ACHIEVING FIRST AND LAST MILE CONNECTIVITY THROUGH CITY WIDE MULTI-MODAL INTEGRATED TRANSPORT PLAN (CMITP)- A CASE STUDY OF MYSURU, INDIA

Goutham Konikar S.M.[1*], Prof. Dr. H.N. Nagendra[2]

Article History: **Received:** 30.05.2023 **Revised:** 02.07.2023 **Accepted:** 10.08.2023

Abstract

Urban transport (UT) is one of the core components of city planning and Commuters use several modes of transport in a city – Public Transport, IPT, Personal and NMT. Mysuru, being the third largest city of Karnataka is witnessing Rapid Urbanization and its current transport systems are unable to achieve the first and last mile connectivity due to non-integration of feeder networks and different transport systems. With growing concerns towards promoting Sustainable Urban mobility and Sustainable cities various National policies emphasises on the need for a City Wide Multi-Modal Integrated Transport Plan (CMITP) that provides seamless city-wide connectivity to the commuters and Promotes coordination between various modes and their infrastructure (new and old). Thus, the main objective of this study is to Identify the components of CMITP and prepare a CMITP for Mysuru city using the five pillars of integration i.e., Institutional, Operational, Physical, Fare and Information

The Study is based on Extensive Reconnaissance survey and field observations, a study area is delineated and further divided into Traffic Analysis Zones (TAZs) for Micro level analysis. The components of Multi modal integrated network namely Public Transport. Transport Network and Non-Motorized Transport are evaluated to understand their degree of Integration. Opinion survey in the form of Structured Questionnaires were carried out for different transport users within the selected Traffic Analysis Zones (TAZs) to identify Key Issues and ProblemsFinally, a Detailed Planning Strategies and Policy Guidelines are proposed using the five pillars of integration, achieved through Preplanning Stage, Planning Stage and Design Stage. Thus, CMITP helps in achieving first and last mile connectivity and promotes Sustainable urban mobility and Sustainable cities.

Keywords: First & Last Mile Connectivity, City Wide Multi-Modal Integrated Transport Plan (CMITP), Traffic Analysis Zones, Five Pillars of Integration, Sustainable Urban Mobility.

[1*]DST-INSPIRE Fellow, School of Planning & Architecture, University of Mysore, Mysuru, Karnataka, India
Email: [1*]gouthamsmkonikar@gmail.com
[2]Professor of Urban and Regional Planning, School of Planning & Architecture, University of Mysore, Mysuru, Karnataka, India.
Email: [2]nagendrahnn@gmail.com

[*]Corresponding Author
Goutham Konikar S.M[1*]
[1*]DST-INSPIRE Fellow, School of Planning & Architecture, University of Mysore, Mysuru, Karnataka, India
Email: [1*]gouthamsmkonikar@gmail.com

DOI: 10.31838/ecb/2023.12.s3.820

1. Introduction

The transport network should be citywide so that the commuter is assured that he / she can complete his / her journey all the way by the modes of their choice with minimal or no use of private vehicle. This, besides road infrastructure and public transport network, includes a continuous citywide facility for pedestrians and cyclists. Public transport whether road based or rail based cannot provide door to door service. Other ancillary modes i.e., walk, cycle, IPT and personal vehicles have to be integrated with the public transport network for the first and last mile connectivity. The network planned should be such that most commuters live and work within 500m of a public transport stop or station. Presently there is Lack of physical integration of different transport infrastructure and terminal points for different transport modes leads to accessibility issues and the current transport systems are unable to achieve the first and last mile connectivity. The National Urban Transport Policy-2014 (NUTP), National Mission on Sustainable Habitat (NMSH), and 12th Five-year plan etc. clearly emphasises on the need for a City Wide Multi-Modal Integrated Transport Plan (CMITP) or Indian Cities.

Ministry of Housing and Urban Affairs (MoHUA) defines CMITP as an approach towards the set-up of amalgamated institution, transportation & information structure for the unified transport network to provide the first mile and last mile connectivity by the use of both private & public modes in each journey made by user. An integrated transport system needs to be planned in a manner, so that there is coordination between various modes and their infrastructure (new and old).

2. Methodology

The study used a multi-dimensional methodology involving both qualitative and quantitative data from various Primary and Secondary Sources. Initially, the Spatial Growth Dynamics and Existing transport system of Mysuru city is studied and the components of CMITP are identified. Based on Extensive Reconnaissance survey and field observations, a study area is delineated and further divided into Traffic Analysis Zones (TAZs) for Micro level analysis. The components of Multi modal integrated network namely Public Transport. Transport Network and Non-Motorized Transport are evaluated to understand their degree of Integration. Opinion survey in the form of Structured Questionnaires were carried out for different transport users within the selected Traffic Analysis Zones (TAZs) to identify Key Issues and Problems. Finally, a Detailed Planning Strategies and Policy Guidelines are proposed using the five pillars of integration, achieved through Preplanning Stage, Planning Stage and Design Stage.

3. Profile of the Study Area

3.1 Population Growth of Mysuru City

Mysuru is the third biggest city in the state of Karnataka covering an area of 128.42 Sq. Kms with a population of 8.87 lakh in 2011 (Census of India, 2011). Mysuru urban agglomeration is among the fastest-growing Indian cities, with a decadal population growth rate of 25.19% with a population of 0.984 million (Census of India, 2011). Mysuru will become a Metropolitan city as the projected population for Mysore city will be 16.5 lakhs for 2021 & 21.00 lakhs for the planning period 2031.

3.2 Urban Structure and Land Use Pattern of Mysuru City

Mysuru is one of the Oldest Planned cities in India (City Improvement Trust Board (CITB)-1903). Mysuru city had 19.20 Km2 of the area in 1901. At present Mysuru city has 106.27 Km2 areas under Municipal Corporation and 128.42 Sq. of area Urban Agglomeration (MC+OG). This demonstrates that the city has expanded significantly in the past 119 years (approx. four times since 1966). It can be seen that as per the existing land use 2009, the total area demarcated for residential is 7032.89 hectares and it constitutes about 25.24%, whereas in Proposed land use of 2031, the total area demarcated for residential is 14,958 hectares and it constitutes about 53.68%.

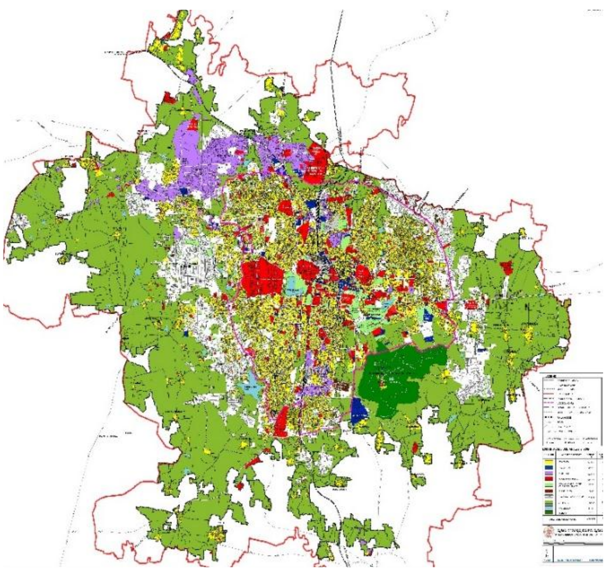


Fig 1: Existing Land Use City-2009

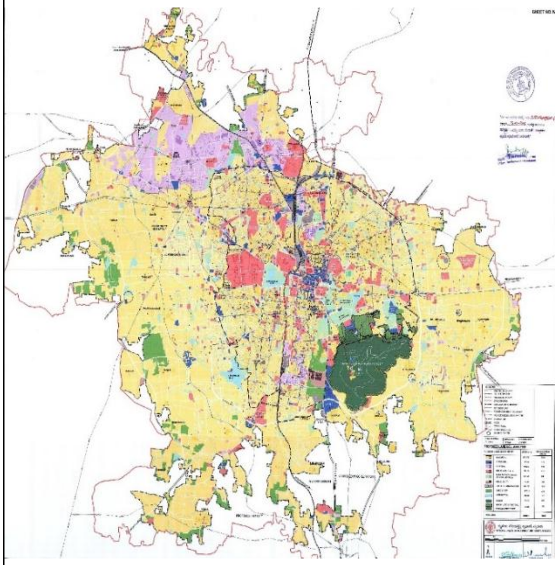


Fig 2: Proposed Land Use City-2031

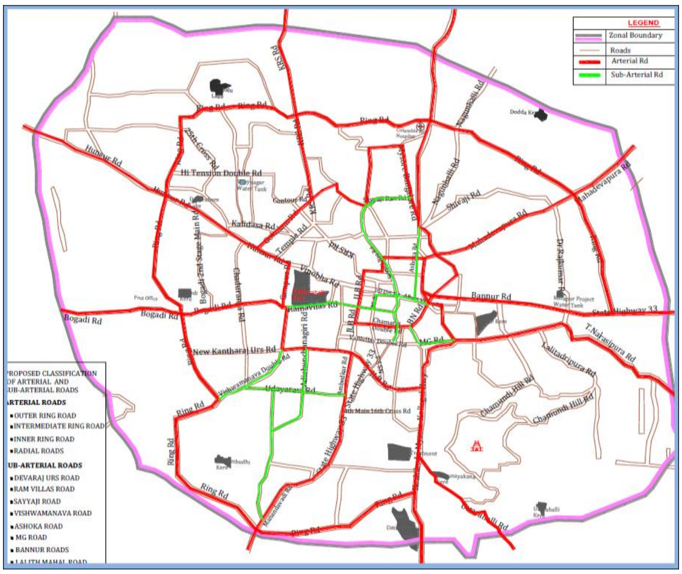
Source: Master Plans, Mysuru Urban Development Authority (MUDA), Mysuru

4. Existing Traffic and Transportation Scenario in Mysuru City

4.1 Road Network

The road pattern in Mysuru is a combination of radial and grid pattern with arterial roads originating from the city centre. The Palace is the focal point from where the roads run radially leading to outer areas of the city. There are eight radial roads and three ring roads in Mysuru city. Amongst the eight radial roads, four of them are state highways and one of them is national highway. The ring roads not only collect traffic from other roads but also act as by-pass reducing congestion especially at the core of the city.

Table :1 Roads Network Characteristics	Number
Municipal Roads (km.)	**1,093**
Length of Good quality road	**90% tarred**
Pavements	**Main roads**
PWD (km.)	**57.78**
NH (km.)	**5**
SH (km.)	**45**
Outer Ring Road (km.)	**32.2**
Intermediate Ring Road (km)	**21.7**
Inner Ring Road (km)	**7.12**
Public Transport	
- Number of Buses (both inter and intra city)	**767**
- Bus Capacity / passengers (Ratio)	**255**
Private Registered Vehicles	**2,89,278**



(Source: KSRTC Annual Report, 2020)	Fig 3: Road Network pattern of Mysuru city (Source: Compiled by Author using GIS)

4.2 Vehicular growth and Ownership

In terms of Vehicular growth, the total number of vehicles which was about 0.06 lakhs in 1970 increased to 5.23 lakhs in 2015 and is expected to increase to 9 lakhs by 2030. Personal Motor-Vehicle Ownership especially the two-wheelers and four-wheelers is doubling every Decade. Based on the data given in Table 2, it is observed that the vehicle growth in Mysuru city is about 145.40% with an annual increase of about 13 to 15% per annum.

Table 2: Vehicular growth rate of Mysuru City (in Thousands)

Vehicles	***1970***	***1976***	***1981***	***1986***	***1989***	***1996***	***2003***	***2007***	***2008***	***2010***	***2015***	***2030***
2 Wheelers	2.6	8.2	18	45.1	68.1	128.3	223.3	290.2	320.8	351.07	439.74	748.97
4 Wheelers	2.1	2.8	3.3	4.8	5.7	11.3	26.1	35.5	38	39.2	46.5	87.47
Truck	0.9	1.2	1.4	2.1	2.3	3.7	5.1	6.2	6.8	7.9	9.1	16.1
Bus/Minibus	0.5	0.7	0.7	1	1.3	1	3.6	4.8	5.2	5.7	6.4	11.11
Auto	0	0	0	0	0	0	12.2	14.8	16.2	17.15	20.74	33.44
Others	0	0	0	0	0	0	6.9	8.96	9.2			
TOTAL	**6.1**	**12.9**	**23.4**	**53**	**77.4**	**144.3**	**277.2**	**360.46**	**396.2**	**417.03**	**523.35**	**899.3**

(Source: RTO, Mysuru)

4.3 Travel Characteristics- Model Split and Trip Length

The change in modal split over the last 24 years is shown in Table 3. The model share of trips by cars has increased due to rising car ownership levels, inadequate and unattractive public transport system. Share of trips by two wheelers has also gone up significantly. Of late two-wheeler users have been switching over to cars due to rising income levels. Share of trips by cycles has declined. The Average Trip Length of cars (8.60 Km) is more than the buses (8.07 Km). This indicates that people give more preference to the private modes over public modes even for longer trip lengths.

Table 3: Trend in Modal Split in Mysuru LPA

Year	Modal Share (%)					
	Car	**Two Wheeler**	**Public Transport**	**IPT**	**Cycle**	**Total**
1982	3.50	12.10	55.00	13.30	16.10	100.00
2003	5.40	36.30	48.90	7.30	2.00	100.00
2006	7.20	32.00	45.70	12.60	2.40	100.00
2011	12.00	24.00	50.00	11.00	3.00	100.00
2016*	7.00	30.00	18.00	12.00	33.00	100.00

Table 4: Distribution of Trips by Mode & Length

Mode	**Average Trip Length (km)**
Bus	8.07
Car	8.60
Two	7.62
Three	7.56
Cycle	5.37
Walk	3.67
Total	7.43

(Source: Comprehensive Traffic and Transport Study of Mysuru City 2012 and other survey conducted in 2016, DULT)

5. Analysis and Evaluation of Components of CMITP

5.1 Delineation of Study Area for Micro Level Analysis

Based on extensive Reconnaissance survey, Field observation and Secondary data, the portion of the city falling between two important radial roads i.e., between K.R.S road and Hunsur road up to the edge of LPA is taken as the study area and delineated by taking a buffer of 250 m around them. The study area covers an area of 7250 Hectares and reflects the overall Mobility characteristics of the entire city.

5.2 Factors considered while delineating the study area

a) In this study area all the land use functions exist with commercial and multi-functional land uses in the centre, industrial area on the north-western part of the study area, major educational institutions in the centre, important public and semi-public areas toward the south, high end residential land uses in the centre and low and medium density residential towards the north west adjacent to the industrial areas on either side of the Hunsur road.

b) This study area represents the transport users having different socio-economic characters writ to their age, occupation, gender, income, education, vehicle ownership, travel purpose & mode etc.

c) It has a strong road network pattern having a combination ring road, arterial roads, major roads, important junction etc. which is connected to the city core. This criterion has been considered because the trip characteristic of different modes of travel varies with respect to the land use function.

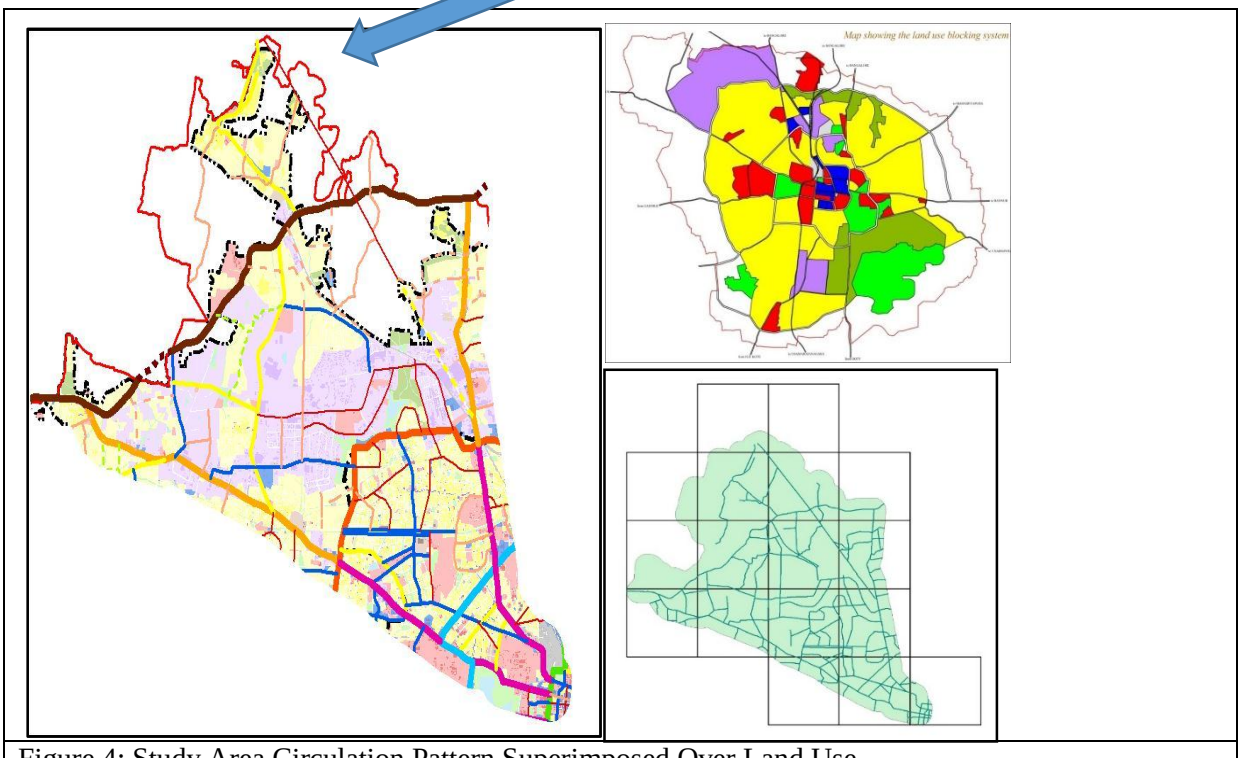


Figure 4: Study Area Circulation Pattern Superimposed Over Land Use
(Source: Author prepared Using GIS)

5.3 Analysis and Evaluation of Components for Selected Traffic Analysis Zones (TEZ)

For micro level analysis and proposals, this study area is further divided into Traffic Analysis Zones (TEZ) of area 3 km x 3 km using ARC-GIS.

Section A-Research paper

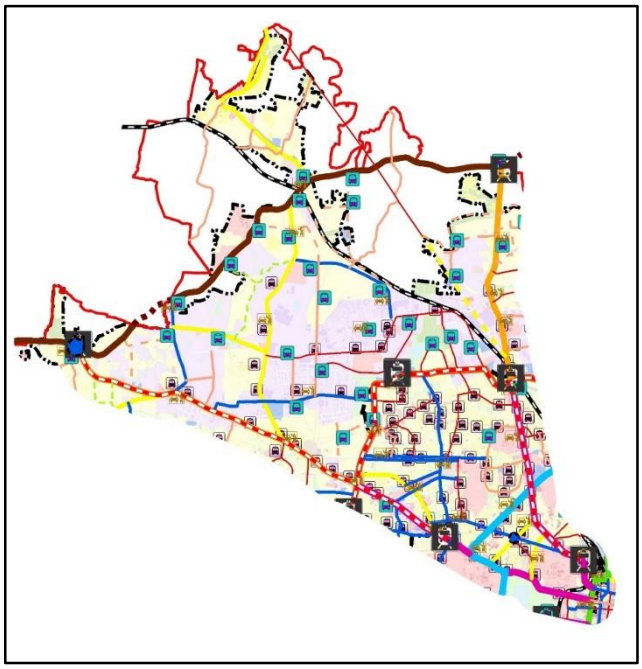


Figure 5: Land use map of the study area superimposed with the following elements

1. Existing bus routes and their bus stops
2. Existing and proposed circulation pattern
3. Proposed monorail corridors
4. Existing IPT stands
5. Proposed district centres

(Source: Author Prepared Using GIS)

5.3.1Public Transport

a) The existing public transport frequency is partially adequate especially along especially along major arterial roads which connects the railway station, the suburban bus stands and finally the city bus stands (CBS).
b) However, the bus service along the North West part of the study area-1 i.e., in the industrial area is not adequate which in turn increase the average waiting time of the passengers.
c) Due to the presence of many education institutions along the route, there is huge student population who use the city bus services extensively which results in overcrowding especially during the peak hours. Also most of the bus shelters lack basic infrastructure facilities.

5.3.2 Intermediate Public Transport (IPT)

a) The auto stands are well located within the reach of Bus stops. But they do have a dedicated place for parking which force them to encroach the foot path used for pedestrians.
b) The maxi cab service extensively serves the transport needs of the people who travel from the surrounding villages to the city centre. They mainly operate along the arterial roads and connect the CBD area with surrounding sub-urban areas. The poor people specially the daily wage workers and the industrial labours use this service due to less price, frequency and reliability.
c) The taxi service offered by OLA & UBER etc. also gaining trend due to the presence of many commercial and shopping centres, the users include residents of high-end residential areas and students of education institutions.

5.3.3 *Non-Motorized Transport (NMT)*

a) Mysuru city is home to India's first Public Bicycle sharing system (PBS) called "Trin Trin". Presently the system is having 52 Bicycle Hubs with 450 cycles.
b) Out of 52 cycle hubs, only 10-12 are present in the study area which is mostly restricted to the to the CBD. There is no dedicated cycle track or cycle lane throughout the study area and in most of places they are not integrated with other modes of travel.

5.3.4 Pedestrian Infrastructure Facilities

a) The pedestrian infrastructure facilities are average in this study area. There are few encroachments near the commercial centres. The footpaths are used for parking vehicles and the pedestrians are

often forced to use the road way often leading to increased congestion and road accidents.

5.3.5 Parking and Road Infrastructure Facilities

a) The parking problem is more near the commercial areas, where vehicles are parked along the road side reducing the carriage width and increasing traffic congestion. In few areas there are paid parking facilities. In few places the foot paths are encroached by two-wheelers.

5.3.6 Smart Application-ITS

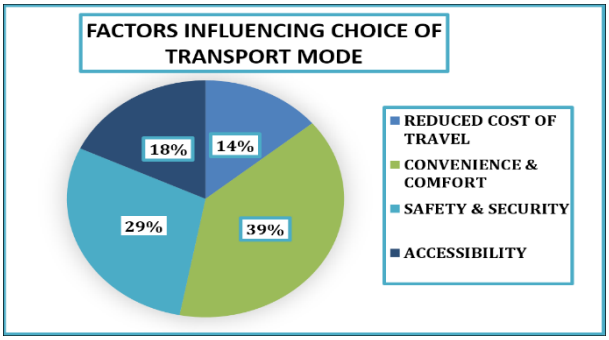
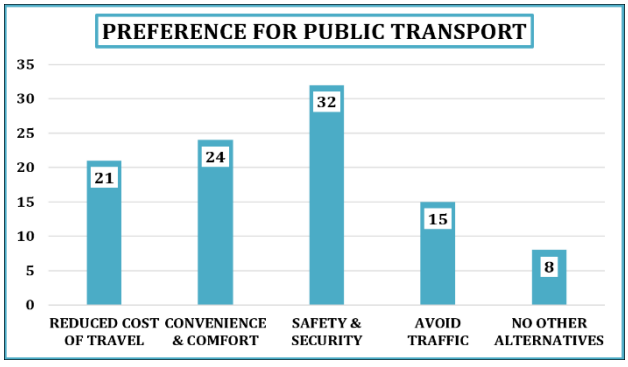
a) The awareness regarding the usage and benefits of ITS & ITS-Mitra app is very poor even among students and educated class. In some of the bus stops the LED display are damaged or not working. Signal synchronization is not available often leading to delays at traffic signals causing congestion and traffic jams**.**

6. Results and Discussions

6.1 Results and Analysis of Opinion Survey

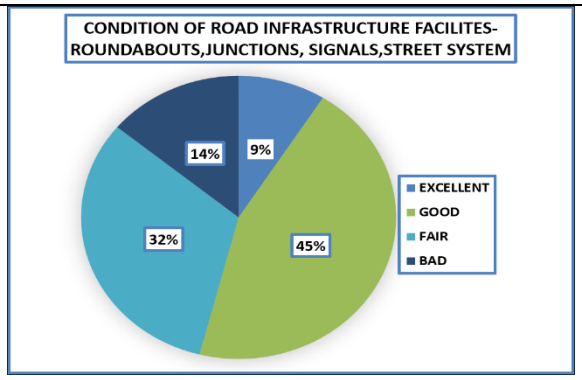
Opinion survey in the form of Structured Questionnaires was carried out for different transport users within the selected Traffic Analysis Zones (TAZs) to identify Key Issues and Problems. The opinion survey was conducted by taking into account the qualification, age, gender, purpose of travel, socio-economic status of the users and different Traffic Analysis Zones so as to ensure that the results truly reflect the travel characteristics of the entire city and the felt needs of different transport users in order to propose effective and efficient planning strategies. The results are Tabulated below

Chart 1: Results and Analysis of Opinion Survey

A. Factors Influencing Choice of Transportation Mode Nearly 39% respondents give priority to comfort and convenience as the prime factor for deciding the mode of travel. Hence two wheelers are a most preferred choice since it is convenient. Safety and security is the second most important factor especially for the female students, women and the elderly people. Accessibility comes third at 18 % followed by reduced cost which is a matter of concern only for the poor people.	
B. Preference for Public Transport 32 % say safety is the prime reason to choose public transport especially the female students, women and the elderly people. Followed by 24 % who say public transport is more convenient and comfort and other 21 % for reduced cost. These parameters help us identify the key issue and suitable planning strategies to increase the modal share of public transport in the context of NUTP, 2014	

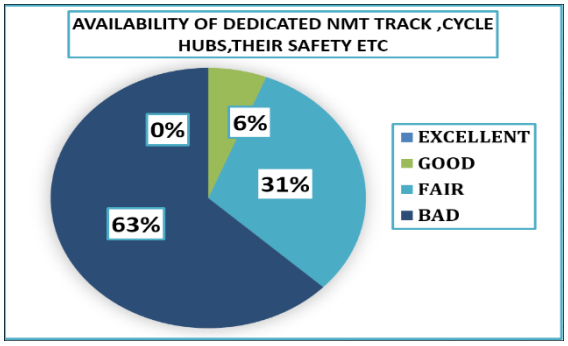
C. Condition of Road Infrastructure Facilities-Roundabouts, Junctions, Signals, Street System

45 % of respondents feel that the level of road infrastructure facility in Mysore is good. This is due to various road improvements undertaken under various schemes like JnNURM etc. Other 32 % still feel there is scope for further improvements.



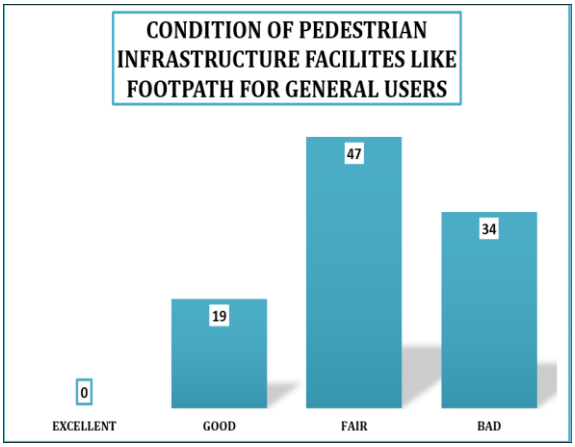
E. Availability of Dedicated Cycle Track, Hubs & Their Safety

Presently there are no dedicated cycle track within the city expect for few km stretch near ATI. The existing cycle hubs are not fully functional and are not integrated with other modes of travel hence 95 % say the level is either bad or fair.



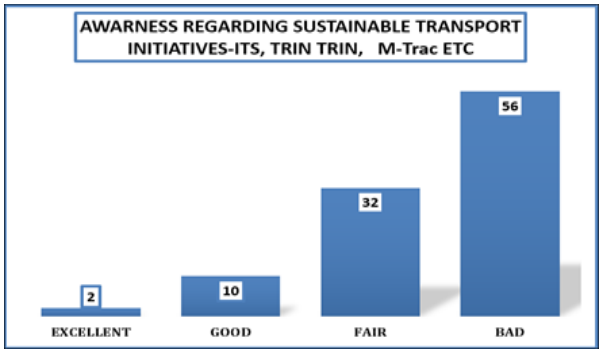
F. Condition of Pedestrian Infrastructure Facilities Like Footpath for General Users

47 % of respondents say that the level of pedestrian infrastructure is fair due to improvement made under different schemes especially under JnNURM but still 34 % of them feel it needs to be improved especially in the CBD where they are either encroached by vehicles or by the street vendors & hawkers.



G. Awareness Regarding Sustainable Transport Initiatives-ITS-MYTRA, TRIN TRIN, M-TRAC ETC.

The awareness regarding the various sustainable transport initiatives such as trin trin, ITS-Mitra is very poor since 85% respondents are either fully or partly unaware about the facilities which affects the overall efficiency of the schemes



(Source: Author Compiled based on Primary Survey)

6.2 Summary of Issues and Problems with respect to Multi Modal Integration

a) Different transport entities in Mysuru are planned, managed and operated by independent agencies without having any accountability and coordination amongst them.
b) Lack of efficient and city-wide coverage of public transport system, lack of information regarding availability of parking slots, traffic signage, public transport scheduling etc., is further increasing the usage of private motor vehicles and decreasing the share of desirable modes such as Bicycle, walking and Public Transport.
c) Infrastructure such as Stations, stops, roads, footpaths, cycle tracks, parking etc. built for different modes are planned in isolation without any synchronization and integration.
d) Lack of physical integration amongst terminal points for different modes is creating a mental block against usage of public transport, leading to accessibility issues. Thus, the current transport systems in Mysuru city are unable to achieve the first and last mile connectivity

Proposals and Recommendations

Based on the recommendations of National Urban Transport Policy-2014 (NUTP), National Mission on Sustainable Habitat (NMSH), and 12th Five-year plan, a detailed Planning Strategies and Policy Guidelines are proposed for city-wide multi-modal integrated transport plan (CMITP) using the five pillars of integration and achieved through Preplanning Stage, Planning Stage and finally the Design Stage are summarized in Table 7.

Figure 6. describes the working of an integrated multimodal transport system which comprises of two levels –transportation (operation, physical & fare integration) & information (information integration), and both must operate under the umbrella of institutional integration. The Five pillars of Integration need strategic planning direction, which aims at enhancing a city "stand- alone transportation systems" into "multi-modal transportation system".

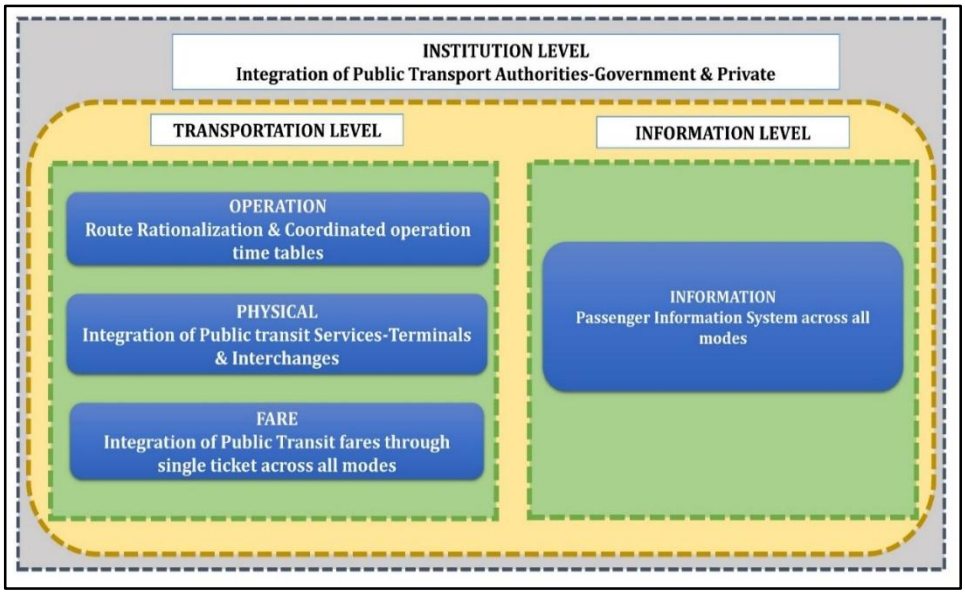


Figure 6. Conceptual framework of Working of Multimodal Transportation System

Table 7: Proposals / Recommendations						
SL NO.	**Pillars Of Integration**	**Component And Sub Component Of**	**Proposals / Recommendations**	**Stages Of Integration**		
				A. Pre-planning stage	**B. Planning stage**	**C. Design stage**

		Integration				
A.	**Institutional Integration**	**1. Public Transport** **2. Transport Network** **3. Non-motorized transport (NMT)**	• *Setting up of Unified Metropolitan Transport Authority (UMTA)*	***Secondary Data of various concerned department*** *: Annual Report (Admin, Financial, Legal & Human Resource), Organizational Chart & Duty, Details of operations and Earlier Study Report*	***Step 1*** *- Identification of Concerned Authorities* ***Step 2*** *- Role & Responsibility of concerned Authorities* ***Step 3*** *– Gap Identification* ***Step 4*** *- Planning for Single Authority Unified Metropolitan Transport Authority (UMTA):*	*Ensuring the activeness of organization by carving out a dedicated secretariat and providing the UMTA with legal backing and financial powers*
B.	**PHYSICAL INTEGRATION**	**1. Public Transport**	*a) Bus Stop* *e) Bus terminal* *f) Metro Station* *g) Intermediate Public Transport (IPT)* *h) Stop* *i) Multi-Modal Hub*	***a. Secondary Data****: City Map for existing location of infrastructure, transfer points* ***b. Primary Survey****: Inventory of Bus Stop/Metro Station/IPT Stop /Bus Terminal / Multi- Modal Hub (Interchange)*	***Step 1*** *- Types of Infrastructure* ***Step 2*** *- Location Identification* ***Step 3*** *– Requirement Analysis*	*a) Bus Stop Bus route, Bus signal priority* *b) Bus Terminal traffic demand, traffic characteristics, function of terminal* *c) Metro Station circulation pattern, bus/ parking/ IPT facility, sub-station* *d) Multi-Modal Hub bus terminal, rail link, metro station, IPT, personal mode (Car &2W) & NMT traffic*
		2. Transport Network	*a) Road Network* *d) Intersection* *e) Parking Ridership*	***a. Secondary data****: Existing road network, Intersections and other On street & off street parking locations*	***Step 1*** *- Review of Existing Condition/ Location Identification* ***Step 2*** *- Traffic*	*a) Road Network: Road speeds, space standards, cross sectional elements,* *b) Intersection:* road *speeds,*

				***b. Primary Survey**; Road Network Inventory, Intersection Inventory, & Parking Inventory*	*Composition/Volume Study* ***Step 3** – Requirement Analysi*	*space standards, cross sectional elements,* *c) Parking: space standards for parking*
		3. Non-motorized transport (NMT)	*a) Cycle Track and* *b) Parking Station* *c) Footpath*	***a. Secondary data:** Existing Infrastructure details of Footpath & Cycle Track* ***b. Primary Survey**; Footpath Inventory & Access, Bicycle track Inventory & Intersection Treatment*	*Step 1 – Types of Infrastructure: Cycle Track & Footpath* *Step 2 – Location Identification : Cycle Track and Parking Stations.,* Footpath	*Design standards for* *a) Footpath* *b) Pedestrian Crossing* *c) Street Furniture* *d) Pedestrian Facilities at Transit Areas* *e) Design of Cycle Track and other facilities*
C.	**OPERATION INTEGRATION**	**1. Public Transport**	*a) Route Network Planning* *b) Service Plan*	*a. **Secondary Data**: Fleet Usage Detail, Fleet utilization rate, Route inventory along with bus stops, Cost & Fare (Operation cost per km, Revenue per km, Profit/loss)* *b. **Primary survey**: Route Detail (Headway on different routes, Average route speed, Service reliability)*	***Step 1** - Review of Existing PT Scenario* ***Step 2** - Demand Estimation* ***Step 3** – Co-ordinated Routing & Scheduling*	*The design for operation integration which when planned and implemented differs from region to region because of its different need Transit services can be designed in two ways customer-oriented design and technology driven design*
		2. Transport Network	*NA*		*NA*	
		3. Non-motorized transport (NMT)	*NA*		*NA*	
D.	**FARE INTEGRATION**	**1. Public Transport**	• *One ticket for all means of transport*	***Secondary data:** Fare Structure (For various Modes of Transport), Financial Performance*	***Step 1** - Existing Fare Scenario* ***Step 2** - Gap Identification* ***Step 3** – Standardizati*	*The design of MORE card issued by MoUD*
		2. Transport Network				
		3. Non-				

		motorized transport (NMT)		*Report, Fare Policy/Revision etc.*	*on of Operation Procedures*	
E.	**INFORMATION INTEGRATION**	**1. Public Transport** **2. Transport Network** **3. Non-motorized transport (NMT)**	• *Inter-modal real time passenger information systems*	***Secondary data**: Existing ways of information flow to commuters, if any, Details of its Operations & Maintenance, Earlier Study Report, if any*	***Step 1** - Existing System Study* ***Step 2** - Gap Identification* ***Step 3** – Component Identification* ***Step 4** – Req. Analysis*	*Design features for ITS architecture, concept layout of control centre, and ITS framework.*

(Source: Author Proposed based on Analysis)
(Source: Author Proposed Using GIS)
Figure 10: Proposals and Recommendations for different components under CMITP (Source: Author Proposed based on Secondary source)

7. Conclusions

City Wide Multi-Modal Integrated Transport Plan provides seamless city-wide connectivity to the commuters and Promotes coordination between various modes and their infrastructure (new and old), By achieving first and last mile connectivity It also promotes Sustainable transport.

Acknowledgments
We are most thankful for the Department of Science and Technology (DST), Government of India for awarding the Inspire Fellowship that has provided financial support to Goutham Konikar S.M to carry out this research.

8. References

1. "Bus System Toolkit" (2006), *Ministry of Urban Development, Government of India*.
2. "Evolution of Unified Metropolitan Transport Authorities in India (2012)", *Institute of Urban Transport (India).*
3. "Handbook on Service Level Benchmark for Urban Transport (2011)", *Ministry of Urban Development, Government of India*.
4. "Introduction to Multi-Modal Transportation Planning Principles and Practices (2014)", *Victoria Transport Policy Institute.*
5. "Guidelines for Pedestrian Facilities (2012)", *Indian Road Congress: 103-2012.*
6. "Recommended Practice for The Design and Layout of Cycle Tracks (2009)", *Indian Road Congress: 11-1962.*
7. "Space Standards for Roads in Urban Areas (2009)", *Indian Road Congress: 69-1977.*
8. "Guidelines for The Design of Interchanges in Urban Areas (2011)", *Indian Road Congress: 92-1985.*
9. "National Mission on Sustainable Habitat (2011)", *Ministry of Urban Development, Government of India*.
10. "National Transport Development Policy Committee (NTDPC) (2011)", *Ministry of Urban Development, Government of India.*
11. "National Urban Transport Policy (2014)", *Ministry of Urban Development, Government of India.*
12. "Recommendations of Working Group on Urban Transport for 12th Five Year Plan, 2011", *Ministry of Urban Development, Government of India.*
13. "Street Design Guidelines (2010)", *UTTIPEC.*
14. "Toolkit for Preparation of Comprehensive Mobility Plan for a City (2014)", *Ministry of Urban Development, Government of India.*

15. "Toolkit on Intelligent Transport System for Public Transport & BRTS (2013)", *Ministry of Urban Development, Government of India.*

16. "Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines, Volume I, (2015)". *Ministry of Urban Development, Government of India.*