

# **PERFORMANCE EVALUATION OF INTERMEDIATE PUBLIC TRANSPORT BY BENCHMARKING APPROACH :A CASE STUDY**

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# ABSTRACT

Due to an emerging trend in urbanization and modern living patterns, the necessity of transportation and mobility has a drastic impact in the growing countries like India. The existing public transport is not able to cater the needs of the demand and mobility patterns for better connectivity. These scenarios have lead to the development of a new transportation system i.e Intermediate Public Transport (IPT).The IPT these days turned into a vital mode of transportation throughout urban India and acts as a feeder to public transportation system and it is essential mode in rural and urban fringes. An effective management by monitoring the performance of IPT helps in sustainable urban transport. To carry out the study, Srikakulam district (Urban), has been selected. The execution of IPT in Study area has been assessed by considering parameters like Performance Areas and Key Performance Indicators (KPI). For this performance evaluation of Study area the concept of Benchmarking Approach is adopted. These approaches incorporates the perception of the city, system and passenger. This study represents LOS (Level of Service) values for various KPI which are calculated using various methodologies adopted by MoUD (Ministry of Urban Development) and other agencies. A comparative study of obtained values with the standard LOS values is done to obtain the OLOS (Overall Level of Service) of the case study area.

**Key Words:** Intermediate Public transport, Key Performance Indicators, Benchmarking approach.

# INTRODUCTION

- ✓ As a lag between growing public transport demand and service capacity results in an increase of travel cost, congestion, and unreliable service, thereby creating economic loss and environmental degradation.
- ✓ Public transport is considered to be one of the performance indicators to monitor the urban transport performance . Public transport system of a city constitutes of conventional form like city buses, LRT(Light Rail Transit) and non-conventional form like shared autos.
- ✓ Though Conventional public transport is operating in high capacity but it has fixed routes, stops, schedule and mostly travel in mixed traffic conditions which causes long waiting time and more travel time and thus causing irregularity in service.
- ✓ In contrast IPT provides greater access by flexibility, connectivity, availability on demand and comfort and operate easily through the narrow streets where buses can't operate.
- ✓ Therefore, the performance of public transport system of a city cannot be judged only by conventional form of public transport, non-conventional form should also be taken into consideration if it exists.
- ✓ In the present study, passenger, city, system perception has been considered to evaluate the performance of IPT system. In this case study share-autos and maxi cabs are considered and their performance is evaluated using the benchmarking approach.

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### Bench Marking:

The SLB(Service Level Benchmarking) can be defined as “The process of determining how effectively and efficiently the present Transportation system is performing in the existing situation” or simply “The quantification of qualitative aspects in urban transportation.”

- ✓ Benchmarking, basically helps us to understand how our transportation system is performing as a whole and in which sectors it was lagging along with its severity, so that we can have a clear plan for the future development.

# AIM & OBJECTIVES

## **Aim of the study:**

- ✓ The aim of the present study is to evaluate the performance of the IPT system by Benchmarking process, considering Key Performance Indicators(KPI).

## **Objectives of the study:**

- ✓ To identify different IPT modes operating in Srikakulam.
- ✓ To develop KPI's based on the performance areas of availability, mobility, safety, affordability, Intelligent Transportation System(ITS) facility, comfort and convenience.
- ✓ To assess the vehicular occupancy of IPT modes operating in Srikakulam, assess the passenger attitude and trip maker characteristics.
- ✓ To compare IPT mode to two-wheeler mode in terms of mobility and safety.
- ✓ To identify areas of excellence and gaps and to derive performance report card to set targets.

# LITERATURE REVIEW

- ✓ **CEPT University (2013); IUT University (2013)** has Conducted the studies on various Indian cities and helps in standardizing the procedure for Benchmarking to arrive at key performance indicators.
- ✓ **Service level benchmark's MoUD (2009)** wants to address institutional and operational aspects for ensuring long term sustainability of the benchmarking activity.
- ✓ **TCQSM, 2nd edition (2003); TCRP Report 88** provides current research-based guidance on evaluating quality of service, reflecting how passengers perceive the quality of the transit service offered and provided.
- ✓ The Present Study helps in filling the gaps in the areas of Convenience and Safety in terms of Vehicle occupancy, Waiting time and Accident Rate which helps in improving the LOS of study area and its Performance.

# STUDY METHODOLOGY

Study Area Identification for Performance evaluation of IPT

Bench Marking Approach

Key Performance Indicators

Data Collection Using Primary Surveys and  
Secondary Sources

Evaluating the Performance of IPT

Identifying the areas that need Improvement

Performance Report Card for Improving LOS





# KEY PERFORMANCE INDICATORS (KPI)

Performance Measure	Performance indicators/ service attributes	Standard's adopted from
Availability	Extent of supply of IPT	Draft report of urban transport for six Indian cities, CEPT University
	Service coverage	SLB handbook, MoUD
Comfort*	Driver behavior, Co passenger behavior, Cleanliness of the vehicle, Sitting beside the driver	Present Study(* <i>Performance measure based on service attributes</i> )
Convenience	Waiting time	Author
	Vehicle occupancy	Author
	Travel Time Ratio (TTR)	TCQSM part 3, quality of service
Mobility	Travel speed	Draft report of urban transport for six Indian cities, CEPT
Safety	Accident rate for IPT	Author
Affordability	Affordability	Draft report of urban transport for six Indian cities, CEPT
ITS Facility	GPS for IPT	Draft report of urban transport for six Indian cities, CEPT

# DATA COLLECTION FOR BENCHMARKING

Data	Type	Source
Vehicle strength and growth	Secondary	Andhra Pradesh Transport Department, Regional Transport Authority (RTA), Srikakulam
Accident data	Secondary	Secondary Traffic police
Waiting time, affordability, trip maker characteristics and service rating	Primary	Trip maker survey
Acceptable waiting time, relative weightage of indicators	Primary	Passenger attitude survey
Travel speed, travel time ratio	Primary	Speed and delay study by conducting trail runs
Load factor	Primary	Vehicular occupancy survey of IPT

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## DATA COLLECTION FOR BENCHMARKING:

The Various Surveys Conducted to collect DATA for Benchmarking are :

- Trip maker survey
- Passenger attitude survey
- IPT occupancy survey
- Speed and delay study

The Various Survey Formats are as follows:

[UMI Conference\2.Required\Survey Formats.docx](#)

The Image of Study Area:

[UMI Conference\2.Required\Study Area Image .jpg](#)

# CALCULATIONS

Calculations: [link to Calculations](#)

## 1. **Affordability:**

Affordability= Total expenditure on transportation x 100/ Monthly income

Eg: From Trip maker survey for a person named S. kameswara rao

- total expenditure on transportation = 10
- Monthly income = 30,000/-  
=> Affordability = (10 x 100)/30,000 = 0.033

## 2. **Comfort:**

$$I_a = \sum(S_i \times F_i)/N$$

Where

$I_a$  = Index of acceptability for the service attribute 'a',

$f_i$  = frequency of respondents giving rating  $i$  to service attribute 'a',

$S_i$  = scale value of the rating  $i$ ,

$N$  = summation of frequencies of respondents giving lowest to highest rating

(Contd..)

### 3. **Average IPT occupancy:**

- Average IPT occupancy = Total Occupancy / No of Observations
- Average load factor = Total Occupancy / Total Capacity
- % of IPT travelling with more than their capacity = overloaded vehicles / no of observations

4. **Travel Time Ratio:** *(For TTR calculation 2 wheeler mode is considered as other mode because the 2 wheeler mode is having the lesser delays which effects the travel time to a greater extent.)*

Travel Time Ratio = Travel Time by IPT mode / Travel Time by 2wheeler mode

### 5. **Travel Speed:**

- For Calculation of Travel Speed, all the road networks are considered with in the Study area.

Travel Speed = Distance between the Origin & Destination (O\D) / Average Travel time taken

Weightage = Distance between the Origin & Destination (O\D) / Total Corridor length

LOS density = LOS x Weightage

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## 6. Accident rate:

Accident rate = total no accidents IPT responsible for x 100 / total no of accidents

For the year 2016

total no accidents IPT responsible for = 3

total no of accidents = 36

Accident Rate =  $(3 \times 100) / 36 = 8.333$

## 7. Numerical Rating:

Safety while travelling:

- Average Weightage =  $(20 \times 5 + 31 \times 4 + 6 \times 3 + 2 \times 2 + 0 \times 1) / (20 + 31 + 6 + 2 + 0)$
- Relative Weightage ( $W_i$ ) = Average Weightage / Total weightage
- Service quality w.r.t unity ( $R_i$ ) = Average Weightage / 5
- QOIPTS<sub>i</sub> (Quality of Intermediate public transport) =  $W_i \times R_i$
- QOIPTS =  $\sum QOIPTS_i$

# RESULTS

## 1.Extent of Supply:

Evaluation and LOS criteria for extent of supply of IPT (CEPT)

INDICATOR	Evaluation	RANGE	LOS
Presence of IPT vehicles/1000 population	Total number of IPT vehicles = 9118	<4	1
	Total population = 132487	5-6	2
	Presence of IPT vehicles/1000 population =	7-8	3
	$9118/(132487/1000) = \mathbf{68.822}$	>8	<u>4</u>

## 2.Service coverage:

Evaluation and LOS criteria for service coverage of IPT (SLB)

Indicator	Evaluation	Range	LOS
Service coverage of IPT in the city	Total length in route kms of the corridors on which IPT ply in the city (a) =55.9 Km Area of the urban limits of the city in sq. Kms (b) = 14.56 km <sup>2</sup> Service coverage of IPT = (a/b) = <b>3.84</b>	$\geq 1$	<u>1</u>
		0.7 – 1	2
		0.3 – 0.7	3
		< 0.3	4

## (Contd..)

### 3.Affordability:

Affordability of IPT for different classes of income

Monthly Household income	Affordability (%) = total expenditure on transportation*100/monthly income
5000 to 10000	2.99
10000 to 20000	4.55
20000 to 30000	5.00
30000 to 40000	1.89

### LOS criteria for Affordability (CEPT)

Affordability (%) = total expenditure on transportation by IPT * 100 / monthly income	LOS
<10 ( <i>Calculated value=3.61</i> )	<u>1</u>
11 – 14	2
15 – 19	3
>20	4

### 4.Average waiting time:

LOS criteria for average waiting time (SLB)

Defined minimum % of passengers	Acceptable maximum waiting time in minutes	LOS
100	$\leq 4$	1
75	4 – 6 ( <i>Calculated value=4.21</i> )	<u>2</u>
50	6 – 10 <small>5-Dec-17</small>	3
<50	>10	4



## (Contd..)

### 5.Comfort:

LOS criteria for level of comfort (Samir)

Minimum value of the Performance index, (i.e. Geometric mean of the Relative values of 4 elements of comfort)	LOS
>0.85	1
0.85-0.5 ( <i>Calculated value=0.73</i> )	<u>2</u>
0.5-0.25	3
<0.25	4

### 6.Vehicle occupancy:

LOS criteria for Vehicle Occupancy of IPT(Present Study)

Percentage of IPT vehicles travelling with more than their capacity	LOS
0	1
<20	2
20 – 50 ( <i>Calculated value=35</i> )	<u>3</u>
>50	4

### 7.Travel Time Ratio:

LOS criteria for TTR of IPT (TCQSM)

Travel time of IPT to private	LOS category
<=1	1
1-1.25	<u>2</u>
1.25-1.5	3
>1.5	4

## (Contd..)

### 8.Travel Speed:

LOS criteria for travel speed of IPT (CEPT)

Average speed of IPT along Major corridors	LOS category
>20( <i>Calculated value=28.97</i> )	<u>1</u>
18-20	2
16-18	3
<16	4

### 9.Accident rate:

LOS criteria for accident rate of IPT(Present Study)

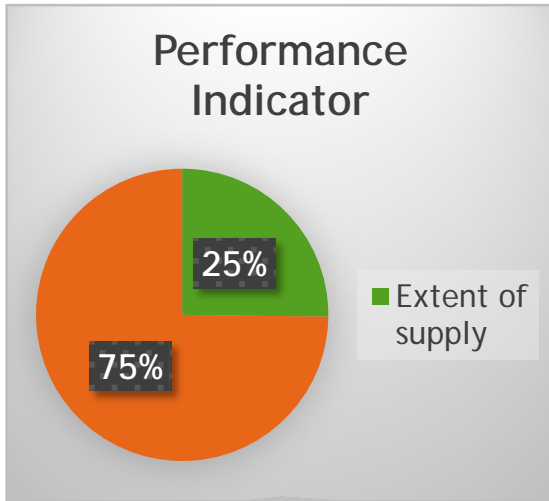
Indicator	Evaluation	Range	CLOS
Accident rate for IPT	Total number accidents recorded within the city limits for a given calendar year (a) = 36 Total number of accidents (fatal and non-fatal) IPT responsible for (b) = 3 Accident rate for IPT = $(b) \times 100 / (a) = 8.33$	<10	<u>1</u>
		10-15	2
		15-20	3
		>20	4

### 10.GPS facility:

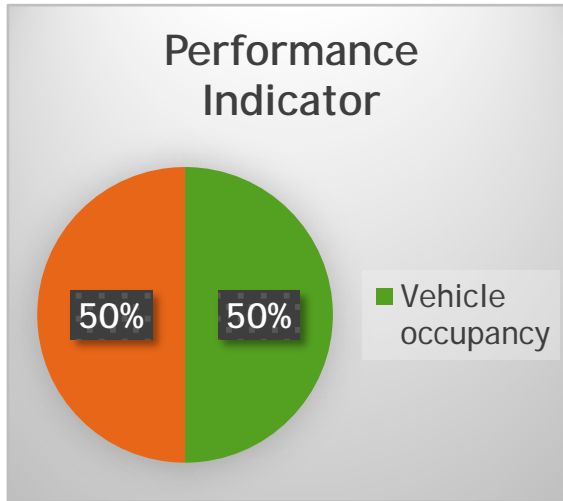
LOS criteria for GPS facilities (CEPT)

Indicator	Evaluation	Range (%)	CLOS
IPT vehicles with GPS facilities	Total number of IPT vehicles (a) = 9118 Total number of IPT with GPS (b) = 0 GPS facilities = $(b \times 100 / a) = 0$	$\geq 75$	1
		50 – 75	2
		25 – 50	3
		<25	<u>4</u>

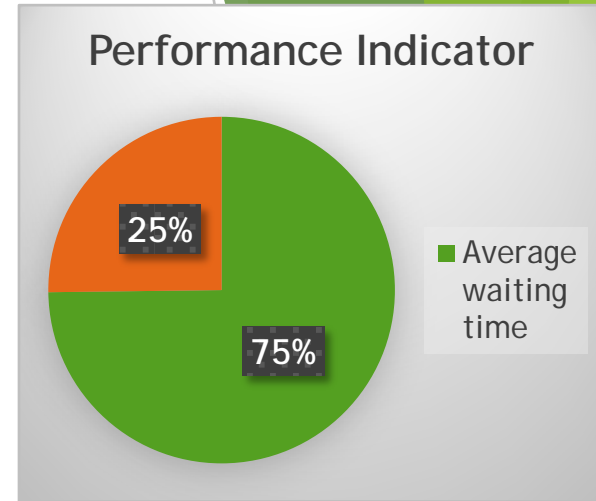
# (Contd..)



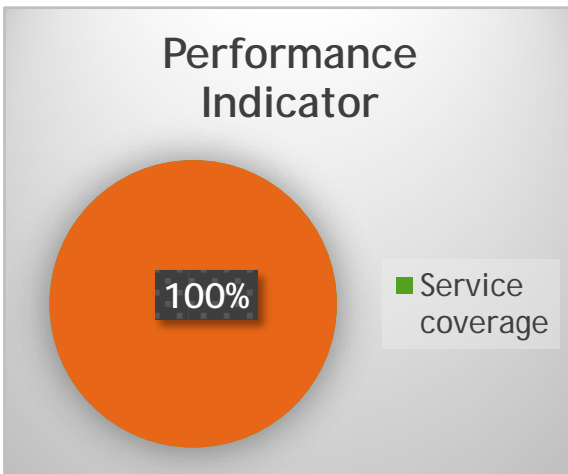
LOS:4



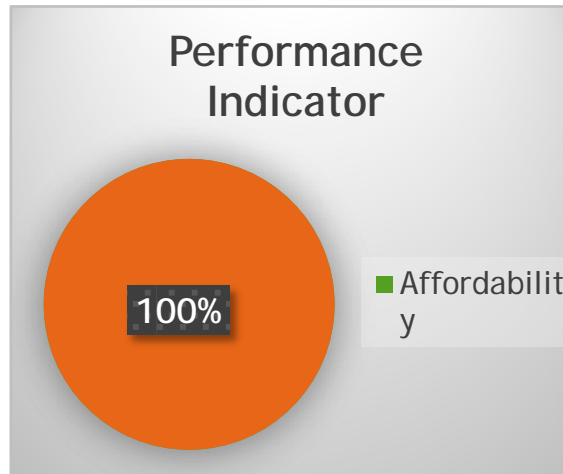
LOS:3



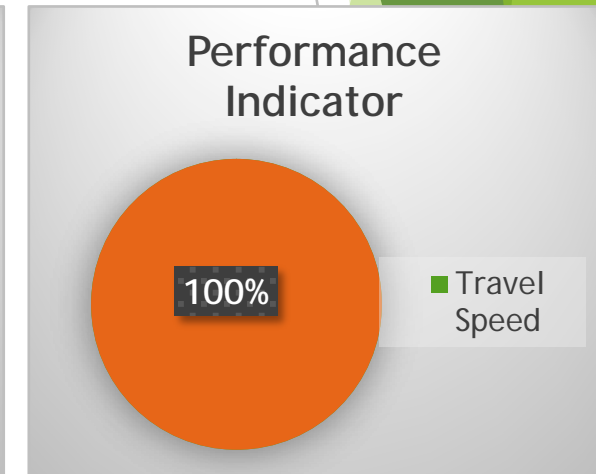
LOS:2



LOS:1

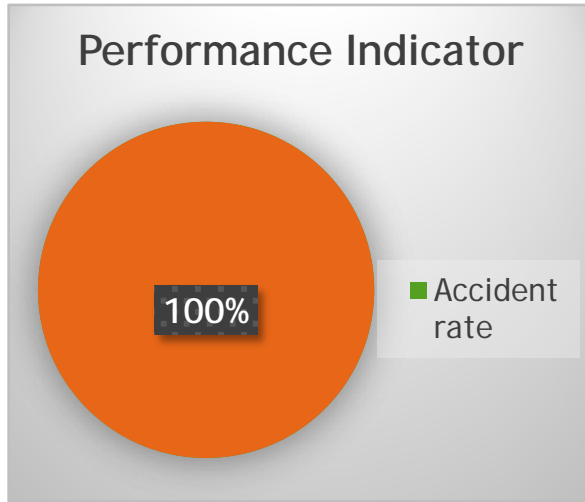


LOS:1

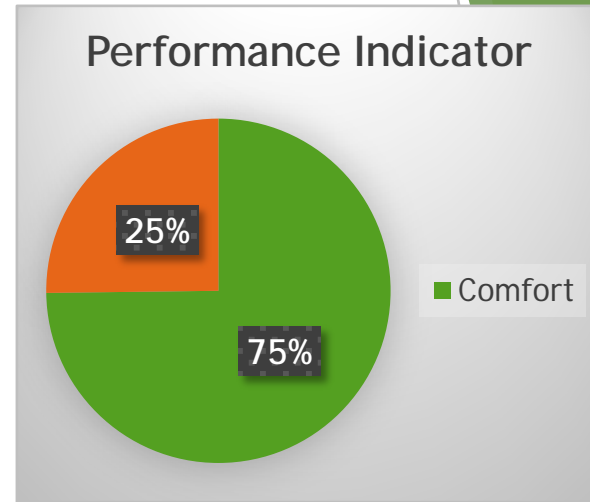


LOS:1

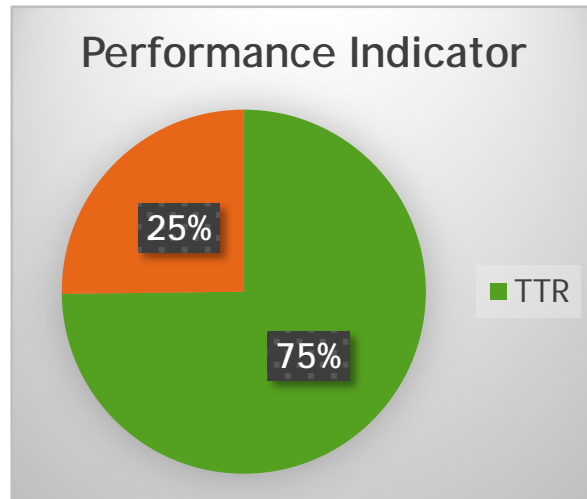
# (Contd..)



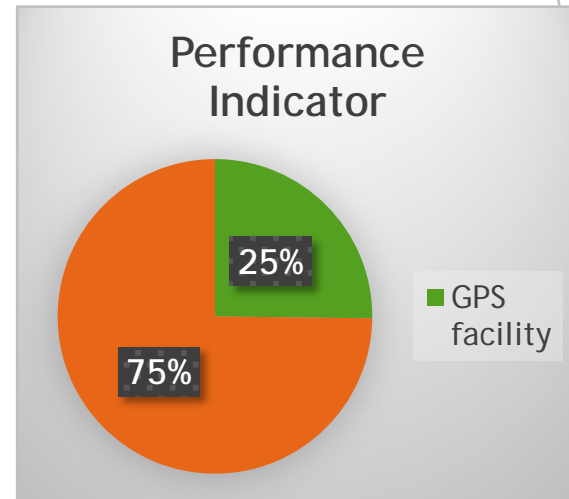
LOS:1



LOS:2



LOS:2



LOS:4

## (Contd..)

From the above results of the ten KPI, the average of the CLOS(Calculated Level of Service) of each KPI will give the Overall Level of Service (OLOS) of the IPT system for the Srikakulam city. Therefore, the OLOS of the IPT system by benchmarking process is the summation of CLOS of all the indicators, the CLOS of **extent of supply** is 4, CLOS of **service coverage** is 1, CLOS of **comfort** is 2, CLOS of **average waiting time** is 2, CLOS of **vehicle occupancy** of IPT is 3, CLOS of **TTR** is 2, CLOS of **travel speed** is 1, CLOS of **accident rate** is 2, CLOS of **affordability** is 1, CLOS of **GPS facilities** is 4.

The summation of all the CLOS is,  $4+1+2+2+3+2+1+1+1+4= 21$  and the average of all the **CLOS** is given by  $21/10 = 2.1$ .

This reflects the poor performance of the IPT system, and to improve the performance of IPT by benchmarking involves fixing targets for each of the ten indicators and to achieve them in the upcoming years. Suggestions to achieve targets are given in the performance report card of IPT for Srikakulam city in the below Table.

# PERFORMANCE REPORT CARD

IPT Performance report card for the city of Srikakulam by Benchmarking process

Indicator	CLOS	LOS Targeted	Suggestions to achieve target
Extent of supply	4	3	Registration of new IPT vehicles should be allowed to act as a feeder to Mass Transit System to improve Mobility
Service coverage	1	1	Though it has met the LOS target for ease in transportation, increase IPT Service where PT is not available.
Affordability	1	1	Though it has met the LOS target for ease in transportation, government has to Standardize the fares for IPT and shared services and to check regularly.
Comfort	2	1	The Authorities should check & The Commuters should discourage in travelling by seating beside the driver.
Average waiting time	2	1	Based on the corridor demand, the frequency of IPT may be increased in peak hours.
Vehicle occupancy	3	2	No of IPT vehicles can be increased to reduce the Load factor and Vehicle Occupancy to increase the LOS.
Travel Time Ratio	2	1	IPT may be used as public transport in the outsscirts areas and should be integrated with city bus routes to act as feeder.
Travel speed	1	1	Though it has met the LOS target for ease in transportation,the speed can be Maintained as Safe Speed to avoid accidents and to maintain a smooth movement of vehicles with in the Urban Corridor.
GPS for IPT	4	3	IPT vehicles should be upgraded with technology for sustainable & safe transport.
Accident rate	1	1	Though it has met the LOS target for ease in transportation,checking the over speeding of IPT vehicles on Urban Streets by speed laser gun and instruct IPT vehicles to operate safely to act as a feeder to PT.

# CONCLUSIONS

The Conclusions are Drawn from the work executed for the Srikakulam Urban area:

- The various IPT modes operating in Srikakulam town are identified.
- The KPI's for the performance areas of availability, mobility, safety, affordability, Intelligent Transportation System(ITS) facility, comfort and convenience are developed and analysed.
- The vehicular occupancy of IPT modes operating in Srikakulam is assessed.
- Passenger attitude and trip maker characteristics are assessed.
- In terms of mobility IPT and 2 wheeler modes are compared.
- The areas of excellence and gaps are derived and performance report card is prepared to set targets.
- OLOS of IPT is obtained to be 2.1, which shows there is a need for improvement in the performance. Suggestions to improve the IPT system have been presented in the report card.

# FUTURE SCOPE & RECOMMENDATIONS

## Future scope:

- To evaluate the overall performance of IPT, additional performance areas and Key performance indicators can be considered such as service accessibility, hours of service, ridership, etc.
- Also to evaluate the performance of IPT, other methodologies can be adopted along with benchmarking and numerical rating such as fuzzy sets, DEA (Data Envelopment Analysis), etc for better results.
- A comparative study of IPT with the city bus system and private mode can be made.
- The LOS criteria considered for the KPI, comfort, average waiting time, TTR, vehicle occupancy of IPT, the accident rate for IPT can be standardized by evaluating the performance of IPT using benchmarking for various cities with different population size.
- The KPI like Security can also be considered for the performance evaluation of IPT for various cities to improve the quality of service for the city.
- The upcoming technologies like smart vehicular technology , ITS , traveler information system , vehicular damage assessment can be implemented for the IPT vehicles to improve the service quality for the city.



## (Contd..)

### **Recommendations:**

- The IPT system should be regularized and should be confined to operate zone wise for its better functioning and well-coordinated with the city bus system in terms of routes and frequencies.
- There is a need to check the uncontrolled growth of auto rickshaws and the commuters are needed to be shifted to organized public transport.
- The traffic police should check that no driver allows the commuters to sit next to them.
- Based on the corridor demand, the frequency should be increased within the core of the city to reduce the waiting times and making IPT available in the routes where trips by city bus is not feasible.
- The IPT system of Srikakulam town should be improved in technology for clean mobility, and they are creating congestion in urban streets because of unsystematic parking policy, over speeding on MDR(Major District Roads) roads and overcrowding of passengers.
- There is a need to check that no IPT vehicle should stop or parked at least 100 meters from bus stops and major junctions.

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**THANK YOU**

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