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A Review on Integrated Transportation System for Bangalore City

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Abstract: ***Bangalore is one of the fast growing IT hubs has traffic scourge with rising vehicle ownership dropping down on roads. Today more than 12.3 million people are living and vehicular trips increased more than 3 times which has overwhelmed traffic network. Increased traffic congestion results in huge economic loss due to traffic congestion where fuel loss is estimated at Rs 2.8 lakhlitres per hour, 50 crore litres per year, in monetary terms this translates to a loss of Rs 3700 crores per year and Rs 2350 crores towards work hours lost. Intelligent transportation system harmonizes the traffic flow for better efficiency of passengers. It has been observed that the city is in the grip of rising levels of concentration of pollutants through vehicle emission. The road accidents and fatalities also disrupt the traffic on the roads. It has seen over 3396 number of accidents in 2017 from January to August. In order to improve the efficiency of transportation andto reduce the operating cost measures for dependency on importing fossil fuels is possible by developing renewable sustainability in order to control the pollution through CO_2 emission.***

Key words: Traffic congestion, Traffic network, Intelligent Transportation system, Fatalities, Efficiency

I. INTRODUCTION

A. General

In today's world transportation mobility, accessibility and safety continues to be a challenge. India within a generation will be an urbanized country which means hundreds of people are moving into urban spaces. Today Bangalore is at an inflection point. Increased personalized vehicles result in a negative toll on citizens. During peak hours congestion Index is 5.78 in the city. In order to understand traffic better and to develop transport models to meet future requirements certain surveys like screen line volume counts, OD surveys , speed and delay, road network, turning volume counts, trip generation ,trip distribution, modal split have to be conducted. From all fronts the need for aggressive intervention has become increased apparently. To reduce delays, optimal scheduling is necessary.

B. Present situation

The Bangalore city current vehicle population is 67.22 lakhs. There is a huge demand for multimodal integration of all modes of transportation along with the provision of footpaths, parking and cycling facilities. Traffic jams/extreme congestion ,decline in journey speed from 18kmph to 11kmph in 2015 results in network hampering trip rate at 0.9 per capita per day whose modal share is 52% trips on vehicular traffic and 48% on public transport includes private buses. Air pollution and high noise levels are checked regularly. In order to check all the traffic problems sustainable traffic solution is required. Vehicular trips increased more than 3 times whose network speed drops at 8kmph and at peak hours less than 5kmph whose V/C ratio greater than 1 and vehicular emission which results in environment pollution increased 3times.

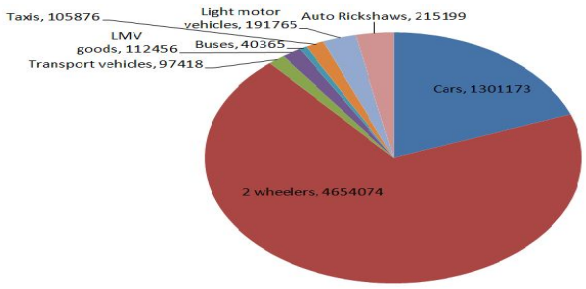

Fig 1.2.1 Different registered vehicles composition as on 2017 September

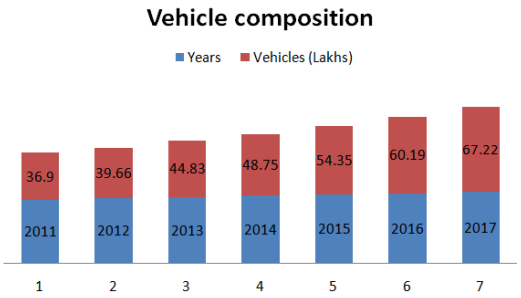

Fig 1.2.2 Vehicle composition in different years on roads

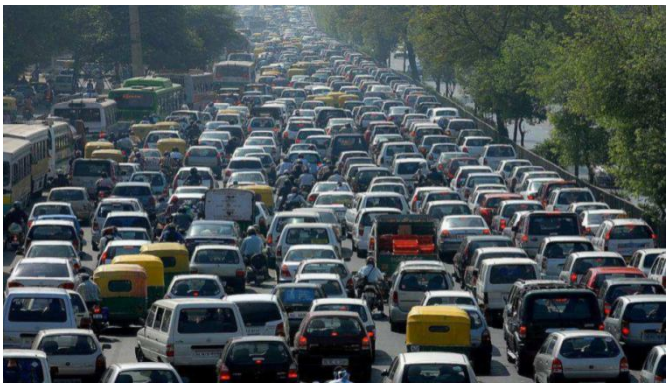

Fig 1.2.3 Traffic scenario in Bangalore city

C. Challenges with public transport

1) Long ticketing queues
2) On the go planning unavailable
3) Ticket machine familiarity and functioning
4) Last mile connectivity
5) Road inadequate capacity and no scope to increase road capacity
6) Trip rates increased
7) Lack of infra structure for public transport, walking and cycling
8) Pedestrians and parking facilities
9) Enforcement policies and land use
10) Cash transaction in BMTC i.e. cash change problem
11) Ticketless travelling , misuse of bus passes and non issue of tickets

II. MASS TRANSPORTATION SYSTEM

The total mass transportation system is mainly due to BMTC, BMRCL, private mode of transport like 2 wheelers, 3 wheelers, and 4 wheelers. Now a day's private mode of 2 wheelers are predominant next to cars results in traffic snarls in the city. Only 50% of public transportation system is present in the city out of which 45% BMTC and only 5% BMRCL as on date**.**

A. BMTC

1) *Implemented:*BMTC has 6444 vehicles as on September 2017 whose fleet is 6422Km carrying 50.2 lakhs and for metro it is 42.3Km carrying 3.4 lakhs commuters daily. It has different types of services like Suvarna, Pushpak, Vayu Vajra, and Vajra to hop on and hop off the passengers.
2) *Under plan:*EMV contactless smart card is linked with Axis bank by BMTC. Trimax IT Infrastructure and Service Ltd is developing the intelligent transportation system and Global is developing a mobile application.
3) *Yet to be Implemented:*The Intelligent Transportation system helps commuters to know the arrival time of buses in which GPS is fitted and bus stops might be equipped with LED boards along with smart phone connectivity through SMS or toll free helpline.

Fig 2.1.1Different BMTC buses

B. Bmrcl

1) *Phase I Implemented:*Increases many folds with the metro interchange. The footwall with Namma metro being added to the bus and rail hubs is over 10 lakhs even on any weekday. There is no relief from traffic woes though the metro of 148Km of which phase I aiding a network of 42.9Km is completed. Majestic area has developed into an intermodal transport hub. Present ridership of Namma metro is 3.4 lakhs commuters as on August 2017 which is expected to raise to 5 lakhs with the commissions of entire phase I. In phase –I till Nagasandra on North,Puttanehalli on south was finished.

Table 2.2.1 Phase I Metro corridors

S.No	Line	Corridors	Length (Km)
1	Purple line	Baiyyappanahalli - Mysore road	18.7
2	Green line	Hesaraghatta – Puttenahalli cross	24.2

2) *Phase 2 yet to be implemented:* Phase 2 has a span length of 72.095 Km of which 13.79Km underground,0.48Km at grade and 57.825 Km elevated which adds total 61 stations to the to the phase-I network of which 12 are underground and 6 are elevated.

Table 2.2.2 Phase -2 Metro corridors

Line	Terminals	Length (Km)
Purple line	Mysore road-Challegatta near Kengeri	8.81
Purple line	Baiyyappanahalli-Whitefield	15.50
Green line	Yelachenahalli-Anjanapura	6.29
Green line	Hessaraghatta cross- BIEC	3.77
Line 3	RV road- Bommasandra	18.82
Line 4	Gottigere-Nagawara-Bangalore Airport	21.25
Outer Ring Road Metro	Silk board-K.R.Puram	17

3) *Phase 3 under plan:*Phase 3 have a total length of 127km which consists of 2 lines covering outer ring road on east and west.

Table 2.2.3 Phase – 3 Metro corridors

Location	Length(Km)
Outer ring road from Silk board to Hebbal covers	33 – eastern side 31.37 – western side
Hosakerehalli to Outer ring road at Marathahalli	21.31
Sarjapur road – Yelahanka	33
Nice road – Magadi road	8.89

D. Power supply

1) *Implemented:*The ABB group was given a contract to provide power supply with four substations each rated at 66/33 kV in 2009 with third rail traction to use 750 V DC. The BMRC is paying Rs 5.7 per unit of electricity to BESCOM.
2) *Yet to be implemented:* BMRCL signed an agreement to set up solar installations with Clean Max Solar at Baiyyapanahalli, Peenya stations, Challaghatta, White field, Kothanur and Hebbagodi at a rate of Rs.5.5 per unit of electricity for 3 years.
3) *Airport rail link under plan:* An extension from Nagawara via Kannur of 25.9Km was the shortest route and an extension from Yeshwanthpur via Yelhanka, Kannur and Bangalore of 35.4 Km was the longest route. Bangalore Development Minister K.J.George announced that the Nagawara-Rama Krishna Hegde Nagar- Jakkur-Yelhanka route to the airport was finalized on 12 May 2017.
4) *Yet to be approved***:** International Airport will have 2 metro stations a detailed project report prepared which is yet to be approved covering 29Km consists of 6 stations which will be an extension of the Gottigere-Nagawara metro line phase – II which is having different halt at Hegde Nagar, Jakkur, Yelhanka and Chikkajala which is elevated one except the Yelhanka metro station which will be at ground level.

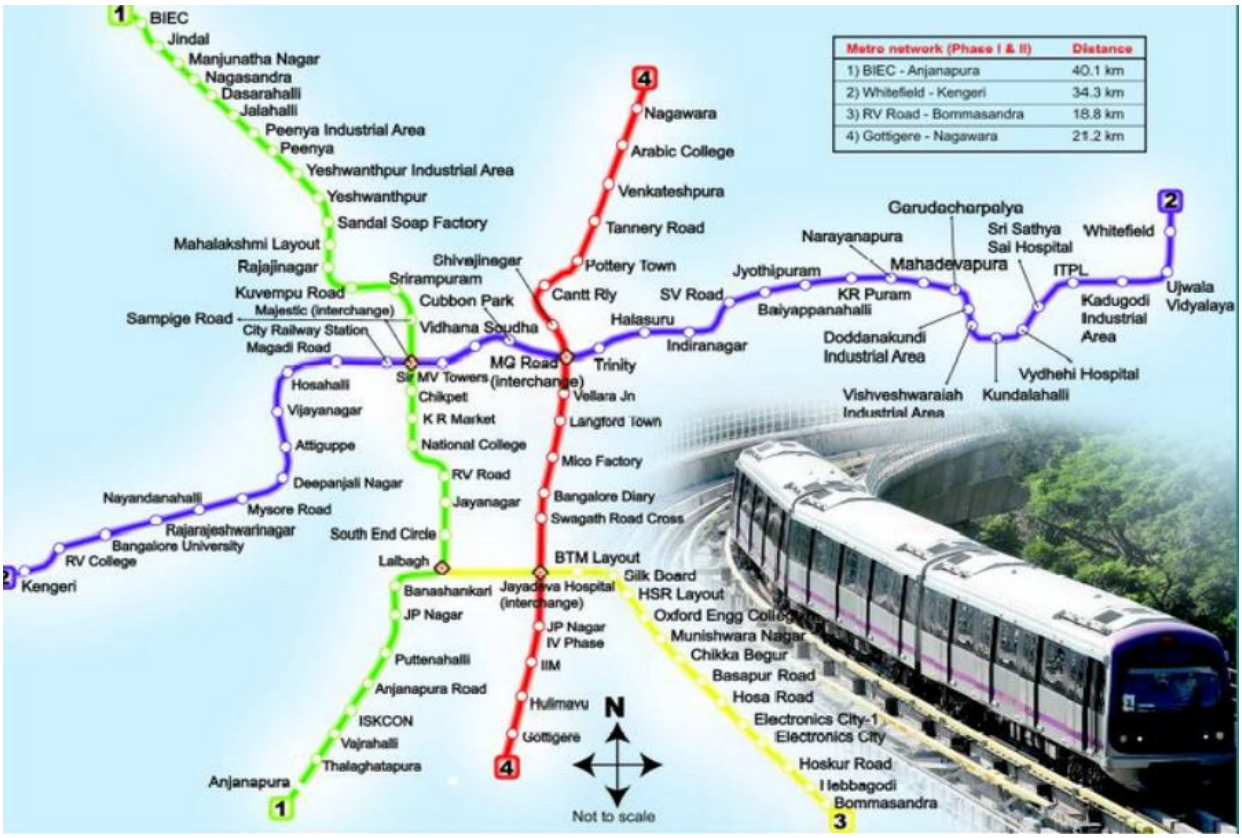

Fig 2.2.1 Metro route map

5) *High speed rail link under plan***:**The total length of this corridor is about 34 Km out of which 1Km at- grade and 33km is elevated connecting City centre to BIA at Devanahalli passing through corridors Cubbon road, Bhavan road and Sankey road.
6) *Light rail transit system under plan:*The LRT is preferred over Mono rail is in tune with 2 corridors along with 40 stations.The total length of 77.3 Km light rail transit connects Bannerghaatta road with Hebbal through Bhadrappa layout, BEL circle, HMT lay out, Peenya I phase, Goraguntepalya, Magadi road, Nayandahalli, Padmanabhanagar, Kanakapura road, JP Nagar.

Table 2.4.1 Light rail corridor

S.No	Corridor	Length (Km)
1	Hebbal – JP Nagar	31.3
2	Toll Gate – PRR	9.7
3	National college – Kathriguppe junction	5

4	Hosur – BG road	13.8
5	Indiranagar – White field	17.2
	Total	77

7) *Sub urban commuter railway network under plan:*The experts convinced that sub urban rails can decongest the roads unlike metro it will not take decades of time with less cost. The sub urban system currently not used optimally which is of 120Km of rail system. Sub urban railway commuter services along the corridors are identified by RITES along with the proposal of utilizing 62Km track. The DULT might be responsible for monitoring and supervision. Intermediate signals on the existing track at a distance of 2Km instead of 4 Km.

Table 2.5.1 Sub urban commuter railway network corridors

S.NO	Corridor	Length(Km)
1	Kengeri to Ramanagaram	32
2	Baiyyappanahalli to Hosur	41
3.	Yeshwanthpur to Tumkur	64
4.	Yelhanka to DOddabalapur	24
	Total	161

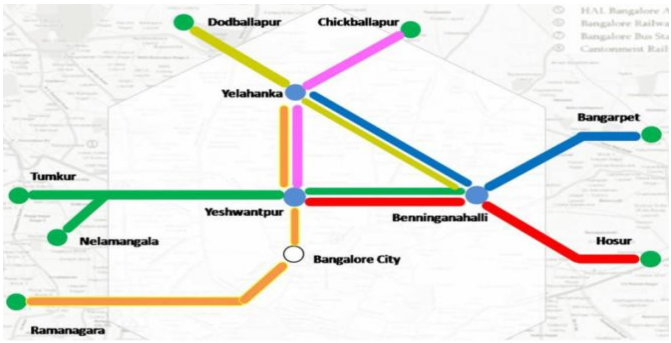

Fig 2.5.1.Sub urban commuter railway network corridors

8) *Electric trains under plan:*An anvil proposal connecting Baiyyappanahalli and Whitefield in order to decongest snarls in the city at the time of construction of the metro line between the 2 suburbs.

9) *Autos implemented:*Autos 3 wheeled vehicles easily accessible, affordable but the commuters accusing drivers for overcharging and the drivers accuse commuters for not understanding the hassles they are facing on daily basis which in turn results in testy relationship. An mgaadi (Auto rickshawsapp) is yet to be developed to win the proposition. The Transportation Department announced that the fare should not be more than Rs.19.5 per Km.Ola also introduced Auto app for Rs.29 for 4Km.

10) *Cabs implemented:*A popular mode of transport leading to traffic snarls in the city is due to taxis as the roads are narrow which makes an issue during peak hours when they wait on road side. Ola and Uber are predominant cabs providing different services. Uber provides pool, go, economy and excel while Ola provides auto, share, mini, micro, sedan services to the travellers.

Table 2.8.1 Number of Cabs

Year	Number of cabs lakhs
2012	46235
2013	56890
2014	66264
2015	80204
2016	105876

11) Pods under plan:A proposal of 35.5Km of six stretches is identified which is personal rapid transit to address the last mile connectivity.

Table 2.9.1 Pods proposal stretch

Stretch	Distance in Km
MG road metro station – Leela Palace junction	4
Leela Palace – Marathahalli junction	6
Marathahalli junction – EPIP , White field	6.5
MG road metro station - Koramangala	7
Jayanagar 4th block – JP Nagar 6thphase	5.3
Sony Junction – Indiranagar Metro station	6.7

III. MULTIPLE SMART CARDS

The metro is providing smart cards and tokens to travel along with the contactless smart cards. The minimum cost of smart card is Rs. 50 which offers discount of15% to 23% as compared to the tokens. This is implemented but there is lack of integrated ticketing system.

A. Sanchar and Varshik cards implemented

Sanchar cards designed for commuters who always travel between two fixed points. Varshik card stores a credit of Rs.1500 and the fare is deducted for each trip. The card swiped at entry and exit points of metro stations through which a minimum fare of Rs. 7.65 and Rs. 8.50 on Sanchar and Varshik cards saved for each trip. Group tickets for 10 members are also available.

B. Saral and Saraag tickets yet to be implemented

An integrated ticketing system which helps travellers for unlimited journeys through Metro to Bus for the whole day. Saral and Saraag ticket costs of Rs.110 and Rs.70 and is valid for travellers to travel on air conditioned buses and non air conditioned buses except airport buses.

C. Combo cards yet to be implemented

Combo cards is an SBI debit cum transit card which is having contactless chip for ticketing and magnetic stripe for banking application which offers a discount of 15% to 21% when compared to tokens.

D. Yet to be implemented

The smart cards are easily top – up done at several metro ticket outlets and also through Airtel retail outlets and SBI debit card, net banking and mobile banking. If unique number is given to travellers it is easy to track the traveller's details on the card holder and helps in further integration.

IV. METHODOLOGY

In order to integrate we should understand the real problems. The primary data collection is very important along with secondary data collection through traffic surveys.

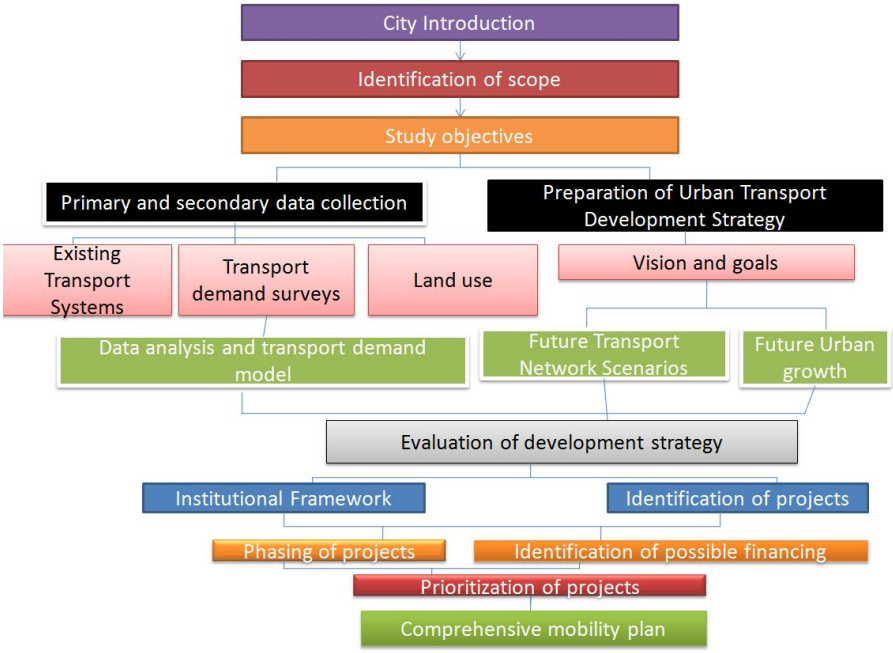

Fig 4.1.1 Structure of Integration

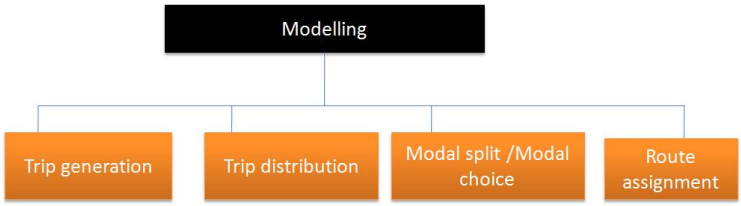

Fig 4.1.2 Modelling types

V. TRANSPORTATION FUTURES

To meet expected travel needs of commuters a multi modal public transportation network is necessary along with the evolution of economic, transportation planning with a low cost transportation system operating under certain policies providing commuters facilities. Direct origin and destination service for commuters providing is not possible. There is a need of providing seamless connectivity for the passengers to cross various modes of transportation at low cost. A circular grid corridor on radial networks provided such that the commuters does not needed one or two interchanges.

A. Integrating transportation land use and environmental planning for sustainable urban development
B. Ride sharing technology in transportation.
C. Optimal coordination of connected and autonomous cars in smart cities
D. Feeder services i.e.Para Transit modes within 0.5 – 1Km is provided.
E. Pedestrian facilities like foot over bridges
F. Adequate parking areas.
G. Route guides withtime tables along with information boards.
H. Promote balanced spatial growth.

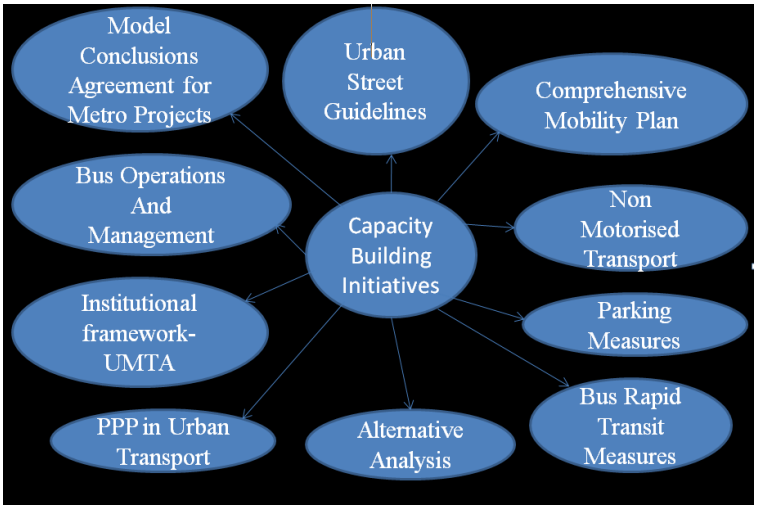

Fig 5.1 Integrated transportation system

VI. ROAD ACCIDENTS

The road accidents and fatalities also disrupt the traffic on the roads which also results in tangible costs to the economy through vehicle damage. Increase of accidents is due to

A. Driving aggressively
B. Over speed of the vehicle
C. Drink and drive without seat belt and helmet
D. Not following signs on the roads

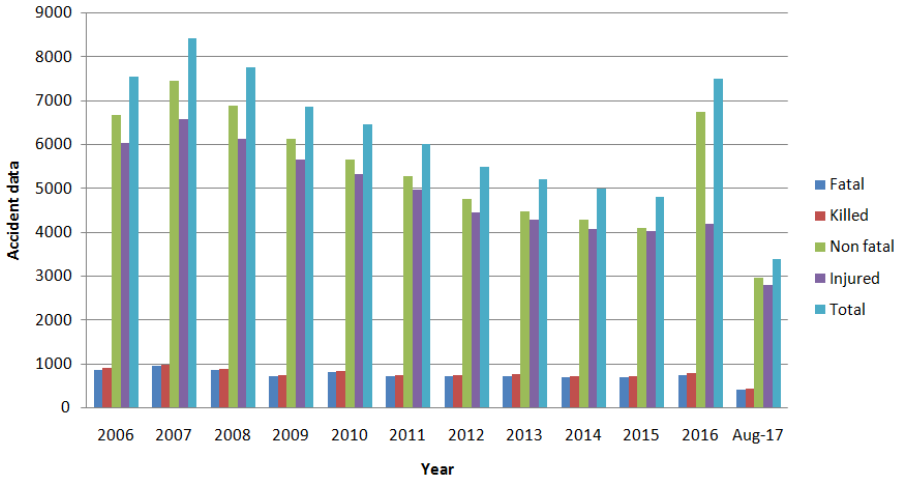

Fig 6.1 Road accident data

VII. COST AND ECONOMIC EVALUATION

Operation, capital cost and due to decongestion savings in terms of money and time are evaluated. The transportation department under BBMP and BDA works on the evaluation. There is no circulation of economy in BMRCL once the money is deposited in the account which has to be integrated.

VIII. TRANSPORTATION FUELS

Apart from CO other pollutants like HC,NOX and CO are also emitted. Ethanol diesel fuel blend with high sulphur diesel, low sulphur diesel,biodiesel and ULSD gives less polluting, cheaper renewable energy. Compressed natural gas is cheaper, environmental friendly like Methane.

IX. CONCLUSIONS

The transportation system management comprising proposals for public transportation system providing intercity bus terminals, pedestrians facilities along with the parking facilities of road infrastructure. Flyovers only divert the traffic flow which is not a permanent solution to the traffic snarls. Next fast track system like magnetic trains, hyper loop trains are necessary in order to reach the destinations quickly. The travel time,road accidents, pollution,capital and operating costcan be reduced by implementing the measures. To assess the cost, economic evaluation with real price anomalies is necessary.

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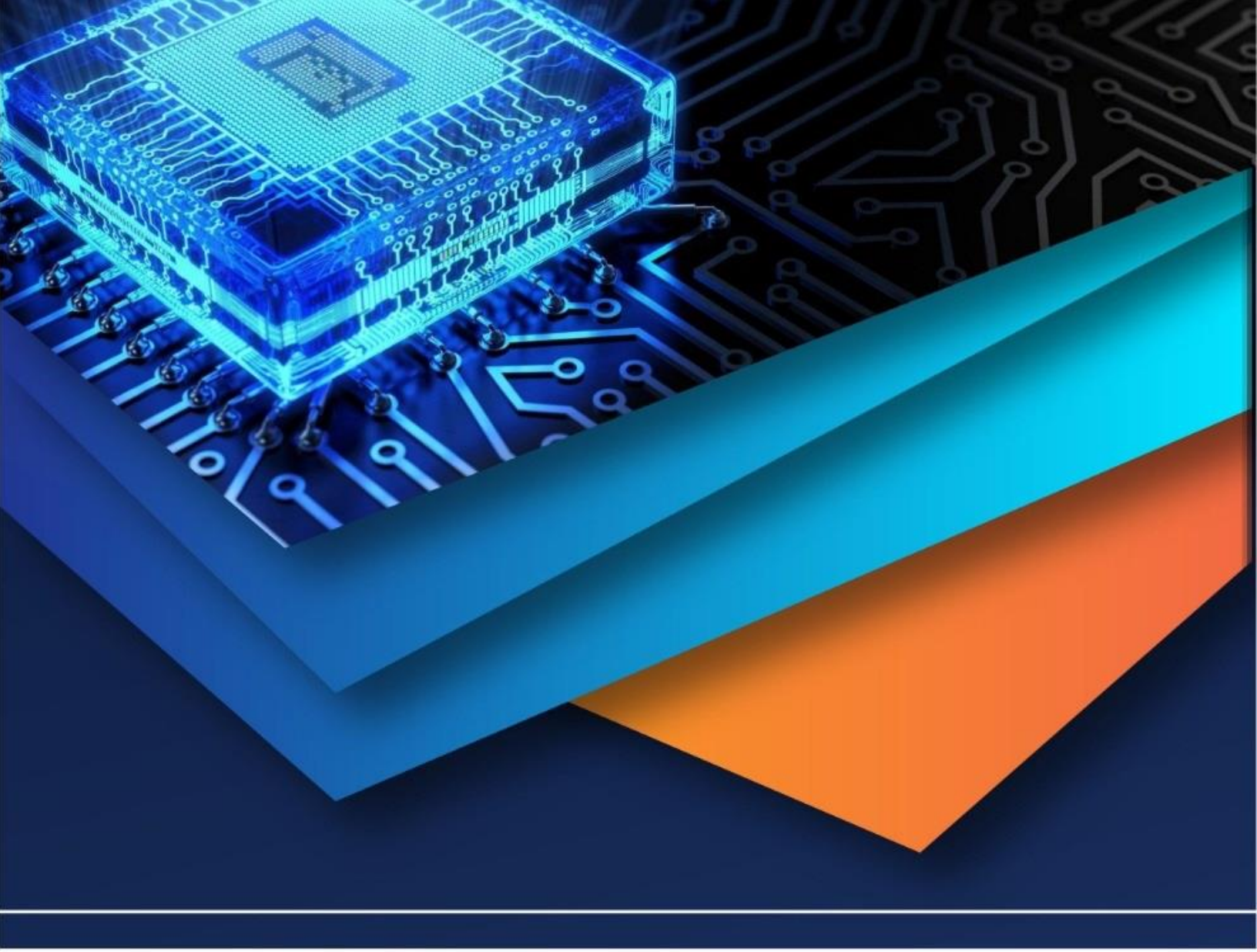

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