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BBMP TRANSPORTATION ANALYSIS BASED ON ONTOLOGY THROUGH GEOSPATIAL TECHNOLOGIES

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ABSTRACT:

Providing Transportation is the major problem in the Metropolitan cities. Bangalore Administration division is known as Bruhat Bengaluru Mahanagara Palike. It is fastest growing city in term of Population. Creating transportation facilities for the public is becoming headache to the local government. Bangalore city is giving transportation facility through BMTC and KSRTC Departments. Floating populations is more while comparing to the fixed population. From all the corners daily commuters used to come to Bangalore city for different causes. Government is made a good attempt to solve the public problem and take some initiatives to create good transportation network. Here Geospatial Technology has been used to solve the certain problems based on Ontology. Ontology is composed of Conceptualization and relationship. In this research paper some transportation related component have been used and examined. Different data set have been used to achieve the objective of the research paper. The major objective of the paper is doing the analysis of BBMP Transportation using ontology concept applying Geospatial Technologies. Data's collected from the concern government agencies. Arc GIS software used to do the maps and analysis part. Some proposals have been given using the Ontology concept in Transportation.



KEYWORDS: BMTC, BBMP, KSRTC, Ontology, Geospatial and Floating Population.

INTRODUCTION :

Bangalore is known for its Traffic Problems and issues. Bangalore Transport consists of Government Buses, Railways, Metros, Autos and new arrival of Ola and Uber Services. In the year 1973 Mysore was renamed as Karnataka. In the same year MSRTC (Mysore State Road

Transport Corporation) was renamed to KSRTC (Karnataka State Road Transport Corporation). In August 1997, KSRTC got split to another branch called Bengaluru Metropolitan Transport Corporation (BMTC). In November 1997, another new road transport corporation called North Western Karnataka Road Transport Corporation (NWKRTC)

was formed to support the transportation needs of North Western parts of Karnataka. Later, the North Eastern Karnataka Road Transport Corporation (NEKRTC) was also formed with its corporate office in Gulbarga. Bangalore City has witness a phenomenal growth in Urban Population leading to increase in Vehicular Population. To solve

Bangalore's Traffic congestions, Bangalore Traffic Police has established various effective traffic Management Plans, by using "State of the Art Technology" like surveillance Camera, Digital Sign Boards. Chennai and New Delhi are willing to copy similar techniques to Control Congestions.

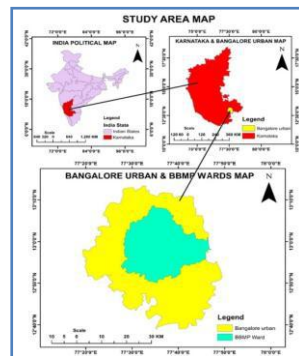
Kempegowda Bus Station is the Centre of the city. One can get buses to any part of the city from here. KBS was constructed in 1975 which is known as the intercity Bus Station or Majestic. Majestic Bus Station is located near the KSRTC Bus Station, Railway Station (Krantivira Sangoli Rayanna: South Western Railways) and Metro Station. Bangalore Metropolitan Transport Corporation (BMT) is the cheapest means of Public Transport in Bangalore City.

The word Ontology comes from two Greek words "Onto" meaning Existence or being real and "Logia" meaning Science or Study. Ontology can be defined as a data Model that represents knowledge as a set of concepts that exists in the real world or realm and the relationships between these concepts. Philosophical Ontology can also be defines as study of Concepts which exist or what is real. An example of Philosophical ontology is that it questions What are the fundamental parts of the world? And how they are related to each Other? Are Physical Material more real than Immaterial. Philosophers use the concept of ontology to discuss challenging questions to build theories and models, and to better understand the ontologies status of the world. There are subcategories in Philosophical Ontology, which is supposed to be Ontological materialism and Ontological idealism.

Ontology in a non-Philosophical concept, it is described as what exist specifically within a determined field. For example, every part that exist in a specific information system. This includes the relationship and hierarchy between these parts. Unlike philosophers, these researchers are not primarily interested in discussing if these things are the true essence, core of the system. Nor are they discussing if the parts within the system are more real compared to processes that take place within the system. Rather, they are focused on naming parts and processes and grouping similar ones together into categories.

STUDY AREA:

The **Bruhat Bengaluru Mahanagara Palike (BBMP)**, is the administrative body responsible for civic resources and some infrastructural features of the Bangalore metropolitan area. It is the fourth largest Municipal Corporation in India which has an approximate population of 8.8 million in an area of 709 km². BBMP's boundaries have expanded more than 10 times over the last six decades. Bangalore has two unique Topography terrains—North Bangalore taluk and the South Bangalore taluk. The North Bangalore taluk is more level plateau comparatively and lies between an averages of 839 to 962 meters above sea level.



Bangalore is the capital city of Karnataka and also the largest. Karnataka is a State of India. Bangalore is considered to be the 3rd largest city of India and 27th largest city around the world. In 2016 it was noticed that it had 15 million populations. Bangalore is said to be one of the most culturally diverse cities as most of its populations (around 51%) are Migrants from various parts of India and world. Bangalore city is governed by Municipal Corporation which comes under Bangalore Metropolitan Region. The Bangalore city is located in Karnataka state of India. In 2011 Bangalore population is

estimated to be 8,443,675, as per Census of India's Provisional Report, of which male and female are 4,391,723 and 4,051,952 respectively.

BBMP administration roles includes the development of the city structurally. This basically includes zoning and building regulations, health, hygiene, licensing, trade and education, as well as quality of life such as public open space, water bodies, parks and greenery. BBMP represents the third level of government (the Central Government and State Government being the first two levels). BBMP is looked after by a city administration composed of elected representatives, called "corporators". BBMP have 7 RTO's and 8 TTMC's. **Bangalore Metropolitan Transport Corporation (BMTC)** is a government agency that operates the public transport bus service in Bengaluru, India. It has the highest number of Volvo buses operated by a public transport company in India.

OBJECTIVE:

We know that Bangalore is one of the fastest growing metropolitan cities. It is having some many infrastructural problems in that Transportation is also one. In this research paper we have made an attempt to give some suggestion using Ontology concept and Geospatial technologies. The major objective of these papers is analysing the BBMP Transportation suggesting the probably alternatives using Ontology and Geospatial Technology. Many Transportation related aspects have been examined using GIS and Ontology.

DATA SOURCE:

For the research paper many data set have been used from different governing bodies. The source of data can be categories into Primary and Secondary data, these can be further categories into Spatial (Locations of important bus Stops using GPS) and Non-Spatial data (Observation of Traffic Congestions. Population data of year 2011 was collected from Census of India. RTO, TTMC, etc Data were collected from the BMTC website. Metro Data Map was collected the metro rail guy website. Bangalore Ward data was collected from BBMP wards website. BBMP RTO was collected from Acko site. TTMC Data was collected My BMTC website. Bus Location Map was collected from Open Street Map. **Vehicles registration** data from January 2015 - May 2019 was collected from RTO website).

METHODOLOGY:

Geospatial technologies have been used for this research paper. The methods used under the Arc GIS are data base creation, digitizing, attribute creation, topology creation, and analysis part including ontological model creation, BBMP Transportation analysis, and others.

RESULT AND DISCUSSION:

Ontology is a set of Concepts and Categories that exists in the domain of real world which shows its features and relationship. On the basis of the studies regarding Bangalore BBMP Transportation Ontology consists of the following Ontology categories. As we know there are different mode of Urban Transportation which includes Roadways, Railways, Metro Railways and Waterways in some areas if any. Each of the modes has different concepts which are interrelated and exists in real world. Representation of Key Letters used in this Project for Traffic Ontology:

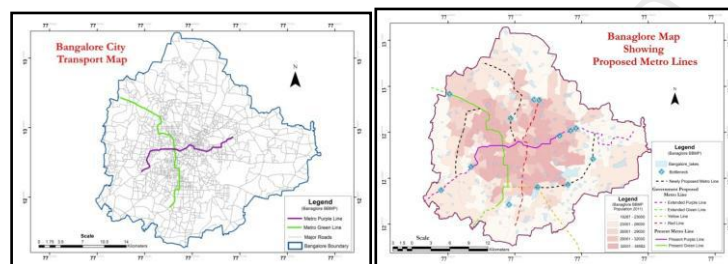
O={C, B, L, b, R, D, A, T, V, P}

Whereas C refers to roads, B refers to bottle neck, L refers to Lakes, b refers to Bus Stops, R refers to RTO, D refers to Depots, A refers to Accessible Area, T refers to TTMC, V refers to Vehicular Population, P refers to BBMP ward wise Population. All these concepts are real and exist in the world and also have a relationship among them. For example considering P and V, due to the rise in population and urbanization the vehicular population is also increasing. Similarly, there is inter-relation between each concept. Due to the increase population there is increase in urban vehicular population and urban sprawl that leads to the creation of new roads. Due to the creation of new roads there are

huge no. of vehicular (bus, private vehicles etc.) movement on the roads which causes huge traffic in the bottle neck areas. As the main objective of TTMCs is to manage and control traffic therefore it should be located near the bottle neck regions where the traffic is more. RTO's main objective is to provide registration to the vehicles, so it is important for it to be located where there is huge number of population. Coming to Depots the locations of depots should be distributed all over BBMP area and the buses travelling in the nearby routes should be shelter in the nearest depots.

Bangalore City Transportation (BBMP)-Bangalore BBMP is an urban area which has undulating land mass. The roads metro lines and railway stations are well planned. Major Bangalore Urban Areas are Majestic and Shivaji Nagar. Majestic is an important junction and a centroid for all types of Transportation such as metro, Bus terminal, and Railway station.

The Map below shows Bangalore Major Road Networks and existing Green and Purple Line of Metro. Bangalore Metro consists to two color-coded lines with a total length of 42.3 km and it serves 41 Stations. Bangalore BBMP Road network are of 14,000 km in length and it consists of 93,000 roads in number. This is the Ontology that these features exist in real world.



Map 1 Transport Route Map of BBMP Map 2 Ontology Map of Proposed Metro Line in BBMP

PROPOSED METRO LINE:

Metro Railways are truly helpful in management of Traffic. Metro Railways has been helping to manage Transport by providing quick and shortest means of transport, interconnecting among the main areas of the metropolitan cities. As Bangalore is well-known for its IT Hub, it is equally well-known for its traffic. So, metro lines were introduced. Government of Bangalore has proposed 2 new color coded lines of Metro railways and also the extended the existing metro lines. The dotted Lines are Proposed Lines by the government were as follows:

Purple Line: At Present Purple Line covers station from Mysore Road to Baiyyapanahalli. It covers some of the important stations like Vijayanagar, Magadi Road, Majestic, Sir M Visveshwaraya, Mahatma Gandhi Road and Indiranagar. The Planners are extending from Baiyyapanahalli to Whitefield and Mysore Road Metro to Challehatta.

Green Line: At Present Green Line covers station from Yelachenahalli to Hesaraghatta Cross (Nagasandra). It covers some of the important Station like Yeshwanthpura, Majestic, Cubbon Park, Lalbagh, K. R. Market, Rashtreeya Vidyalaya Road and Banashankari. The Planners are extending from Extended from Yelachenahalli to Anjanapura Township and Hesaraghatta Cross (Nagasandra) to BIEC.

Red Line: This line starts from Nagawara North Ramp to Gotigere. This line covers some of the important Stations like Cantonment, Shivaji Nagar, JP Nagar, and IIM Bangalore.

Yellow Line: This line starts from Rashtreeya Vidhyalaya Road to Bommasandra covering some of the important stations like Banashankari, BTM Layout, Electronic City, and Huskur Road.

Most of the Lines are covering all the traffic and bottle neck areas of Bangalore BBMP but four to five bottleneck areas are not considered. On the Basis of which I have proposed few more metro lines as shown below. Areas Line Surjapura Junction, Marathalli Junction and Mekhri Circle are not covered under metro Lines. To reduce the Traffic in all these areas I have proposed two metro Lines, one connecting from Silk Board to Yedehi Hospital covering surjapura junction and Marathalli junction. Another covering Mekhri Circle, starting from East Ramp and extending towards the area above

because the population there is increasing. A Line connecting from Yeswanthpur to Kengeri has been proposed because these two areas are considered as important places. Increasing the accessibility of Metro Lines and increasing the number of bogies in metro Lines will help is better transport. Thus the Number of government and Privates Buses on the roads can be reduced which shall reduce traffic Problems to some extent.

Bangalore Road Network and Ontology:

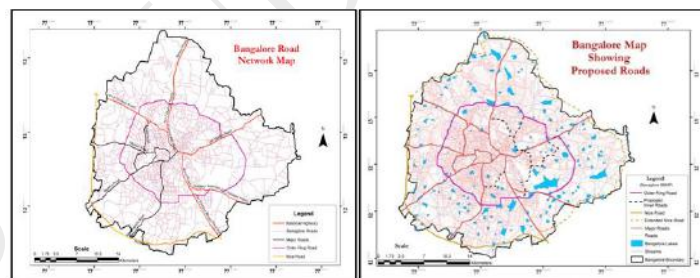
The ontology for Road networks-----**Road Network O={C, C^M, C^D}**

C refers to Roads, C^M refers to Major or Minor roads, C^D refers to types of roads made for Decongestions.

Bangalore Urban Roads can be categorized under various terms. Roads are the network which helps in the flow of population, goods and services from one place to another. In Bangalore the roads can be categorized as Major or Minor Roads depending on the places they connect. Another category can be the types of Roads made for Decongestion of Bangalore Traffic which are also considered as major roads. Nice Road, Outer Ring Road falls under C^D types. Major Roads consists of Mysore Road, Kanakapura Road, Hosur Road(NH 7), Sarjapura Road(NH 207), Old Madras Road (NH 4), Bellary Road (NH 7), Tumkur Road (NH 4), Magadi Road. The relationship between all these roads are that transportation is not possible if the important points or places are not connected via Road, here is where roads comes in being in the real world.

Ontology of Road Network

In the previous paragraph it is mentioned that Nice Road and Outer Ring road plays an important role in Bangalore Traffic Management which are connected with the major roads, minor roads and National Highways making the roads accessible. There are Few proposed roads to ease out Traffic Congestions further. Completing the formation of Nice Road as shown in the Map below. Creating Intermediate or Inner Roads from Major or Busy roads to keep the traffic in control as shown in the map below with black dotted Lines. This will help the flow of vehicles in a way that it doesn't clog in one place leading to stagnant traffic, delaying passenger's reaching time etc.



Map 3 Major Road Network in BBMP Map 4 Ontology Map of Major Road Network in BBMP

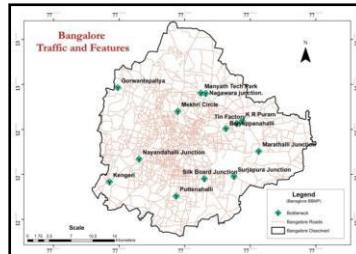
Bangalore Traffic and Future Ontology:

The Ontology here is for Traffic----**Traffic O={C, C^t, C^B, V, P}**

C refers to roads, C^t refers to Roads having Traffic, C^B refers to Bottle Neck, V refers to Vehicular Population and P refers to BBMP Population. Let's have a look about what is Traffic. Traffic is a concept where the flow of groups (Population, Vehicle, Goods and services etc.) are hindered, where the flow has stagnated. Now Traffic Depends on various factors like population concentration, rise in Vehicular population, types of road, Bottle Neck areas and many others.

In Bangalore there has been immense rise in the IT Opportunities and other job opportunities. Resulting to this the Bangalore population got injected with the immigrants from other states as well as other countries. There felt a need for urban expansion and that slowly lead to Urban Sprawl and Urban Slums. There was a need to develop a Proper Road network. Bangalore has been planning well for its roads but the problem of traffic doesn't seem to get solved. In BBMP Bangalore there are few areas with

Bottle Neck and without Bottleneck where the traffic is dangerous and it is affecting the daily life of the passengers. Thirteen Traffic – Bottleneck areas have been identified within Bangalore BBMP such as Gorwantepallya, Manyath Tech Park, Nagawara Junction, Mekhri Circle, K R Puram, Tin Factory, Baiyyappanahalli, Marathali Junction, Nayandahalli Junction, Kengeri, Silk Board, Surjapura Junction, Puttenahalli. There are places nearby this area which are highly in demand due to which the flow of Vehicles in this Point are as high to form Congestion.

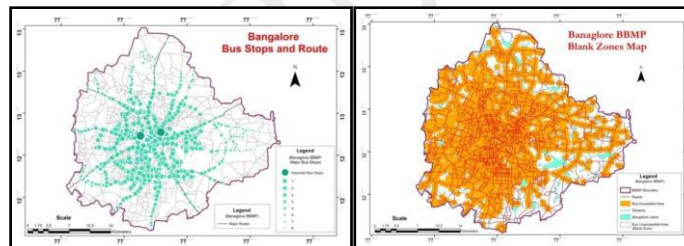


Map 5 Major Traffic Congested areas in BBMP Region

Bangalore Bus Stops and Routes Ontology:

The Ontology here is for Bus Stops and Routes: **Bus Stops and Route $O = \{C, b, b^M\}$**
 C refers to Roads, b refers to Bus Stops, b^M refers to Types of Bus Stops (Major and Minor).

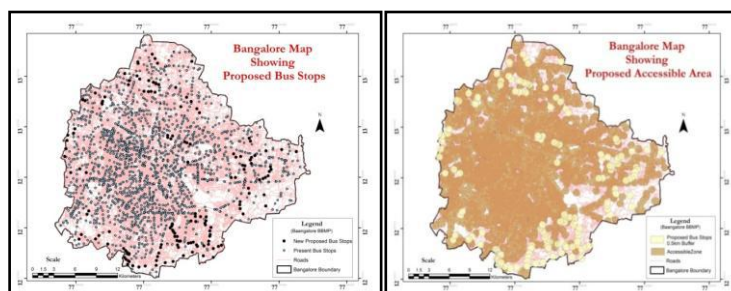
According to Bangalore BMTC there are two very Important Bus Stops namely Kempegowda Bus Station and Shivajinagara. There are 27 BMTC Major Bus Stations and 10 BMTC TTMC Bus Stations. From the Map bellow we can see that the density of Bus Stops is decreasing from the Centre of the city to the BBMP Bangalore Boundary. The Size of Bus Stops are based on most important to least important depending upon density from 0-8, where 0 is the Most important ad 8 is the least Important. The other Map helps in identifying Blank Zones which are inaccessible due to the absence of Bus Stops. The white patches within the BBMP area shows the inaccessible zones.



Map 6 BMTC Bus Stops and Routes in BBMP Map 7 Buffer Map to show Blank zones

Ontology Concept to Increase the Number of Bus Stops

The Map below shows that most of the Bangalore BBMP area is accessible whereas few areas which have good road networks still is not accessible as Bus Stops are not available in those areas. In Urban Planning it should be seen that every area is accessible and the population living there is not suffering due to the same.



Map 8 Ontology Map of Proposed BMTC Bus Stops Map 9 Ontology Map of Proposed New Areas to Access

Bangalore BBMP Blank Zone Map helped to identify the inaccessible areas with good road network. Thus, on the basis on the inaccessible proposed some bus Stops depending upon the following:

- Well Developed Road Network
- 0.5 Km Buffer around the existing bus stops to show the accessible areas.
- Presence of Population and Absence of water bodies.

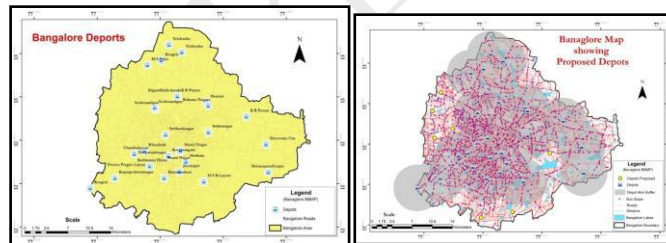
After creating buffer around the proposed bus Stops, it can be seen that BBMP is more accessible by roads and the bus Stops have touched almost all the developed road networks.

Bangalore Depots Ontology:

The Ontology here is for Bangalore Depots: **Depots O={C, L, b, D}**

C refers to Roads, L refers to Lakes, b refers to Bus Stops and D refers to Depots. Depots are Transport System’s Operating base, which provides parking to the Buses. Some of the main objectives of Depots are as follows: Allotting buses and crews to their duties. Dispatching buses according to schedule. Maintaining records of cash collected by conductors or drivers.

Bangalore has 30 depots in number. Maximum Depots are located in the centre of BBMP because this area has huge flow of busses and numbers of busses are more, so there is a requirement for the buses to have shelter when they are not being used. This is where the concept of Depots comes in being. More Accessible roads inject to the increase in buses, which further influences to making the areas more accessible using bus Stops. Lake data are used to avoid overlapping of newly proposed Depots. The following Map Shows that the location of the depots are well planned and are also located and important junctions like Majestic, K. R. Puram, Banasankari, Kengeri, Yelahanka etc. there is a need to develop more depots. Depending upon the bus routes and number of Buses, buses should be hibernating in the nearby depots.



Map 10 Locations of BMTC Depo’s Map 11 Ontology Map of Proposed Depo’s and BMTC Stops

Ontology of Proposed Bus Depots

To see the accessible areas of the depots covering the bus routes and stops, 4 km buffer around the depots has been extracted. After extracting, it is clearly noticeable that bus Stops are even present beyond the buffer zones. Therefore it can be said that the some buses from these depots travel more than 4kms and returns to the depots taking a lot of time. Where, some buses have accessibility to more than one Depots, within 4Km Depot Accessible Zone. Busses in Bangalore travel more than 4km in average but here due to the analysis of Location of Depots, 4km buffer is considered as the accessible area for Depots to Buses. Depots are homes for buses where they come and rest. Some Buses can access more than one home whereas others can access only one home also have to travel a long distance than others. Looking at the Map proposal for new depots has been given as shown below. The proposals are made on the basis of Depots Accessibility, and the Bus Stops the Buses Serves. One Bus Depots near the Airport is also very essential.

Bangalore RTO:

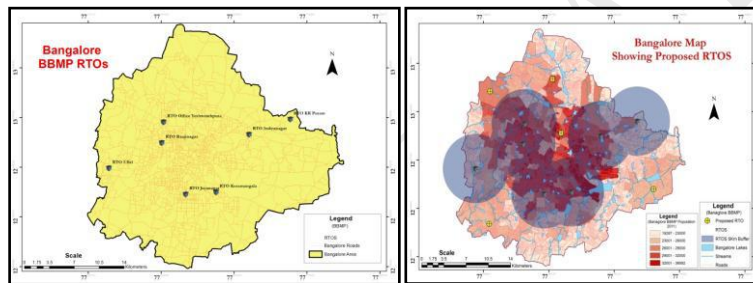
The Ontology here is for Bangalore Depots: $RTO\ O = \{C, P, L, V\}$

C refers to Roads, P refers to BBMP Population, L refers to Lakes. V refers to Vehicular Population.

RTO refers to Regional Transportation Office. The some objectives of RTO are as follows:

- To handle the registration of each governmental as well as private vehicles.
- Maintaining a database for all registered vehicles.
- Issuing licenses to vehicle owners or drivers.
- Inspecting vehicles periodically.
- Issuing certificates on the basis of vehicle's health and fitness.
- Collecting one-time road tax for motor vehicles from vehicle owners.
- Implementing any new rules issued by the government with regard to motor vehicles.
- Checking emissions and issuing pollution certificates for vehicles

RTOs can be estimated where the population is high. Movement of various vehicles in human populated regions tend to be high. It is also known that due to the rise in population (P) there is an increase in vehicular population (V) on BBMP road. In BBMP there are 7 RTOs each located in Yeshwathpur, Rajajinagar, UllalJayanagar, Koramangala, Indiranagar, K R Puram.



Map 12 RTO in BBMP Map 13 Ontology Map of Proposed RTO with Buffer

Ontology Proposal for new RTOs

BBMP has only 7 RTOs. Due to expansion in population, outwards from the center of BBMP, there is a need to build more number of RTOs because it will be easy for the people to access a nearby RTOs rather than going far away again and again to get their registration work done. 5km Buffer Zones have been created around the Present RTOs to see that whether these RTOs are accessible to all people or not. For the people living in the Centre of the City, it is easy for them to access the RTOs. Whereas, there are lots of people who has no easy access to these present RTOs. Therefore new RTOs should be built in places where people can access easily and do their registration. The Map below shows few Proposed locations for RTOs where there are good number of Population.

CONCLUSION:

Bangalore is a very peaceful city. It never sleeps. So, it is the Government's duty to make the lives of people easier and a bit less difficult. Bangalore has a rising trend in traffic which is causing various problems like Pollution, congestion, delay for work, time consuming. As traffic is one of the most significant and critical part of a nation it should be taken care off. Health of a nation can also be predicted by studying the traffic. Half of the traffic problems can be solved if the people's behavioural setup changes. If people learn not to rust, if they follow the traffic rules, if they use public transport, if they also help the fellow vehicles to pass, if they move on roads maintaining distance between them, if the use proper indicators for letting the others know which way they are heading. The traffic and Transport problems also effect industrial growth. Time is very crucial to every industry, loss one minute might cost heavily. Traffic congestions tend to takes thousands of hours from the industries,

which will lead to slow growth of a city. Thus, it is very crucial to first study transportation in detail and solve the problems that arises.

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