so. Therefore we have restricted the data collection and analysis only to PMPML.

For benchmarking of PMPML, we have identified some parameters which would be important from the users' perspective to not only enhance their experience, but also to attract new users. The following parameters were chosen for evaluation, based on a study of the Service Level Benchmarks prescribed by the Ministry of Urban Development, as well as on our inferences made through interaction with PMPML users.



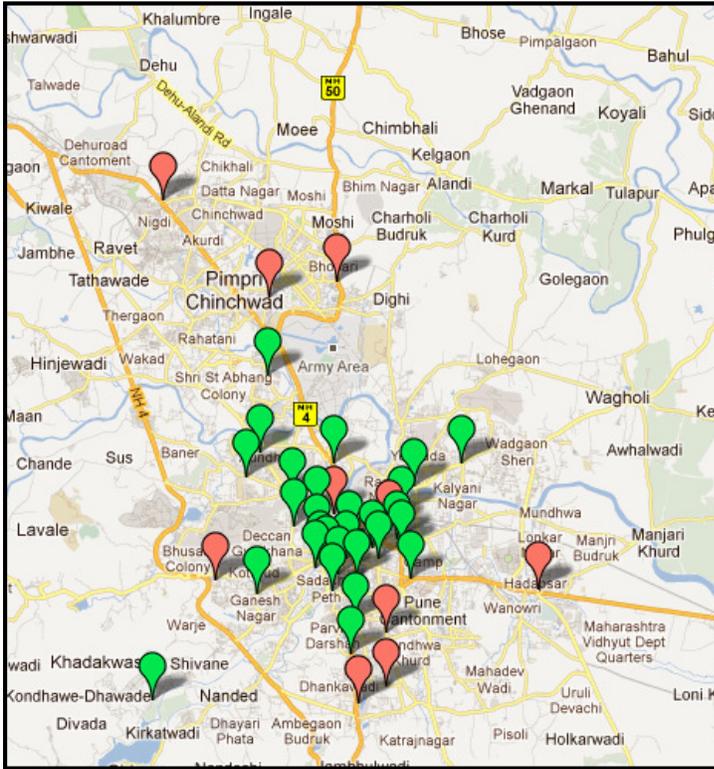
Data received from PMPML should ideally span from April 2012 to March 2013, but this may not have always been the case due to non-availability of information for some parameters.

Total number of buses inspected were 503 (from outside) and 103 (from inside) for parameters related to cleanliness and maintenance. A total of 39 bus stops were surveyed, including 10 bus depots.

List of bus stops surveyed – Deccan Gymkhana, Pimpale Gurav, Kothrud Stand, Appa Balwant Chowk, S.P. College, Mangala Talkies, Nal Stop, Pune University, Aundh, Dandekar Bridge, Alka Talkies, Fergusson College, LIC Office (near Shivajinagar), Khadki Post Office, Yerawada, West End Talkies, Apollo Talkies, GPO, Bhapkar Petrol Pump, Padmavati, MG Road, Mamledar Kacheri, Ramwadi Jakat Naka, Ruby Hall, Gokhale Nagar, Baner, Ganesh Peth, NDA Gate, Shaniwarwada.

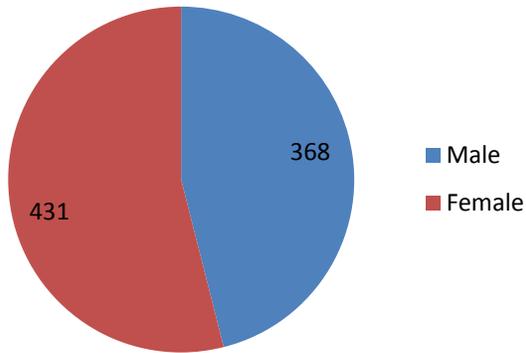
List of Depots surveyed – Katraj, Upper Indira Nagar, Market Yard, Hadapsar, Kothrud, Pune Station, Narvir Tanaji Wadi (Shivajinagar), Nehru Nagar, Bhosari, Nigdi.

Map of the bus stops and bus depots surveyed:

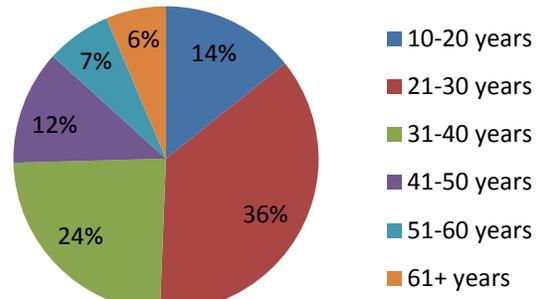


799 users were surveyed. Basic data of the sample is as follows.

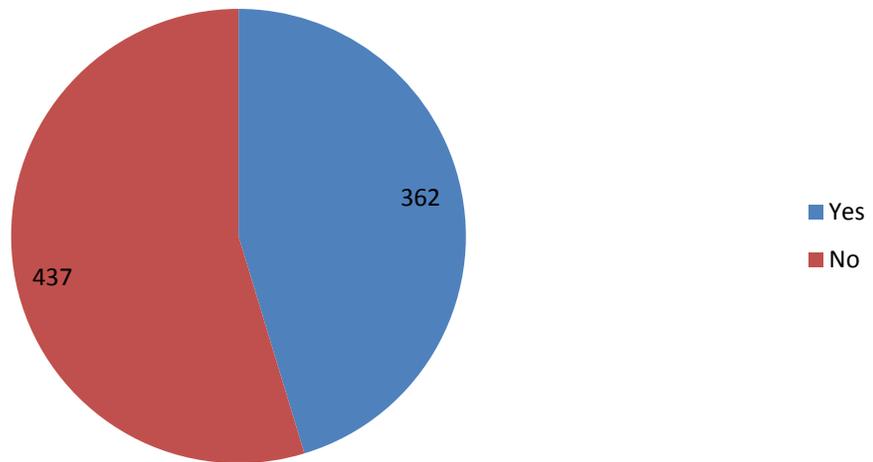
Gender profile of people surveyed



Age profile of people surveyed



Number of pass holders



4.3. How was the data collected

Data has been collected from three sources:

1. Official PMPML reports (monthly performance sheets publishing operational data like distance covered, scheduled kms, breakdowns, ticket sale, number of passengers etc),
2. User surveys,
3. Observations.

For the last two sources, forms and questionnaires were designed to get the required information.

4.4. How was the data processed

Any tools and techniques used for cleaning up and processing the data. Any caveats, constraints on data.

4.4.1. Scoring system

The scoring system for this parameter is based on the one suggested in the "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India.

Four major parameters considered. Equal weightage was given to all four parameters. These four parameters were:

1. Reliability,
2. Comfort,
3. Convenience,
4. Affordability.

The respective tables given below were used to determine the scores with respect to each parameter.

Reliability

Sub-parameter	Weight	Source	Method/ formula/ question	Sub-Weight
Time reliability	0.5	PMPML data	-	-
		Actual observation	No. of buses leaving on time, late and very late as well as cancelled	1

Route reliability	0.5	PMPML data	Cancelled kms/ scheduled kms	0.5
		Actual observation	Cancelled trips/scheduled trips	0.5

Comfort

Sub-parameter	Weight	Source	Method/ formula/ question	Sub-Weight
Cleanliness	0.15	PMPML data	Not available	0.5
		Actual observation	Observation of buses from inside	0.5
Maintenance	0.15	PMPML data	% breakdowns per day	0.5
		Actual observation	Bus check from outside and inside	0.5
Crowding	0.25	PMPML data	-	-
		Actual observation	Bus check from outside	1
Boarding	0.25	PMPML data	-	-
		Actual observation	Observing whether the bus stops in front of the bus stop and whether it comes to a complete halt	1
Bus station design	0.20	PMPML data	-	-
		Actual observation	Observing whether the bus stations have facilities like adequate seating, shade, route maps, and whether depots have toilets, drinking water, dust bins and route maps/ information service.	1

Convenience

Sub-parameter	Weight	Source	Method/ formula/ question	Sub-Weight
Bus	0.3	PMPML data	-	-

Sub-parameter	Weight	Source	Method/ formula/ question	Sub-Weight
Network		Actual observation	Distance covered by each bus stop= total area of the city/total no. of bus stops. Average walking time to the bus stop=area covered by each bus stop(radius)/average walking speed of an adult(5km/hr)	1
Waiting Time	0.3	PMPML data	-	-
		Actual observation	Time tracking of 10 people at each bus stop and noting down when and if they get a bus, or resort to an auto/walk away	1
Reservation of seats for women, senior citizens	0.2	PMPML data	Whether there is a policy document in place, whether it has an agreement with the police regarding penalization and whether conductors, drivers are trained to handle conflict situations	1
		Actual observation	-	-
Customer Service	0.2	PMPML data	Number of resolved complained/total complaints registered	1
		Actual observation	-	-

Affordability

Sub-parameter	Weight	Source	Method/ formula/ question	Sub-Weight
Affordability	1.0	PMPML data	-	-
		Actual observation	Comparison with bus fares of other cities, and with two wheelers	1

Calculating scores

An example will make this clear.

1. Consider sub-parameter “Maintenance” under parameter “Comfort”.
2. Data for the same is available from PMPML and actual observation.
3. Let us assume that the respective scores out of 100 are S_{actual} and S_{PMPML} . Then the score for the sub-parameter “Maintenance” = $S_{\text{TR}} = (0.5 * S_{\text{actual}}) + (0.5 * S_{\text{PMPML}})$
4. The score for the sub-parameter “Route reliability”, S_{C} is calculated in a similar manner.
5. In turn, cleanliness, maintenance, crowding, boarding and bus station design have a weight of 0.2 each towards the parameter “Comfort”.
6. Therefore the score for “Comfort”, $S_{\text{C}} = (0.2 * S_{\text{CL}}) + (0.2 * S_{\text{M}}) + (0.2 * S_{\text{CR}}) + (0.2 * S_{\text{B}}) + (0.2 * S_{\text{BSD}})$
7. Scores for the four major parameters are calculated. Since the four parameters have equal weight, overall score = average of scores of the four parameters.

Note: For the purpose of maintaining coherence in the TSR, user survey results have been analyzed separately to keep the score solely based on factual data. The score obtained hereafter is thus a combination of objective observation and official data from PMPML.

4.5. Inferences drawn from data processing

4.5.1. Data collected

The table below summarizes the data collected using the two sources described earlier (official PMPML data + objective observation). The top 2 scores are highlighted in yellow and the bottom two scores are highlighted in magenta for easy interpretation.

Parameters and weight	Sub-parameters	Sub-parameter weight	Sub-parameter score	Factor score
Reliability, 0.25	Time Reliability	0.50	73	64
	Route Reliability	0.50	55	
Comfort, 0.25	Cleanliness	0.15	30	57
	Maintenance	0.15	41	
	Crowding	0.25	52	
	Boarding	0.25	84	
	Bus Station Design	0.20	61	
Convenience,	Bus Network	0.30	100	70

Parameters and weight	Sub-parameters	Sub-parameter weight	Sub-parameter score	Factor score
0.25	Average Waiting Time	0.30	48	
	Reservation for women, senior citizen, disabled	0.20	60	
	Customer Service	0.20	68	
Affordability, 0.25	Bus Fares	1.00	45	45
Overall, 1.00				59

Example of calculation for determining “factor score”:

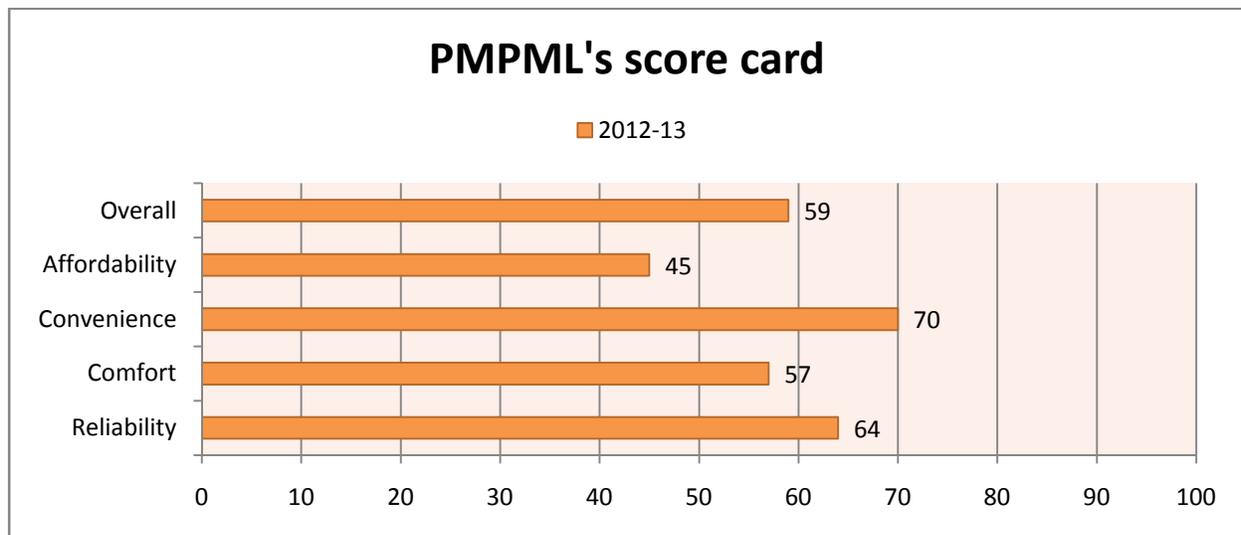
For “convenience” factor, the score is calculated as

$$\begin{aligned}
 & (0.30 * 100) + (0.30 * 48) + (0.20 * 60) + (0.20 * 68) \\
 & = 30 + 14.4 + 12 + 13.6 \\
 & = 70
 \end{aligned}$$

Overall score is the average of the score of the four factors.

4.5.2. Key observations

The scorecard is depicted graphically below.



Key positives

1. The bus network is quite good.
2. Buses come to a complete stop at bus stops, thus boarding the bus is not very problematic.

Key negatives

1. The buses are not clean.
2. Maintenance of the buses is bad.

4.5.3. Calculating Pune's score

As described above, Pune's overall score is calculated to be 59 out of 100.

5. Facilities for pedestrians

5.1. Why was this parameter selected

Pune was once known to be a cycling city. However the picture has changed drastically today, with the city's traffic being dominated by two wheelers and cars. Even in this situation it is estimated that about 4.6 lakh trips are made on cycle everyday in the city. In medium and large cities the modal share of cycling can range from 10%-20%. A significant number of people depend on bicycles for their livelihood. With increasing vehicles, it therefore becomes essential to provide for facilities for safe cycling. These facilities may also be crucial in encouraging people to cycle, thereby directing the city's development towards sustainable traffic patterns.

Pune has a cycle track network of 132 kms on record. Pune's CMP sets a target for 50% of the trips being carried out by walking and cycling. It is therefore important to examine the state of the cycle tracks.

The Service Level Benchmarks by MoUD have been devised to measure the efficacy of cycle tracks to mandate constant improvements and appraisals of cycling infrastructure. These benchmarks have been taken as a reference for this TSR.

5.2. What data was collected

The following data was collected:

- Length of the road network in Pune. Only arterial and sub-arterial roads were considered for this purpose.

- List of roads along which cycle tracks are proposed and lengths of proposed cycle tracks.
- Actual length of these roads and of cycle tracks along these roads.
- Lengths of patches of cycle tracks that were blocked.
- Cycle parking at major interchanges in Pune.

5.3. How was the data collected

All cycle tracks were surveyed by physically visiting and observing their entire lengths.

The following form was used.

CYCLE TRACK OBSTACLE SURVEY					
SURVEY DATE:		TIME			
SURVEYOR:					
START POINT:		END POINT:			
MISSING LENGTH (LHS):		MISSING LENGTH (RHS):			
	Type of obstruction	LHS (total obs/ length in metres)	LHS (partial obs)	RHS (total obs/ length in metres)	RHS (partial obs)
1	Tree				
2	Pole				
3	ELEC/TEL/CCTV Boxes				
4	PMPML Bus Shelter				
5	Permanent built encroachment (building, stairs, wall, ramp etc)				
6	Hawkers/ Vendors				
7	Movable materials (construction debris, garbage containers, barricades etc)				
8	Parked vehicles				
9	Other				
	Total				

Obstructions were divided into various categories as above. Further, only those which amounted to obstruction of total width of the cycle track were measured in length to obtain

the total length of obstructed cycle track. While doing so, in reality, even one obstruction could render an entire segment of a cycle track not accessible to cycles; but only the length of the obstruction was measured and not the length of the blocked segment.

5.4. How was the data processed

5.4.1. Scoring system

The scoring system for this parameter is exactly as stated in the "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India.

The SLBs are as follows:

Indicators to calculate City-wide Overall Level of Service (LoS) of NMT facilities			
LoS	1. % of network covered	2. Encroachment on NMV roads by Vehicle Parking (%)	3. NMT Parking facilities at Interchanges (%)
1	> =50	< =10	>=75
2	50 - 25	10 - 20	50 - 75
3	25- 15	20 - 30	25- 50
4	< 15	> 30	< 25
Data Requirement to Calculate the Level of Service of NMT facilities			
S.No	Data required for calculating the indicator	Unit	Remarks
1. % network covered			
a)	Total length of road network	Km	calculate the total length of road network
b)	Total Length of NMT network	Km	calculate the total length of NMV network
c)	% of city covered	1/2/3/4	Calculate = [b/a]*100. Compute LoS as mentioned in indicator 1 i.e. % of city covered

2. Encroachment on NMV roads by Vehicle Parking (%)			
a)	Total length of the Parking on Cycle Track	Km	Calculate Total road length where Parking on Cycle Track is present
b)	Total length of NMT network	Km	calculate the total length of NMT network
c)	% of on street parking on cycle track	1/2/3/4	Calculate = [a / b]*100. Compute LoS as mentioned in indicator 2 i.e. Encroachment on NMV roads by Vehicle Parking (%)
3. NMT Parking facilities at Interchanges (%)			
a)	Total no. of interchanges	no.	Calculate the total no. of interchanges i.e. major bus stops, terminals and railway stations.
b)	Total no. of interchanges having bicycle parking	no.	Calculate the total number of interchanges having NMT parking facilities (within 250 m radius)
c)	NMT Parking facilities at Interchanges	1/2/3/4	Calculate = [b / c]*100. Compute LoS as mentioned in indicator 3 i.e. NMT Parking facilities at Interchanges (%)
Overall Level of Service (LoS) of Non Motorized facilities (NMV) City-wide			
The calculated level of service (LoS) of Non Motorized facilities is = (LoS ₁ + LoS ₂ + LoS ₃) and identify overall LoS as mentioned below			
Overall LoS	Calculated LoS	Comments	
1	3 - 5	The city has adequate NMT facilities at overall road network.	
2	6 - 8	The city has NMT facilities which may need some improvements in terms of encroachments, parking facilities at interchanges etc as some parts of the city are not served by it. The system provided is comfortable and sustainable	
3	9 - 10	The city has NMT facilities which may need considerable improvements as many parts of the city are not served by it.	
4	11 - 12	The city lacks adequate NMT facilities	

Accordingly, the following elements were calculated to find out the different percentages specified in the SLBs:

1. Network coverage:
 - a. Total length of the roads, arterial and sub-arterial
 - b. Total length of cycle tracks
2. Total length of obstructed cycle track
3. Availability of cycle parking at interchanges

5.4.1.1. Score out of 100

The "calculated LoS" as per the SLB has a range from 3 to 12. Therefore the calculated LoS is converted to a score out of 100 using the following formula:

$$\text{Score} = 10 * (13 - \text{LoS})$$

Thus if LoS = 12, Score = 10 and if LoS = 3, Score = 100.

5.5. Inferences drawn from data processing

5.5.1. Data collected

5.5.1.1. Length of the road network in Pune

Total length of the roads (arterial and sub-arterial) is 525 km¹.

5.5.1.2. Proposed cycle tracks

Data was collected on the following roads, which were selected for the survey based on the reply to an application in 2010 under the RTI Act. Additionally, cycle tracks which were added after 2010 have also been included in the list.

Road Name	Proposed length by PMC (m)		
	LHS	RHS	Total
Alandi Road (*)			
Aundh Road (*)	0	1090	1090
Deccan College Road	1,720	1,720	3,440
Dr. Ambedkar Path	2,430	2,430	4,860
Ganesh Khind Road	2,890	2,890	5,780
Karve Road	6,500	6,500	13,000
Law College Road	260	0	260
Nagar Road (*)			
Old Canal Road (Across Law College-Prabhat-Bhandarkar Roads)	2,161	0	2,161
Paud Road	4,030	4,030	8,060
Sahasrabuddhe Road (Model	1,811	0	1,811

¹ CDP Pune, 2001-12

Road Name	Proposed length by PMC (m)		
Colony)			
Satara Road	5,805	5,775	11,580
Sinhagad Road	4,761	4,761	9,522
Solapur Road	9,670	9,276	18,946
Swami Vivekananda (Bibwewadi) Road (*)	2504	0	2504
Vishrantwadi-Airport Road	2,233	2,233	4,466
TOTAL			87,480

(*) No official information about proposed length could be obtained for Aundh Road and Swami Vivekananda Road. Nagar Road and Alandi Road cycle tracks were constructed after 2010.

5.5.1.3. Actual length of roads, cycle tracks and obstructions

The following table shows the data collected from this survey. Explanation of the numbers is provided in the note below the table.

Name of the road	Total road length (m)	Proposed cycle track (m)	Existing Cycle Track (m)	Missing/ Obstructed/ Encroached (m)
Airport Road	2,220	4,466	437	94
Alandi Road	13,120	(*) 13,120	8,940	819
Ambedkar Road	1,700	4,860	2,183	171
Aundh Road	1,500	1,090	667	33
Deccan College Road	3,266	3,440	1,855	39
Ganeshkhind Road	5,642	5,780	2,540	38
Karve Road	12,400	13,000	7,862	146
Law College Road	260	260	119	0

Name of the road	Total road length (m)	Proposed cycle track (m)	Existing Cycle Track (m)	Missing/ Obstructed/ Encroached (m)
Nagar Road	10,900	(*) 10,900	1,939	121
Old Canal Road (Across Law College-Prabhat-Bhandarkar Roads)	2,162	2,161	2,161	12
Paud Road	8,200	8,060	5,539	78
Sahasrabuddhe Road (Model Colony)	1,396	1,811	1,233	15
Satara Road	11,600	11,580	6,378	215
Sinhagad Road	11,600	9,522	7,155	165
Solapur Road	18,960	18,946	10,879	58
Swami Vivekanand Road (Bibwewadi Road)	1,400	2,504	768	58
Total	106,326	111,500	61,355	2,062
(Ref. notes below)	(1)	(2)	(3)	(4)

Notes:

1. Total road length is obtained using Google maps. This includes both sides of the road, so typically the length of a 2-way road as given in the table above is two times the length of the road on a map.
2. Lengths of proposed cycle tracks are obtained from PMC's response to an application under the RTI Act, submitted in 2010. These numbers also include cycle tracks on both sides of the road, where applicable.
 - However, the Alandi Road and Nagar Road cycle tracks were planned and built after 2010. Their proposed length is taken to be the same as the length of the road.
3. Length of the existing cycle track was also obtained using Google maps. This length is the distance between the two endpoints of the actual track on ground.
4. Length of missing track/ obstructions/ encroachments:

- The "missing tracks" refer to sections missing from "existing" tracks as above, not planned or proposed.
- For large missing sections, the length was obtained using Google maps by marking landmarks where possible, else by counting walking steps and then converting count of steps into meters by measuring by tape the standard walking step length of the surveyor.
- Lengths of obstructions and encroachments were measured by counting walking steps as above.

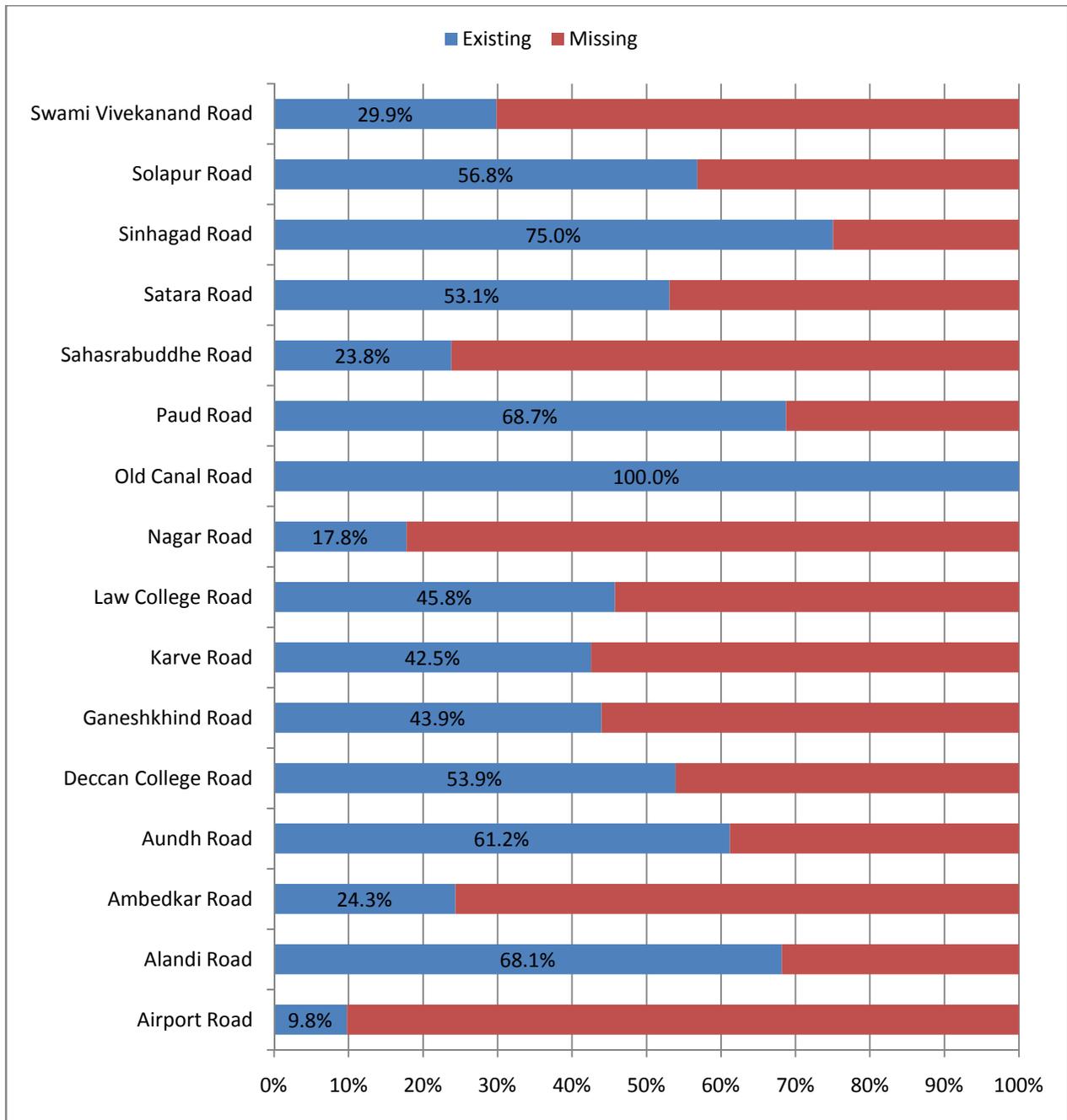
5.5.1.4. Parking at major interchanges in Pune

Availability of bicycle parking at Pune Station, Swargate and Shivajinagar was considered. Actual inspection of these sites revealed that designated cycle parking is available at Pune Station only, and not at Shivajinagar and Swargate.

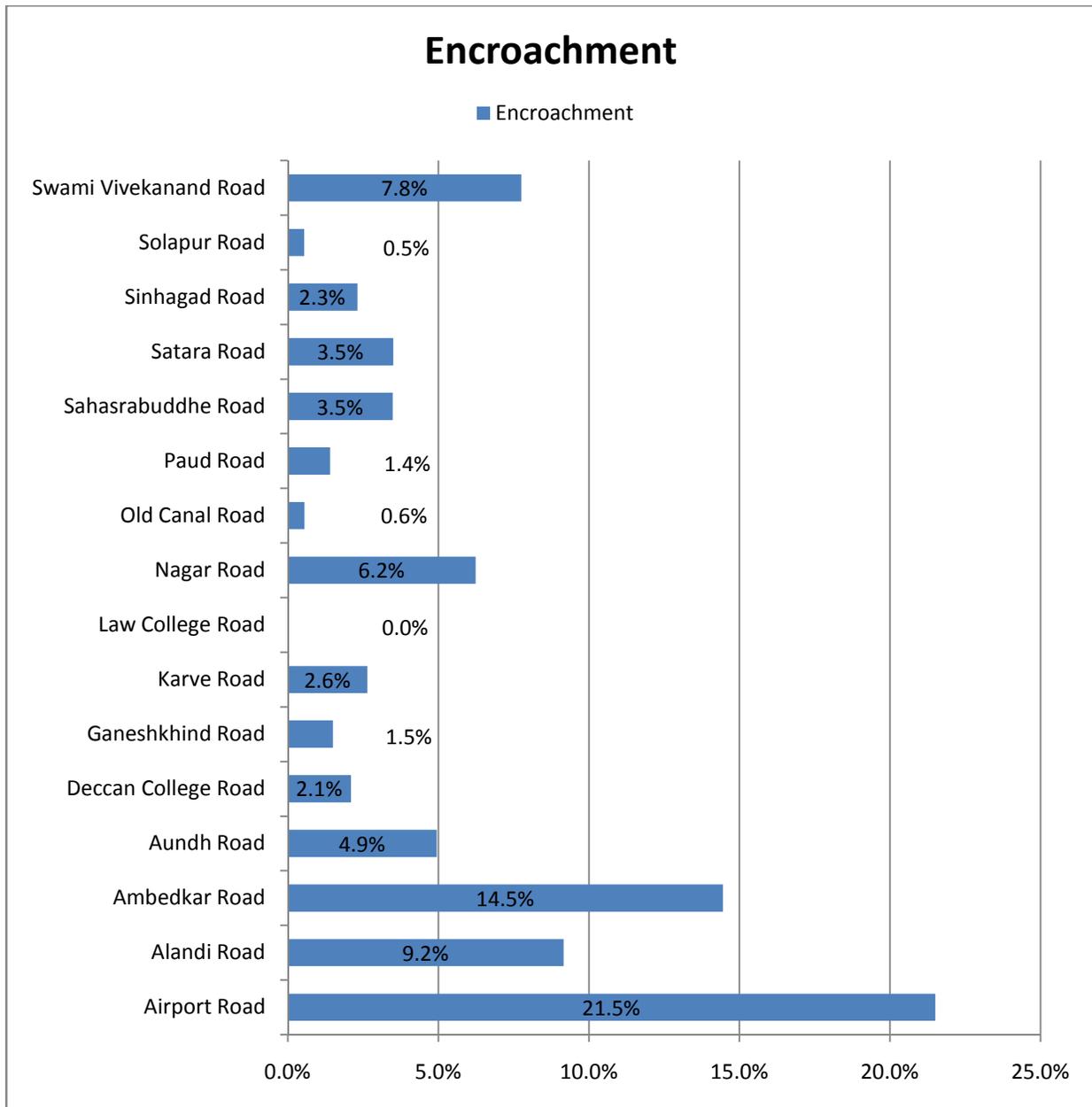
5.5.2. Key observations

5.5.2.1. Cycle tracks missing or not implemented

It was found that of all the roads designated to have cycle tracks, 55% cycle track network exists. Virtually all cycle tracks had varying missing lengths.



5.5.2.2. Percentage of encroachment on cycle tracks



5.5.3. Calculating Pune's score

Based on the SLB given earlier, the NMT facilities in Pune are benchmarked as follows:

1. Network coverage:
 - a. Total length of the roads (only arterial and sub-arterial) = 2 sides * 525 km = 1,050 km

- b. Total length of cycle tracks = 61.345 km
 - c. % of city covered = $[b/a] * 100 = 5.85\%$
 - d. Level of Service (LoS) for this indicator = 4
2. Encroachment on NMT roads
- a. Total length of obstructions = 28,441 meters
 - b. Total length of NMT network = 57,476 meters
(Aland Road and Nagar Road cycle tracks are not considered for this calculation as segment wise encroachment data was not collected for these roads.)
 - c. % of encroachment and blockage on NMT roads = $[a/b] * 100 = 56.35\%$
 - d. Level of Service (LoS) for this indicator = 4
3. Availability of cycle parking at interchanges
- a. Total no of interchanges = 3
 - b. Total no of interchanges having bicycle parking = 1
 - c. NMT parking facilities at interchanges = $[b/a] * 100 = 33\%$
 - d. Level of Service (LoS) for this indicator = 3

Calculated LoS = 4 + 4 + 3 = 11 out of maximum 12

Overall LoS as per SLB = 4

According to the SLB, Pune's NMT facilities can be described as "The city lacks adequate NMT facilities".

The methodology to calculate the Level of Service for the parameter 'encroachment on NMT roads' in the SLBs has been modified to give a more realistic meaning to the word 'encroachment'. While the SLB considers only parked vehicles as encroachments, in reality there are many more obstructions on cycle tracks. Also, if a particular segment of cycle track has more than a certain number of total obstructions, the remaining unobstructed part is unlikely to be used by cyclists as well. Thus, we decided on a threshold of such total obstructions per segment of the cycle track and derived those stretches which were completely unusable due to obstructions.

5.5.3.1. Score out of 100

Score = $10 * (13 - \text{calculated LoS}) = 10 * (13 - 12) = 10$.

6. Time to Commute

6.1. Why was this parameter selected

The objective of a transportation system is not only to help one commute from one place to another, but also to do it in the most efficient way. Therefore a good transportation system or network helps one commute safely, by spending as little money or fuel as possible, and also as quickly as possible.

People generally have an idea of how long (distance wise) their commute is and want to estimate how much time it would need for that commute. People also want to compare different parts of the city with respect to time taken to commute.

Different people travel with different modes of commute. Transportation planners try to provide the best possible facilities for all modes of commute. Since it is the time taken to commute that heavily rules the mode people prefer (of course, given similar levels of comfort, safety etc), transportation planners would also want to know which modes are the fastest.

Moreover, how the time to commute a certain distance changes year over year for various modes can throw some light on whether it is becoming easier to use certain modes as compared to others.

6.2. What data was collected

The objective was to find out the average time taken to commute 1 km using various modes and in different parts of the city.

The modes chosen were:

- PMPML bus
- Bicycle
- 4-wheeler
- 2-wheeler

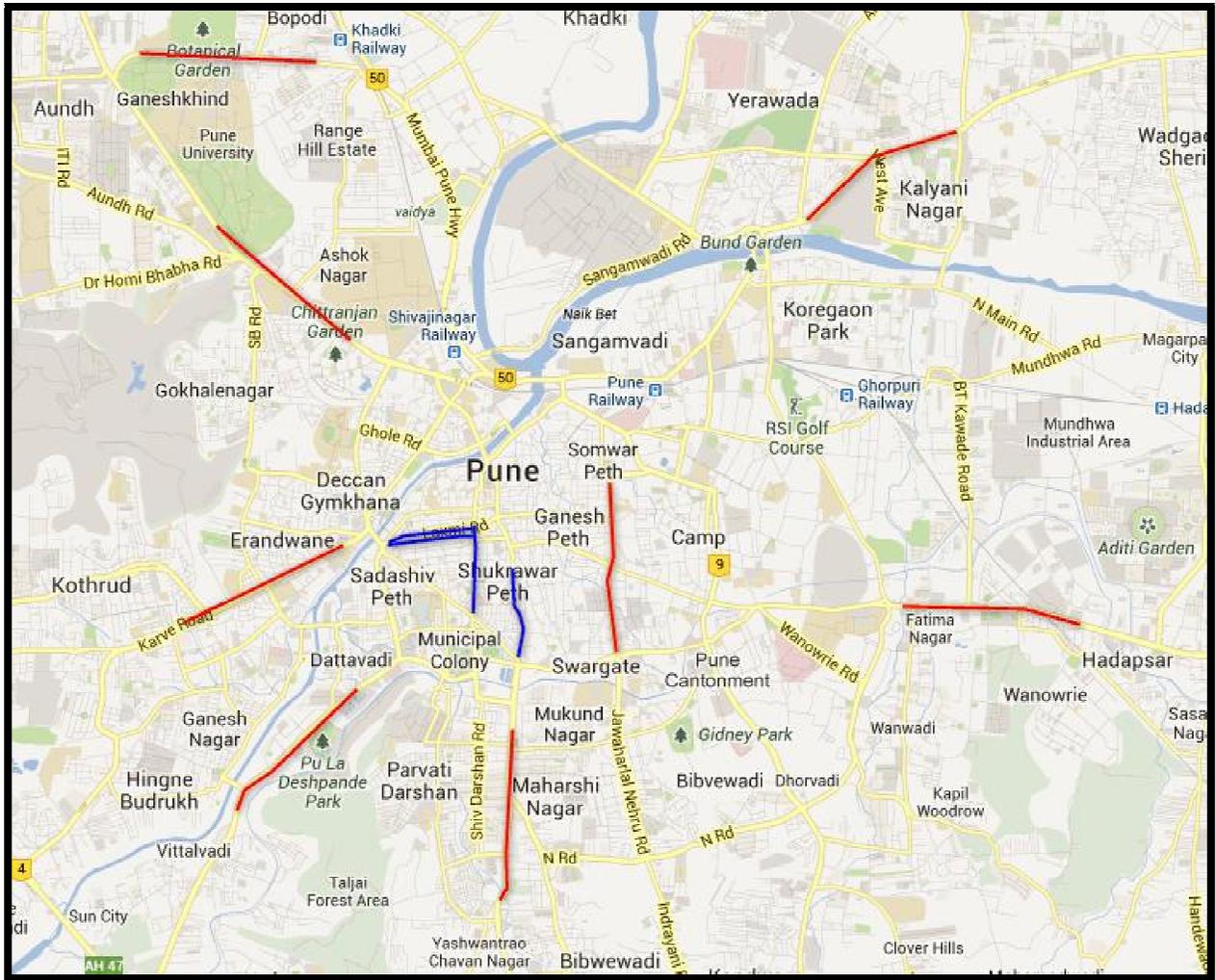
These four modes were chosen because as per the CMP of Pune, these four modes should carry about 55% of the trips. Out of the remaining 45%, walking should carry about 30%, the Metro is expected to carry about 5% and rickshaws and taxis would carry the rest (10%). Though the number of trips to be carried by rickshaws is about the same as 4 and 2 wheelers combined, collecting data on time taken by rickshaws to commute 1 km was very difficult, considering the method used.

Since a distance of 1 km is rather short, it could include a lot of variation in speed, caused by traffic signals, any intersections, bottlenecks or temporary traffic jams etc. Therefore, ideally this data should be collected for a longer distance. However, considering the method used for collecting the data (described below), a longer distance increases the possibility that the vehicles tracked might leave the stretch of the road along which the data is gathered. Therefore stretches of 2 km were chosen to find how much time various modes take, except 4 stretches in the core city where 1 km stretches were chosen.

The data was collected along the roads in the list below. Data was collected in morning as well as evening peak hours. Morning peak hours were considered as 9:30 am to 11 am, while evening peak hours were considered as 5:30 pm to 7 pm. Data was collected in the peak hour direction, which is generally towards the city center in the morning and away from it in the evening. Traffic on roads in core city area might not display distinct characteristics with respect to morning or evening peak hour. The time when data was collected on such roads is indicated below.

1. Spicer College Rd (am and pm)
2. Ganeshkhind-University Rd (am and pm)
3. Karve Road (am and pm)
4. Sinhagad Road (am and pm)
5. Core city, east-west:
 - a. Kumthekar Road (am)
 - b. Laxmi Road (pm)
6. Nehru Road (am and pm)
7. Satara Road (am and pm)
8. Solapur Road (am and pm)
9. Core city, north-south:
 - a. Bajirao Road (am)
 - b. Shivaji Road (pm)
10. Nagar Road (am and pm)

The specific stretches of the roads where data was collected are indicated in the map below. Red lines indicate stretches of 2 km, while the blue lines indicate stretches of 1 km.



6.3. How was the data collected

Video recording of the traffic on these roads was conducted during peak hours as stated above, at locations as per the map. Locations along all roads except 5 and 9 were 2 km apart. Locations along roads 5a, 5b, 9a, 9b were 1 km apart.

Both video recordings were started at the same time. Traffic at the upstream location was recorded for 15 minutes. Since different vehicles travel at different speeds, the traffic at the downstream location was recorded for 30 minutes.

6.4. How was the data processed

Let us call the upstream recording as "Recording A" and the downstream recording as "Recording B". The following technique was used to determine the time taken by a vehicle to cover this distance:

1. Play "Recording A" on a computer.
2. Pause and play the recording as needed. Identify a few vehicles in "Recording A". For each vehicle, record the timestamp displayed in the media player.
3. Play "Recording B" on a computer.
4. Pause and play the recording as needed. Try to identify as many of the same vehicles as follows. For each vehicle, record the timestamp displayed in the media player.
5. Difference in the timestamps gives the time taken by the respective vehicle to commute over that distance.

At least four different vehicles of each of the four types of vehicles were identified in each of the pair of videos. An average of the time taken was calculated using the "2 sigma" method. However, it is to be noted that in many cases, since the number of vehicles of a given type that were identifiable in both videos was small, the "2 sigma" method might not have discarded any samples as abnormal.

6.4.1. Scoring system

As explained for the parameter "Modal Split", the CMP of Pune has stated some broad objectives for modal split. The following objectives can be derived from them:

- Approximately 25% by PMPML
- Approximately 20% by bicycles
- Approximately 10% by personal motorized vehicles, among which
 - Approximately 7% by 2-wheelers
 - Approximately 3% by 4-wheelers

Therefore, the target modal split only among these 4 modes becomes, approximately:

- 45% by PMPML
- 35% by bicycles
- 15% for 2-wheelers
- 5% for 4-wheelers

Therefore the scoring system is designed to give the respective weightage to these 4 modes. In other words, we are thrice as much concerned about the time taken by PMPML than we are about 2-wheelers.

The CMP states a desired "network" speed of 30 kmph. While it is easily possible for PMPML and personal vehicles to achieve this "running speed", the maximum "running speed" of a bicycle in urban areas is about 15 kmph.

Considering the above, the scoring system is designed as follows:

- For each mode, average of time taken for 1 km along all stretches, in seconds, is considered as 't'.
- This value is converted to speed in kmph, which is expressed as 's'. $s = 3600/t$.
- The desired speed for that mode is taken from the following table as 'd'.
- The weightage for each mode is taken from the following table as 'w'.

Mode	Desired speed, 'd'	Weightage, 'w'
PMPML bus	30 kmph	45
Bicycle	15 kmph	35
2-wheeler	30 kmph	15
4-wheeler	30 kmph	5

- The score for each mode is calculated as:
 - $\text{score} = w$ if $s > d$
 - $\text{score} = (w * s/d)$ if $s < d$
- Scores for all modes are added to arrive at the city's score.

6.5. Inferences drawn from data processing

6.5.1. Data collected

We had intended to collect this data for 20 stretches (10 in morning and 10 in evening). However, the rainy season did not allow many breaks where "normal" traffic could be recoded. We intend to conduct this survey earlier in the year for subsequent editions of the TSR.

The table below shows the time taken to travel 1 km along different roads in Pune for various modes. The time is given in MM:SS. Score for individual roads is calculated. The last 2 rows give the average time and speed, and score as calculated from average times.

Road	PMPML	Bicycle	2-wheeler	4-wheeler	Score
	<u>Morning peak hours: Time per km</u>				
Karve Road	3:10	2:38	2:16	2:40	80
Kumthekar	3:21	4:36	2:21	2:44	74
Nehru Rd	3:35	3:49	3:35	3:54	71
Solapur Rd (BRT)	1:43	2:53	1:34	1:42	100
Bajirao Rd	5:07	5:57	2:57	4:23	54
	<u>Evening peak hours: Time per km</u>				
Karve Road	4:03	4:34	3:18	2:47	66
Laxmi Rd	2:57	3:12	1:39	2:53	84
	<u>Average: Time per km and speed in kmph</u>				
Average time	3:25	3:57	2:31	3:00	75
Average speed	17.6	15.2	23.8	20	

Note: Although Karve road towards Deccan recorded the fastest time for a bicycle, a gentle downward gradient assists bicyclists on this road.

The score of each road is calculated as explained in the example below, of Karve Road in evening peak hour:

1. Time taken by PMPML to travel 1 km = 4:03 minutes.
2. PMPML's speed = 14.8 kmph.
3. Since PMPML's desired speed is 30 kmph, the actual speed is $14.8/30 = 0.49$ times the desired speed.
4. Since weightage given to PMPML is 45 (please see the table on the previous page), PMPML's score for this road = $0.49 * 45 = 22.2$.
5. Scores of bicycles, 2-wheelers and 4-wheelers are calculated using the same method and are found to be 30.6, 9.1 and 3.6 respectively.
6. Total of scores for all 4 modes = 66.

6.5.2. Key observations

The road that has the best score: Solapur Road (with BRT): 100 out of 100.

The road that has the worst score: Bajirao Road: 54 out of 100.

6.5.3. Calculating Pune's score

Pune's score is the average score of the roads surveyed, which is 75 out of 100.

7. Pollution

7.1. Why was this parameter selected

Air quality has direct impact on the human health and wellbeing. Transport is a major contributor of human caused air pollution in urban areas as it consumes fossil fuels and produce gasses and particulate matters which act as pollutants in atmosphere.

The pollution from vehicles/automobiles is dealt under the Motor Vehicle Act as exhaust gas emissions from the tail pipe. It is measured at individual vehicle level using instrument called exhaust gas analyzer, this can be seen used for PUC (pollution under control) certification. In this process the emission of pollutant from the vehicle is measured and there is standard for vehicular emission for individual vehicle/automobile based on the fuel type used, but there is no account of impact of vehicular emissions on the atmospheric air quality.

The atmospheric air quality is covered under the Air (Prevention and Control of Pollution) Act, 1981 and notification there under for the national ambient air quality standards for a particular area as per its land use. The ambient air quality is measured with reference to the air quality parameters as presence of certain types of pollutants in the atmosphere. The principal of air quality study and management is the identification of the source and receptor and their interaction.

The presence of pollutants in the atmosphere deteriorates the quality of air. These pollutants can have direct impact on the health of the human beings as well as on other living and non-living things.

According to World Health Organisation (WHO), collected air quality levels are alarmingly threatening people's health in cities, over 2 million people die every year by human caused air pollution, a large number of them are in South Asia and East Asia. Air pollutants such as fine particles (PM₁₀ - particles of 10 micrometers (µm) or less) can "penetrate into the lungs and may enter the bloodstream, can cause heart disease, lung cancer, asthma, and acute lower respiratory infections." WHO further states that increasing levels of PM₁₀ are common in urban areas, and these particles originate from combustion sources, like power plants and motor vehicles.

Air pollution has huge health burden on national and household economy. According to WHO's study on "Mortality and burden of disease from outdoor air pollution" in 2008, urban air pollution was responsible for 1.3 million annual deaths, representing 2.4% of the total deaths.

Worldwide, urban air pollution is estimated to cause about 9% of the lung cancer deaths, 5% of cardiopulmonary deaths and about 1% of respiratory infection deaths².

The study concludes that the estimated mortality in 2008 attributable to outdoor air pollution in India was 1 lakh 68 thousand premature deaths which is increasing as compared to 1 lakh 40 thousand in 2004. In children under 5 years, mortality attributable to outdoor air pollution is 6905 (in 2008) and 4331 (in 2004). The mortality rate per 1 lakh capita attributable to outdoor air pollution is 14 in 2008 and 13 in 2004. Similarly, for per lakh population the deaths attributable to outdoor pollution is 5 in 2008 and 3 in 2004 in children under 5 years³.

Table: Mortality in India attributable to Air Pollution
(From the data of Global Health Observatory of WHO⁴)

Description	2004	2008
Deaths attributable to outdoor air pollution	140,937	168,601
Deaths attributable to outdoor air pollution , in children under 5 years	4,331	6,905
Deaths attributable to outdoor air pollution , per 1,00,000 people	13	14
Deaths attributable to outdoor air pollution , per 1,00,000 children under 5 years	3	5

7.2. What data was collected

The main source of human created air pollution is the activities of burning of fossil fuels like coal and petroleum products for power plants and motor vehicles. Other main sources are industrial activities, burning of biomass, etc.

The air pollution relevant to transport are those originating from burning of petrol, diesel and to some extent gases (CNG/LPG) in the internal combusting engine of vehicles/automobiles. This air pollution is measured as presence and concentration of pollutants in the atmosphere. The pollutants that originate from the vehicular emissions are sulphur dioxide, nitrogen dioxide, carbon monoxide, carbon dioxide, fine particulate matters (tiny particles suspended in the air), lead, etc. These pollutants may have sources other than transport also based on the activities

² WHO, http://www.who.int/gho/phe/outdoor_air_pollution/en/

³ Global Health Observatory of World Health Organization <http://apps.who.int/gho/data/node.main.156>

⁴ Global Health Observatory of World Health Organization <http://apps.who.int/gho/data/node.main.156>

on ground or land use in that area. These could be activities using fossil fuels such as power plants, industries, or burning of fuel of biomass at household, etc.

The National Ambient Air Quality Standards are notified under the Air Act, 1981 for the pollutants that should be measured for monitoring the ambient air quality of an area. The National Ambient Air Quality Monitoring (NAAQM) program monitors the air quality for Pune city and measures some of these pollutants.

Therefore TSR collected data for the following pollutants:

- Sulphur dioxide (SO₂), in per unit volume of air (unit of measurement - µg/m³)
- Oxides of Nitrogen (NO_x) as nitrogen dioxide (NO₂), in per unit volume of air (unit of measurement - µg/m³)
- Suspended particulate matter (SPM), in per unit volume of air (unit of measurement - µg/m³).
- Fine particles suspended in air as RSPM (respirable suspended particulate matter) or PM₁₀ (Particulate matters of particles size of 10 micrometers (µm) or less), in per unit volume of air (unit of measurement - µg/m³).

7.3. How was the data collected

Pune city has three ambient air quality monitoring stations set up under the National Ambient Air Quality Monitoring (NAAQM) program. These stations are operational under the Pune Regional Office of MPCB.

These stations are based at following places.

1. **Nal Stop** – operating twice a week, located at MSEB Office, Nal Stop, Pune.
2. **Swargate** – operated twice a week, located at Traffic Police Chowki, Swargate, Pune.
3. **Karve Road** – operated daily, located at PMC Regional Office Building, Pune.

MPCB uploads these air quality data on their website and this was downloaded from their website (<http://mpcb.gov.in/envtdata/demoPage1.php>). The data was downloaded for the year and months to obtain the annual and monthly averages.

7.4. How was the data processed

Yearly data can be obtained from the website selecting the dates. One can also obtain monthly data based on need.

Annual average data were compiled to prepare the linear graph to obtain the trends for pollutants over the years. Similarly, monthly average data were compiled to understand the level of air pollution within a year or span of time.

This data was compared against the maximum levels prescribed for every pollutant in the National Ambient Air Quality Standards (NAAQS)⁵ by Centre for Pollution Control Board. The NAAQS is provided here for easy reference:

Sr No	Pollutant	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area
1.	Sulphur Dioxide (SO ₂), µg/m ³	Annual*	50	20
		24 Hour**	80	80
2.	Nitrogen Dioxide (NO ₂), µg/m ³	Annual*	40	30
		24 Hour**	80	80
3.	Particulate Matter (size less than 10 µm) or PM ₁₀ , µg/m ³	Annual*	60	60
		24 Hour**	100	100
4.	Particulate Matter (size less than 2.5 µm) or PM _{2.5} , µg/m ³	Annual*	40	40
		24 Hour**	60	60
5.	Ozone (O ₃) µg/m ³	8 Hours*	100	100
		1 Hour**	180	180
6.	Carbon Monoxide (CO) mg/m ³	8 Hours*	02	02
		1 Hour**	04	04

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limit but not on two consecutive days of monitoring.

⁵ http://cpcb.nic.in/National_Ambient_Air_Quality_Standards.php

Note – Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limit specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigations.

7.4.1. Scoring system

The scoring system used is as follows:

The four pollutants, SO₂, NO_x, RSPM and SPM are assigned "Level of Service" numbers according to their annual mean concentrations in µg/m³, as follows:

Level of Service	SO ₂	NO _x	RSPM	SPM
1	0 - 40	0 - 40	0 - 40	0 - 180
2	40 - 80	40 - 80	40 - 80	180 - 360
3	80 - 120	80 - 120	80 - 120	360 - 540
4	More than 120	More than 120	More than 120	More than 540

There are 3 monitoring stations, viz., Nal Stop, Swargate and Karve Road. Nal Stop and Karve Road stations are not far from each other and Karve Road station does not monitor SPM. Therefore only Nal Stop and Swargate stations are considered for determining the Level of Service. The average of their respective readings is taken and the Level of Service is determined from the average.

Calculated LoS is the sum of Level of Service for all 4 pollutants. The city's pollution level is determined from overall LoS, which is determined from Calculated LoS as follows:

Calculated LoS	Overall LoS	Comments
<= 5	1	Level of pollution in the city is very low.
6 - 9	2	Need some improvements in emission standards, checking pollution etc.
10 - 13	3	Need considerable improvements in emission standards, checking pollution etc.
14 - 16	4	Level of pollution in the city is very high.

Score out of 100

The calculated LoS can have values from 4 to 16. Calculated LoS of 4 indicates good air quality while 16 indicates bad air quality.

Pune's score is calculated using the following formula:

$$\text{Score } S = 8 * (17 - \text{Calculated LoS}) - 4.$$

Thus if calculated LoS = 4, score = 100 and if calculated LoS = 16, score = 4.

The score of all stations in all pollutants measured at the stations is added and expressed as a percentage of the maximum possible score.

7.5. Inferences drawn from data processing

7.5.1. Data collected

The following data refers to the year 2012 (January to December). Violations on 25% to 50% days or violations of permissible levels by 25% to 50% are shown by yellow highlight. Violations on more than 50% days or violations of permissible levels by more than 50% are shown by magenta highlight.

7.5.1.1. Nal Stop monitoring station

Pollutant	Daily minimum	Daily maximum	Permissible daily level	Annual average	Permissible annual level
SO ₂ , µg/m ³	11	54	80	21	50
NO _x , µg/m ³	16	92	80	44	40
RSPM, µg/m ³	17	306	100	93	60
SPM, µg/m ³	38	558	200	215	140

Nal Stop: compliance with NAAQS

Pollutant	Measured on	No of days violated	Annual average
SO ₂	All (100) days	0	58% under permissible level
NO _x	All (100) days	1 day out of 100	10% above permissible level
RSPM	All (100) days	37 days out of 100	55% above permissible level

SPM	All (100) days	51 days out of 100	54% above permissible level
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7.5.1.2. Swargate monitoring station

Pollutant	Daily minimum	Daily maximum	Permissible daily level	Annual average	Permissible annual level
SO ₂ , µg/m ³	11	45	80	19	50
NO _x , µg/m ³	14	114	80	50	40
RSPM, µg/m ³	6	209	100	81	60
SPM, µg/m ³	20	584	200	206	140

Swargate: compliance with NAAQS

Pollutant	Measured on	No of days violated	Annual average
SO ₂	All (103) days	0	58% under permissible level
NO _x	All (103) days	11 days out of 103	25% above permissible level
RSPM	All (103) days	39 days out of 103	35% above permissible level
SPM	All (103) days	50 days out of 103	47% above permissible level

7.5.1.3. Karve Road monitoring station

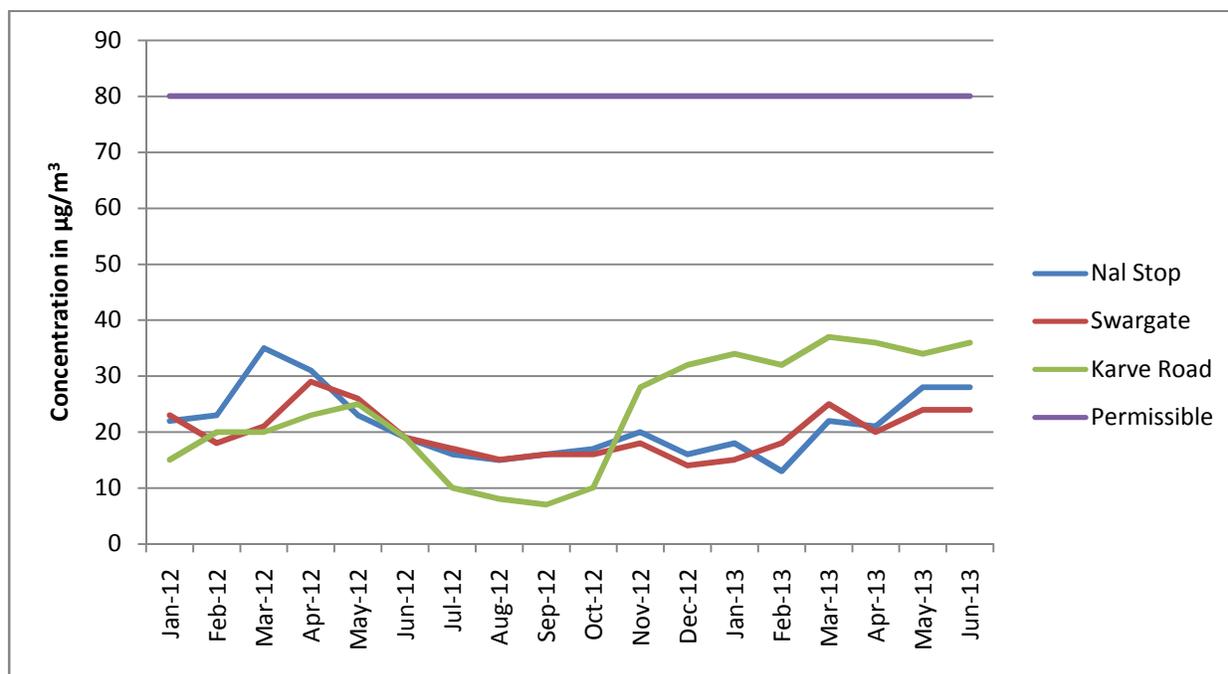
Pollutant	Daily minimum	Daily maximum	Permissible daily level	Annual average	Permissible annual level
SO ₂ , µg/m ³	6	38	80	19	50
NO _x , µg/m ³	19	137	80	63	40
RSPM, µg/m ³	27	428	100	123	60
SPM, µg/m ³	Not measured	Not measured	200	Not measured	140

Karve Road: compliance with NAAQS

Pollutant	Measured on	No of days violated	Annual average
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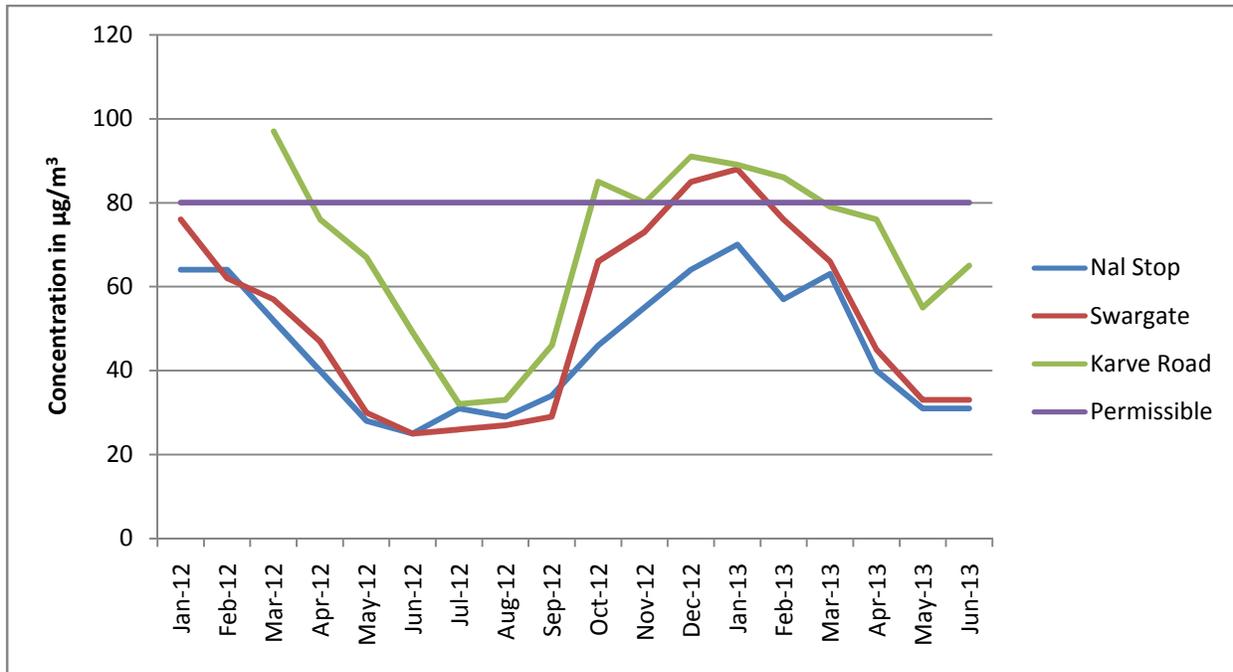
SO ₂	All (360) days	0	62% under permissible level
NO _x	All (360) days	79 day out of 360	58% above permissible level
RSPM	All (360) days	217 days out of 360	105% above permissible level
SPM	Not measured	Not measured	Not measured

7.5.1.4. Monthly average data of SO₂



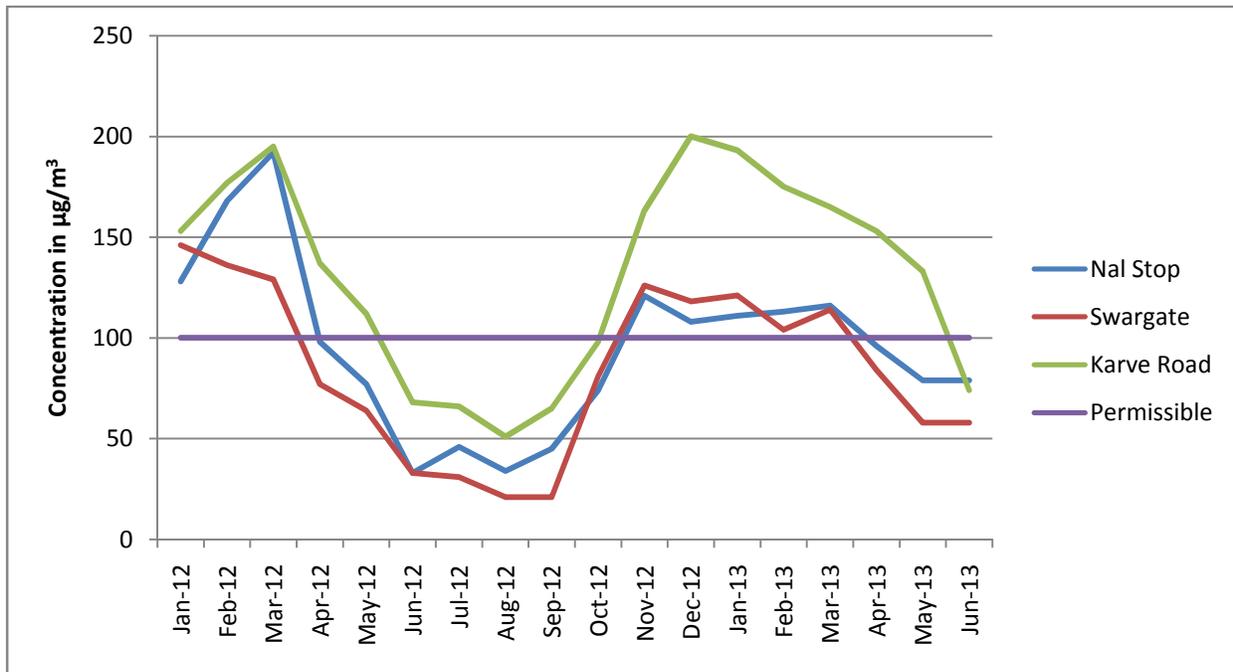
The level of sulphur dioxide is well within the permissible level for the three monitoring stations in Pune. It decreased during the monsoon and increased in the months of winter.

7.5.1.5. Monthly average data of NO_x



The level of nitrogen dioxide is varying over the months. It went above the permissible level during the months of winter and remained below it during the monsoon season.

7.5.1.6. Monthly average data of RSPM

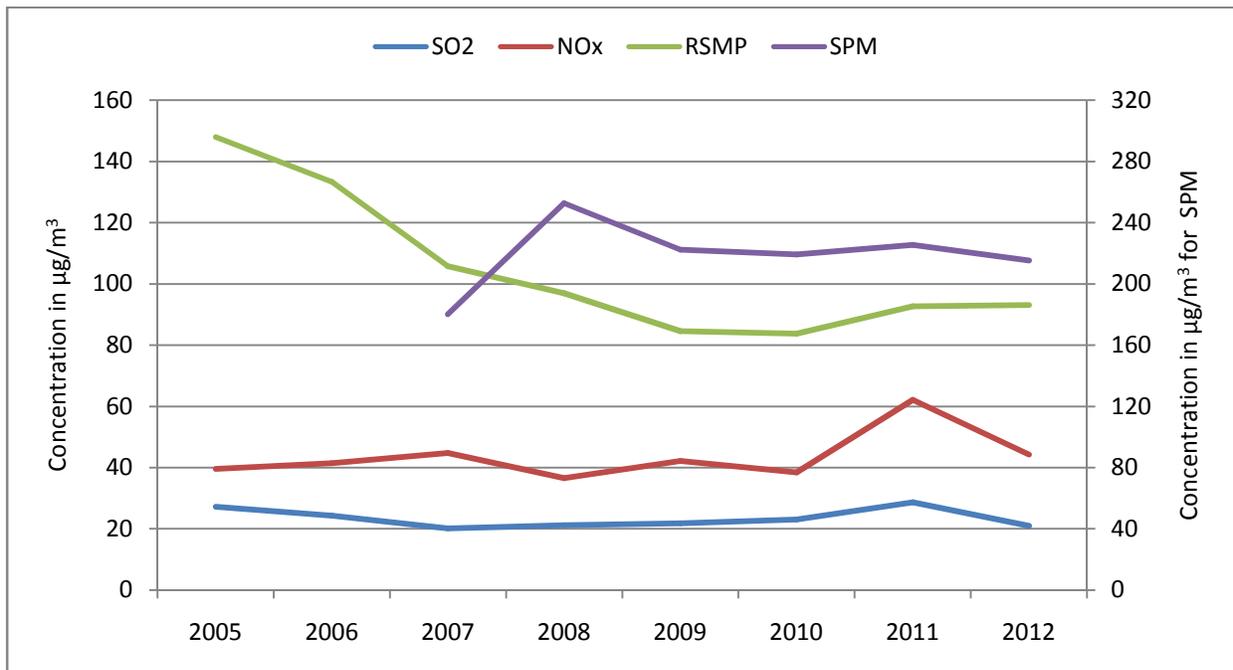


The RSPM is critical for Pune. RSPM is mostly above the permissible level except during the rains which washes away the particulate matters suspended in the air. The trend over the month is consistent for the three monitoring stations. Thus, RSPM is of concern for good air quality of Pune.

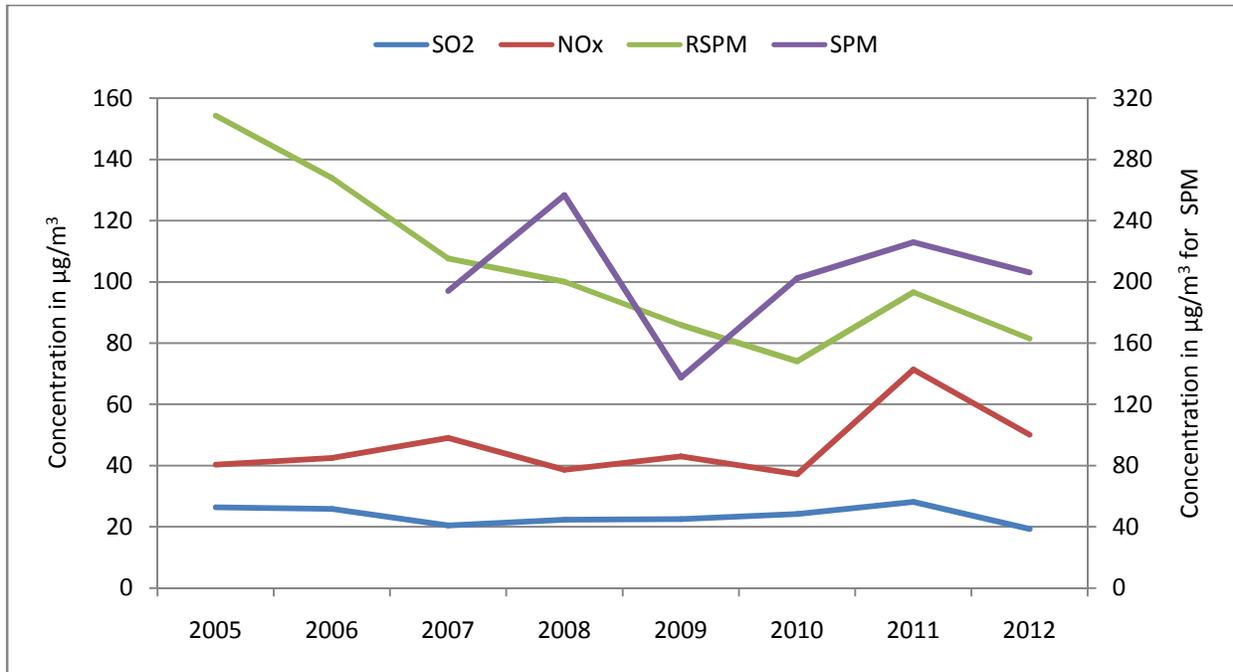
7.5.1.7. Annual trends of air quality in Pune

The following three charts present the air pollution trends in Pune over the years, using the annual average for the previous year's data.

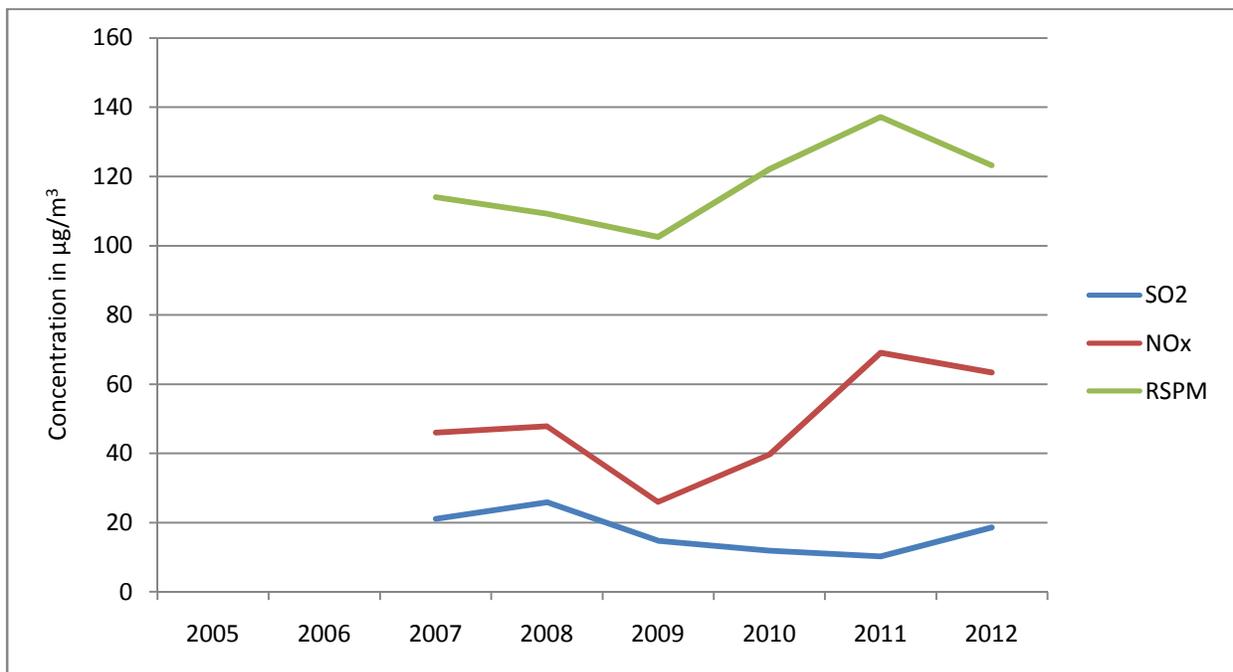
Air pollution trends at Nal Stop



Air pollution trends at Swargate



Air pollution trends at Karve Road



7.5.2. Key observations

The annual average level of RSPM is seen higher than the annual average standard of RSPM (60 $\mu\text{g}/\text{m}^3$). The annual average level of NO_x is on the border line till 2009-10 but found increasing above the annual average standard (50 $\mu\text{g}/\text{m}^3$) after 2010. SO_2 is well below the annual average standard (40 $\mu\text{g}/\text{m}^3$).

7.5.3. Calculating Pune's score

Pollutant	Annual average at Nal Stop	Annual average at Swargate	Average	Calculated LoS
$\text{SO}_2, \mu\text{g}/\text{m}^3$	21	19	20	1
$\text{NO}_x, \mu\text{g}/\text{m}^3$	44	50	47	2
RSPM, $\mu\text{g}/\text{m}^3$	93	81	87	3
SPM, $\mu\text{g}/\text{m}^3$	215	206	210.5	2
Calculated LoS				8

Overall LoS determined from the calculated LoS is 2. This indicates that Pune's air pollution "Needs some improvements in emission standards, checking pollution etc."

Calculated score out of 100 is $8 * (17 - \text{Calculated LoS}) - 4 = 8 * (17 - 8) - 4 = 60$ out of 100.

8. Parking on Mobility Corridors

8.1. Why was this parameter selected

As the number of vehicles grows in a city, so does the land use directed towards fulfilling its various demands. While it is acknowledged that vehicles need space for parking, providing more and more land for parking vehicles can potentially deprive land to other modes of transport and also reduce land available for other purposes.

On the other hand, parking can be used as an effective tool by the authorities to control congestion and private vehicle usage in the city, especially in the already congested areas. Therefore the National Urban Transport Policy directs parking policy to be on the following line of thought:

"Land is valuable in all urban areas. Parking places occupy large portions of such land. This fact should be recognized in determining the principles for allocation of parking space. Levy of a

high parking fee, that truly represents the value of the land occupied, should be used as a means to make the use of public transport more attractive. Preference in the allocation of parking space for public transport vehicles and non-motorized modes as well as easier access of work places to and from such spaces would go a long way in encouraging the use of sustainable transport systems. Park and ride facilities for bicycle users, with convenient inter-change, would be another useful measure. Simultaneously, a graded scale of parking fee, that recovers the economic cost of the land used in such parking, should be adopted. The objective would be to persuade people to use public transport to reach city centers."

For this reason, the Ministry of Urban Transportation, Government of India, has included "Parking on mobility corridors" as a parameter in its Service Level Benchmarks for Urban Transport. We are using the same benchmarks in this report.

8.2. What data was collected

Pune's Comprehensive Mobility Plan (CMP) provides the following map of mobility corridors of Pune:

1. Old Pune Mumbai Road
2. Shankar Sheth Road
3. Jangli Maharaj Road
4. Fergusson College Road
5. Pashan Road
6. Senapati Bapat Road
7. Pune Nagar Road
8. Alandi Road
9. Paud Road
10. Karve Road
11. Nehru Road
12. Sinhagad Road

This study is representative, and does not cover all the roads designated as mobility corridors.

Parking maps were procured from the Traffic Police for these roads.

Depending on the coherence and availability of the maps from Traffic Police, some parts of some roads may not have been included in the calculations. Hence the total road length considered may be different from the actual total length of the roads.

An application under the RTI Act was filed to find out any changes made in parking arrangements. With reference of the maps, the available lengths of parking space were calculated with the help of Google Maps, thereby giving a fairly accurate measure of available parking space, compared to the total length of the road. The RTI application filed also asked for arrangements for paid parking in the city. However, these had to be verified by actually conducting a survey on the roads.

According to the reply, Fergusson College Road and Jangli Maharaj Road from the mobility corridors were specified as having paid parking. These were then inspected to measure the actual length of paid parking on each road.

Parking for two wheelers is free in the city, and the roads which have paid parking charge only for car parking. Effectively, an astounding amount of parking in the city is free which is amply reflected in the data collected.

8.4. How was the data processed

8.4.1. Scoring system

The scoring system for this parameter is exactly as stated in the "Service Level Benchmarks for Urban Transport", published by the Ministry of Urban Development, Government of India.

The SLB from MoUD specifies the following method to calculate the "Level of Service" (LoS) for this parameter.

Level of Service	1. Availability of on street paid public parking spaces (%)	2. Ratio of Maximum and Minimum Parking Fee in the City
1	>= 75	> 4
2	50 - 75	2 - 4
3	25 - 50	1 - 2
4	< 25	1
Overall Level of Service (LoS) for Availability of Parking Space City-wide		
Calculated LoS = (LoS ₁ + LoS ₂) and identify overall LoS as mentioned below.		
Overall LoS	Calculated LoS	Comments
1	2	Paid parking spaces are available in the city and the demand is well managed by incorporating differential parking rates for the CBD.
2	3 - 4	Paid parking spaces are available in the city and the demand is well managed by incorporating differential parking rates for the CBD. However some improvements may be required
3	5 - 6	Paid parking spaces provided in the city need to be improved upon and to cater to the demand some differential parking rates for the CBD have been adopted. The city authorities need to imitative considerable improvements measures.
4	7 - 8	The city authorities need to initiate immediate actions with respect to providing paid parking spaces and demand management for parking.

The SLB by MoUD considers the following two factors:

1. How much of on street parking is paid and not free,
2. Whether parking charges reflect the varied cost of land and demand for parking in certain parts of the city.

The CMP of Pune has an objective of reducing parking on mobility corridors to zero, thus making road space available for transportation by various modes. Therefore we are adding another attribute to the LoS above, for "mobility corridors used for parking". This is calculated as

a	Length of mobility corridor roads where paid or free parking is permitted
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b	Length of mobility corridor roads
c	Mobility corridor used for parking, $c = [a / b] * 100$

The LoS for "mobility corridors used for parking" is determined from the following table:

Value of c	0-25	25-50	50-75	75-100
Level of Service	1	2	3	4

The "calculated LoS" is addition of the three LoS values. The Overall LoS is calculated from the table below:

Calculated LoS	3 - 5	6 - 8	9 - 10	11 - 12
Overall LoS	1	2	3	4

The "calculated LoS" as per the SLB has a range from 3 to 12. Therefore the calculated LoS is converted to a score out of 100 using the following formula:

$$\text{Score} = 10 * (13 - \text{Calculated LoS})$$

Thus if LoS = 12, Score = 10 and if LoS = 3, Score = 100.

8.5. Inferences drawn from data processing

8.5.1. Data collected

The lengths of the roads in the map above were determined using Google Maps and are as shown in the table below:

Sr No	Mobility Corridor	Length, km
1	Mumbai-Bangalore Highway bypass	23.8
2	Baner Road	7.5
3	Aundh-Ravet (PMC area)	5.0
4	Old Mumbai-Pune Road (PMC area, up to Sancheti bridge)	5.5

Sr No	Mobility Corridor	Length, km
5	Pashan Road	8.1
6	Senapati Bapat - Law College Roads	4.1
7	Paud Road	5.8
8	Karve Road	6.2
9	Jangli Maharaj	2.3
10	Ganeshkhind Road	2.9
11	Fergusson College	1.8
12	Shastri Road	1.6
13	Sinhagad Road upto Dandekar Pul	5.0
14	Swargate - Dandekar Pul	1.6
15	Sangamwadi - Alandi Road	10.2
16	Dhanori - Lohagaon	6.2
17	Vishrantwadi - Khese Park - Airport	5.7
18	Airport Road	3.6
19	Dr Ambedkar - Don Bosco - Loop Road	2.4
20	Nagar Road	8.8
21	Kharadi Bypass - Mundhwa	6.9
22	Ghorpadi - Mundhwa	5.1
23	Koregaon Park - Prince of Wales	4.3
24	Bund Garden - Sasoon - Raja Bahadur Mill Roads	3.8
25	Sancheti Grade Separator - Ambedkar - up to Moledina Road	2.2
26	Mahatma Gandhi - Moledina Road	2.9
27	Jawaharlal Nehru Road	4.9
28	Swargate - Solapur Road	11.3
29	Saswad Road (PMC area)	2.1
30	Prince of Wales - Lullanagar - N Road	5.7
31	Camp - Lullanagar - Kondhwa Road	7.0

Sr No	Mobility Corridor	Length, km
32	Katraj - Kondhwa Road	4.3
33	Swargate - Satara Rd - Katraj	7.1
	TOTAL	185.7

The following table gives the data collected on availability of paid and free parking on some of these "mobility corridor" roads. It should be noted that the "surveyed length" refers to both sides of the road. About 60.9 km of road "sides" was surveyed, which is equivalent to 30.5 km or about 16.4% of the mobility corridor roads.

Sr No	Name of the Road	Surveyed length of the road (km)	Total parking (km)	Paid parking (km)
1	Old Mumbai Pune Road	2.3	1.7	
2	Shankar Sheth Road	2.3	0.9	
3	Jangli Maharaj Road	1.8	1.6	0.74
4	Fergusson College Road	2.3	2.0	0.76
5	Pashan Road	11.6	10.7	
6	Senapati Bapat Road	2.9	0.0	
7	Pune - Nagar Road	7.1	3.7	
8	Alandi Road	2.4	0.4	
9	Paud Road	4.9	4.2	
10	Nehru Road	9.6	9.2	
11	Karve Road	7.4	5.8	
12	Sinhagad road	6.3	5.4	
	Total	60.9	45.6	1.5

Where parking was provided at a cost, the parking rates were the same across the city.

8.5.2. Key observations

The Municipal Corporation has not been charging two wheelers for parking on roads. In fact a decision to charge two wheeler parking was withdrawn in 2010, fearing people's discontent, thus making two wheeler parking on roads free for all, at all times and for any duration.⁶

At the same time, it provides for multi storied parking spaces for cars as well as two wheelers for nominal charges, at major points in the city.⁷ In Pune, plans are to construct more multi-storey and mechanized parking lots despite earlier failures. The mechanized parking lot that can house 80 cars on Jungli Maharaj Road built in 2006 is underutilized. The multi-level parking at Mahatma Phule market has not resolved parking issues.⁸

Even in case of residential parking, there has been a trend towards increasing the minimum parking area allotted to residents in new constructions.

8.5.3. Calculating Pune's score

8.5.3.1. How much of on street parking is paid and not free

Length of "mobility corridor" roads where parking is allowed = a = 45.6 km

Length of road with paid on street parking = b = 1.5 km

Percentage = $[b / a] * 100 = 3.3\%$

Level of Service = 4

8.5.3.2. Ratio of maximum and minimum parking fee

Maximum parking fee = a = Rs. 5 /hr

Minimum parking fee = b = Rs. 5 /hr

Ratio = $b / a = 1$

Level of Service = 4

⁶http://articles.timesofindia.indiatimes.com/2010-05-25/pune/28296547_1_parking-fees-civic-administration-pay-and-park-schemes

⁷http://articles.timesofindia.indiatimes.com/2011-12-17/pune/30528081_1_pay-and-park-scheme-important-roads-gold-adlabs

⁸http://articles.timesofindia.indiatimes.com/2012-05-16/pune/31725849_1_multi-level-parking-car-parks-parking-lots

8.5.3.3. Mobility corridors used for parking

Length of mobility corridor roads where paid or free parking is permitted = 45.6 km

Length of mobility corridor roads surveyed = 60.9 km

Mobility corridor used for parking = $[45.6 / 60.9] * 100 = 74.9\%$

Level of Service = 3

8.5.3.4. Pune's score

Calculated LoS = $4 + 4 + 3 = 11$

Overall LoS = 4.

This is described in the SLB by MoUD as

"The city authorities need to initiate immediate actions with respect to providing paid parking spaces and demand management for parking."

Pune's score out of 100 is

Score = $10 * (13 - \text{calculated LoS}) = 10 * (13 - 11) = 20$.

9. Public Opinion

9.1. Why was this parameter selected

Over the last few decades, transportation planning has developed into a full-fledged science in itself. Yet it is possible that even a well planned and technically sound transportation system of a city may not satisfy people's expectations. All said and done, it is important to ensure whether a city's transportation makes people happy and helps them in their daily lives. Therefore it is important to understand how people perceive the transportation system of their city.

9.2. What data was collected

After discussing the possible objectives of a city's transportation system with a few transportation planners, we listed down the main objectives as follows:

- Safety: This includes reduced and less severe traffic accidents, low rate of crime etc.
- Time: Are people able to reach their destinations in the expected amount of time?

- Mobility to all: Do people think that the city provides mobility to all kinds of people? Are people able to go around in the city reasonably unassisted?
- Effect on health: Does the daily commute cause any health issues, like back pain, respiratory problems, stress and related ailments etc?

People were asked whether the transportation system is safe, whether it takes expected amount of time for their commute, whether it provides mobility to all people according to them and whether they agree that the transportation system does not cause any health issues.

They were asked to state their answers as: Strongly disagree/ disagree/ agree/ strongly agree.

9.3. How was the data collected

These opinions were collected during the survey conducted to understand the city's modal split. The same form included questions related to perception of the transportation system.

9.4. How was the data processed

The data was processed using simple MS Excel techniques.

9.4.1. Scoring system

People's perception of the transportation system is sought on 4 attributes.

For each attribute, percentage of number of people describing their perception as strongly disagree/ disagree/ agree/ strongly agree is determined. The percentage points are multiplied by 0, 1, 2 and 3 respectively, the products are added and the sum is divided by 3 to get that attribute's score out of 100. Thus, if everyone marked a certain attribute as "strongly agree", that attribute would get 100% marks and if the opinion were divided equally with 25% people rating the attribute as strongly disagree/ disagree/ agree/ strongly agree, it would get 50% marks.

Average score of all 4 attributes is taken as Pune's score out of 100.

9.5. Inferences drawn from data processing

9.5.1. Data collected

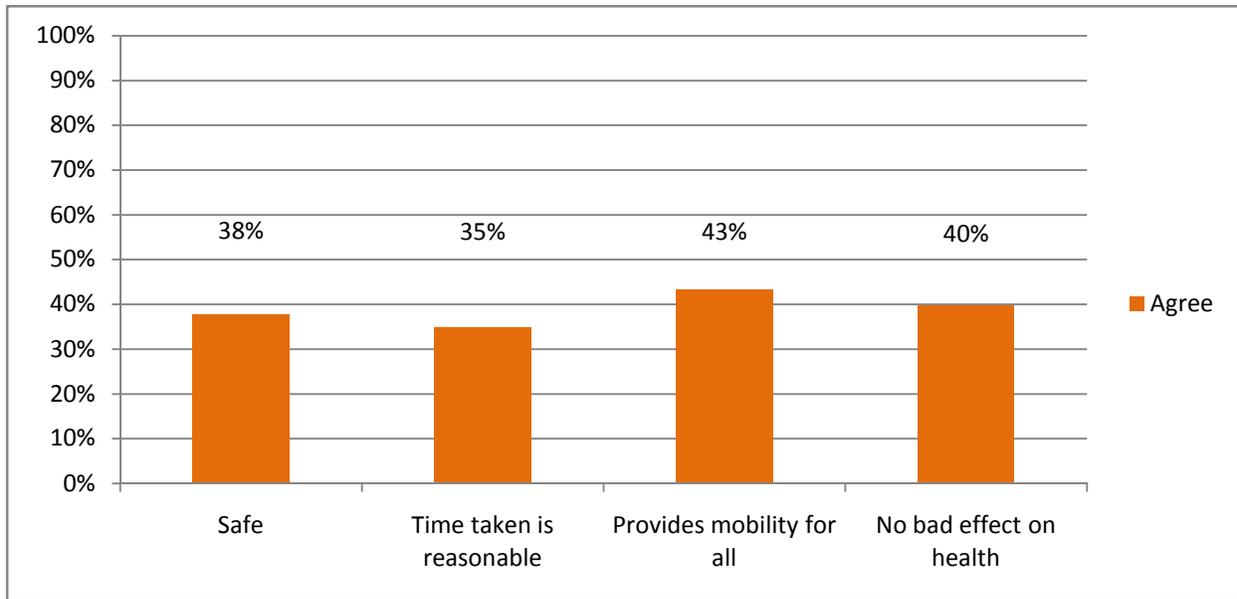
The table below summarizes people's responses to the questionnaire.

"Strongly agree" indicates a favourable perception.

Attribute	Strongly disagree	Disagree	Agree	Strongly agree
Safe	1021	1110	862	423
Does not take more than expected time	818	1393	907	269
Provides mobility to all	709	1212	1073	397
Does not adversely affect health	1039	1012	933	416

9.5.2. Key observations

Combining the opinions "Agree" and "Strongly agree" together gives the following pictorial representation of the citizens' perception of Pune's transportation system.



9.5.3. Calculating Pune's score

Using the scoring system described earlier, Pune's score is computed in the table below:

	Strongly disagree	Disagree	Agree	Strongly agree	Score
Safety	30%	32%	25%	12%	
Time	24%	41%	27%	8%	
Mobility	21%	36%	32%	12%	
Health	31%	30%	27%	12%	
(Multiplying factor)	0	1	2	3	
Safety	00	32	50	37	40.0%
Time	00	41	54	24	39.5%
Mobility	00	36	63	35	44.7%
Health	00	30	55	37	40.5%

Thus Pune's score for people's perception of the transportation system is 41 out of 100.

I. PMC Budget

A. Why was this parameter selected

There are various government organizations that play their respective roles in planning and running our city's transportation system. The Pune Municipal Corporation's role is perhaps the most crucial in this regard for various reasons.

- Virtually all funding for transportation infrastructure comes from PMC:
 - PMC is responsible for installation and maintenance of all day to day traffic infrastructure like road signs and markings, traffic signals, roads etc.
 - Larger infrastructure projects like flyovers are also funded by PMC.
- Even JNNURM funds are also routed through PMC. The proposals for projects to be funded by JNNURM comes from PMC.
- PMC is responsible for long term transportation planning for the city, and it is therefore expected that PMC spends funds in accordance with the transportation objectives set forth through documents like the CMP.

The CMP very clearly sets an objective for Pune to increase modal share of public transportation and cycling and to reduce modal share of personal vehicles.

It is therefore important to understand the budgetary allocations from PMC budget made for various modes of transportation.

B. What data was collected

The PMC budget for 2013-14 provided the data used in this chapter.

C. How was the data collected

As above.

D. How was the data processed

1. Beneficiaries of allocations

As far as transportation is concerned, the PMC budget is divided in two major sections: One for operational expenses and another for capital expenses. Therefore these sections were analyzed separately. Even then, there may be some value in combining the two, so the outcomes of analysis of these two sections is added up to present a combined analysis.

Objectives of specific works or projects for which an allocation is made were examined to see which mode among the following would be the primary beneficiary of the work or project:

- Walking (W)
- Cycling (C)
- Bus, or public transport in general (B)
- User of a personal vehicle (V)
- Miscellaneous (M)

Some works or projects stated in the budget clearly favour a single mode, while others consider multiple modes. In absence of detailed information on each such work, the following reasoning was used to determine which mode the budget allocation would be considered to favour.

	Type of project	W	C	B	V	M
1	Footpaths, pedestrian subways, foot overbridges	1.0				
2	Cycle tracks		1.0			
3	Generic "non-motorized transport" projects	0.3	0.7			
4	Bus stop, bus bay or any work related to BRT/ PMPML, Metro			1.0		
5	Road widening, tarring, concretization, paver blocks, maintenance				1.0	
6	Flyovers and grade separators				1.0	
7	Storm water drains					1.0
8	Street furniture (signage, zebra stripes etc)	0.6			0.4	
9	Traffic signals	0.5			0.5	
10	Thermoplastic paint (markings other than zebras)	0.4			0.6	

11	Junction improvements	0.5		0.5
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It could be said that road tarring and concreting helps buses and cyclists too. However, it should be noted that the primary beneficiaries of such projects are supposed to be personal vehicles. In fact, speed of personal vehicles increases after the road is smoothed and that endangers cyclists. Therefore such allocations were considered in favour of personal vehicles.

It could be said that pedestrian subways and foot overbridges help buses, cyclists and personal vehicles because they take pedestrians out of their way. However, it should be noted that the primary beneficiaries of such projects are supposed to be pedestrians. Therefore such allocations were considered to be in favour of pedestrians.

A similar argument can be put forth for cycle tracks.

Some projects, however, could have multiple modes as primary beneficiaries. No. 8 to 11 in the table above lists such categories.

Combined allocations that said "footpath and road work", for example, were considered to favour both modes equally.

2. Analyzing the budget

Each "line item" in the budget that fell under sections related to transportation was examined. The budgetary allocation was noted down. Beneficiary mode of each allocation was noted in separate columns as above. Where an allocation favoured multiple modes, it was noted accordingly. Budgetary allocation was accordingly split in favour of multiple modes.

The following example will explain the process. Please refer to "List A12" on page no 190 of the PMC budget for 2013-14.

Code	Details	Rs. lakhs	Proportionate beneficiary					Effective allocation				
			Walk	Personal vehicles	Public transport	Cycling	Misc	Walk	Personal vehicles	Public transport	Cycling	Misc
109	Tarring and such improvements	45		1				0.00	45.00	0.00	0.00	0.00
110	Surveys	15					1	0.00	0.00	0.00	0.00	15.00
111	FoB, subway, BRT: maintenance, CCTV etc	75	0.5		0.5			37.50	0.00	37.50	0.00	0.00

112	Traffic management study, reports	25				1	0.00	0.00	0.00	0.00	25.00
113	Cycle sharing	50				1	0.00	0.00	0.00	50.00	0.00
114	BRT road cleaning	30			1		0.00	0.00	30.00	0.00	0.00
115	Subway beautification	22.50	1				22.50	0.00	0.00	0.00	0.00

Effective allocations in favour of respective modes were added up separately for operational expenses and capital expenses.

3. Scoring system

No scoring system is envisaged for this parameter, hence none is proposed.

E. Inferences drawn from data processing

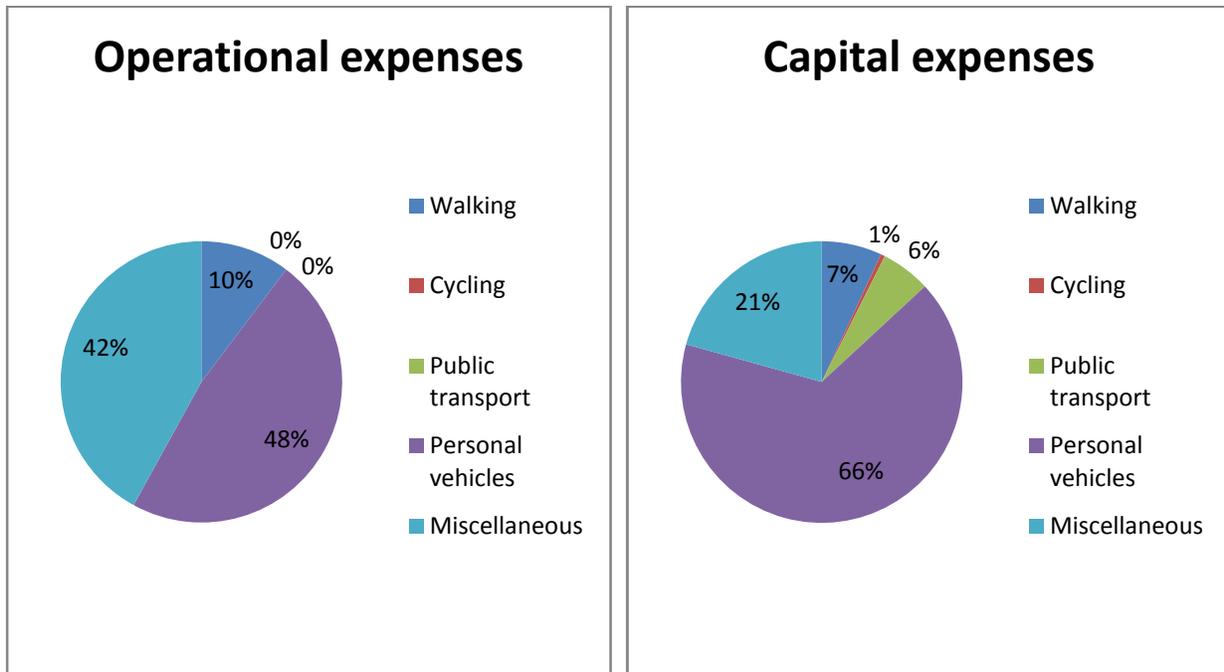
The following tables show the budgetary allocation in favour of various modes of transportation.

Today's modal split as observed by the modal split survey and the target modal split as stated in the CMP is also provided for comparison.

	Walking	Cycling	Public transport	Personal vehicles	Total of row
Operational expenses, Rs. Cr.	9	0	0	44	92
Capital expenses, Rs. Cr.	109	8	90	1,043	1,576
Total, Rs. Cr.	118	8	90	1,087	1,667
Operational expenses, % (1)	10.3%	0%	0%	47.7%	
Capital expenses, % (1)	6.9%	0.5%	5.7%	66.2%	
Total, % (1)	7.1%	0.5%	5.4%	65.2%	
Today's modal split (2)	33.2%		18.8%	46.9%	
Target modal split	50%		40%	10%	

1. The budget allocations for the four modes would not add up to the total of the row as the remaining allocation is for miscellaneous purposes.
2. These 3 numbers add up to 98.9%, as 1.1% trips are carried by other modes today.

The above observation may be shown pictorially as:



II. Initiatives of Pune Traffic Police

A. Why was this parameter selected

Pune Traffic Police play an important role in short term transportation planning of the city. Although all traffic infrastructure, right from road signs and traffic signals to flyovers, is PMC's responsibility, the Traffic Police have to give their consent to all or most of it.

In fact, virtually all of the changes in traffic flow are initiated by Traffic Police. They include, but may not be limited to, the following:

- Deciding which roads should be 1-ways,
- Parking restrictions like P1-P2, no parking, no stopping,
- Allowing and banning turns - at all times or specific times of the day,
- Timing patterns of traffic signals,
- etc.

How these initiatives are designed has a marked impact on people's transportation choices, including which mode to choose, which road to take or avoid at what time etc.

It may be noted, not as a comment but out of academic interest, that the Traffic Police do not have any formal training in transportation planning.

B. What data was collected

No data was collected for the Transportation Status Report of 2012-13. However, we intend to do this analysis in subsequent TSRs, for which we intend to collect data like the following:

- Number of initiatives by Traffic Police.
- Documented objectives of these initiatives.
 - e.g. Whether an initiative was intended to relieve congestion, eliminate detours of PMP buses, make crossing a road safer, etc.
- Documented evidence of before and after situations.
- Observation of specific actions by traffic police staff, e.g. whether they overrule the pedestrian phase at traffic signals and allow, even gesture, vehicles to start before the signal turns green for vehicles.

C. How was the data collected

Not applicable for this year.

D. How was the data processed

Not applicable for this year.

1. Scoring system

No scoring system is envisaged for this parameter, hence none is proposed.

E. Inferences drawn from data processing

Not applicable for this year.

III. Discipline

A. Why was this parameter selected

Traffic discipline, or the lack of it, is one of the day to day traffic issue close to the common man's heart. So much so that many people equate disciplined traffic with good transportation. without going in the discussion of whether that is the case, it suffices to say that traffic discipline is an important aspect of a city's transportation system.

While we recognize traffic discipline is an important parameter, we have not yet devised a system to quantify the state of traffic discipline. Whereas it may be possible to say over a few years whether the discipline has improved or not, it would be preferable to analyze some information to arrive at some sort of "Level of Service" quantification. We intend to work on such quantification in the next year's TSR. Therefore this section serves only as a placeholder in this year's TSR, and as a reminder of work to be done.

B. What data was collected

None.

C. How was the data collected

Not applicable.

D. How was the data processed

Not applicable.

1. Scoring system

Not applicable.

E. Inferences drawn from data processing

Not applicable.

IV. Number of Licenses and Failures

A. Why was this parameter selected

Roads were predominantly for pedestrians until not too long ago. Though riding animals and animal driven carts did provide mobility to people, walking was the primary mode of commute till bicycles and motorized vehicles arrived.

One needs a driving license to drive most motorized vehicles on public roads. The word "license" implies "permission". Motorized vehicles are much heavier than humans, and can therefore cause injuries to humans in case of a collision. That is the reason why one needs a permission to bring such a vehicle on roads that really belong to pedestrians. The "license" acknowledges that the holder of the license is aware of the responsibility s/he has when s/he brings a motorized vehicle on roads, and that s/he has received sufficient training to ensure safety of all road users.

Driving is a privilege and not a right.

Most developed nations understand the importance of granting driving licenses only to the deserving people - people who can demonstrate that they have the necessary skills to ensure that the vehicle they are driving will not hurt other road users.

It is this thought that leads to tough driving tests in developed countries, where typically only about 40-60% people get their driving license in the first attempt.

Examining the number of people applying for a driving license, number of licenses granted and number of people failing their driving test could throw some light on how strict our driving tests are, and in turn how serious we are about recognizing that driving is a privilege and not a right.

B. What data was collected

1. Number of licenses granted

The following information was sought:

- Number of applications for driving license
- Number of candidates failing the written test
- Number of candidates failing the practical test
- Number of driving licenses granted

This information was sought about the following types of licenses:

- Light motor vehicle (personal)
- Motorcycle with gears (personal)
- Motorcycle without gears (for persons above 18 years) (personal)

2. Details about written tests

- Whether the test is computerized
- How many candidates can appear at a time
- How much time is needed for written test of one batch of candidates

3. Details about practical tests

- Whether the test is computerized
- How many candidates can appear at a time
- How much time is needed for written test of one batch of candidates

4. Capacity of the RTO to conduct practical tests

- Number of inspectors with RTO to examine the candidates
- How much time do they spend in one week for examining practical tests

C. How was the data collected

An application under the RTI Act was submitted to the Pune RTO office to seek the information above.

Their answer is awaited.

D. How was the data processed

The data is not yet received.

1. Scoring system

No scoring system is envisaged for this parameter, hence none is proposed.

E. Inferences drawn from data processing

Not applicable.

V. Number of vehicles

A. Why was this parameter selected

Vehicles are a component of traffic. Vehicles transport people, occupy space on roads, need parking space and also emit pollutants in air. Therefore the number of vehicles as well as their rate of growth need to be studied if the city wants to forecast the future of its transportation system and plan accordingly.

It is to be noted that "planning accordingly" does not necessarily mean "planning to accommodate the increasing number of vehicles." Planning could also mean "planning to attempt a reduction in the rate of growth in the number of vehicles."

B. What data was collected

Number of vehicles registered with Pune RTO:

- Population of vehicles in Pune over the last few years,
- New registrations in Pune in a given year over the last few years.

Note that adding the figures of the population of vehicles in a given year and new registrations in the next year may not give the population of vehicles in the next year, because vehicles are also scrapped, destroyed in accidents or transferred to other cities.

C. How was the data collected

An application under the RTI Act was submitted to the Pune RTO office. The following information was sought in the application:

- | | |
|--|---|
| १. माहितीचा विषय: | नोंदणी झालेल्या वाहनांची आजची संख्या |
| २. कोणत्या कालावधीसाठी माहिती हवी आहे: | ३१ मार्च २०१२ ते ३१ मार्च २०१३. |
| ३. माहितीचे विवरण: | |
| | <p><u>प्रश्न क्र. १)</u> ३१ मार्च २०१३ च्या रोजी आपल्या कार्यक्षेत्रामध्ये किती प्रवासी रिक्शा नोंदणीकृत होत्या? (येथे किती रिक्षांना मीटरनुसार भाडे घेऊन व्यवसाय करण्याची परवानगी होती ती संख्या अपेक्षित आहे.)</p> <p><u>प्रश्न क्र. २)</u> ३१ मार्च २०१२ च्या रोजी आपल्या कार्यक्षेत्रामध्ये किती वाहने नोंदणीकृत होती? येथे केवळ सदर दिवशी नोंद झालेल्या वाहनांची संख्या अपेक्षित नसून त्या दिवसापर्यंतची एकूण वाहन</p> |

संख्या अपेक्षित आहे.

सदर वाहनसंख्येचे पुढील पानावर दिलेल्या तक्त्यानुसार खाजगी/ व्यावसायिक तसेच पेट्रोल/ डिझेल असे वर्गीकरण द्यावे.

प्रश्न क्र. ३) १ एप्रिल २०१२ ते ३१ मार्च २०१३ ह्या कालावधीमध्ये आपल्या कार्यक्षेत्रामध्ये किती वाहनांची नोंद झाली?

३१ मार्च २०१३ ची आकडेवारी उपलब्ध नसल्यास त्यापूर्वीची सर्वात ताजी आकडेवारी द्यावी व तिचा दिनांक नमूद करावा.

प्रश्न क्र. २ व ३ बाबत वाहनांची संख्या खालील प्रकारानुसार द्यावी ही विनंती. (३१ मार्च २०१२ पर्यंत साठी एक आणि १ एप्रिल २०१२ ते ३१ मार्च २०१३ साठी दुसरा असे दोन वेगवेगळे तक्ते द्यावेत ही विनंती.)

वाहनाचा प्रकार	खाजगी	व्यावसायिक	पेट्रोल	डीझेल
चारचाकी (कार)				
चारचाकी (जीप/ सुमोसारखी वाहने)				
दुचाकी				
प्रवासी रिक्षा				
इतर ३ चाकी (मालवाहू रिक्षा इ.)				
बस, मिनीबस				
ट्रक, टॅपो				
इतर सर्व प्रकार (ट्रॅक्टर इ.इ.)				
एकूण				

For vehicular population and new registrations, the RTO has furnished the data in a standard template with a breakup of different types of vehicles.

For data on number of vehicles according to type of fuel used: Old The RTO has furnished data on vehicular population up to 31st March 2012 and new registrations in 2012-13. However, the RTO says that the old data is rather unreliable in this regard. Reliability of this data for 2012-13 is said to be better.

D. How was the data processed

The data was processed using MS Excel.

1. Scoring system

No scoring system is envisaged for this parameter, so none was devised.

E. Inferences drawn from data processing

1. Data collected and key observations

The data provided by RTO Pune is as follows:

a) New registrations

	2-wheelers	Cars	Jeeps	Station wagons	Taxi cabs	4-wheelers	Other	Total
1999-00	54,463	8,972	1,808	27	36	10,843	6,731	72,037
2000-01	59,436	9,151	1,649	3	14	10,817	8,352	78,605
2001-02	62,409	11,010	1,813	0	259	13,082	7,152	82,643
2002-03	69,426	11,125	1,638	3	485	13,251	7,631	90,308
2003-04	77,382	13,372	1,656	2	671	15,701	7,186	100,269
2004-05	84,186	17,914	1,797	0	1,366	21,077	7,713	112,976
2005-06	95,073	21,059	2,501	1	1,310	24,871	9,729	129,673
2006-07	104,406	25,088	3,519	1	2,887	31,495	12,502	148,403
2007-08	87,499	25,056	2,837	0	2,354	30,247	12,153	129,899
2008-09	94,346	26,873	1,393	0	1,354	29,620	7,790	131,756
2009-10	102,620	30,047	915	0	1,363	32,325	8,171	143,116
2010-11	128,390	39,591	1,176	0	1,595	42,362	12,195	182,947
2011-12	155,904	48,358	1,442	1	2,003	51,804	12,456	220,164
2012-13	146,240	46,433	941	0	1,032	48,406	7,910	202,556

b) Total number of vehicles

	2wh	Cars	Jeeps	Stn. wagon	Taxi cabs	4wh	Other	Total
31-3-00	609,497	66,475	26,088	944	3,772	97,279	123,833	830,609
31-3-01	665,232	74,957	26,544	946	3,736	106,183	130,859	902,274
31-3-02	723,247	85,410	27,295	946	4,008	117,659	135,647	976,553
31-3-03	788,191	95,571	28,068	947	4,473	129,059	140,129	1,057,379
31-3-04	862,367	108,184	28,838	949	5,005	142,976	144,126	1,149,469
31-3-05	922,674	124,603	29,097	949	6,371	161,020	141,062	1,224,756
31-3-06	1,018,346	146,595	31,708	949	7,672	186,924	147,843	1,353,113
31-3-07	1,125,590	173,865	37,838	950	10,791	223,444	158,814	1,507,848
31-3-08	1,214,671	198,428	39,631	950	12,504	251,513	172,603	1,638,787

31-3-09	1,312,213	217,283	39,063	950	12,923	270,219	180,298	1,762,730
31-3-10	1,418,585	246,286	39,527	950	14,331	301,094	188,115	1,907,794
31-3-11	1,551,628	284,941	40,312	950	16,023	342,226	200,103	2,093,957
31-3-12	1,705,573	332,293	41,327	877	11,904	386,401	175,149	2,267,123

c) Number of vehicles using different types of fuel

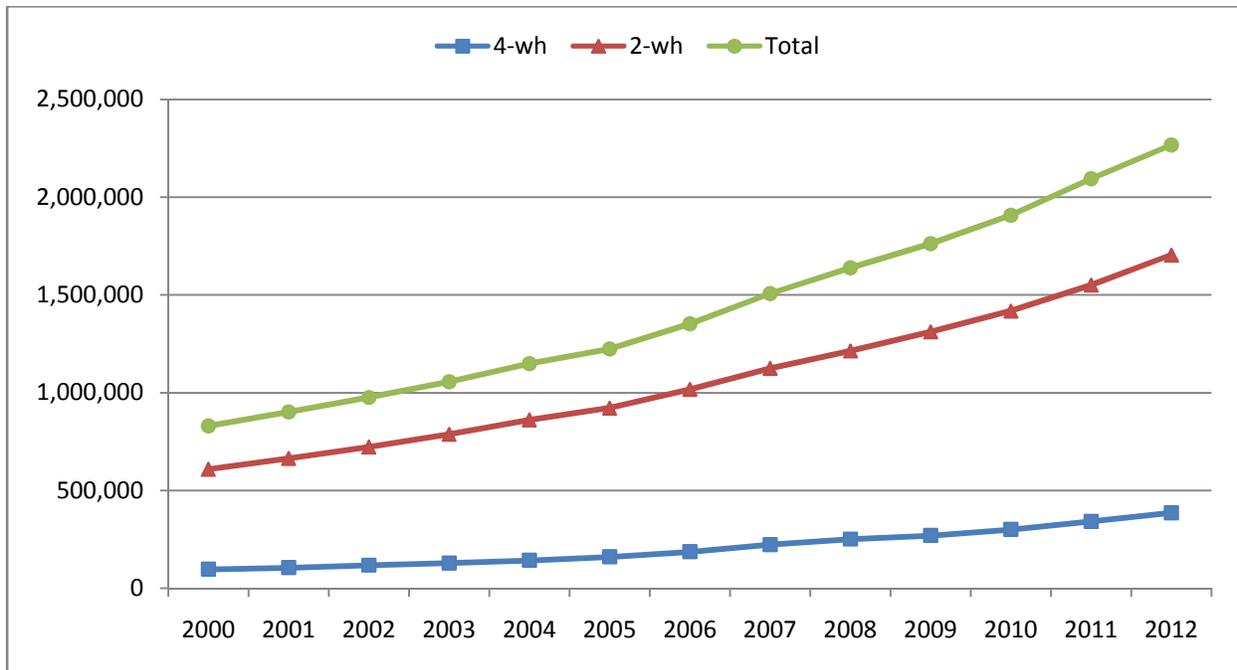
Type	Fuel	Up to 2012	2012-13	Up to 2012	2012-13
		Personal		Commercial	
Car-SUV	Petrol	168,049	21,184	2,905	103
Car-SUV	Diesel	61,784	20,218	51,269	964
Car-SUV	Gas, other	14,569	2,963	742	188
2-wheelers	Petrol	665,787	142,571	3,153	0
2-wheelers	Diesel	68	542	15,352	0
2-wheelers	Gas, other	1,686	404	1,261	0
Rickshaws	Petrol	0	0	28,949	73
Rickshaws	Diesel	0	0	9,441	2,045
Rickshaws	Gas, other	0	0	43,523	2,924
Bus, minibus	Petrol	15	0	879	26
Bus, minibus	Diesel	46	0	54	6,584
Bus, minibus	Gas, other	3	0	4	18
Truck, tempo	Petrol	11	0	36	0
Truck, tempo	Diesel	7	1	15,760	2,633
Truck, tempo	Gas, other	3	0	366	4

2. Key observations

The following observations from the data above could be of interest to the readers.

a) Number of vehicles

The following graph indicates the rise in total number of vehicles as well as number of 2- and 4-wheelers.



b) Number of 2 wheelers versus number of 4 wheelers

Ratio = number of 2-wheelers / number of 4-wheelers.

Year	Ratio for new registrations	Ratio for total number of vehicles
1999-00	5.02	6.27
2000-01	5.49	6.26
2001-02	4.77	6.15
2002-03	5.24	6.11
2003-04	4.93	6.03
2004-05	3.99	5.73
2005-06	3.82	5.45
2006-07	3.32	5.04
2007-08	2.89	4.83
2008-09	3.19	4.86
2009-10	3.17	4.71

Year	Ratio for new registrations	Ratio for total number of vehicles
2010-11	3.03	4.53
2011-12	3.01	4.41

In 1999-2000, about 5 two wheelers were registered for every 4-wheeler. That ratio has come down to about 3 in 2011-12, indicating that more cars are being bought now than earlier.

c) Growth in vehicles using diesel

The ratio of 4-wheelers using petrol and diesel was about 2.72 on 31st March 2012. However, this ratio stood at 1.04 if only vehicles registered in the next year, i.e. 1st April 2012-31st March 2013 are considered. This indicates that the number of vehicles using diesel is increasing much faster than ever before.

It is to be noted that the older data with RTO may not be accurate, as acknowledged by RTO. It would be of interest to see how this ratio changes in the upcoming years.

3. Calculating Pune's score

No scoring system is envisaged for this parameter, hence none is proposed.

VI. PUC Coverage

A. Why was this parameter selected

Pollution is one of the major problems faced cities in India, and Pune is no exception. Transportation is a major contributor to urban air pollution.

This Transportation Status Report considers pollution as a major parameter on which the city's transportation is benchmarked. The amount of various pollutants in the air is considered.

One of the measures taken by the city to control air pollution is to mandate the "PUC" or "Pollution Under Control" certificate to all vehicles. All vehicles are supposed to undergo a "PUC test" twice a year. New vehicles are exempted from this test for one year.

Data on how many PUC tests are actually conducted in the city can give us an idea of

- How serious people are about getting their vehicles tested for pollution and
- How serious the authorities are about mandating that all vehicles be tested.

B. What data was collected

1. How many PUC tests were performed in Pune in 2012-13?
2. What is the number of vehicles in Pune in 2012-13?
3. How many new vehicles were registered in Pune in 2012-13?

C. How was the data collected

1. How many PUC tests were performed in Pune in 2012-13?

The RTO was requested to provide data on number of PUC tests conducted in Pune in 2012-13.

2. How many vehicles were registered with RTO Pune as of 31st March 2011 and 31st March 2012?

An application under the RTI Act was submitted to the RTO, requesting the data.

D. How was the data processed

1. Number of PUC tests

The RTO provided PUC test data from 35 PUC check centers. The officer said that there are about 170 PUC check centers in Pune. Therefore the data was multiplied by a factor of 170/35 to get an estimate of number of PUC tests performed in Pune city.

They provided data for the following categories of vehicles: 2-wheelers, 3-wheelers, 4-wheelers, heavy vehicles, total number of failures. Adding all these numbers gave the total number of PUC tests performed.

No data was available on whether vehicles that failed a PUC test were tested again and whether such vehicles are included in the passed tests. It is assumed that the total number of PUC tests as above indicates how many vehicles appeared for PUC tests.

The category "3-wheelers" could include the passenger as well as good carrier rickshaws.

Considering these issues, PUC coverage was estimated only for the following 3 categories of vehicles: 2-wheelers, 4-wheelers and total number of vehicles.

2. Number of vehicles expected to undergo PUC tests

The following vehicles were expected to undergo the PUC tests in the year 2012-13:

- All vehicles registered in Pune as of 31st March 2011 would be expected to do PUC tests twice in 2012-13.
- All vehicles registered in Pune from 1st April 2011 to 30th September 2011 would be expected to do PUC tests once in 2012-13. Since this data was not available, it was taken as half of the number of vehicles registered in Pune from 1st April 2011 to 31st March 2012.
- It is possible that the number of vehicles on record includes some very old vehicles that are not in use any more, hence cannot realistically be expected to undergo PUC tests. However, there are a lot of vehicles in Pune that are registered with RTO offices other than Pune. It is possible that some of these vehicles might have conducted PUC tests in Pune. Since the effect of both these factors cancels out to some extent, it was ignored.

3. Scoring system

No scoring system is envisaged for this parameter, hence none is proposed.

E. Inferences drawn from data processing

1. Data collected

The following table provides the data acquired and inferred.

Type	No of vehicles on 31 st March 2011	Half of number of vehicles from 1 st April 2011 to 31 st March 2012	No of PUC tests expected	No of PUC tests performed	PUC Coverage
2-wheelers	1,551,628	77,952	31,81,208	291,438	9.16%
4-wheelers	342,226	25,902	710,354	51,947	7.31%
All vehicles	2,093,957	110,082	42,97,996	397,533	9.25%

Pune's score for PUC coverage = 9 out of 100.

2. Key observations

It was learnt that there are about 170 PUC check stations in Pune, and all are supposed to send data on PUC tests every month to RTO. However the RTO was able to provide data only from 35 stations.

VII. Affordability of Transportation

A. Why was this parameter selected

There are all types of people in a city – young and old, rich and poor. Everyone needs to commute for a variety of reasons. Being able to commute enhances people’s earning potential, access to education and improves quality of life in general.

However, transportation is not free, though the cost of transportation depends on the modes chosen. Even then, it may be possible that the poorer people spend a larger percentage of their income on transportation than the richer. If the cost of transportation is high, it adversely affects the amount of money the poor can spend on education and nourishment.

Therefore it is desirable that the financially weaker section gets at least the basic transportation facilities at a cost they can afford. If transportation is affordable, they can commute a longer distance, which increases their employment opportunities and in turn benefits the city’s economy.

B. What data was collected

The objective is to determine the cost of commute per km for various modes of transportation. The following modes are considered:

1. Walking
2. Cycling
3. PMPML bus
4. Rickshaws
5. Taxis
6. 2-wheelers
7. 4-wheelers

The cost of using each of these modes has the following components:

1. One time fixed cost
2. Annual fixed cost
3. Variable or “running” costs

Information required to compute these costs was collected, and it consisted of the following:

1. Purchase price of a vehicle
 - a. Typical life of the vehicle

2. Insurance
3. Repairs and maintenance
4. Fuel

It is to be noted that these components of cost may or may not apply to each mode.

Individual variables/ sub-parameters, regarding which the data was collected.

C. How was the data collected

The data was collected through publicly available information.

Cars: As the purchase price of cars varies wildly depending on the size, engine capacity and luxury levels, fixed cost and variable cost of an entry-level car (Maruti Alto 800 STD) was considered for this exercise. The on-road price in Pune of Maruti Alto 800 STD car was obtained from a local Maruti dealer.

Motorcycle: As the purchase price of motorcycles varies significantly depending on the brand, engine capacity and luxury levels, fixed cost and variable cost of an entry-level motorcycle (Bajaj Platina 100cc) was considered for this exercise. The on-road price in Pune of Bajaj Platina 100cc motorcycle was obtained from the local Bajaj dealer.

Taxi: Fare for 5km was obtained from the website of Wings Radio Cabs⁹.

Rickshaw: Fare for 5km was obtained from RTO, Pune website¹⁰.

PMPML Bus: Fare for 5 km was obtained from PMPML fare structure.

Bicycle: Price of a standard roadster was obtained from BSA Hercules web site¹¹.

Fuel price: Price of petrol as of July 1st, 2013 was obtained from a local petrol pump.

D. How was the data processed

Rickshaw: A trip of 5 km was considered for this exercise.

Taxi: A trip of 5 km was considered for this exercise.

PMPML Bus: A trip of 5 km was considered for this exercise.

⁹ <http://www.wingsradiocabs.com/taxi-service-radio-cab.html>

¹⁰ <http://www.rtopune.info/autorikshawfare.htm>

¹¹ <http://www.bsahercules.com/roadsters-bikes.asp>

Bicycle: Only the fixed cost was considered, as the variable cost is negligible.

Walking: Zero cost was considered.

1. Processing the data

Cost per km by various modes

Following formulas were used:

- Fixed Cost for car per year = (Purchase price / Avg. Life of car) + Insurance + Repairs
- Fixed Cost for car per km = (Fixed Cost per year) / (Avg. usage per year)
- Variable Cost for car per km = (Fuel cost per liter) / (Fuel efficiency in kmpl)
- Total cost per km for car = (Fixed cost for car per km + (Variable cost for car per km)
- Fixed Cost for motorcycle per year = (Purchase price / Avg. Life of motorcycle) + Insurance + Repairs
- Fixed Cost for motorcycle per km = (Fixed Cost per year) / (Avg. usage per year)
- Variable Cost per km for motorcycle = (Fuel cost per liter) / (Fuel efficiency in kmpl)
- Total cost per km for motorcycle = (Fixed cost for motorcycle per km) + (Variable cost for motorcycle per km)
- Cost per km for PMPML bus = (Single journey Ticket fare for 5 km) / 5
- Cost per km for rickshaw = (Fare for 5 km) / 5

Monthly cost of transportation

The following 5 income groups were considered, and their mean income was considered as given in the parenthesis:

1. Less than Rs. 10,000 pm. (Rs. 7,000)
2. Rs. 10-20,000 pm. (Rs. 15,000)
3. Rs. 20-50,000 pm. (Rs. 30,000)
4. Rs. 50,000-1 lakh pm. (Rs. 70,000)
5. Above Rs. 1 lakh pm. (Rs. 125,000)

For each income group, the following information was obtained from the modal split survey conducted for preparing the TSR: Distance travelled per day per individual by the following modes: Walking, cycling, PMPML or private bus, auto rickshaw, 2-wheeler and 4-wheeler.

These distances were multiplied by the per km cost of travel obtained. This gives the cost of travel per day. This was multiplied by 25 to obtain cost of travel per month per person. Family

size of 4 was assumed, and this cost was multiplied by 4 to obtain cost of transportation per month.

The cost of transportation per month was expressed as a fraction of the mean income levels.

E. Inferences drawn from data processing

1. Data collected

Assumed data

The following data was assumed:

1. One time fixed cost: Life of a personal vehicle was taken as 10 years.
2. Annual fixed cost: Insurance and typical repair costs. These were apportioned over 10,000 kms of assumed annual running for cars and motorcycles.
 - a. Annual insurance for car – Rs 3,000
 - b. Annual repairs for car – Rs 2,000
 - c. Annual insurance for motorcycle – Rs 800
 - d. Annual repairs for motorcycle – Rs 500
3. Variable or “running” costs: Fuel cost – This is the per-km cost based on the price of fuel and the fuel efficiency. Petrol was assumed as the fuel as all motorcycles and majority of cars run on petrol at this time. For cars and motorcycles, a fuel efficiency of 20 kmpl and 50 kmpl respectively was assumed.
4. The cost of using a private bus (e.g. a company bus) was considered to be the same as PMPML bus.

Purchase prices of vehicles

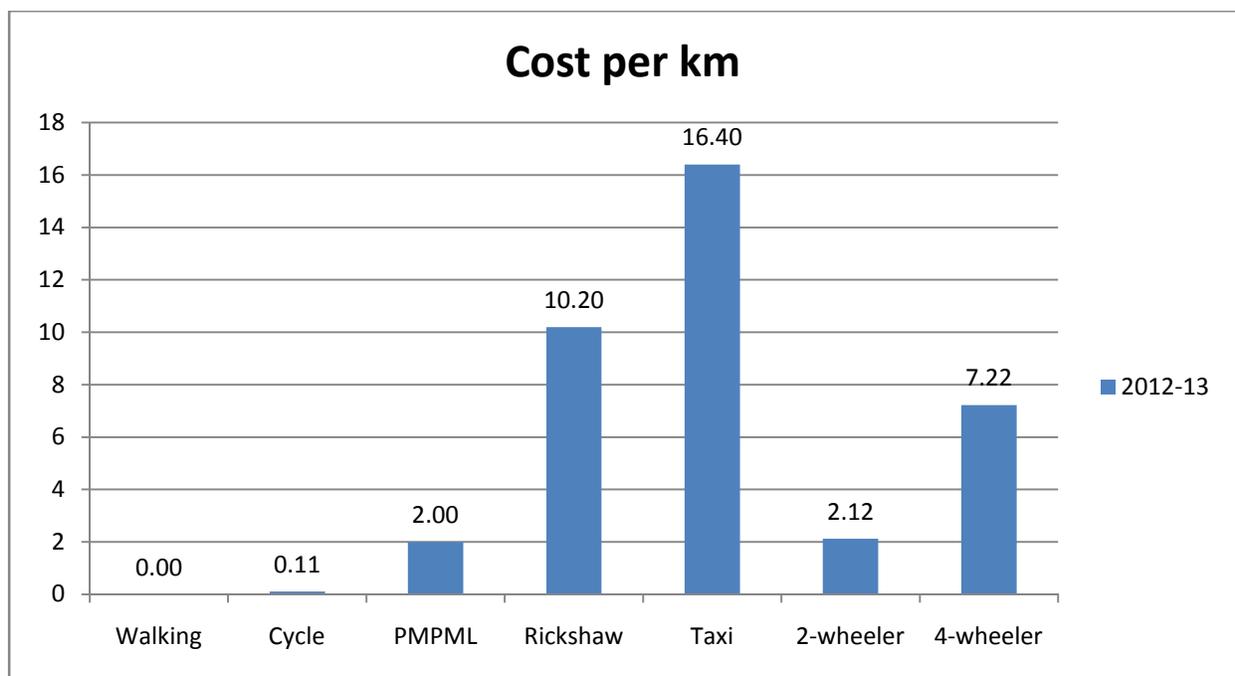
1. On-road price in Pune of Maruti Alto 800 STD: Rs. 285,508
2. On-road price in Pune of Bajaj Platina 100cc motorcycle: Rs. 44,436
3. Price of a standard BSA roadster cycle: Rs. 3,650

Calculation of cost per km

Mode	Purchase Price	Insurance	Repairs	Fixed Cost per year	Fixed cost per km	Variable Cost per km	Fare for 5 km	Total Cost Per km
Walking								0.00

Mode	Purchase Price	Insurance	Repairs	Fixed Cost per year	Fixed cost per km	Variable Cost per km	Fare for 5 km	Total Cost Per km
Bicycle	3,650	0	200	565	0.11	0.00		0.11
Bus							10	2.00
Rickshaw							51	10.20
Taxi							82	16.40
Motorcycle	44,436	800	500	5,743	0.57	1.55		2.12
Car	285,508	3,000	2,000	33,550	3.36	3.86		7.22

The inference from the table above is shown graphically as:



VIII. Fuel consumption

A. Why was this parameter selected

The amount fuel consumed by the city on transportation depends on a variety of factors, e.g.

- The modal split of transportation
- The sprawl of the city

- Traffic congestion
- Preferences towards using more or less fuel efficient vehicles within the same class of vehicles
- etc.

If it is found that the city is using more fuel per person for transportation, it is an indication that the combined effect of factors like the ones noted above is making the city transportation less sustainable. For example, though a slight improvement in modal split of public transport might reduce the city's overall fuel consumption, increasing travel distances might more than offset any such gains.

The amount of fuel the city burns has a significant impact on air quality. Reduction in the amount of fuel consumed not only means more money in people's pockets, but also saving of foreign exchange.

B. What data was collected

Although acquiring fuel sale figures from various petroleum companies is a possible source of data, it is to be noted that petrol and diesel is also used for various other purposes, e.g. for generator back-ups to elevators in multi-story buildings. It was understood that a break-up of how much of the fuel is used for transportation would not be readily available.

A lot of primary data was collected during the modal split survey. Although data was bucketed in terms of time taken for commute, it was assumed that it would still give a reasonable estimate of fuel consumption.

C. How was the data collected

The data was collected as a part of the modal split survey.

D. How was the data processed

The modal split survey provided data on number of stages of transportation during a typical work day. The following figures were derived from this data:

1. Stage-wise modal split of various modes
2. Distance-wise split of various modes
3. An estimate of amount of fuel consumed for these stages

A "what if" scenario was constructed for these stages for a case where the city would have significantly better facilities for PMPML and cycling. In such an event, a different number of

stages over short, medium and long distances, done by various modes today, could switch to PMPML and cycling. The same 3 figures listed above were computed for such an imaginary case.

The table below indicates the current distribution of stages for various modes and also the possible modal shift in case of significant improvements in PMPML and cycling facilities considered for these calculations. This data represents a sample size of 3,387 Pune residents.

Mode	Distance	No of stages	Total distance	alternate mode	% split
Walk	All	3168	2729		
Cycle	<3 km	248	245.4		
Cycle	3-6 km	211	844		
Cycle	>6 km	62	558		
PMP	<3 km	89	142	PMP	80%
				Cycle	20%
PMP	3-6 km	424	2233	PMP	90%
				Cycle	10%
PMP	>6 km	290	3480	PMP	100%
				Cycle	-
Private bus	All	269	2837		
Rick	<3 km	64	128	Rick	80%
				PMP	10%
				Cycle	10%
Rick	3-6 km	293	1963	Rick	70%
				PMP	20%
				Cycle	10%
Rick	>6 km	99	1485	Rick	60%
				PMP	40%
				Cycle	-
Rick	Multi-trips	330	307		
2wh	3 km	755	2265	2-wh	70%

Mode	Distance	No of stages	Total distance	alternate mode	% split
				PMP	10%
				Cycle	20%
2wh	10 km	1716	17160	2-wh	60%
				PMP	30%
				Cycle	10%
2wh	22.5 km	783	17618	2-wh	50%
				PMP	50%
				Cycle	-
2wh	Multi-trips	191	438		
4wh	2.5 km	110	275	4-wh	80%
				PMP	10%
				Cycle	10%
4wh	8.3 km	403	3345	4-wh	70%
				PMP	20%
				Cycle	10%
4wh	18.8 km	357	6712	4-wh	60%
				PMP	40%
				Cycle	-
4wh	Multi-trips	287	419		

"Multi trips" indicates people who use that mode for several trips in a day, e.g. people who deliver milk or newspapers, sales and marketing representatives who visit several clients in a day. These people are unlikely to switch to another mode just because the facilities for that mode have improved.

The vehicles were assumed to use the following fuels with respective fuel efficiency and ridership:

Vehicle	Fuel 1, % use	Fuel 1 efficiency	Fuel 2, % use	Fuel 2 efficiency	Ridership
PMP	CNG 20%	3.5 km per kg	Diesel 80%	3.2 kmpl	40

Private bus	Diesel 100%	4 kmpl			40
Rickshaw	CNG 33%	30 km per kg	Petrol 67%	25 kmpl	1.5
2-wh	Petrol 100%	40 kmpl			1.2
4-wh	Diesel 45%	20 kmpl	Petrol 55%	13 kmpl	2

E. Inferences drawn from data processing

1. Data collected

The data from 3,608 residents included 10,870 stages. However, no data about distances of 666 of these stages was recorded. In effect, it can be said that the data collected represented 3,387 residents.

As indicated earlier in this document, the 2013 population of Pune is considered to be 32,66,046.

2. Key observations

The data was processed as above to arrive at an estimate of fuel consumed per day as well as how much fuel would be consumed if the modal share shifted as suggested in the "what if" scenario described above. The results are tabulated below:

	CNG, kg	Diesel, l	Petrol, l
Today	36,610	173,563	1,052,141
"What if"	31,075	128,070	371,032
Saving, %	15%	26%	65%

The saving in consumption of all petroleum based fuels is thus likely to be as much as 58%.

This translates to an annual saving of between Rs. 1,700 Cr to Rs. 1,750 Cr. for Pune residents.

3. Calculating Pune's score

No scoring system is envisaged for this parameter, hence none is proposed.

Score card for Pune

Sr No	Subject	Score for 2012-13
1	Safety	40
2	Modal share	27
3	Facilities for pedestrians	37
4	Public transportation	55
5	Facilities for bicycles	50
6	Time to commute	75
7	Pollution	60
8	Parking on arterial roads	20
9	Public opinion	41

We would like to reiterate the request to the reader:

Please do not read more than necessary into the absolute score of the city in any parameter. Whether we see improvement next year or not is much more important than the score this year.

Appendix 1. Abbreviations

Abbreviation	Description
CMP	Comprehensive Mobility Plan of Pune
GDP	Gross Domestic Product
IPT	Intermediate Public Transport (Taxis and rickshaws)
LHS	Left Hand Side
LoS	Level of Service
MoUD	Ministry of Urban Development, Government of India
NMT	Non-Motorized Transport
NMV	Non-Motorized Vehicle
NO _x	Various oxides of Nitrogen, collectively
NUTP	National Urban Transport Policy
OMR	Optical Mark Recognition
PMC	Pune Municipal Corporation
PMPML	Pune Mahanagar Parivahan Mahamandal Ltd, the public bus service of Pune
PUC	Pollution Under Control test
RHS	Right Hand Side
RSPM	Respirable Suspended Particulate Matter
RTI	Right To Information
RTO	Road Transport Organization
SLB	Service Level Benchmarks for Urban Transport, published by MoUD
SO ₂	Sulphur Dioxide
SPM	Suspended Particulate Matter
TSR	Transportation Status Report (this report)
WHO	World Health Organization