Template/Pro forma for Submission

NMHS-Himalayan Institutional Project Grant

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research and Demonstrations

NMHS Grant Ref. No.:	GBPNI/NMHS-2019-20/SG, 25.12.2019

Date of Submission:	2	2	0	8	2	0	2	3
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TRIP PATTERNS AND ITS IMPLICATIONS ON INTERMEDIATE PUBLIC TRANSPORT SERVICES IN IMPHAL, INDIA

Project Duration: *from* (**24.12.2019**) *to* (**24.06.2023**).

***Submitted to*:**
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GENERAL INSTRUCTIONS:

1. The Final Technical Report (FTR) has to commence from the start date of the Project (as mentioned in the Sanction Order issued by NMHS-PMU) till completion of the project duration. Each detail has to comply with the NMHS Sanction Order.
2. The FTR should be neatly typed (in Arial with font size 11 with 1.5 spacing between the lines) with all details as per the enclosed format for direct reproduction by photo-offset printing. Colored Photographs (high resolution photographs), tables and graphs should be accommodated within the report or annexed with captions. Sketches and diagrammatic illustrations may also be given detailing about the step-by-step methodology adopted for technology development/ transfer and/ or dissemination. Any correction or rewriting should be avoided. Please provide all information under each head in serial order.
3. Any supporting materials like Training/ Capacity Building Manuals (with detailed contents about training programme, technical details and techniques involved) or any such display material related to project activities along with slides, charts, photographs should be brought at the venue of the Annual Monitoring & Evaluation (M&E) Workshop and submitted to the NMHS-PMU, GBP NIHE HQs, Kosi-Katarmal, Almora 263643, Uttarakhand. In all Knowledge Products, the Grant/ Fund support of the NMHS should be duly acknowledged.
4. The FTR Format is in sync with many other essential requirements and norms desired by the Govt. of India time-to-time, so each section of the NMHS-FTR needs to be duly filled by the proponent and verified by the Head of the Lead Implementing Organization/ Institution/ University.
5. Five (5) hard-bound copies of the Project Final Technical Report (FTR) and a soft copy of the same should be submitted to the **Nodal Officer, NMHS-PMU, GBP NIHE HQs, Kosi-Katarmal, Almora, Uttarakhand**.

The FTR is to be submitted into following two (02) parts:

Part A – Project Summary Report

Part B –Detailed Project Report

In addition, the Financial and other necessary documents/certificates need to be submitted along with the Final Technical Report (FTR) as follows:

Annexure I	**Consolidated and Audited Utilization Certificate (UC) & Statement of Expenditure (SE)**, including the interest earned for the last Fiscal year and the duly filled GFR-19A (with year-wise break-up).
Annexure II	**Consolidated Interest Earned Certificate**
Annexure III	**Consolidated Assets Certificate** showing the cost of the equipment in Foreign/ Indian currency, Date of Purchase, etc. (with break-up as per the NMHS Sanction Order and year wise).
Annexure IV	**List of all the equipment, assets and peripherals** purchased through the NMHS grant with current status of use, including location of deployment.
Annexure V	**Transfer of Equipment** through Letter of Head of Institution/Department confirming the final status of equipment purchased under the Project.
Annexure VI	**Details, Declaration and Refund of any Unspent Balance transferred through Real-Time Gross System (RTGS)/ PFMS in favor of NMHS GIA General**

DSL: Date of Sanction Letter

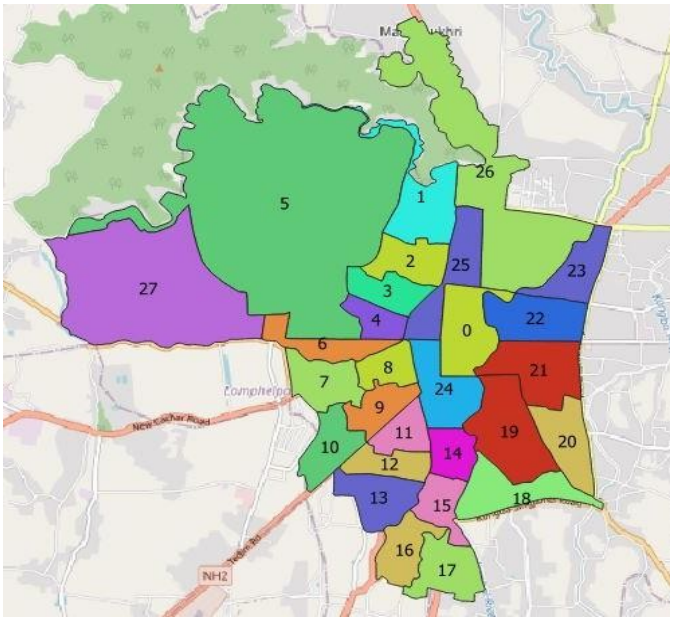
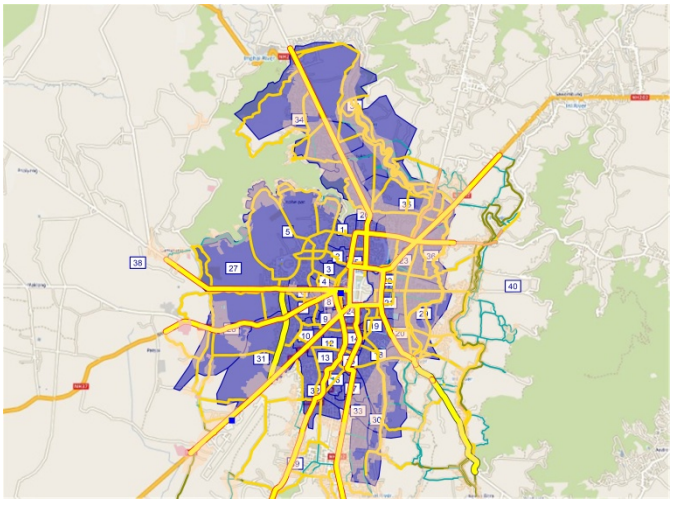
2	5	1	2	2	0	1	9
d	d	m	m	y	y	y	y

DPC: Date of Project Completion

2	4	0	6	2	0	2	3
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Grant Ref. No.:	NMHS_SP_SG_68 NMHS/2019-20/SG68/68						
ii.	Project Category:	Small Grant	yes	Medium Grant		Large Grant		
iii.	Project Title:	Trip patterns and its implications on Intermediate public transport services in Imphal, India						
iv.	Project Sites (IHR States/ UTs covered) (*Location Maps attached*):	 						

v.	Scale of Project Operation:	Local	Yes	Regional		Pan-Himalayan	
vi.	Total Budget:	0.44. (in Cr)					
vii.	Lead Agency:	CSIR-Central Road Research Institute					
	Lead PI/ Proponent:	Dr. S.Padma, Principal Scientist, CSIR-Central Road Research Institute					
	Co-PI/ Proponent:	Manipur Institute of Technology, Takyelpat , Imphal Pin- 795004 (Manipur)					
viii.	Implementing Partners:	Directorate of Transport , Government of Manipur					
	Key Persons (Contact Details, Ph. No., E-mail):	B.K Sharma, Joint Director of Transport, for Director (Transport), Manipur					

2. Project Outcomes

2.1 Abstract/ Summary (not more than 250-300 words)

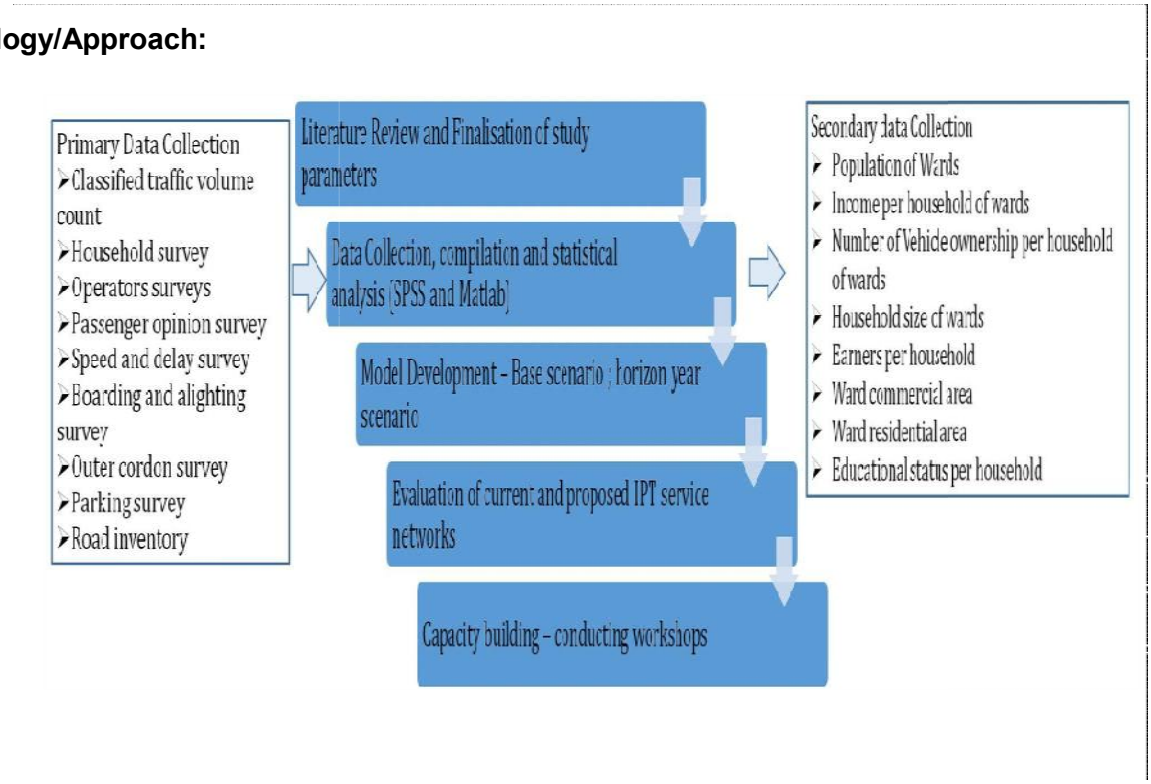
The prominent effect of improvement in transportation system is the ability to easily access the places of work, education and emergency. In cities around the world, it is seen that lower income groups often are moved to the periphery of the city which in turn affects their travel characteristics due to larger commute distance / cost. It is found that public transport (PT) is negligent in Imphal and it is the Intermediate Public Transport (IPT) services which cater to the needs of travel in the city of Imphal (Ahmed and Victory, 2012). In the event of emphasizing the IPT modes, it is imperative to assess whether the existing IPT services in the city can meet the demand generated for travel. In order to make such assessments, the trip pattern of the city needs to be understood. The analytical assessment of travel behavior of commuters would then be used as an input to check if the IPT systems operational in the city are able to cater to the demand generated. An evaluation of the IPT services through the development of a social vulnerability index to identify the wards having increasing social vulnerable groups. Subsequently, it is cross classified based on the accessibility levels to health care facilities for these wards helps to identify the list of wards that need improvement in terms of accessibility. A possible scenario evaluation of route modification of IPT services based on passenger flows was also be carried out for streamlining the existing services. Considering the above, the list of objectives accomplished as given below

Objective:

- To collect and collate the existing database with respect to road network, settlement locations with demographic details along with the operational characteristics of existing Intermediate Public Transport services.

- To collect the primary data with respect to the travel characteristics and satisfaction level in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.
- To carry out empirical analysis of the collected data.
- To develop the revised routing of the intermediate public transport services operational in Imphal if needed.

Methodology/Approach:



Approach:

- All the requisite primary surveys were carried out to develop the four stage model .
- In order to assess the sufficiency of the existing IPT routes a user satisfaction based questionnaire was designed and carried out.
- An index of social vulnerability was developed. A cross classification of the developed indices with the accessibility to various health care facility was ascertained.
- Based on the developed transport model the demand matrix for shared auto services was corrected.
- The corrected demand matrix of share auto was assigned to the self identified line routes and the volume by capacity ratio of these routes was determined.

Outcomes:

- A social vulnerability index highlights the wards which have higher proportion of indicators of social vulnerability. The study showed that the most socially vulnerable wards for the currently defined study area are located in the east Imphal district.

- The trip generation equations for the work trips, education trips as well as other trips were produced along with the estimated gravitation parameters to understand the distribution of various trips within the study area.
- The obtained demand matrix was assigned to the network
- The assigned demand was corrected / calibrated through field observed traffic volumes using 'Least squares' method.
- The corrected demand matrix was then used to ascertain the LOS of the user identified routes of share auto in Imphal study area.

Conclusions:

- The study concluded that from the current surveyed traffic volumes of select corridors of Imphal the need to make infrastructural interventions such as by-pass may be explored.
- The study also finds that conversion of current diesel auto to electric auto is welcomed by both operators as well as commuters.
- The IPT user opinion survey assessed the importance given to various service/infrastructure attributes of IPT by the user and found the average importance given to be mostly 'neutral', 'not important' indicating the need to sensitize/ make aware the users of better features entitled or existing in other metro cities.
- The IPT user opinion highlighted the need to provide training to drivers of IPT with safe driving practices and also sensitize them towards women's safety as these were the attributes with high importance but least satisfaction as rated by the commuters.
- The study identified through the vulnerability index as well as with the cross-classification of accessibility the wards which have high vulnerability index but low accessibility to health care facility. These wards need to have their accessibility to health care facilities improved.
- The study through the time table based assignment of self identified line routes found that during morning hours of 8:00 am to 9:00 am the volume by capacity of the lines was high thereby envisaging a need for possibly a service of higher capacity namely, buses.

Recommendations:

- To introduce E-autos instead of existing diesel share autos, to provide safe driving practice trainings sessions as well as to provide training on sensitization of IPT drivers towards women safety. To explore the possibility of introducing buses to cater to the commute of IPT passengers. To explore the possibility of introducing a bypass for the through traffic of the study area.

2.2. Objective-wise Major Achievements

S#	Objectives	Major achievements (***in bullets points***)
1	To collect and collate the existing database with respect to road network, settlement locations with demographic details along with the operational characteristics of existing Intermediate Public Transport services.	• Ward maps obtained, census data obtained. The existing ward map has been digitized. • The road network has already been input in VISUM. • The details on operational characteristics of IPT services have been obtained from the Directorate of Transport Manipur and they have been integrated into the model.
2	To collect the primary data with respect to the travel characteristics and satisfaction level of commuters in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.	• TAZ's have been fixed for the study area and the social vulnerability index has been developed. Trip generation model has been completed • Trip distribution and mode choice have been carried out in VISUM and the individual vehicle demand matrix is converted into hourly matrix. • The assignment was carried out for a morning hour of the network. The demand matrix was corrected using the primary traffic volume data collected from the field.

3.	To carry out empirical analysis of the collected data	• the social vulnerability index has been developed • The collection of secondary data in terms of the location of schools, colleges, hospitals as well as the route characteristics of IPT services has been carried out. The collected data has been attached herewith in Part B. • Regression based trip generation models namely , productions and attractions were ascertained for the study area and the trips were distributed based on the observed distance based gravitation parameters for various trip purposes. • The mode choice analysis was carried out using the Apollo choice modelling software and the constants only model coefficients were used to arrive at the modal split. • The mode-wise demand matrix was then assigned to the major roads of the Imphal network
4.	To develop the revised routing of the intermediate public transport services operational in Imphal.	• The possible routes as operated by share autos in Imphal had been collected and accordingly the demand has been assigned on the routes as a form of public transport. • Since other intermediate public transport services do not follow explicit routes they have been ignored while assessing the LOS offered by IPT. However these other IPT services have been assigned as a part of private network.

Note: Further details may be summarized in DPR Part-B, Section-5. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

2.3. Outputs in terms of Quantifiable Deliverables*

S#	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations, if any, & Remarks thereof:
1	Ward maps obtained, census data obtained. The details on	Ward maps obtained, census data obtained. The	Ward maps obtained, census data obtained. The details on	No deviations

	operational characteristics of IPT Digitization of existing roadway infrastructure and various means of transport in VISUM	existing ward map has been digitized. The road network has already been input in VISUM. The network details along have been provided for detailed analysis	operational characteristics of IPT Digitization of existing roadway infrastructure and various means of transport in VISUM	
2	To collect the primary data with respect to the travel characteristics and satisfaction level of commuters in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.	Establishment of trip generation models Conducting Trip Distribution Conducting Mode choice of commuters using developed utility functions Base year assignment of private vehicle traffic and IPT traffic	Trip rates have been achieved. Trip distribution model has been established with gravitation parameters calibrated for the home based work, educational and other trips. Base year assignment has been carried out for private and IPT traffic	No deviations
3	To carry out empirical analysis of the collected data	Development of 'index of transport social needs' and 'Index of IPT provision'	The social vulnerability index has been developed	Yes, deviations have been made as the data collected was not sufficient to develop the index of transport social needs and index of IPT provision hence 'vulnerability

				index' has been developed.
4	To develop the model highlighting the existing routes of intermediate public transport network and to assess whether the existing routing is sufficient or not	IPT Indicators of need and provision by wards	Territory indicators in terms of Passenger kilometres (PassKmTrav (AP)) for Share Autos and VehKmTrav (AP) for private vehicles	No deviations

*As stated in the Sanction Letter issued by the NMHS-PMU.

2.4. Strategic Steps with respect to Outcomes (in bullets)

S#	Particulars	Number/ Brief Details	Remarks/ Attachment
1.	New Methodology/ Technology developed, *if any*:	The methodology includes development of social vulnerability index, development of four stage model along with calibrated gravitation parameters for the study area.	
2.	New Ground Models/ Process/ Strategy developed, *if any*:	A tool to support strategic planning is developed	
3.	New Species identified, *if any*:	Not Applicable	
4.	New Database established, *if any:*	Yes , A VISUM based road network database which can be easily imported into any GIS based software has been developed. The database also includes details on hospital locations as well as school locations within the study area.	
5.	New Patent, *if any*:		
	I. Filed (Indian/ International)		
	II. Technology Transfer, *if any*:		
6.	Others, *if any*		

Note: Further details may be summarized in DPR Part-B, Section-5. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

3. Technological Intervention

S#	Type of Intervention	Brief Narration on the interventions	Unit Details (No of villages benefitted/ Area Developed)
1.	Development and deployment of indigenous technology :	The methodology includes development of social vulnerability index, development of four stage model along with calibrated gravitation parameters for the study area.	All 37 wards considered within the study area
2.	Diffusion of high end technology in the region	Not Applicable	
3.	Induction of New Technology in the region	Not Applicable	
4.	Publication of Technological/ Process Manuals	2 papers	
5.	Others, *if any*	Vulnerability Index, Calibrated Gravitation Parameters	Entire study area

4. New Data Generated over the Baseline Data

S#	New Data Details	Status of Existing Baseline	Addition and Utilisation New data
1.	Social vulnerability index is created for the wards within the study area	Census data	The census data was used to arrive at the social vulnerability index and has been furthered to understand the accessibility of various public infrastructure based Points of Interest (P.O.I), namely health care facilities**.** This will enable the decision makers to identify wards wherein infrastructural enhancement for considered POI's needs to be made.

2.	The gravitation parameters as well as the trip generation equations	Road network details	The trip generation equations establish the relationship between the available census variables and the trips produced within the ward. This helps in identifying the trips generated from the wards and the variables that best explain the production and attraction of the trips. The trip rates obtained from these equations help in policy initiations such as identifying the demand and supply gap for the future. Also the calibrated gravitation parameters can be used by policy decision makers to arrive at the accessibility to various public infrastructure based POI's

Note: Further details may be summarized in DPR Part-B. Database files in the requisite formats (Excel) may be enclosed as annexure/ appendix separately to the soft copy of FTR.

5. Demonstrative Skill Development and Capacity Building/ Manpower Trained

S#	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	ST	Women	Total
1.	Workshops						
2.	On-Field Trainings	3	For undertaking various field studies			Women surveyors	
3.	Skill Development						
4.	Academic Supports	1 M.E. thesis in 3 JRFs	Certain activities of the project				
	Others (if any)	Participated in the one week one lab CSIR initiative wherein showcased the study result findings in front of various North Eastern Stakeholders.					

Note: Further details may be summarized in DPR Part-B. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

6. Linkages with Regional & National Priorities (SDGs, INDC, etc.)/ Collaborations

S#	Linkages /collaborations	Detail of activities (No. of Events Held)*	No. of Beneficiaries
1.	Sustainable Development Goals (SDGs)/ Climate Change/INDC targets addressed	Access to various facilities is attached to SDGs	
2.	Any other:	State level authorities focusing on health and educational facilities by providing god accessibility option through road connectivity	State level authorities focusing on health and educational facilities

Note: Further details may be summarized in DPR Part-B, Section-6. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

7. Project Stakeholders/ Beneficiaries and Impacts

S#	Stakeholders	Support Activities	Impacts in terms of income generated/green skills built
1.	Line Agencies/ Gram Panchayats:		
2.	Govt Departments (Agriculture/ Forest/ Water):	The developed vulnerability index will help the town planning agencies to arrive at the regions wherein concentration of socially vulnerable groups is present. The cross mapping of the socially vulnerable groups with the accessibility levels of the wards can be used to provide either enhanced accessibility or provide infrastructural interventions in terms of identified public infrastructure POIs	
3.	Villagers/ Farmers:		
4.	SC Community:		
5.	ST Community:		
6.	Women Group:		

	Others, *if any*:	The assessed LOS for the self identified line of IPT can be used to arrive at the improvement of services by introducing higher capacity services such as Buses which have shown a negative growth over the past decade.	

Note: Further details may be summarized in DPR Part-B, Section-6. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

8. Financial Summary (Cumulative)

Please attach the consolidated and audited Utilization Certificate (UC) and Year-wise Statement of Expenditure (SE) separately, *ref*. **Annexure I.**

9. Major Equipment/ Peripherals Procured under the Project** (*if any*)

S#	Name of Equipment	Quantity	Cost (INR)	Utilisation of the Equipment after project
1.	NIL			

Details should be provided in details **(*ref.* **Annexure III &IV).**

10. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States/ UTs covered:	*01*	
2.	Project Sites/ Field Stations Developed:	*Imphal*	*Data base development as well as policy initiatives*
3.	Scientific Manpower Developed (PhD/M.Sc./JRF/SRF/ RA):	*3 JRF +1 Masters thesis*	
4.	Livelihood Options promoted		
5.	Technical/ Training Manuals prepared	*Technical report prepared*	
6.	Processing Units established, if any		
7.	No. of Species Collected, if any		
8.	No. of New Species identified, if any		
9.	New Database generated (Types):	*Database on road network developed*	
	Others (if any)		

Note: Further details may be summarized in DPR Part-B. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

11. Knowledge Products and Publications:

S#	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.	Journal – Research Articles/ Special Issue:	To be communicated			
2.	Book – Chapter(s)/ Monograph/ Contributed:				
3.	Technical Reports:	Project Report			
4.	Training Manual (Skill Development/ Capacity Building):				
5.	Papers presented in Conferences/Seminars:	2			
6.	Policy Drafts/Papers:				
7.	Others, if any:	Master's thesis - one			

Note: Please append the list of KPs/ publications (with impact factor, DOI, and further details) with due Acknowledgement to NMHS. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

12. Recommendation on Utility of Project Findings, Replicability and Exit Strategy

Particulars	Recommendations
Utility of the Project Findings:	The project has identified not only the socially vulnerable wards but has also cross mapped the accessibility levels to POI's (namely hospitals) from these wards. The operator's opinion survey provides an insight into the revenue generated by the IPT operators. If the routes as well as fleet sizes are known it would be possible to estimate the revenue generated for each IPT along each route and thereby identify the routes with lesser revenue generation. The user opinion survey helped in identifying the importance each IPT commuter associated with the indicators used for assessing an IPT service as well as in identifying the satisfaction levels of the commuters. The LOS assessment of certain road stretches of Imphal along with the projected assessment of the LOS shall help the decision makers in assessing if a widening of these roads is required or is there a need for other infrastructural intervention. The LOS of the self made lines of share autos shall help in understanding the demand vs supply variations for the share auto riders.

Replicability of Project/ Way Forward:	The method adopted in the current study can be adopted to any region or area.
Exit Strategy:	The project has highlighted the methodology required to identify the process involved in identifying policy decisions to be made by stakeholders. The stakeholders can adopt the methodology described in the report for future updation as well as to make revised policy decisions. The methodology highlighted shall enable to identify the key target public infrastructure based POI deficit areas using the estimated gravitation parameters developed. The methodology is robust and shall help the policy makers to make the right decisions.

Dr S.Padma

(**PROJECT PROPONENT**)

(Signed and Stamped)

(**HEAD OF THE INSTITUTION**)

(Signed and Stamped)

Place: New Delhi

Date: …../……/……

Replicability of Project/ Way Forward:	The method adopted in the current study can be adopted to any region or area.
Exit Strategy:	The project has highlighted the methodology required to identify the process involved in identifying policy decisions to be made by stakeholders. The stakeholders can adopt the methodology described in the report for future updation as well as to make revised policy decisions. The methodology highlighted shall enable to identify the key target public infrastructure based POI deficit areas using the estimated gravitation parameters developed. The methodology is robust and shall help the policy makers to make the right decisions.

Dr S.Padma

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(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Place: New Delhi

Date: ...../...../.....

प्रो. मनोरंजन परिड़ा/Prof. Manoranjan Parida
निदेशक/Director
सी.एस.आई.आर.–केन्द्रीय सड़क अनुसंधान संस्थान
CSIR-Central Road Research Institute
नई दिल्ली–110025/New Delhi-110025

PART B: DETAILED PROJECT REPORT

The Detailed report should include an Executive Summary and it should have separate chapters on (i) **Introduction**, (ii) **Methodologies/Strategy/Approach**, (iii) **Key Findings and Results**, (iv) **Overall Achievements**, (v) **Project's Impacts in IHR** (vi) **Exit Strategy** and Sustainability, (vii) **References**, and (viii) **Acknowledgements** (acknowledging the financial grant from the NMHS, MoEF&CC, GoI).
Other necessary details/ Supporting Documents/ Dissemination Materials (*New Products/ Manuals/ Standard Operating Procedures (SOPs)/ Technology developed/Transferred, etc, if any*) may be attached as Appendix(ces).

1 EXECUTIVE SUMMARY (not more than 2–3 pages)

1.1 Introduction:

The prominent effect of improvement in transportation system is the ability to easily access the places of work, education and recreation. In cities around the world, it is seen that lower income groups often are moved to the periphery of the city which in turn affects their travel characteristics due to larger commute distance / cost. It is found that public transport (PT) is negligent in Imphal and it is the Intermediate Public Transport (IPT) services which cater to the needs of travel in the city of Imphal (Ahmed and Victory, 2012). In the event of emphasizing the IPT modes, it is imperative to assess whether the existing IPT services in the city can meet the demand generated for travel. In order to make such assessments, the trip pattern of the city needs to be understood. The analytical assessment of travel behavior of commuters would then be used as an input to check if the IPT systems operational in the city are able to cater to the demand generated. An evaluation of the IPT services through the development of an index for IPT provision in Imphal city was to be made. However due to IPT services lacking designated stop points; the penetration of IPT services with respect to accessibility to identified public infrastructure based Points of Interest was assessed. Since the usage of IPT services predominantly is done by socio economically vulnerable commuters a ward based vulnerability index has been developed. A possible scenario evaluation of route modification of IPT services based on passenger flows was also carried out for streamlining the existing services.

1.2 Objectives and Concept Methodology

- To collect and collate the existing database with respect to road network, settlement locations with demographic details along with the operational characteristics of existing Intermediate Public Transport services.
- To collect the primary data with respect to the travel characteristics and satisfaction level in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.
- To carry out empirical analysis of the collected data.
- To develop the revised routing of the intermediate public transport services operational in Imphal.

For assessing the operational characteristics of existing intermediate public transport system in Imphal a primary survey on user satisfaction levels as well as a survey on operators of intermediate public transport services was carried out. The satisfaction level of the users was ascertained from the questionnaire. The performance of the intermediate public transport system in terms of its existing load profile as well as the accessibility to various public infrastructure based Points of Interest POI's namely health care services was assessed through the conventional four stage modeling. The accessibility can be ascertained through the use of developed calibrated gravitation parameters for work, education and other related trips. The estimated gravitation parameters can be utilized by policy makers to identify regions with lower accessibility and thereby enhance the accessibility to these places. The developed four stage model was used to arrive at the revised routing for intermediate public transport system namely the share-auto. This is ideally because the share autos were the only services with fixed routes which could be modeled for revised routing.

1.3 Study Findings

The wards within the study area which had higher indicators of socio economic vulnerability were identified and were cross mapped with the accessibility of these wards to the health care facility centers in Imphal. The gravitation parameters as calibrated using the collected household data can be used to arrive at the accessibility to any other public infrastructure based POI's such as educational institutes. The mode choice model was used to assess the demand for each of the identified mode of commute in the study area of Imphal. The demand matrixes obtained as such were corrected using the 'least square' method specified in VISUM and accordingly were assigned to the modeled network. The collected OD matrix was able to ascertain the need for by pass in the Imphal study area. The possibility of introducing e-auto services in Imphal was explored through the IPT operator as well as commuter survey. The probability of shifting to E-auto service if introduced was ascertained through the willingness to pay survey. The demand matrix of share auto which was corrected using VISUM was then assigned to a self digitized line routes of share auto services in order to arrive at the level of service on the line routes as experienced by commuters.

2 INTRODUCTION

2.1 Background (max. 500 words)

Limited mobility and accessibility can lead to lower quality of life and well-being, as well as social exclusion. Traditional approaches to transport modeling assess and identify the disparity amongst persons of transport needs and supply through conventional four stage modeling approaches. Literature specify that the quantitative approaches to measure the geographical dispersion of people with transport needs can be a socio –economic measure, population measure, measure of transport supply, and measure of distance, cost and accessibility [6]. In the current paper the need for transport is measured through the identification of social vulnerability based indicators from census of India

website. The indicators reflect the economic profile of households/wards/areas and thereby act as proxy to households/wards/areas of transport need to services such as hospitals. Socio-economic transport needs based indices are often used to identify the gaps between needs and supply [14], [4], [5]. Indices based spatial identification of transport needs gives the flexibility of using existing census based secondary data to arrive at spatial indices that enable clustering of regions into areas of low/high transport needs [18].

While several methods are available to model indices the current paper shall make use of Principal Components Analysis method (PCA) based factor analysis algorithm used in SPSS. PCA is a popular method towards reducing the dimensionality of large number of interrelated indicators while retaining as much as possible the variance in the data [7]. Development of indices using PCA is prevalent in healthcare related services [8], [9]; [10], [11] with off-late importance in transportation planning as well. PCA is utilized to arrive at the weights for each indicator. In several instances only the weights of the first principal component are used for generating the scores [11], [12], [14] however it has been argued that only the usage of first principal components which usually explains a very low variance would be erroneous [11].

The second aspect of study is the heterogeneous customer satisfaction index [16] for the IPT services plying in Imphal. The questionnaire was designed to include various forms of IPT services, namely, auto, share-auto, taxi, e-rickshaw, cycle-rickshaw, Tata Magic (Van) however the survey results indicated that the questionnaire had been filled incompletely without the mention of the IPT type in more than 90% of the sample collected.

The third aspect of the study comprised of understanding the operator characteristics to see the revenue they generate and if they are willing to make necessary shift to an environment friendly mode of transport.

The last aspect of the study is to develop a four stage model to arrive at the demand matrix for share auto which is then assigned onto the self made lines to assess the LOS.

2.2 Overview of the major issues addressed (max. 500 words)

- The infrastructural deficiency in terms of health care facility along with accessibility deficiencies can be assessed with the methodology specified as well as the estimated gravitation parameters.
- The user satisfaction index can be used to assess the indicators that require intervention in the intermediate public transport services from user perspective
- The operators survey indicates the operational characteristics of the IPT services that ply within Imphal.
- The origin destination survey at the outer cordon points indicate the amount of external to external trips which show the feasibility of construction of a by- pass. Since the percentage

bypassable traffic as captured by the survey is in the range of maximum 16 to 37% of the total traffic destined to the respective zones

- the requirement of a bypass can be explored.
- The choice of mode predominantly for IPT users in event of introduction of e-auto.

2.3 Baseline Data and Project Scope (max. 500 words)

The current study utilized the existing secondary data on the road infrastructure, health centers, and educational institutes as well as census data. The secondary data available on health centers was digitized by physical visits to the site of various helath providers. The secondary data so collected was as follows:

Table 2.1: List of institute from which various data has been collected.

S. No.	Institute/ Organization	Type of Linkages	Brief Description
1	Directorate of Transport, Imphal, Manipur	Secondary Data collection as well as end usage of the recommendations	The secondary data has been collected from the Directorate in terms of the number of IPT routes operational within the Imphal city and the fare structure of the same
2	Health Department	Secondary data collection	The list of hospitals with the study area has been obtained from the department.
3	Directorate of Economics and Statistics	Secondary Data Collection	The list of hospitals was also obtained from them and a discussion was held with the officials to ascertain if there have been any recent studies carried out with respect to the number of literates, unemployed as well as school going kids in Imphal region.
4	Manipur Remote sensing application centre	Secondary data collection	The ward boundary map was given to use by the division
5	Directorate of Education	Secondary data collection	The list of schools with details of number of students enrolled in various classes and their geo positions have been obtained

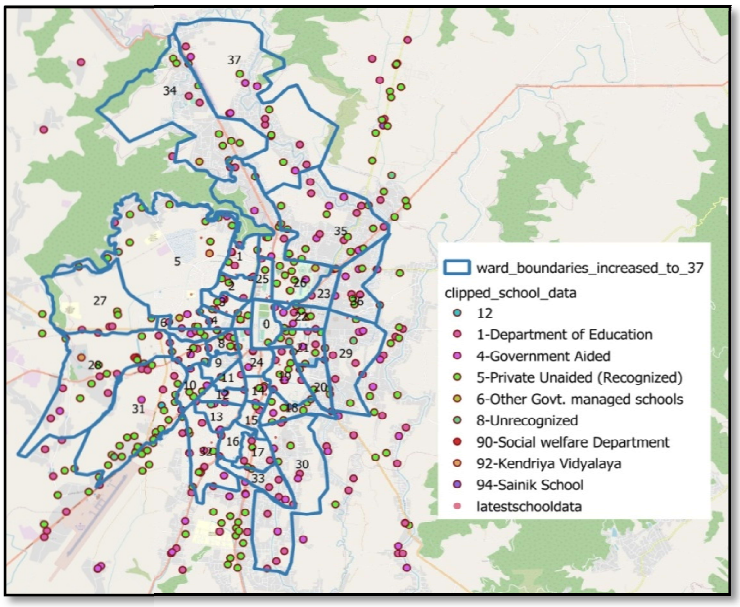


Figure 1: TAZ's and school locations

Table 2.2 - LIST OF HOSPITALS and their coordinates			
1	GOVERNMENT HOSPITAL		
	Imphal East		
	JNIMS	24.81272	93.959238
	UPHC Sangaipat	24.788115	93.951773
	PHC Bashikhong	24.7500283	93.947045
	UPHC konok	24.75286	93.935438
	UPHC Minuthong	24.822672	93.95075
	UPHC Mantripukhri	24.849173	93.93433
	Health & Wellness Center Kairang Meitei	24.842953	93.954156
	PHC Heingang	24.855906	93.953791
	PHC Akampat	24.774649	93.949004
	Imphal West		
	RIMS	24.815673	93.925212
	PHC kakwa	24.76898	93.937471
	UHC Singjamei (Mongsangei)	24.78273	93.937556
	UPHC kwakeithel	24.790103	93.92583
	UPHC Langol Tarung	24.831404	93.933876
2	PRIVATE HEALTHCARE FACILITIES		
	Imphal East		
	Remedy Hospital	24.802693	93.94761
	Christian Hospital	24.823662	93.945403
	Advanced Hospital	24.798073	93.946273
	Acme Fertility & Healthcare center	24.8040283	93.951256
	Mangal Life Care Super specialty Hospital	24.814485	93.947678
	Horizon Hospital	24.81313	93.959327

Little Clinic	24.827342	93.95059
City Hospital	24.825528	93.944285
Aadarsh Medicare Services	24.812723	93.958858
Babina Diagnostics	24.812593	93.957267
Escent diagnostics	24.80296	93.951196
Shaibo Hospital	24.830355	93.969877
Heal Plus Hospital	24.80502	93.95986
Saina Institute of Medical Sciences	24.806958	93.958022
Catholic Meical Centre	24.883354	93.920499
Imphal West		
Maipakpi Maternity & Child Hospital	24.81511	93.94241
Asian Hospital	24.788086	93.922238
Imphal Hospital & Research Centre	24.812472	93.929157
Sky Hospital	24.81296	93.928037
Iboyaima Hospital	24.784456	93.938521
Raj Medicity	24.815898	93.943808
Shija Hospitals	24.836065	93.913903
Suba Hospitals & associated reproductive centre	24.812812	93.924805
Lamjingba Hospital	24.812307	93.924073
Mother's Care Children's Hospital	24.803628	93.92658
Imphal Heart Institute	24.803632	93.926588
Hillside Charitable Hospital	24.827172	93.932745
AyangLeima	24.81156	93.934233
Care n Cure	24.825233	93.931818
50 bedded integrated Ayush Hospital	24.830857	93.925353
Sangai Healthcare	24.8119	93.923908
Irengbam Thamcha Devi Nursing & Healthcare	24.806847	93.928527
ILANG hospital	24.741096	93.93586
Yaima eye hospital	24.78716	93.935593
iGastro Care	24.790378	93.924806
Chamber Hospital	24.809775	93.936248

The present study shall focus on assessing the travel behavior patterns of commuters in Imphal, Manipur. The study area is more or less a flat area of 3472.51 hectares. Figure 2 shows the study area along with the ward boundaries.

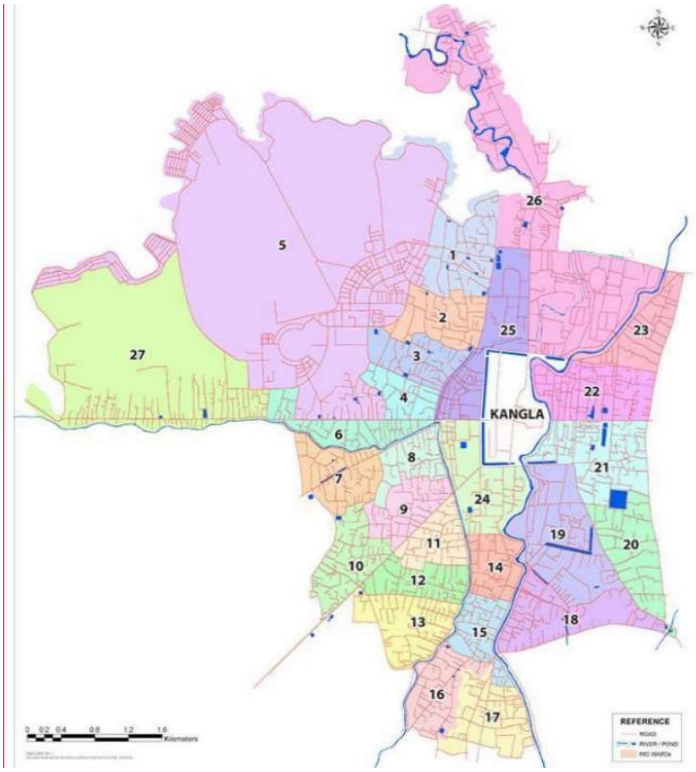


Figure 2: Ward boundaries of Imphal city (Source : www.amrut.gov.in)

2.4 Project Objectives and Target Deliverables (as per the NMHS-Sanction Order)

Project Objectives	Quantifiable Output against each objective	Progress made against Monitoring Indicators (specified in Sanction Letter)	Remarks
To collect and collate the existing database with respect to road network, settlement locations with demographic details along with the operational characteristics of existing Intermediate Public Transport services.	Ward maps obtained, census data obtained. The details on operational characteristics of IPT Digitization of existing roadway infrastructure and various means of transport in VISUM	Ward maps obtained, census data obtained. The existing ward map has been digitized. The road network has already been input in VISUM. The network as well as ward boundaries need further refinement which is currently under progress.	The details on operational characteristics of IPT services have been obtained from the Directorate of Transport Manipur and they are in the process of being integrated into the model.

To collect the primary data with respect to the travel characteristics and satisfaction level of commuters in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.	Establishment of trip generation models Conducting Trip Distribution Conducting Mode choice of commuters using developed utility functions Base year assignment of private vehicle traffic and IPT traffic	TAZ's have been fixed for the study area and the social vulnerability index has been developed. All aspects of four stage modeling completed.	All stages completed and the results have been tabulated.
To carry out empirical analysis of the collected data	Development of 'index of transport social needs' and 'Index of IPT provision'	the social vulnerability index has been developed	The collection of secondary data in terms of the location of schools, colleges, hospitals as well as the route characteristics of IPT services has been carried out. The collected data has been attached herewith.
To develop the model highlighting the existing routes of intermediate public transport network and to assess whether the existing routing is sufficient or not	IPT Indicators of need and provision by wards	The secondary data on the existing routes of the IPT services has been collected and the process of digitizing the routes has been initiated.	

If required, to develop the revised routing of the intermediate public transport services based on passenger flows	Based on gaps identified, new routes would be specified	Based on cross classification the gaps have been identified assuming the gravitation parameters of a previous study	Given in appendix.

3 METHODOLOGIES/STARTEGY/ APPROACH – *supporting documents to be attached.*

3.1 Methodologies used (max. 500 words)

Figure 3 highlights the broad methodology of the study. The flow chart highlights the conventional four stage modeling which has been enhanced by identification of wards with high vulnerability index.

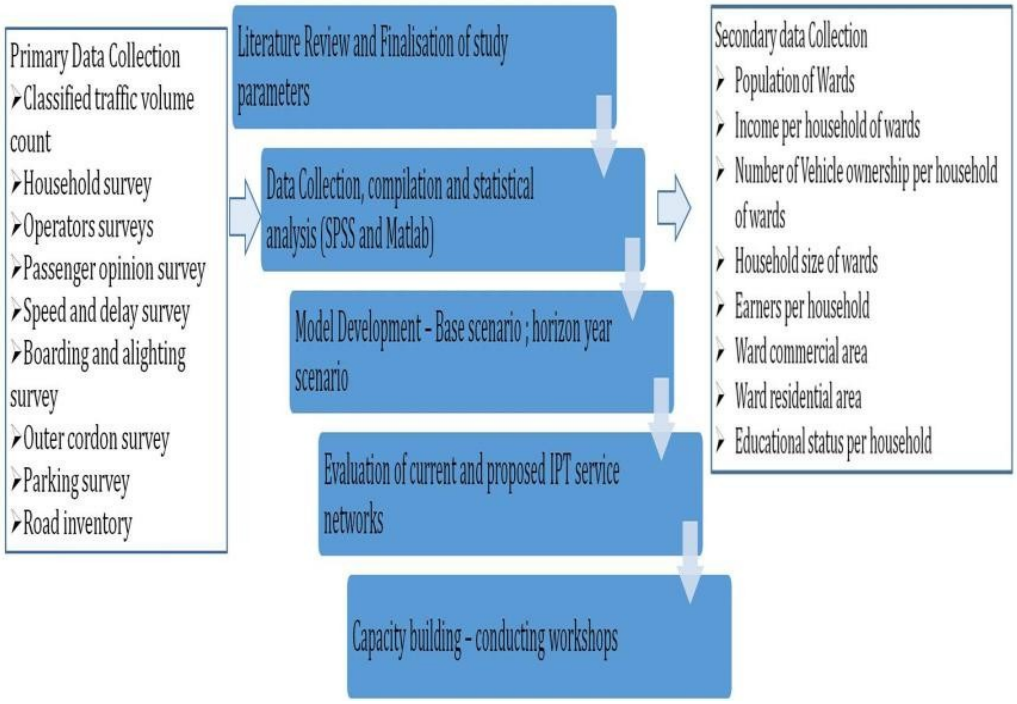


Fig 3 : Broad Methodology

3.1 a) The development of vulnerability index involves the following methods:

Indices development using PCA has been quite prevalent in the field of health sciences, urban quality of life and business climate indicator. The current paper utilizes the steps highlighted in [8] and [12] which encompass broadly the methodology of formulating indices based on PCA algorithm based factor analysis. [8] Highlights the application of PCA based factor analysis in developing a socio economic composite index with indicators foreseen to impact early childhood development. The paper discusses the statistical requirements of chosen indicators in order for it to be used in development of index. A similar approach adopted in [12] highlights the indicators that can be used to assess the

areas with transport deficiency.

The area based index for social vulnerability is formulated using personal socio economic status based indicators. Since the measure is on social vulnerability the developed index indicates advantaged areas through low index score whereas disadvantaged areas are indicated through high index score [6], [12]. The index has been calculated for the 37 Traffic Analysis Zones (TAZs) within Greater Imphal Region (Fig 4).

Fig 4: Study area Traffic Analysis Zones (TAZs) for Imphal encompassing Greater Imphal area.

The ABISV is calculated as followed in two different ways from the literature:

1. It is calculated as the weighted sum of the factor score coefficients/components scores [8]

   $ABISV_j = \sum_{k=1}^{K} \omega_k FSC_k$ (1)

K - total number of factors/components determined to be extracted for maximum explanation of variance within the data

$$\omega_{\mathrm{k}} = \frac{\text{percentage variance explained by component/ factor k}}{\text{total variance explained uptill K}}$$

$\mathrm{FSC_k}$- factor score coefficient of component/factor k corresponding to each ward j

2. It is calculated as the weighted sum of the indicators [12] of social vulnerability for different indicators within the wards. The formulation of the index is as follows:

   $\mathrm{ABISV_j} = \sum_{i=1}^{n} \mathrm{TI}_{ij} \mathrm{P}_{ik}$ (2)

$\mathrm{TI_{ij}}$ – the standardised personal socio economic indicator for transport needs i of ward j ; and $\mathrm{P_{ik}}$ is the weighting of the personal socio economic Indicator for transport needs i under component/factor$\mathrm{k}$ where k is assumed to be 1 (component/factor 1) . The indicators of transport disadvantage are standardised so that they take values between 0 and 1, using the following equation:

$$T_{ij} = \frac{I_{ij} - I_i^{min}}{I_i^{max} - I_i^{min}} 100$$

And the weights for the indicators are assessed as follows [13], [21]:

$$\mathrm{P_{ik}} = \frac{(\mathrm{FL_{ik}})^2}{\lambda_{\mathrm{k}}}$$

FL_{ik} - is the factor loading of indicators i for component/factor $k = 1$

λ_k – eigenvalue for component/factor $k = 1$

The indicators chosen for development of index were proportion of female, proportion below 6, proportion of female kids below 6, proportion of illiterates, proportion of female illiterates, proportion of marginal workers, proportion of female marginal workers, proportion of non workers, proportion of female non workers, proportion of female main workers, proportion of main other worker, proportion of female main other worker, proportion of marginal other worker, proportion of marginal other worker female, proportion of main workers from agriculture, industrial and cultivation, proportion of main workers from household industries and cultivation female, proportion of marginal workers from household industries and cultivation female, proportion of marginal workers from industries and cultivation. Some of the indicators mentioned above form the subset of other indicators for eg, proportion of main workers essentially encompasses proportion of main 'other' workers and proportion of main agriculture labourers, industrial and cultivation workers. The above mentioned indicators were initially processed to carry out the necessary descriptive analysis and from these a set of indicators were finally chosen as they confirmed to the requisite condition for carrying out PCA based factor analysis in SPSS.

Table 3.1 shows the final set of indicators chosen such that the KMO statistics obtained was 0.665 and the Bartlett's test is significant (table 3.2).

Table 3.1: Area based personal socio economic Indicators considered for area based index for Social Vulnerability for the study area of Imphal

Indicator	Mean	5% Trimmed Mean	Skewness	Kurtosis	Range
Prop of population less than 6 years of age	0.1077	0.1081	-0.307 0.388	0.018	0.05
Prop of illiterate Female Population*	0.3383	0.3374	0.548 0.388	-0.250	0.11

Prop of households with no Assets*	0.1493	0.1490	0.223 0.388	0.709	0.16
Prop of households not availing bank facilities	0.4251	0.4278	-0.228 0.388	-0.004	0.64
Prop of households without latrine facility within the premises*	0.1598	0.1596	0.140 0.388	-0.771	0.23
Prop of households not having treated tap water as main source of drinking water*	0.4754	0.4707	0.272 0.388	0.013	0.85
Prop of households with single and no exclusive dwelling room*	0.3810	0.3796	0.424 0.388	0.284	0.27
Prop of household with drinking water far away from premises*	0.4923	0.4914	-0.093 0.388	-0.686	0.71

*square root transformation: new indicator value= sqrt (old indicator value)

Table 3.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.665
Bartlett's Test of Sphericity	Approx. Chi-Square	124.812
	df	28
	Sig.	0.000

Interpretation of results from PCA

The indicators as shown in table 3.1 were included in the factor analysis. Since the indicators were not standardized the correlation matrix was used to extract the principal components. The individual indicator's measure of sampling adequacy was ascertained from the anti image correlation table. The components with eigenvalues above 1 were used as the criteria to extract the components and accordingly 3 components were extracted. The factor loading obtained are as shown in Table 3.3.

Table 3.3: Result of PCA: Varimax rotation factor matrix

Indicators	Component		
	1	2	3
Prop of households with no Assets*			0.805
Prop of households not availing bank facilities	0.565		0.545
Prop of households without latrine facility within the premises*			0.821
Prop of households not having treated tap water as main source of drinking water*	0.442	0.774	
Prop of households with single and no exclusive		-0.739	

dwelling room			
Prop of household with drinking water far away from premises*		0.813	
Prop of illiterate Female Population*	0.911		
Prop of population less than 6 years of age	0.888		
Percent of Variance	41.24	19.817	13.823

Table 3.3 shows the correlation of the indicators with the components it is to be noted that a positive loading indicates negative association with the component.

3.1 (b) Development of four stage model

Conventional methods for four stage modeling namely Trip generation, trip distribution, mode choice and assignment were carried out. Trip generation includes the cross classification method which was then used to arrive at the regression coefficients for various trip purposes. The trip distribution model involved estimation of the gravitation parameters using KALIBRI function in VISUM. The mode choice involved assessing of the coefficients of the utility function using APOLLO choice modeling software.

3.1 (c) Evaluation of scenarios

- Scenario 1: possibility of constructing a bypass: the possibility of constructing a bypass around the study area was evaluated by assessing the through traffic currently passing through the study area. This is undertaken using the OD matrix.
- Scenario 2: Proportion of people shifting to E-Auto upon introduction of E-auto: Currently the auto's and share autos are either diesel or petrol driven. Instead it is proposed that Electric autos be introduced. Accordingly a fare structure for E-autos is assumed and the mode choice between existing autos/share autos/e-rickshaws and e-autos is evaluated
- Scenario 3: the lines of share autos are assumed to follow public transport lines and accordingly the V/C ratios of the lines were evaluated

3.2 Data collected and Equipments utilized (max. 500 words)

The data collected includes both primary and secondary data. The primary data consisted of several surveys such as

- Household survey – completed
- Classified traffic volume count at 18 junction and 8 mid-blocks with occupancy
- Outer cordon Survey with road side interview – completed

- Passenger opinion survey – completed and data obtained
- Operator survey – completed and data obtained
- Boarding –Alighting survey – completed
- Road side interview survey – completed
- Spot speed survey - completed
- Speed and Delay Survey – completed

All the above surveys made use of paper based questionnaire surveys, video recordings, radar gun survey as well as moving car method to assess speed and delay. The secondary data collected has been elaborated in section 3.3

3.3 Details of Field Survey conducted, if any (max 500 words)

The primary data collected include:

- Household survey – completed
- Classified traffic volume count at 18 junction and 8 mid-blocks with occupancy
- Outer cordon Survey with road side interview – completed
- Passenger opinion survey – completed
- Operator survey – completed
- Boarding –Alighting survey – completed
- Road side interview survey – completed
- Spot speed survey - completed
- Speed and Delay Survey – completed

3.3 (a) Household Data

The household data was collected and preliminary data analysis was carried out. The following figures indicate that of the total household samples collected 52 % of the sample population was male and 48% of the sample population was female. The sample population with driver's license was 60% and the remaining 40% had no drivers license. Similarly the vehicle ownership details indicated that 51% of the sampled population had two wheelers, 6% had cars and 26% had both cars and two wheelers.

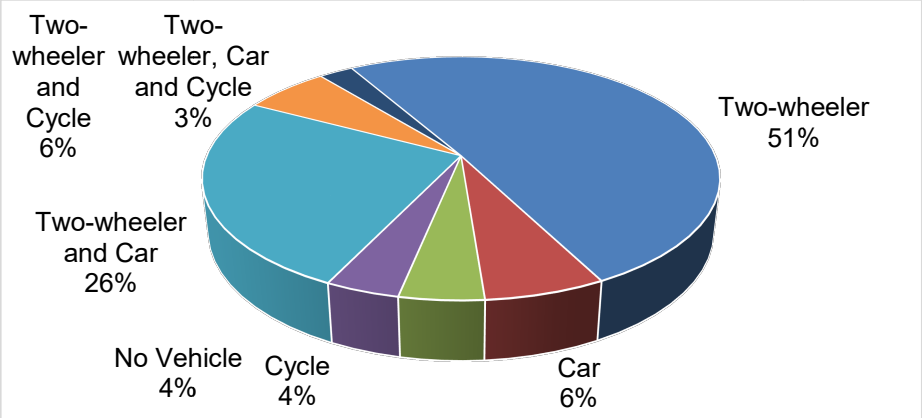


Figure 5 : Vehicle Ownership details of the sampled households

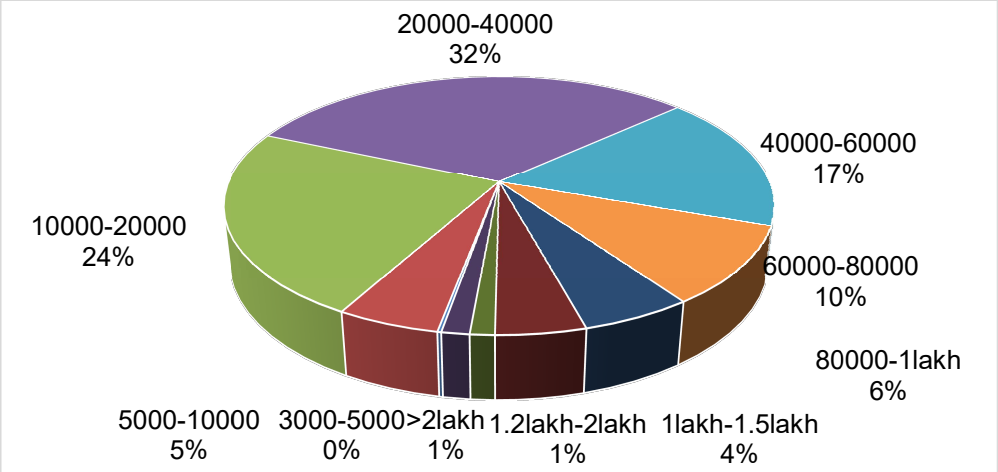


Figure 6 : The monthly household income details of the sampled households

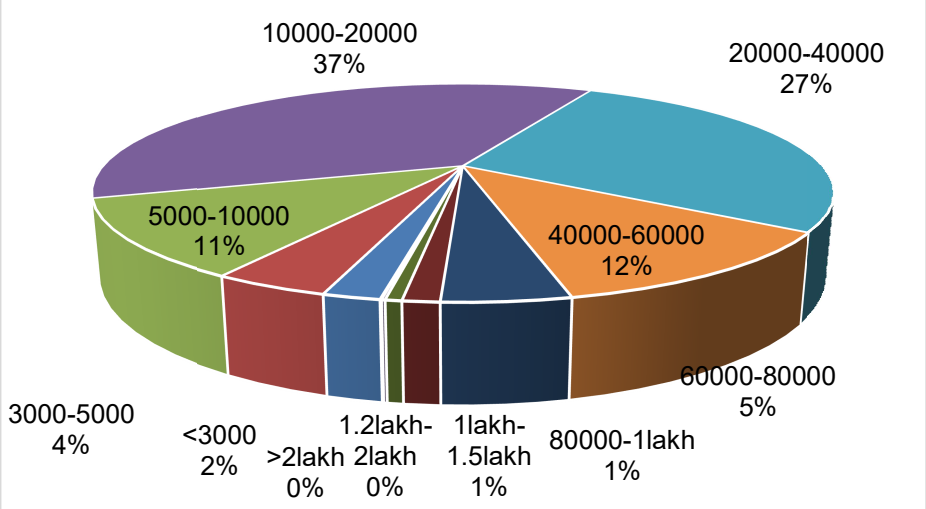


Figure 7 : Individual income of the sampled population

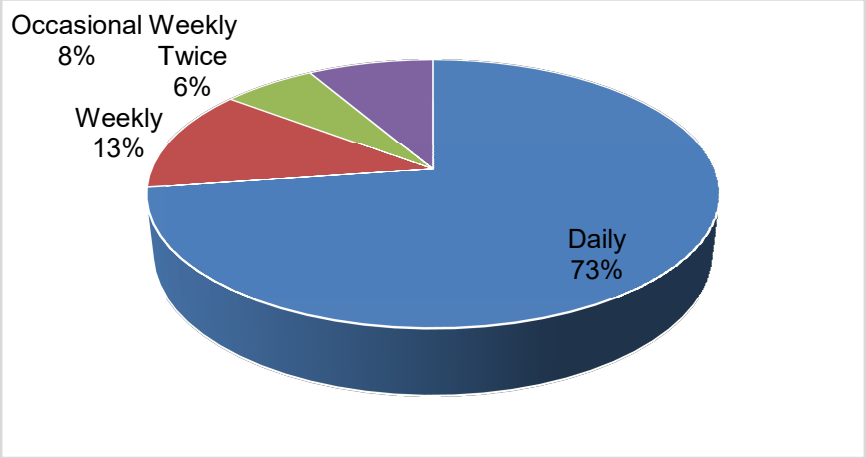


Figure 8: Trip frequency of the sampled population

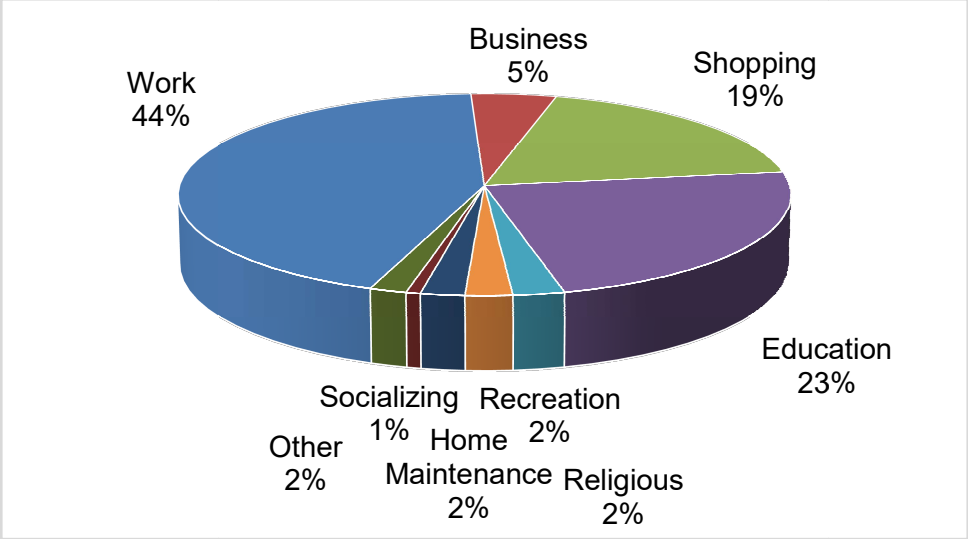


Figure 9: Trip purpose of the sampled population

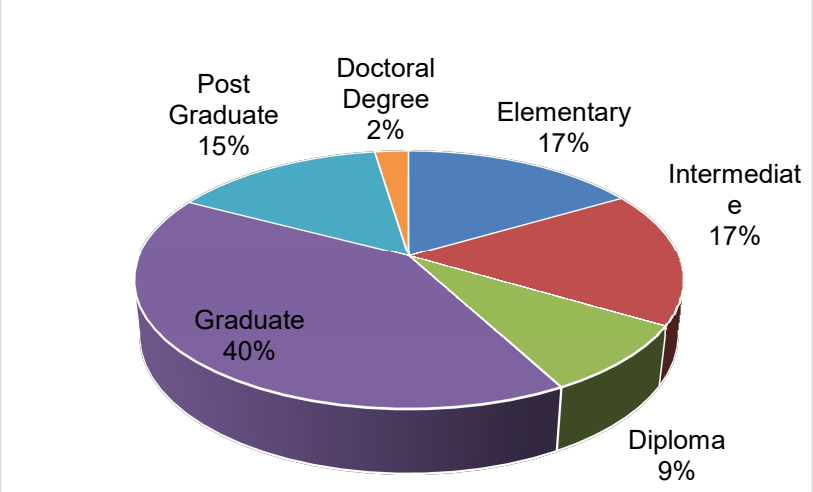


Figure 10 : Distribution of sampled population based on their educational qualification

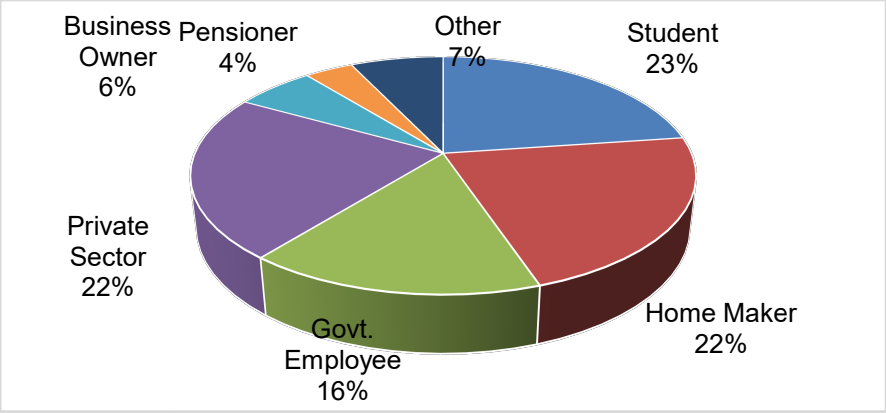


Figure 11 : Distribution of sampled population based on their occupation

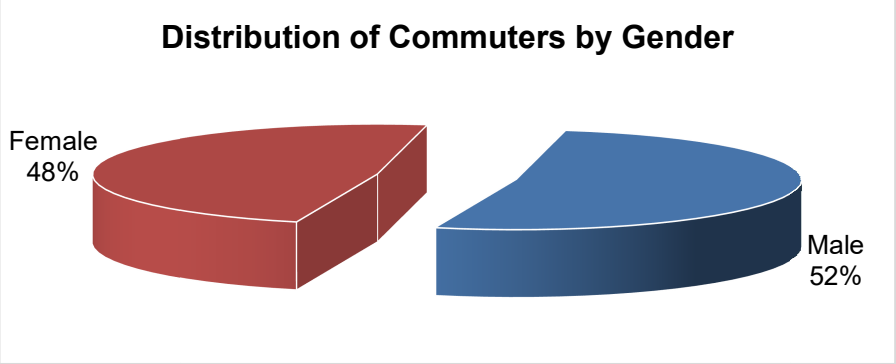


Figure 12: Distribution of the gender of the sampled population

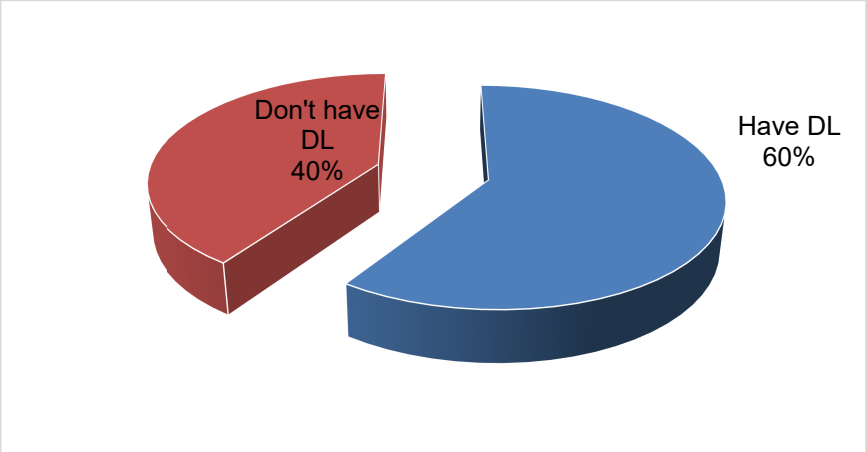


Figure 13 the distribution of sampled population by possession of driving license

3.3 (b) Intermediate Public Transport Survey (IPT) Operator

The chapter presents the summary of IPT operator in Imphal. There are two types of survey; a) user survey: includes the public that uses IPT, b) operator survey: includes the IPT driver. IPT operator

survey aims to know the operational and user characteristics of the present scenario and identify the problems and issue and find appropriate solutions for solving the problems in the future plan. The assessment capture the perception of IPT driver related to their income, trips& distance per day, educational qualification, vehicle ownership, maintenance and various other related heads. Thus, this study could be helpful in creating a clear and vivid picture of IPT operator.

Five types of IPT modes are operating the Imphal municipal area and include three-wheeler auto-rickshaw, tata magic, maruti van, taxi and E-rickshaw as describe below:

- Three- wheeler auto rickshaw

It is the predominant IPT modes operating in the city. The maximum numbers of passengers are transported by the auto-rickshaw in the Imphal city.

- Auto-rickshaw (Petrol based)

These vehicles run on petrol based, and are an integral part of the society of major urban areas. They are used for door-to- door services such as feeder trips, social and recreational trips, etc. This auto-rickshaw has a capacity of carrying four passengers at a time.

- Auto-rickshaw (Diesel based)

These vehicles run on high speed diesel and normally operate in the suburban areas. These vehicles have a capacity of carrying six passengers. They are mainly used as an IPT mode on shared basis.

- Tata Magic

The eight seated Tata magic operates on diesel fuel in Imphal city. It is now widely used to transport passengers from the greater Imphal areas. The vehicle is mainly used for long distance regional trips for inter- district passenger transportation. Due to this, the urbanites do not prefer the mode for local transportation.

- Maruti van

Maruti vans are servicing as taxis in Imphal. Most of these vehicles are used in school services for students as vanpools. It has a seat capacity of seven.

- Taxi

Taxi services are not popular in Imphal. It is used for specialized trips such as feeder trips to airport, trips made by tourist and some occasional trips. Some of the carpools are also used as taxi with four seated capacity.

- E- Rickshaw

E-rickshaws have become operational as IPT mode in Imphal during the last five years. This vehicle is batteries operated which can be chargeable by electricity. There are two rows of seat with four opening with the capacity of 4 persons excluding the driver. E-rickshaws have become one of the preferred modes of transport between short distances and are operating in major urban and suburban areas and townships.

IPT operator survey has been conducted to understand the socio- cultural status of the IPT operators,

service and infrastructure facilities. It is conducted in the municipal area of Imphal, Manipur. Primary data collections i.e., direct interview is done at their parking lots and garages where the operators were resting or waiting for the passengers. A set of questionnaire has been asked to know the characteristics of the operators. A sample size of 607 operators was collected and analysis has been done. From the collected sample, the percentage share of each IPT modes were found out and shown in figure 14. It is observed that auto-rickshaw (petrol based) has the maximum percentage share of 30%, maruti van 29%, shared auto 17%, tata magic 12%, taxi 6% and E-rickshaw 5%.

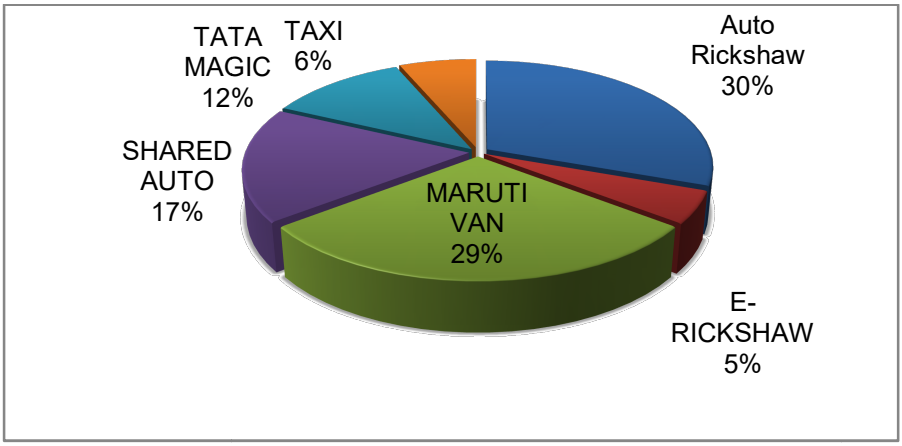


Figure.14: Percentage share of vehicle type within IPT modes at Imphal.

In socio- cultural characteristics; a set of questionnaire was asked to the operator which includes ages, income, and their educational qualifications. Infrastructure facilities and service facilities were also asked to the operators to know the present scenario of the operators. The operator characteristics (socio-economic characteristics and trip-related information) obtained from collected survey data are presented in (Table 3.4) and Figure 15 & 16.

Table.3.4: User Characteristics

Characteristic	Statistic	
1. Ages group	20-30 yrs	20.6%
	31-40 yrs	57.1%
	41-50 yrs	20%
	51-60 yrs	2.1%
	>65 yrs	0.2%
2. Educational Qualification	Under matriculate	16%
	Matriculate	55%
	Intermediate	22%
	Graduate	5%
	Postgraduate	1%
	Illiterate	1%

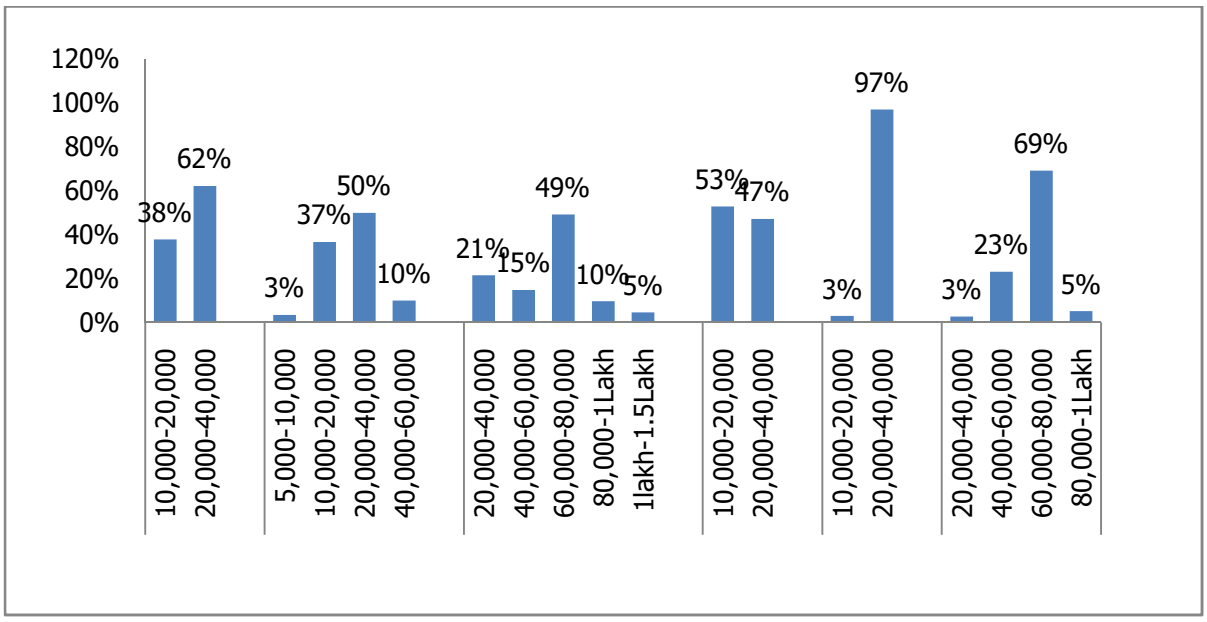


Figure.15: Percentage income level per month with respect to each IPT mode.

From the above table, it is observed that auto driver, shared auto and tata magic are reported to earn between Rs.10000 to Rs.40000 per month, likewise Rs.5000 to Rs.60000 for e-rickshaw, Rs.20000 to Rs.1.5 Lakh for maruti van, Rs.20000 to 1Lakh for taxi. These monthly incomes are their take home incomes keeping aside all their daily, monthly, annual expenditures and rent if they have rented the vehicle.

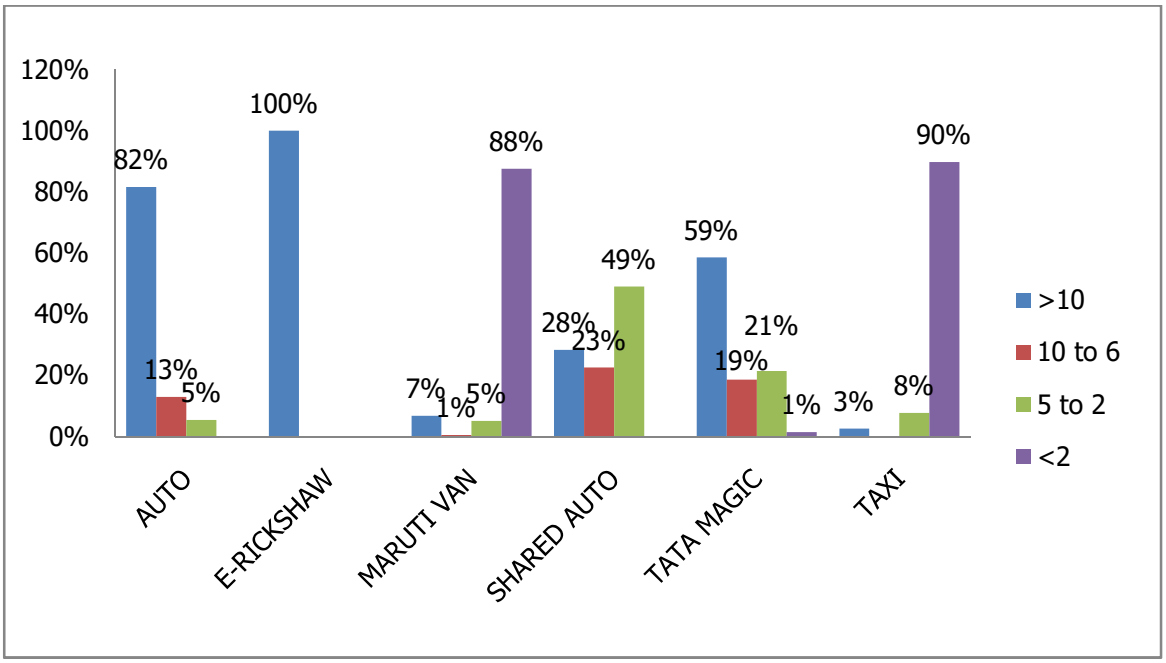


Figure.16: Percentage for trips per day with respect to each IPT mode types.

IPT modes in Imphal can be classified in three groups based on their movement pattern. IPT modes whose origin and destination are within Imphal area are placed under the 'Core to Core' category, while those having the origin within the Imphal and destination outside Imphal are classified in 'Core to semi-periphery' category. Those having the origin within the Imphal and destination outside the state are classified in the 'Core to periphery' categories .607 routes were surveyed and among the movement category, 61% routes are from core to core, while 25% routes are based on core to periphery movement and the rest 14% routes are core to semi-periphery routes.

After analyzing the survey, the total percentage share of IPT ownership were found out and shown in figure 17. It is observed from the figure that the rented IPT has 16% share among the other modes. However, within the rented IPT, auto operator rented the service of Rs.500-Rs.1000 per day, maruti van Rs.600- Rs.1000, shared auto Rs.700-Rs.800 and taxi Rs.800- Rs.1000 per day, whereas most of the e-rickshaw & tata magic driver owned the vehicle.

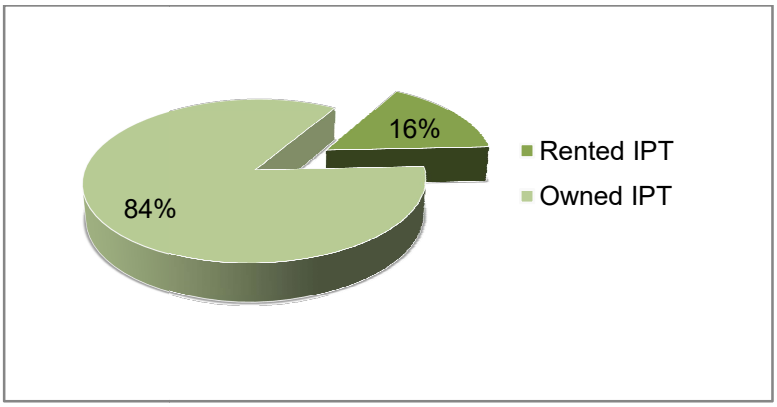


Figure.17: IPT ownership in overall Imphal

In the primary survey, it was found the 98% of the driver in Imphal, having their own IPT modes has not taken loan for buying the vehicle. While only the mere 2% of the driver has taken loan from nationalized bank, private bank and private money lender.

In the survey it is found that, the majority trip length per day for auto rickshaw is between 20 to 50kms, 60 to 100kms for e-rickshaw, 250-500kms for maruti van, 60-100kms for shared auto, 20-50kms for tata magic and 100-250kms for taxi.

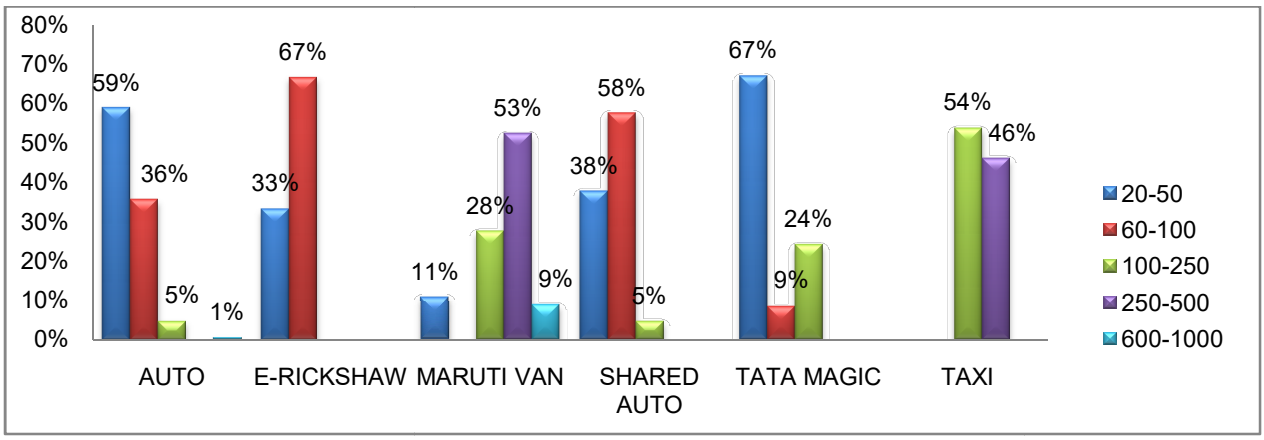


Figure.18: Percentage distance driven for each IPT mode

The seating capacity of the vehicle for each IPT modes are already mentioned above but from the collected data the below figure show the average passenger carried per trip.

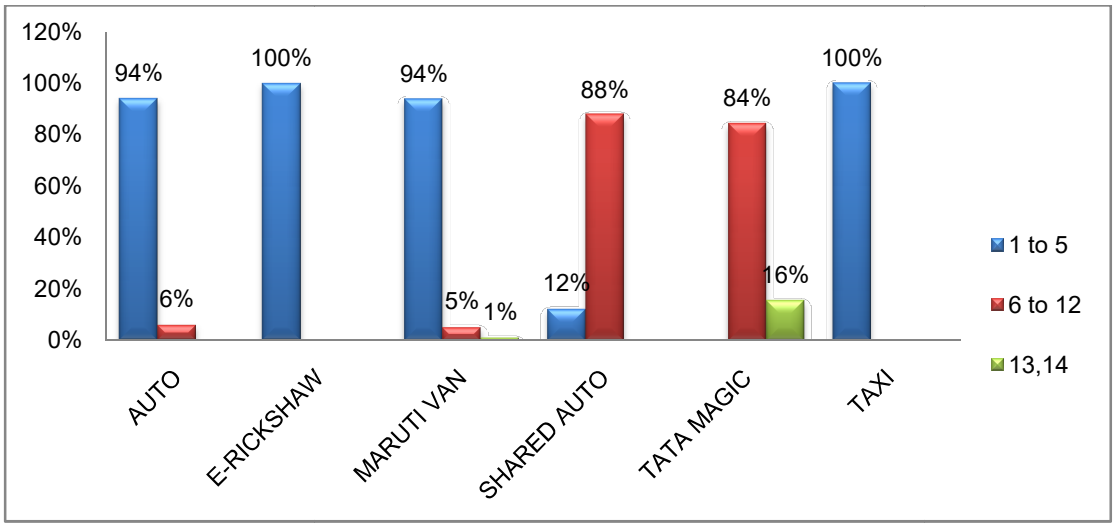


Figure.19: Percentage for avg. no. of passenger with respect to each IPT mode types.

IPT driver spent an average of 10 to 12 hour a day on working. Out of which 15% of maruti van & taxi driver spent 15 to 20 hour a day as they travel to other neighboring state (Nagaland, Mizoram, Assam etc.,) outside Manipur.

Maintenance costs are the cost of periodical repairing and servicing, including the costs of consumable items like brake shoes, battery, tyres etc. For those who have own the vehicle, the monthly cost of periodical maintenance and servicing was found to mostly in the range of Rs.1000- Rs.2000 for auto rickshaw and shared auto, Rs.1000-Rs.1500 for e-rickshaw, Rs.1500-Rs.3000 for Tata magic and Maruti van and taxi has the highest maintenance of Rs.2000-Rs.3000. Monthly paid fines and penalties for petty crimes or other registration charge are in the range of Rs.200-Rs500 for auto rickshaw & shared auto, Rs.100-Rs.150 for e-rickshaw, Rs.1000-1500 for Maruti van & taxi and Rs.500-Rs.200 for Tata

magic. The driver of IPT modes should pay a membership fees if he/she is the member of IPT union. The table below shows the range of each IPT mode.

Table.3.5: Membership fees for each IPT modes

IPT Modes	Average paid fees for membership
Auto	Rs.100
E-Rickshaw	Rs.100
Maruti Van	Rs.500
Shared Auto	Rs.500
Tata Magic	Rs.100
Taxi	Rs.500

The major components of the vehicle are motor, fuel, mileage etc, below are the detailed from the collected data.

Table.3.6: Technical specification of vehicle used by IPT operator

	Vehicles	Vehicle technology driven	Fuel	Mileage (km/l)
1.	Auto	4-stroke	Petrol (86%) Diesel (10%)	7-12 (27%); 15-25 (72%)
2.	E-rickshaw	2-Stroke	Electric	70-80
3.	Maruti Van	4-stroke	Petrol	7-12 (64%); 15-25 (36%)
4.	Shared Auto	4-stroke	Diesel	15-25
5.	Tata Magic	4-Stroke	Diesel	15-25 (86%); 30-35 (14%)
6.	Taxi	4-Stroke	Petrol (31%) Diesel (69%)	7-12 (72%); 15-25 (28%)

Table.3.7: Problem analysis of IPT operator

CATEGORY	YES	NO
Designated parking point for the service	22%	78%
Immediate access to repair shops	94%	6%
Proper access to restrooms and drinking water facilities	21%	78%
Adequate access to the fuel station	94%	6%
Switch to an electric operated auto given an opportunity	90%	10%
Routes assigned to you by the RTO/Union	54%	46%
Fares fixed by RTO/Union	62%	38%
SOCIAL BENEFIT		

1) Driving training 2) Insurance	Driving Training	Insurance	Medical facilities
41%	50%	8%	2%

3.3 (c) Spot Speed Survey

Spot speed survey was carried out to assess the speed profile of various vehicles plying within the study area so as to use them in four stage modeling. A sample of the data collected has been shown in the following tables:

Table 3.8 Spot speed Survey

			Lower 15th Percentile Speed	**Median 50th Percentile Speed**	**Upper 85th Percentile Speed**	**Design 98th Percentile Speed**
1	Uripok Kangchup Road (24.80762302,93.9268273)	Car	15	25	32	40
		2-Wheeler	17	24	29	38
		Bus	12	19	22	27
		LCV/HCV	15	22	29	37
		Shared Auto/Auto	22	28	32	38
		3/4 wheeler-	19	26	31	34
2	Keishampat Road (24.7971474,93.9322976)	Car	31	39	47	52
		2-Wheeler	24	34	48	58
		Bus	19	32	39	46
		LCV/HCV	26	31	39	48
		Shared Auto/Auto	24	30	35	42
		3/4 wheeler-	27	34	39	45
		E-rickshaw	15	20	24	28
3	Mayai Lambi Road (24.78957038,93.9365762)	Car	28	35	42	47
		2-Wheeler	26	32	39	48
		Bus	22	27	33	37
		LCV/HCV	27	35	40	44
		Shared Auto/Auto	24	29	34	43
		3/4 wheeler-	22	32	37	42
		E-rickshaw	10	14	17	18
4	Indo Myanmar RD. Pisum Leirak (24.7845492,93.9385934)	Car	21	30	38	50
		2-Wheeler	22	29	37	43
		Bus	26	29	32	37
		LCV/HCV	20	27	36	43
		Shared Auto/Auto	21	26	32	37
		3/4 wheeler-	24	31	37	44
5	Wangkhei main Road (24.79376339,93.9526505)	Car	21	26	32	40
		2-Wheeler	18	22	29	39
		LCV/HCV	20	24	27	33
		Shared Auto/Auto	21	26	32	38
		3/4 wheeler-	20	25	32	39
6	Lamlong Tinsid Road	Car	24	29	36	42

	(24.82298329,93.9677546)	2-Wheeler	21	26	32	36
		Bus	20	25	28	32
		LCV/HCV	20	26	31	36
		Shared Auto/Auto	19	24	29	32
		3/4 wheeler-	21	29	35	39
7	Imphal Ukhrul Road (24.8328199,93.9726436)	Car	26	32	40	46
		2-Wheeler	21	27	34	38
		Bus	25	29	33	37
		LCV/HCV	26	31	35	39
		Shared Auto/Auto	21	27	31	35
		3/4 wheeler-	19	26	31	36
8	Imphal Pangei RD. (24.84263849,93.9692475)	Car	27	32	41	48
		2-Wheeler	24	30	39	48
		Bus	27	32	36	38
		LCV/HCV	20	25	31	37
		Shared Auto/Auto	22	29	33	37
		3/4 wheeler-	21	26	30	34
9	Luwangsangbam Main RD. (24.86685277,93.9275811)	Car	36	41	54	64
		2-Wheeler	37	39	49	58
		Bus	24	34	47	56
		LCV/HCV	27	37	46	52
		Shared Auto/Auto	30	35	41	47
		3/4 wheeler-	34	39	47	52
10	Lukhram Leirak RD. (24.7946341,93.9154674)	Car	20	25	32	35
		2-Wheeler	17	23	27	29
		Bus	15	19	22	25
		LCV/HCV	15	20	25	29
		Shared Auto/Auto	16	21	26	30
		3/4 wheeler-	15	19	22	24
		E-rickshaw	14	19	22	23
11	RIMS RD. (24.81336633,93.9269693)	Car	11	15	19	22
		2-Wheeler	11	15	19	22
		LCV/HCV	14	17	21	23
		Shared Auto/Auto	10	14	19	22
		3/4 wheeler-	12	15	17	19
12	Kwakeithel Khagempalil RD.(24.7862579,93.9260633)	Car	19	22	18	37
		2-Wheeler	18	23	27	36
		Bus	14	16	22	27
		LCV/HCV	14	16	19	24
		Shared Auto/Auto	10	14	17	19
		3/4 wheeler-	9	14	19	22
13	Porompat DC RD. (24.8072906,93.96107413)	Car	20	32	46	60
		2-Wheeler	20	25	30	39
		Bus	20	25	29	32
		LCV/HCV	19	24	28	32
		Shared Auto/Auto	19	25	30	33
		3/4 wheeler-	21	26	30	32

3.3 (d) Speed and Delay Survey

Similarly the speed and delay studies were carried out:

Table 3.9 : Speed and Delay

Imphal College to Hatta Bazaar	**DATE**	1-Aug-22	**TIME**	9:15 AM	**DIRECTION**	1	
	Latitude	**Longitude**	**Distance**	**Stop**	**Start**	**Delay**	**Reason**
	24.785685	93.919051			9:17 AM		
	24.789242	93.923234		01:06.06	2:50.43	01:44.37	Signal
	24.789506	93.923556		05:24.13	5:28.74	00:04.62	Car Obstruction
	24.798629	93.933889		05:47.97	08:55.91	03:07.94	Signal
	24.799524	93.93481		09:43.50	11:27.43	01:43.93	Signal
	24.802119	93.937896		12:01.27	12:14.68	00:13.41	Traffic Jam
			CTVC 3- 13:17.90				
	24.80253	93.939153		15:23.36	15:33.24	00:11.68	Car Obstruction
	24.81.4056	93.950242		09:35	17:09.69		

Hatta Bazaar to Imphal College	**DATE**	1-Aug-22	**TIME**	11:09 AM	**DIRECTION**	1	
	Latitude	**Longitude**	**Distance**	**Stop**	**Start**	**Delay**	**Reason**
	24.813885	93.950425			11:09		
	24.807587	93.949799		01:53.63	02:15.95	00:12:22	Signal
	24.802963	93.949384		03:18.76	03:32.47	00:13.71	Obstruction
	24.802534	93.941494		05:09.69	06:42.05	01:32.36	Signal
	24.800466	93.936228		08:06.75	08:34.99	00:28.24	Obstruction
	24.799791	93.93537		08:48.48	11:59.87	03:11.39	Signal
	24.790158	93.924552		14:19.56	15:22.43	01:02.87	Signal
	24.78555	93.919127		11:25	16:44.69		

Imphal College to Hatta Bazaar	**DATE**	1-Aug-22	**TIME**	11:30 AM	**DIRECTION**	2	
	Latitude	**Longitude**	**Distance**	**Stop**	**Start**	**Delay**	**Reason**
	24.785885	93.919282			11:30		
	24.789295	93.923396		01:05.17	03:14.65	02:09.48	Signal
	24.799361	93.93466		05:45.48	08:56.52	03:11.04	Signal
			CTVC 3 - 11:18.41				
	24.813855	93.950181		11:45	15:11.98		

3.4 Strategic Planning for each activity with time frame (max. 200 words)

Based on the research methodology the study is divided into seven broad tasks, which involves seven activities put together with each other.

Task 1: Literature review: involved assimilation of several relevant literature useful towards completion of the current research

Task 2: Based on the literature reviewed the study parameters were formulated.

Task 3: Primary as well as secondary data collection was initiated and the database preparation was done.

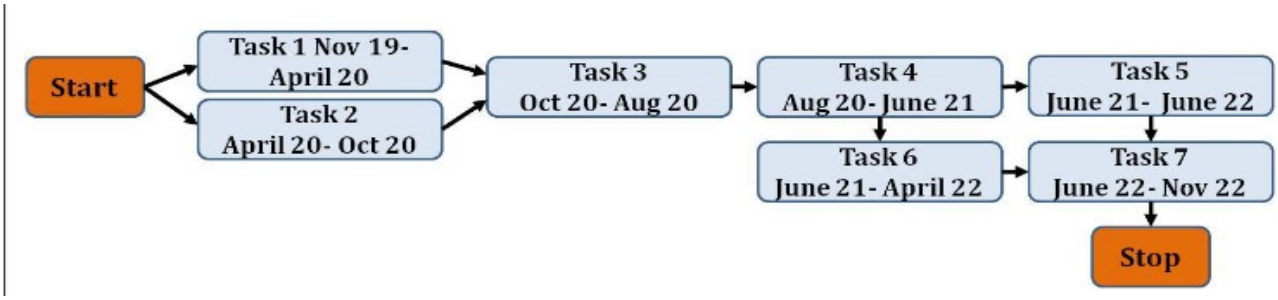
Task 4: Data compilation initiated: Development of vulnerability index such that the wards with least vulnerability are identified. This is subsequently cross mapped with the accessibility levels of various wards to the identified public infrastructure based POI's, namely, healthcare services. Activity 1.1 involved development of vulnerability index using factor analysis based PCA method. Activity 1.2 involved identification of location of public infrastructure based POI's namely health care services, and thereby developing the accessibility indices for the wards.

Task 5: Four stage model development : This involved the development of four stage model. Activity 2.1 involves trip generation models namely the production and attraction models. Activity 2.2 involves estimation of gravitation parameters which are used to define accessibility to identified public infrastructure based POI's, namely health care services and also to understand the distribution of trips. Activity 2.3 involves mode choice modeling wherein only constants models were developed. Activity 2.4 involves assignment wherein the demand matrix was calibrated for a peak hour volume and the calibrated share auto demand matrix was reassigned to self developed share auto routes.

Task 6: Evaluation of current IPT services : Development of customer satisfaction index and heterogeneous customer satisfaction to identify indicators that require interventions and Operators opinion as well as characteristics of IPT operators.

Task 7: Capacity building through dissemination workshop: As a part of One week One Lab CSIR-CRRI initiative the study was presented amongst the dignitaries of NE research council.

The PERT Chart below presents various activities, their dependency among each other with time frame for every activity. Time frame shows the number of months (the dates needs to revised as per the sanction dates):



4 KEY FINDINGS AND RESULTS – *supporting documents to be attached.*

4.1 Major Activities/ Findings (max. 500 words)

From the analysis one can deduce that the criteria wherein policy intervention would be required would be when ABISV is high (Above) and Accessibility is low (Below). Therefore wards 27,28, 31 32 30,18,20,22,23,36,25,26,34 and 37 would require policy interventions for provision of health services or for better accessibility to existing facilities.

The indicators used to arrive at the vulnerability index can be grouped into three factors/components which in total explains 74.88 % of the total variance in the data. Component 1 can be described to indicate the 'Literacy based economic wellbeing'. It means that a better 'literacy based economic wellbeing ' is associated with lower proportion of illiterate females and lower proportion of children less than 6 year, low proportion of household not availing bank facilities and low proportion of households not having treated water.

Component 2 explains 19.817% of the variance and is indicative of the 'Basic amenities service level' implying a better 'basic amenities service level' through low proportion of households with drinking water far away from premises and low proportion of households not having treated tap water as main source of drinking water and a high proportion of households with single and no exclusive dwelling room. Essentially the negative loading on proportion of households with single and no exclusive dwelling room is indicative of the fact that the certain characteristics is lacking in the latent variable associated with the principal component.

Component 3 which explains 13.823 % of the variance can be described as indicative of 'economic wellbeing' implying that a better 'economic wellbeing' of the area is indicated through low proportion of households with no assets, low proportion of households without latrine facility within the premises and low proportion of households not availing banking facilities.

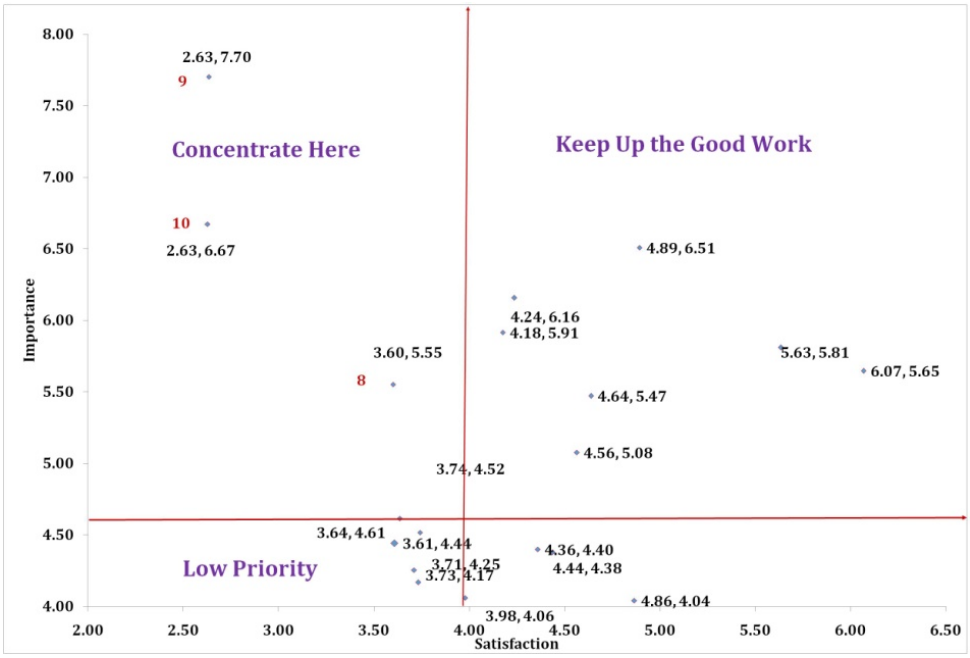


Figure 20: Mapping of satisfaction vs importance scores given by commuters to various attributes of IPT services

The Customer Satisfaction Index and the heterogeneous customer satisfaction Index provide overview of the attributes of the IPT service that require improvements as revealed by the users. In the current study the attributes that were ranked high by the users but were low on their satisfaction levels are 1: the safety within an IPT/Bus service in terms of property theft/eve teasing while travelling between your origin and destination in terms of your usage of the IPT/Bus service 2: the safety at the IPT/Bus stop in terms of property theft/eve teasing while waiting for the service at the IPT/Bus stop in terms of your usage of the IPT/Bus service and 3: the safe driving practices of an IPT/Bus driver while travelling between your origin and destination in terms of your usage of the IPT/Bus service.

The calibrated gravitation parameters indicate that distribution of trips peaks at a distance of 3.5 km for work trips and other trips whereas for education trips it peaks at 4 km. The estimated gravitation parameters as obtained for various trip purposes enables us to evaluate the accessibility of chosen public infrastructure based POI's in the study area. The results of evaluated scenarios are presented below:

Scenario 1: The OD matrix for through traffic as shown below :

Table 4.1 : Origin and Destination matrix

O/D	38	39	40	41
38				12.22%
39	6.95%		1.64%	1.64%
40	6.76%	6.76%		2.70%
41	37.04%	16.67%		

The maximum percentage of through traffic originates from zone 38 and has a destination at zone 41. Therefore the need for a bypass can be explored.

Scenario 2: The proportion of IPT riders shifting to E-Auto: In order to evaluate the possibility of introducing an E-auto service the following fare structure has been assumed as follows:

Table 4.2 Distance and Fare structure assumed for E Auto

Dist	Fare	Dist	Fare	Dist	Fare	Dist	Fare
1	14.31	9	32.03	17	50.56	25	68.34
2	14.31	10	34.49	18	52.78	26	70.56
3	18.70	11	37.21	19	55.00	27	72.78
4	20.42	12	39.45	20	57.21	28	75.01
5	22.15	13	41.67	21	59.43	29	77.23
6	23.87	14	43.89	22	61.67		
7	25.59	15	46.10	23	63.90		
8	29.56	16	48.32	24	66.12		

Assuming that the introduced E-Auto would travel at a speed of 35kmph the travel time using the E-Auto was estimated for the distance travelled. The fare structure was used to arrive at the cost for the journey. When the fare structure was lesser than the amount specified in the 'willingness to pay survey' of the commuters the commuter is assumed to use E-Auto. The coefficients determined are as shown in section 4.2.4. The assumptions resulted in the probability of E-Auto being chosen between present IPT as 33.9% and the probability of present IPT as 66.1%.

Scenario 3: The share auto services are assumed to be similar to public transport lines and accordingly the lines were drawn between the identified share auto stands and various locations. A time table based assignment was carried out to assess the demand vs supply deficiencies in form of volume by capacity ratios for the various indentified lines. The assessment identified the following lines had high volume to capacity ratios averaged over various runs within the analysis period. It is observed that the demand generated within the analysis period is not met by the supply. The demand therefore accumulates to the next time period.

Table 4.3 Self identified line routes for IPT – Share Auto

line name	direction	stops served	length	link run time	number of service trips		PassKm travelled	V BY C
AIRPORTURIPOK	>	10	4.32km	5min 17s	3	12.97km	1439.1km	13.86
AIRPORTURIPOK	<	10	4.32km	5min 17s	4	17.29km	2018.1km	14.58
GMHALL	>	23	6.46km	11min 57s	4	25.8km	631.8km	3.05
Heirok	>	15	5.21km	6min 31s	3	15.6km	140.6km	1.12
Heirok	<	15	5.21km	6min 31s	4	20.8km	290.3km	1.74
KGELJANG	>	11	4.98km	9min 57s	8	39.9km	236.5km	0.74
KGELJANG	<	12	4.98km	9min 59s	5	24.9km	116.09km	0.58
langjing crpf gate	>	13	4.57km	9min 8s	5	22.8km	151.35km	0.82
langjing crpf gate	<	13	4.57km	9min 8s	8	36.6km	538.31km	1.83
MANTRIPUKRI	>	21	9.05km	13min 11s	4	36.2km	2373.8km	8.19
MANTRIPUKRI	<	21	9.028km	13min 11s	11	99.3km	1548.3km	1.94
NAGAMAPALRIMSGATE	>	3	1.34km	2min 41s	2	2.6km	145.1km	6.75
NAGAMAPALRIMSGATE	<	3	1.34km	2min 41s	2	2.6km	171.2km	7.96
NAGKHANGAMPALI	>	13	3.37km	6min 43s	2	6.7km	357.8km	6.62
NAGKHANGAMPALI	<	13	3.37km	6min 43s	2	6.7km	386.05km	7.14
self 15	>	22	8.99km	12min 7s	3	26.9km	1679.1km	7.78
self 15	<	22	8.96km	12min 7s	3	26.8km	274.2km	1.27
self1	>	13	6.11km	12min 13s	3	18.3km	307.7km	2.09
self10	>	17	6.85km	9min 55s	3	20.5km	432.8km	2.63
self10	<	17	6.85km	9min 55s	2	13.7km	462.4km	4.21
self11	<	14	6.31km	12min 15s	2	12.6km	102.0km	1.01
self12	>	11	4.58km	9min 46s	2	9.1km	48.8km	0.66
self13	>	15	4.03km	7min 5s	3	12.1km	106.7km	1.1
self13	<	15	4.03km	7min 5s	2	8.1km	28.5km	0.44
self2	>	18	5.49km	10min 9s	2	10.9km	152.1km	1.73
self2	<	18	5.49km	10min 9s	2	10.9km	281.7km	3.20
self20	>	15	6.73km	11min 39s	2	13.4km	356.4km	3.31
self20	<	15	6.73km	11min 39s	2	13.5km	683.6km	6.34
self22	>	15	5.29km	10min 34s	2	10.6km	507.9km	5.99
self22	<	15	5.29km	10min 34s	2	10.6km	341.7km	4.03
self24	>	13	4.27km	7min 29s	2	8.5km	457.07km	6.69
self24	<	13	4.27km	7min 29s	2	8.5km	425.64km	6.2
self25	>	18	7.77km	14min 28s	2	15.6km	188.07km	1.5

self25	<	18	7.77km	14min 28s	3	23.3km	187.7km	1.0
self26	>	9	2.98km	5min 57s	2	5.96km	54.09km	1.13
self26	<	9	2.98km	5min 57s	2	5.96km	6.5km	0.14
self27	>	11	4.87km	8min 22s	3	14.6km	265.4km	2.26
self27	<	11	4.87km	8min 22s	2	9.7km	12.3km	0.15
self29	>	8	4.05km	8min 4s	3	12.1km	403.7km	4.15
self29	<	8	4.05km	8min 4s	5	20.2km	886.8km	5.47
self32	>	12	4.14km	8min 53s	3	12.4km	136.2km	1.37
self32	<	12	4.14km	8min 53s	7	28.9km	53.9km	0.23
self36	>	19	7.27km	9min 28s	7	50.8km	991.1km	2.43
self36	<	19	7.27km	9min 28s	3	21.8km	246.7km	1.41
self38	>	10	5.09km	10min 11s	6	30.5km	308.6km	1.26
self38	<	10	5.09km	10min 11s	3	15.2km	338.5km	2.77
self39	<	14	6.81km	10min 31s	4	27.2km	734.6km	3.36
self40	>	18	7.64km	13min 34s	4	30.5km	903.2km	3.69
self40	<	18	7.64km	13min 34s	6	45.8km	572.2km	1.56
self41	>	14	7.26km	11min 5s	4	29.06km	1282.2km	5.51
self41	<	14	7.26km	11min 5s	2	14.5km	459.4km	3.95
self45	>	15	5.01km	10min 34s	7	35.07km	655.1km	2.33
self46	>	13	7.96km	15min 41s	5	39.8km	210.3km	0.66
self48	>	16	11.55km	23min 5s	7	80.8km	306.5km	0.47
self48	<	15	11.55km	23min 3s	2	23.09km	74.7km	0.40
self49	>	11	5.96km	9min 59s	3	17.8km	469.8km	3.28
self49	<	10	5.96km	9min 57s	3	17.8km	556.8km	3.89
self5	>	13	6.6km	12min 13s	3	19.8km	308.5km	1.94
self5	<	14	6.6km	12min 15s	6	39.6km	619.7km	1.95
self50	>	11	4.99km	9min 59s	4	19.9km	378.1km	2.36
self50	<	11	5.05km	10min 51s	3	15.1km	1008.7km	8.32
self51	>	19	12.06km	15min 56s	6	72.4km	1919.4km	3.31
self52	>	22	11.2km	18min 59s	5	56.09km	632.9km	1.41
self52	<	22	11.25km	18min 59s	7	78.7km	2118.2km	3.36
self54	>	8	6.14km	8min 30s	4	24.5km	1352.1km	6.88
self54	<	8	7.63km	8min 30s	3	22.9km	715.4km	3.90
self56	>	18	12.25km	13min 13s	3	36.7km	3240.2km	11.02
self56	<	18	12.22km	13min 13s	4	48.8km	3175.9km	8.11
self6	>	17	5.77km	11min 31s	6	34.6km	528.6km	1.9

self6	<	17	5.77km	11min 31s	2	11.5km	86.1km	0.93
self9	>	18	5.25km	10min 28s	2	10.4km	57.8km	0.69

Most of the digitized lines were self made as shown below:

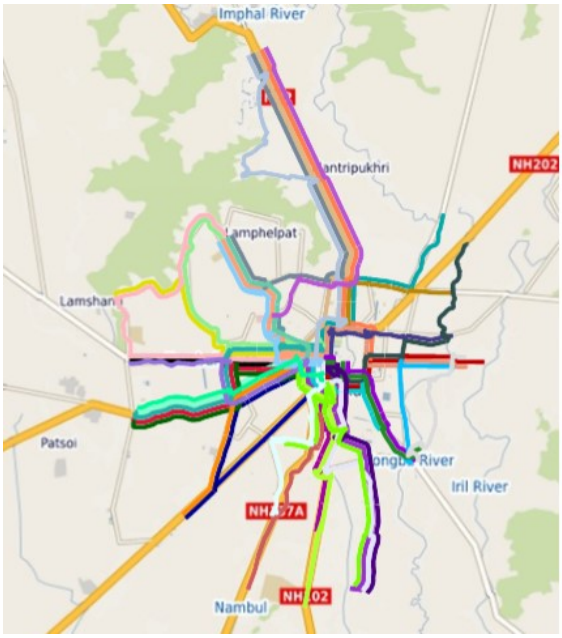


Fig 21: Self Digitized share auto lines for the study area

4.2 Key Results (max. 500 words in bullets covering all activities)

4.2.1 Vulnerability Index

Social Vulnerability Index for various TAZ's (0 SVI – low Vulnerability ; 1 SVI – High Vulnerability) Access – (Higher value better access). The area based index for social vulnerability is formulated using personal socio economic status based indicators. Since the measure is on social vulnerability the developed index indicates advantaged areas through low index score whereas disadvantaged areas are indicated through high index score (Currie, 2010; Jaramillo.C., et.al., 2012). The index has been calculated for the 37 Traffic Analysis Zones (TAZs) within Greater Imphal Region.

The indicators chosen for development of index were proportion of female, proportion below 6, proportion of female kids below 6, proportion of illiterates, proportion of female illiterates, proportion of marginal workers, proportion of female marginal workers, proportion of non workers, proportion of female non workers, proportion of female main workers, proportion of main other worker, proportion of female main other worker, proportion of marginal other worker, proportion of marginal other worker female, proportion of main workers from agriculture, industrial and cultivation, proportion of main workers from household industries and cultivation female, proportion of marginal workers from household industries and cultivation female, proportion of marginal workers from industries and cultivation. Some of the indicators mentioned above form the subset of other indicators for eg, proportion of main workers essentially encompasses proportion of main 'other' workers and proportion of main agriculture laborers, industrial

and cultivation workers. The above mentioned indicators were initially processed to carry out the necessary descriptive analysis and from these a set of indicators were finally chosen as they confirmed to the requisite condition for carrying out PCA in SPSS. Table 4.4 shows the developed index values for various TAZ's using two different formulations available in literature.

Table 4.4 : The developed social vulnerability index

TAZ no	SVI	SVI_FIRSTC	Access	SVI-AORB	SVI-FCOM	Access AorB	DESCRIPTION
1	0.51	0.539	297.71	Above	Above	above	Imphal (MCI) WARD NO.-0001
2	0.56	0.542	302.53	Above	Above	above	Imphal (MCI) WARD NO.-0002
3	0.37	0.363	301.84	Below	Below	above	Imphal (MCI) WARD NO.-0003
4	0.16	0.18	293.89	Below	Below	above	Imphal (MCI) WARD NO.-0004
5	0.51	0.508	1231.8	Above	Above	above	Imphal (MCI) WARD NO.-0005
6	0.35	0.392	284.44	Below	Below	above	Imphal (MCI) WARD NO.-0006
7	0.6	0.561	265.1	Above	Above	below	Imphal (MCI) WARD NO.-0007
8	0.29	0.195	274.08	Below	Below	below	Imphal (MCI) WARD NO.-0008
9	0.43	0.354	256.42	Below	Below	below	Imphal (MCI) WARD NO.-0009
10	0.49	0.439	233.09	Below	Below	below	Imphal (MCI) WARD NO.-0010
11	0.35	0.29	245.84	Below	Below	below	Imphal (MCI) WARD NO.-0011
12	0.35	0.24	242.93	Below	Below	below	Imphal (MCI) WARD NO.-0012
13	0.5	0.457	213.52	Above	Below	below	Imphal (MCI) WARD NO.-0013
14	0.06	0.072	238.36	Below	Below	below	Imphal (MCI) WARD NO.-0014
15	0.30	0.295	214.77	Below	Below	below	Imphal (MCI) WARD NO.-0015
16	0.39	0.312	191.25	Below	Below	below	Imphal (MCI) WARD NO.-0016
17	0.51	0.471	184.11	Above	Below	below	Imphal (MCI) WARD NO.-0017
18	0.64	0.566	223.02	Above	Above	below	Imphal (MCI) WARD NO.-0018
19	0.42	0.435	247.89	Below	Below	below	Imphal (MCI) WARD NO.-0019
20	0.57	0.542	242.39	Above	Above	below	Imphal (MCI) WARD NO.-0020
21	0.41	0.354	264.01	Below	Below	below	Imphal (MCI) WARD NO.-0021
22	0.76	0.88	268.89	Above	Above	below	Imphal (MCI) WARD NO.-0022
23	0.76	0.91	255.16	Above	Above	below	Imphal (MCI) WARD NO.-0023
24	0	0	264.21	Below	Below	below	Imphal (MCI) WARD NO.-0024
25	0.47	0.451	290.68	Below	Below	above	Imphal (MCI) WARD NO.-0025
26	0.62	0.625	266.67	Above	Above	below	Imphal (MCI) WARD NO.-0026
27	0.63	0.75	251.74	Above	Above	below	Imphal (MCI) WARD NO.-0027

28	0.68	0.68	197.41	Above	Above	below	Imphal (MCI) WARD NO.-0028 (270117 - Langjing (CT) WARD NO.-0001-28, 801487 - Bijoy Govinda (OG) WARD NO.-0028 (Rural MDDS CODE:269934), 270123-Sagolband (Part) (CT) WARD NO.-0001 - 28 ,270124 - Takyel Mapal)
29	0.75	0.779	688.8	Above	Above	above	Imphal (MCI) WARD NO.-0029a (270312 - Porompat (CT) WARD NO.-0001-29, 270300 - Top Naoria-29, 270301 - Kongba Nongthombam Leikai-29)
30	0.68	0.689	154.39	Above	Above	below	Imphal (MCI) WARD NO.-0030 (270313 - Torban (Kshetri Leikai) (CT) WARD NO.-0001 -30, 270314 - Khongman (CT) WARD NO.-0001 - 30, 270322 - Thongju (CT) -30)
31	0.75	0.745	188.13	Above	Above	below	Imphal (MCI) WARD NO.-0031 (270116 - Lamjaotongba (CT) WARD NO.-0001 - 31, 270115 - Sangaiprou Maning -31)
32	0.76	0.753	175.64	Above	Above	below	Imphal (MCI) WARD NO.-0032 (270 118 - Heinoukhongnembi -32, 270122 - Naoriya Pakhanglakpa (CT) WARD NO.-0001 -32, 270119 - Maibam Leikai -32)
33	0.38	0.427	162.21	Below	Below	below	Imphal (MCI) WARD NO.-0033 (270120 - Ahongsangbam Leikai - 33, 270121 - Sorokhaibam Leikai - 33, 801487 - Oinam Thingel (OG) WARD NO.-0029 (Rural MDDS CODE:269935) - 33)
34	0.72	0.671	186.96	Above	Above	below	Imphal (MCI) WARD NO.-0034 (270315 -Luwangsangbam (CT) WARD NO.-0001 , 270278-Matai ,

							270279 -Kontha Khabam ,270285 - Lamlongei)
35	0.94	1	221.14	Above	Above	below	Imphal (MCI) WARD NO.-0035 (270283 - Kairang Muslim- 35, 270280 - Kairang Meitei , 270281- Khomidok, 270317 - Lairikyengbam Leikai (CT) WARD NO.-0001 , 270318 - Laipham Siphai (CT), 270319 - Khurai Sajor Leikai (CT) WARD NO.-0001 , 270282 -Khurai Konsam Leikai)
36	0.55	0.609	230.55	Above	Above	below	Imphal (MCI) WARD NO.-0036 (801487 - Porompat Plan Area (OG) WARD NO.-0030 (Rural MDDS CODE:270324) -36, 801487 - Kongkham Leikai (OG) WARD NO.-0031 (Rural MDDS CODE:270325) -36, 270293 - Kongkham Leikai (Part)-36, 270294 -Khaidem Leikai-36, 270320 - Chingangbam Leikai (CT) WARD NO.-0001-36,270286-Thangjam Leikai-36)
37	1	0.987	161.74	Above	Above	below	Imphal (MCI) WARD NO.-0037 (270276 - Achanbigei -37, 270316 - Heingang (CT) WARD NO.-0001 - 37, 270284- Kontha Ahallup- 37)

4.2.2 Trip Generation equations

Table 4.5 Productions:

Model Parameters	Log(HBW) (t-stat)	Log(HBE) (t-stat)	Log(HBO) (t-stat)
a_1- coefficient for log(other workers)	1.018(5.39)	*	*
a_2 - coefficient for log(Literates)	*	0.712 (2.246)	*
a_3 - coefficient for log(Population)	*	*	0.493 (1.714)
Constant	0.447(0.29)	1.815 (0.636)	3.897 (1.47)

Table 4.6 Attractions:

Model Parameters	Log(HBW) (t-stat)	Log(HBE) (t-stat)	Log(HBO) (t-stat)
a_1- coefficient for log(other workers)	2.518 (1.262)	*	*
a_2 - coefficient for log(Literates)	*	1.572 (0.578)	*
a_3 - coefficient for log(Population)	*	*	4.270 (1.753)
Constant	0.687 (3.116)	0.722 (2.445)	0.542 (1.713)

4.2.3 Trip Distribution

Estimation of Gravitation Parameter

Work trips – Function form – f(U) = a*e^(cU); U=distance matrix

Estimated Coefficients : a=3.615 c=-0.556 rating = 0.224 (figure 22)

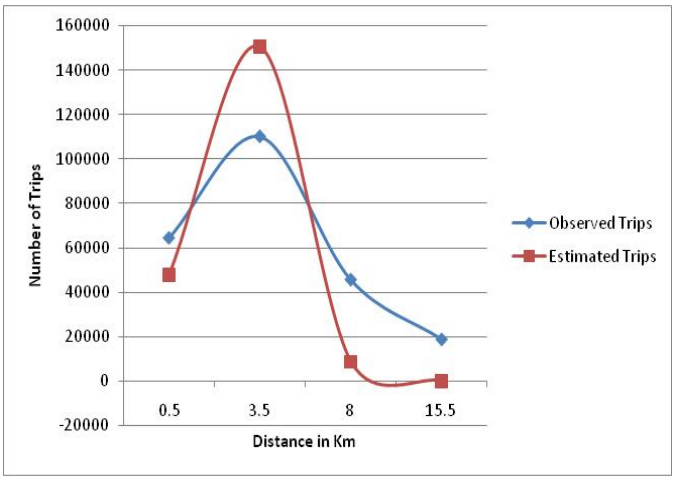


Figure 22: Observed vs estimated trip distribution for work trips

Education trips – Function form – f(U) =a*U^b*exp(cU); U=distance matrix

Estimated Coefficients : a=0.016, b=0.302, c=0.521 rating = 0.435 (figure 23)

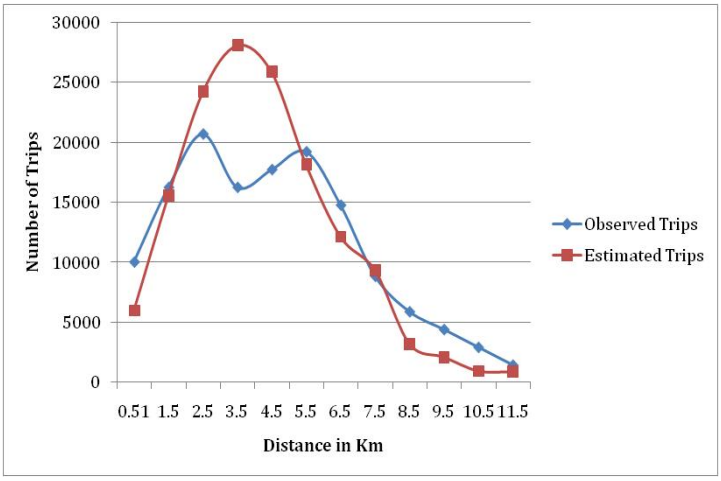


Figure 23: Observed vs estimated trip distribution for education trips

Other trips – Function form – f(U) =a*U^b*exp(cU); U=distance matrix

Estimated Coefficients : a=0.16, b=-1.13, c=0.264 rating = 0.762 (figure 24)

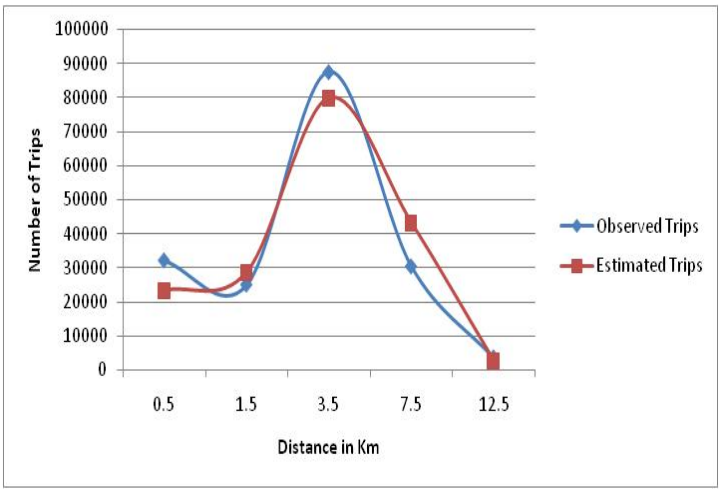


Figure 24: Observed vs estimated trips for other trips

4.2.4 Mode choice – Constant only model

Table 4.7 Work Trips

Coefficients	Estimate	t – ratio	LL(start)	LL(final)	AIC	BIC
asc_car	0.365	5.658	-5955	-2200	4414.5	4456.6
asc_tw	0	NA				
asc_auto_hired	-4.5621	-25.765				
asc_van	-4.4248	-26.645				
asc_bus	-3.9139	-29.742				
asc_shareauto	-2.4712	-33.123				
asc_TataMagic	-6.6911	-13.402				
asc_NMT	-3.6108	-31.316				

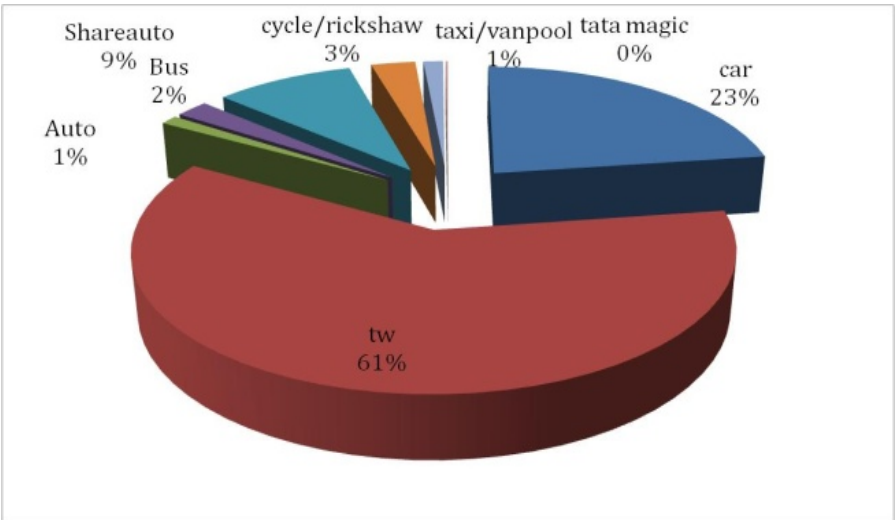


Fig 25 The mode choice as observed in the household data sampled work trips

Table 4.8 Education Trips

Coefficients	Estimate	t – ratio	LL(start)	LL(final)	AIC	BIC
asc_car	-1.5191	-7.382	-2610.1	-1672.2	3358.3	3394.6
asc_tw	0	NA				
asc_auto_hired	-2.6169	-12.019				
asc_van	0.7992	10.877				
asc_bus	-1.9918	-12.072				
asc_shareauto	-0.2942	-3.242				
asc_TataMagic	-3.6722	-10.234				
asc_NMT	-2.8096	-11.806				

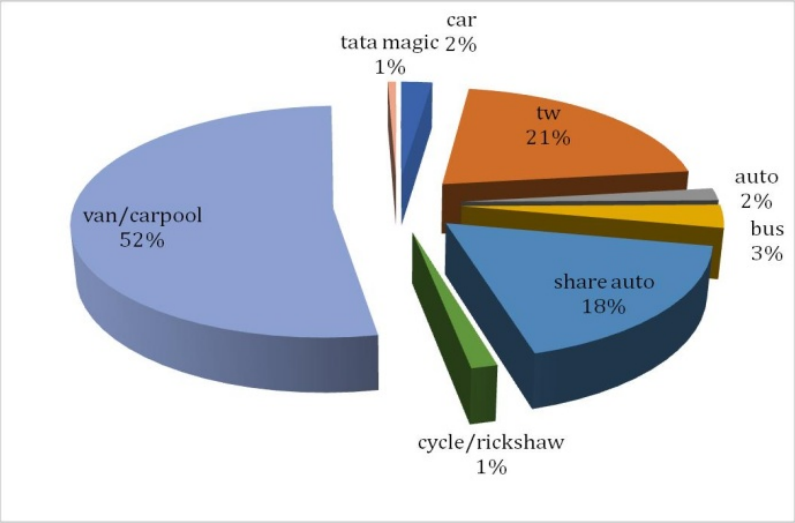


Fig 26 The mode choice as observed in the household data sampled education trips

Table 4.9 Other Trips

Coefficients	Estimate	t – ratio	LL(start)	LL(final)	AIC	BIC
asc_car	-0.9280	-7,271	-4267.02	-2853.42	5720.8	5760.6
asc_tw	0	NA				
asc_auto_hired	-1.7744	-17.021				
asc_van	-3.0761	-16.6				
asc_bus	-2.6816	-17.372				
asc_shareauto	0.4500	8.158				
asc_TataMagic	-4.9015	-10.9				
asc_NMT	-0.7236	-10.072				

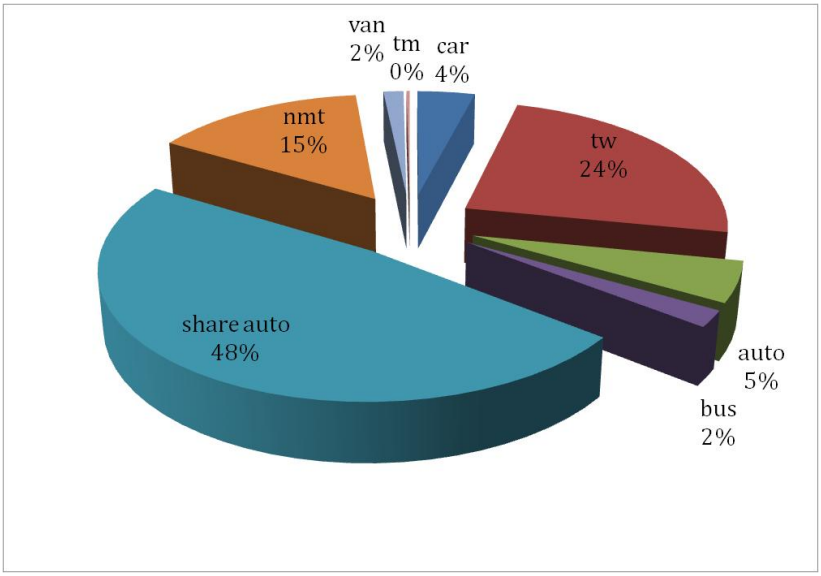


Fig 27 The mode choice as observed in the household data sampled other trips

Table 4.10 Choice of E-AUTO

Coefficients	Estimate	t – ratio	LL(start)	LL(final)	AIC	BIC
asc_PVEH	0	NA	-114.37	-55.82	117.65	126.97
asc_EVEH	-1.0752	-2.896				
b_t	-0.007	-3.732				
b_cost	5.665	6.458				

4.2.5 Classified traffic volume at select locations: The present Level of Service (LOS) and the anticipated LOS

Table 4.11 Peak Hour Traffic at the surveyed stretches:

S. No	Road	Peak Hour Time (hour)	Peak Hour Traffic (Veh/hr)	Peak Hour Traffic (PCU/hr)
1	Paona bazar to Uripok road	10:00-11:00 AM	2879	2315
	Uripok road to Paona bazar	16:00-17:00 PM	2815	2206
2	Singjamei to Imphal Bazar	16:00-17:00 PM	2398	1830
	Imphal Bazar to Singjamei	10:00-11:00 AM	3401	2581
3	Babupara to Sanjenthong	13:00-14:00 PM	1920	1584
	Sanjenthong to Babupara	17:00-18:00 PM	2311	1836
4	KeishamThong Bazar to Chingamakha Bazar	18:00-19:00 PM	2272	1670

	Chingamakha Bazar to KeishamThong Bazar	09:00-10:00 AM	1998	1453
5	DC Porampat to Lamlong Bazar	09:00-10:00 AM	910	664
	Lamlong Bazar to DC Porampat	18:00-19:00 PM	885	620
6	Mayaikaibi to Lukram Leirek	16:00-17:00 PM	524	402
	Lukram Leirek to Mayaikaibi	09:00-10:00 AM	616	486
7	Thiyam leikei to Sagolband	17:00-18:00 PM	789	567
	Sagolband to Thiyam leikei	16:00-17:00 PM	787	564

Table 4.12 Level of Service (LOS) for existing service:

S. No	Roadway	Peak hour (PCU/hr)	No of lanes	Divided or Undivided	Capacity (DSV/0.7)	V/C ratio	LOS
1	From Paona bazar to Uripok road	2315	6	Divided	3071	0.75	**C**
	From Uripok road to Paona bazar	2206			3071	0.72	**C**
2	From Singjamei To Imphal Bazar	1830	4	Divided	2571	0.71	**D**
	From Imphal bazar to Singjamei	2581			2571	>1	**F**
3	From Babupara To Sanjenthong	1584	4	Divided	2071	0.76	**D**
	From Sanjenthong to Babupara	1836			2071	0.88	**E**
4	From KeishamThong Bazar to Chingamakha Bazar	1670	4	Divided	2071	0.8	**D**
	From Chingamakha bazar to KeishamThong	1453			2071	0.7	**C**
5	From DC Porampat To Lamlong Bazar	664	2	Undivided	857	0.78	**D**
	From Lamlong bazar to DC Porampat	620			857	0.72	**D**
6	From Mayaikaibi To Lukram Leirek	402	2	Undivided	857	0.46	**B**

	From Lukram Leirek to Mayaikaibi	486			857	0.56	**C**
7	From Sagolband to Thiyam leikei	564	2	Undivided	857	0.66	**C**
	From Thiyam Leikei to Sagolband	567			857	0.66	**C**

Table 4.13 Econometric model for estimation of growth rate

Vehicles	Equation	R^2	Co-efficient of (PCI/GDP)
Car/jeep	ln Car = 1.0943 ln PCI - 1.2039	0.898	1.0943
Bus	ln Bus = -0.8294 ln PCI +17.366	0.3153	-0.8294
Trucks	ln Truck = 1.372 ln GDP -3.3225	0.7425	1.372
TW	ln TW = 0.4814 ln PCI +7.0188	0.2743	0.4814
AR	ln AR = 0.4948 ln PCI+4.2208	0.2188	0.4948

Table 4.14 Growth rate of traffic in Imphal city for every 5 year period (Using compound rate model as per IRC 108-1996)

Vehicle type	Rate
TW	4.89
Car	10.85
Bus	Negative
AR	4.93
Commercial vehicle (trucks)	8.5

Table : 4.15 Anticipated traffic Volume of various roadways of Imphal city

S. No	Roadways	Anticipated Peak Hour Volume (2023-2027)	
		(Veh/hr)	(PCU/hr)
1	Paona bazar to Uripok road	3930	3243
	Uripok road to Paona bazar	3867	3046
2	Singjamei to Imphal Bazar	3767	2956
	Imphal Bazar to Singjamei	4750	3726
3	Babupara To Sanjenthong	2763	2258
	Sanjenthong to Babupara	3249	2677

4	KeishamThong Bazar to Chingamakha Bazar	3118	2391
	Chingamakha Bazar to KeishamThong Bazar	2679	2019
5	DC Porampat to Lamlong Bazar	1191	914
	Lamlong Bazar to DC Porampat	1186	866
6	Mayaikaibi To Lukram Leirek	747	556
	Lukram Leirek to Mayaikaibi	882	674
7	Sagolband to Thiyam leikei	1075	816
	Thiyam leikei to Sagolband	1079	816

Table 4.16 Projected LOS as per Indo-HCM

S. No	Roadways	Peak hour (PCU/hr)	No of lanes	Divided or Undivided	Capacity (DSV/0.7)	V/C ratio	LOS
1	From Paona bazar to Uripok road	3243	6	Divided	3071	>1	**F**
	From Uripok road to Paona bazar	3046			3071	0.99	**E**
2	From Singjamei To Imphal Bazar	2956	4	Divided	2571	>1	**F**
	From Imphal bazar to Singjamei	3726			2571	>1	**F**
3	From Babupara To Sanjenthong	2258	4	Divided	2071	>1	**F**
	From Sanjenthong to Babupara	2677			2071	>1	**F**
4	From KeishamThong Bazar to Chingamakha Bazar	2391	4	Divided	2071	>1	**F**
	From Chingamakha bazar to KeishamThong	2019			2071	0.97	**E**
5	From DC Porampat To Lamlong Bazar	914	2	Undivided	857	>1	**F**
	From Lamlong bazar to DC Porampat	866			857	>1	**F**
6	From Mayaikaibi to Lukram Leirek	556	2	Undivided	857	0.64	**C**
	From Lukram Leirek to	674			857	0.79	**D**

	Mayaikaibi						
7	From Sagolband to Thiyam leikei	816	2	Undivided	857	0.95	**E**
	From Thiyam Leikei to Sagolband	816			857	0.95	**E**

4.2.6 Attributes for Customer satisfaction Index and Heterogeneous customer satisfaction index

Table 4.17 Attributes for Customer satisfaction Index and Heterogeneous customer satisfaction index

Description		Importance		Satisfaction	
		Mean	Var	Mean	Var
the distance of the IPT/Bus stop from your origin (access distance) in terms of your usage of the IPT/Bus service	1	4.77	2.41	3.74	1.18
the distance of the IPT/Bus stop from your destination (egress distance) in terms of your usage of the IPT/Bus service	2	4.47	2.95	3.58	1.35
number of routes of IPT/Bus between your origin and destination in terms of your usage of the IPT/Bus service	3	4.49	2.20	3.85	1.63
the frequency of IPT/Bus services between your origin and destination in terms of your usage of the IPT/Bus service	4	4.37	2.80	3.66	1.72
the arrival of IPT/Bus services at the designated time (reliability) between your origin and destination in terms of your usage of the IPT/Bus service	5	4.75	2.66	4.05	1.84
the seat availability within an IPT/Bus service while travelling between your origin and destination in terms of your usage of the IPT/Bus service	6	5.29	2.57	4.57	2.18
the cleanliness within an IPT/Bus service while travelling between your origin and destination in terms of your usage of the IPT/Bus service	7	5.66	3.23	4.78	2.79
the safe driving practices of an IPT/Bus driver while travelling between your origin and destination in terms of your usage of the IPT/Bus service	8	5.90	3.74	4.64	3.05
the safety within an IPT/Bus service in terms of property theft/eve teasing while travelling between your origin and destination in terms of your usage of the IPT/Bus service	9	7.53	4.39	4.01	3.12
the safety at the IPT/Bus stop in terms of property theft/eve teasing while waiting for the service at the IPT/Bus stop in	10	7.63	5.21	3.84	2.87

terms of your usage of the IPT/Bus service					
the total travel time between an Origin and Destination while using an IPT/Bus service in terms of your usage of the IPT/Bus service	11	5.34	3.83	3.85	2.10
IPT stop/ bus stop ambiance (lighting, seating availability, shelter) in terms of determining your usage of the IPT/Bus service	12	4.78	3.10	3.99	1.86
the maintenance of IPT service in terms of number of breakdowns for determining your usage of the IPT/Bus service	13	4.34	4.13	3.89	2.96
ticket cost for determining your usage of the IPT/Bus service	14	4.66	2.96	4.24	2.07
ecological vehicle such as E-rickshaw or E-Auto or E-bus for your choice to commute	15	4.70	2.27	4.43	1.78
the space required for accommodating the goods that you are carrying within the service in determining your usage of the IPT/Bus service	16	4.76	2.20	4.22	2.15
the comfort of seats within an IPT/Bus service while travelling between your origin and destination in terms of your usage of the IPT/Bus service	17	4.70	2.92	4.13	2.33
the number of transfers of IPT/Bus service while travelling between your origin and destination in terms of your usage of the IPT/Bus service	18	4.64	2.79	3.92	2.16
the presence of a designated IPT /Bus stop in terms of usage of the IPT/Bus service	19	4.54	2.90	3.94	2.14
the total monthly expenditure spent travelling from your origin in terms of usage of the IPT/Bus service	20	4.45	2.84	3.94	2.13
the waiting time to assess an IPT service between your origin and destination	21	4.29	2.84	4.03	2.58

Table 4.18 Customer satisfaction Index and Heterogeneous customer satisfaction index

CSI	4.02		HCSI	4.14

4.3 Conclusion of the study (max. 500 words in bullets)

The study had aimed to assess the penetration of IPT services within the study area of Imphal. The initial aim was to assess the demand and supply for IPT service modeled as public transport services by deriving two separate indices however it was found that there are no designated stops for share autos/ other IPT services within each wards . The stops of the services are not fixed i.e. they stop as and where

a passenger wants to board or alight if occupancy is available. Else they are sheltered in stands where the commuters can board and alight. In context of the above to assess the penetration of IPT services to various public infrastructure POI's namely health care services and to understand the accessibility of the identified POI's by those who would be the captive riders to IPT namely the socially vulnerable group a social vulnerability index was developed for various wards within the study area. The gravitation parameters were calibrated to understand how the distance acts as a detriment to accessibility and finally the derived coefficients were used to identify interventions as mentioned in section 4.2 which indicated that the accessibility of wards 27,28, 31 32 30,18,20,22,23,36,25,26,34 and 37 with regard to reaching health care services needs to be improved.

It is concluded from the study as indicated by the low importance values given to various attributed of IPT services that the commuters in general are not aware of improved services that could be availed by them. It is therefore needed that the commuters be made aware of the latest as well as possible comforts that can be availed while commuting. It s concluded from the study that there is a scope for building bypass and thereby reducing the through traffic moving through the city. It is also concluded from the study that e-Autos/Buses can be introduced as a means of faster commute as well as a better ride option especially given that the current IPT services seem to not be able to cater to the 8:00 to 9:00 a.m. IPT demand (with high v by c ratio).

5 OVERALL ACHIEVEMENTS – *supporting documents to be attached.*

5.1 Achievement on Project Objectives/ Target Deliverables (max. 500 words)]

S#	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations, if any, & Remarks thereof:
1	Ward maps obtained, census data obtained. The details on operational characteristics of IPT Digitization of existing roadway infrastructure and various means of transport in VISUM	Ward maps obtained, census data obtained. The existing ward map has been digitized. The road network has already been input in VISUM. The network details along have been provided for detailed analysis	Ward maps obtained, census data obtained. The details on operational characteristics of IPT Digitization of existing roadway infrastructure and various means of transport in VISUM	No deviations
2	To collect the primary data with respect to	Establishment of trip generation models	Trip rates have been achieved.	No deviations

	the travel characteristics and satisfaction level of commuters in Imphal using household survey and details on existing load profile along various routes and the occupancy survey of the intermediate public transport services.	Conducting Trip Distribution Conducting Mode choice of commuters using developed utility functions Base year assignment of private vehicle traffic and IPT traffic	Trip distribution model has been established with gravitation parameters calibrated for the home based work, educational and other trips. Base year assignment has been carried out for private and IPT traffic	
3	To carry out empirical analysis of the collected data	Development of 'index of transport social needs' and 'Index of IPT provision'	The social vulnerability index has been developed	Yes, deviations have been made as the data collected was not sufficient to develop the index of transport social needs and index of IPT provision hence 'vulnerability index' has been developed.
4	To develop the model highlighting the existing routes of intermediate public transport network and to assess whether the existing routing is sufficient or not	IPT Indicators of need and provision by wards	Territory indicators in terms of Passenger kilometres (PassKmTrav (AP))	No deviations

5.2 Interventions (max. 500 words) Nil

5.3 On-field Demonstration and Value-addition of Products, if any (max. 500 words)

The study involved skilled execution of several questionnaires which were duly filled by the field surveyors. These surveyors were repeatedly trained in order to make the evaluators understand the importance of the questions as well as the meaning of the question. The students were also initially trained to carry out various surveys.

5.4 Green Skills developed in in State/ UT (max. 500 words)

The study involved skilled execution of several questionnaires which were duly filled by the field surveyors. These surveyors were repeatedly trained in order to make the evaluators understand the importance of the questions as well as the meaning of the question. The students were also initially trained to carry out various surveys.

5.5 Addressing Cross-cutting Issues (max. 200 words)

The project was carried out majorly in the covid times therefore several cross cutting measures were carried out. The first being that the initially envisaged equipment namely the VBOX was not indented and the amount was reapportioned into field activities. Since the household survey was carried out after the second wave of COVID the people were apprehensive to let the enumerators into the house. Hence the help of DC Imphal was sought to carry out the household surveys. Some of the lines of share auto were identified using the help of students of Manipur Institute of Technology.

6 PROJECT'S IMPACTS IN IHR – *supporting documents to be attached.*

6.1 Socio-Economic impact (max. 500 words)

The developed gravitation parameters shall help in assessing the accessibility to various public infrastructure based point of interest. The study has shown the means of identifying wards having higher social vulnerability. The above highlighted methodologies as well as results shall help the stakeholders arrive at a learned decision on identifying wards wherein infrastructural interventions needs to be undertaken. It shall also help the stakeholders identify regions which have higher concentration of social vulnerability.

6.2 Impact on of Natural Resources/ Environment (max. 500 words)

The study recommends the use of E-Auto and buses for travelling in order to improve the congestion but also act as a deterrent to the onset of adverse environmental conditions.

6.3 Conservation of Biodiversity/ Land Rehabilitation in IHR (max. 500 words) N.A

6.4 Developing Mountain Infrastructures (max. 200 words)

The study recommends exploration of bypass of the through traffic and also the proposition of introducing e-Autos.

6.5 Strengthening Networking in State/ UT (max. 200 words)

The findings of the project are especially useful to field and practicing engineers. The study findings highlights the need for a bypass, the indicators that require improvement with respect to the operation of IPT services have been identified. This shall help the PWD to consider the option of building a bypass. The wards which require interventions in terms of accessibility to public infrastructure POI's, namely hospitals, have been identified. This enables the town planning division to look into the prospect of building the hospital infrastructure. The current LOS for select corridors within Imphal was computed along with the predicted LOS using growth rates. This again enables the PWD to look at the possibility of improving the LOS through infrastructural interventions. The study had also modeled a fare structure for E-Auto and has evaluated the proportion of people shifting to the service based on the assumptions of the assumed fare structure and operating speed. The study has evaluated the IPT services a public transport services and found the LOS for the same. The Directorate of Transport can look into the above proposal and consider the introduction of a new mode of service.

7 EXIT STRATEGY AND SUSTAINABILITY – *supporting documents to be attached.*

7.1 Utility of project findings (max. 500 words)

The findings of the project are especially useful to field and practicing engineers. The study findings highlights the need for a bypass, the indicators that require improvement with respect to the operation of IPT services have been identified. The wards which require interventions in terms of accessibility to public infrastructure POI's, namely hospitals, have been identified. The current LOS for select corridors within Imphal was computed along with the predicted LOS using growth rates. The study had also modeled a fare structure for E-Auto and has evaluated the proportion of people shifting to the service based on the assumptions of the assumed fare structure and operating speed. The study has evaluated the IPT services a public transport services and found the LOS for the same.

7.2 Other Gap Areas (max. 200 words)

The current data was collected predominantly when COVID fear was still prevalent hence the prediction accuracy of the mode choice model can be improved. Similarly the assignment results also can be improved with revised traffic counts.

7.3 Major Recommendations/ Way Forward (max. 200 words)

The major recommendation of the study include that the possibility of E-Auto instead of the currently operational diesel autos be initiated. In ward numbers ,28, 31 32 30,18,20,22,23,36,25,26,34 and 37 (figures 28 and 29) accessibility to key services such as health care needs to be improved. Possibility of enhancing the existing Bus fleet size needs to be explored as the growth rate of buses over the last decade is negative. This will also help reduce the v by c values on the lines of share autos as estimated. The possibility of introducing a bypass needs to be explored which shall pave way for faster services such as E-auto. Driver training programs towards safer driving practices as well as towards sensitization on needs of women safety issues needs to be promoted.

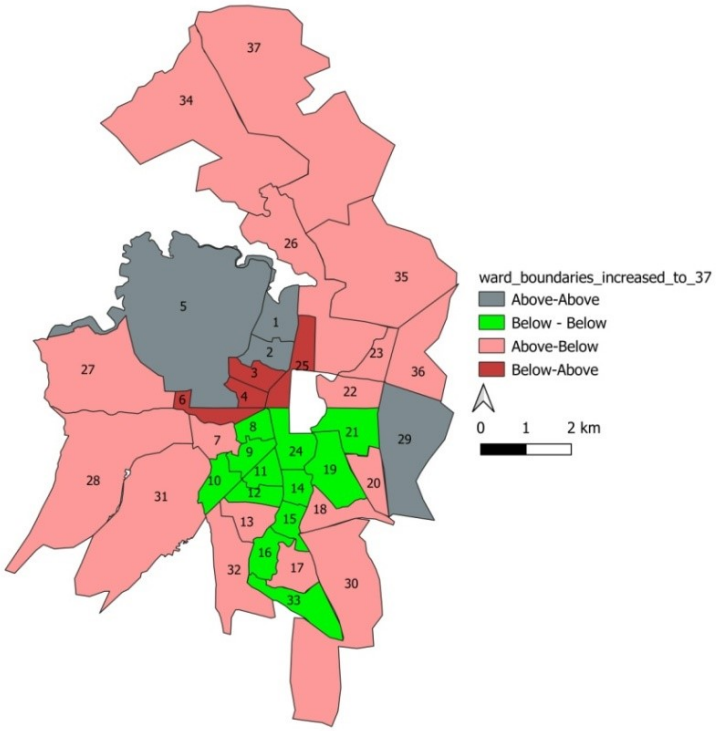


Fig 28: Cross classification based on ABISV (equation 1) and Accessibility Measure

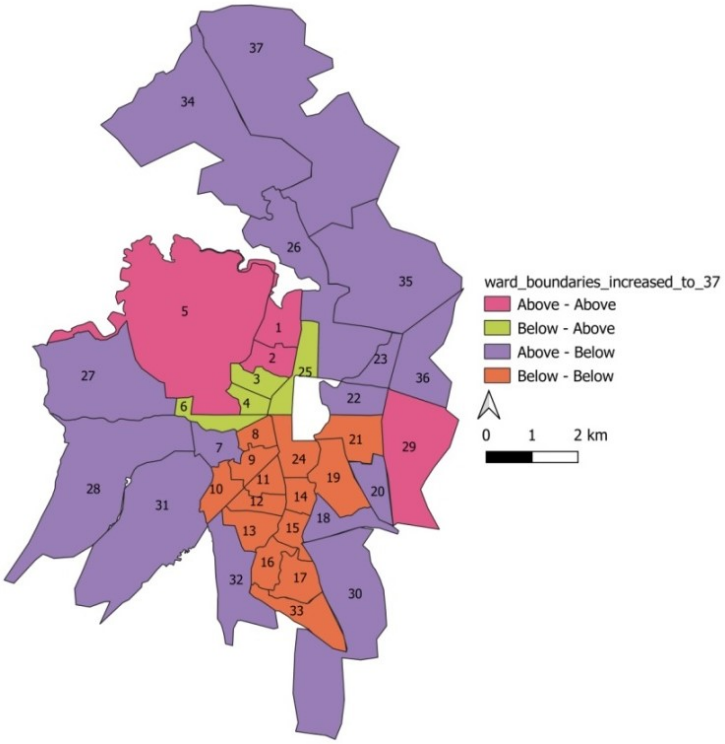


Fig 29: Cross classification based on ABISV (equation 2) and Accessibility Measure

7.4 Replication/ Upscaling/ Post-Project Sustainability of Interventions (max. 500 words)

It is necessary that periodic collection of traffic data be carried out to calibrate the existing four stage models. This shall ensure appropriate gravitation parameters development as well as appropriate identification of LOS of key roads. It is also advised that the trainings on women safety as well as proper driving procedures be periodically imparted to the drivers of IPT services.

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APPENDICES

Appendix 1 – Details of Technical Activities

Appendix 2 – Copies of Publications duly Acknowledging the Grant/ Fund Support of NMHS

Appendix 3 – List of Trainings/ Workshops/ Seminars with details of trained resources and dissemination material and Proceedings

Appendix 4 – List of New Products (utilizing the local resources like NTFPs, wild edibles, bamboo, etc.)

Appendix 5 – Copies of the Supporting Materials like Manual of Standard Operating Procedures (SOPs) developed under the project

Appendix 6 – Details of Technology Developed/ Patents filled, if any

Appendix 7 – Any other

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Annexure-III

Consolidated Assets Certificate

Assets Acquired wholly/ substantially out of Government Grants

(Register to be maintained by Grantee Institution)

Name of the Sanctioning Authority: _____National Mission on Himalayan Studies_____

1. Sl. No. _____
2. Name of Grantee Institution: ___CSIR – Central Road Research Institute_____
3. No. & Date of sanction order: _____
4. Amount of the Sanctioned Grant: ___44,00,000_____
5. Brief Purpose of the Grant: _____Research_____
6. Whether any condition regarding the right of ownership of Govt. in the property or other assets acquired out of the grant was incorporated in the grant-in-aid Sanction Order: __**Not Applicable** _____
7. Particulars of assets actually credited _____**Nil Procured**_____ or acquired_____
8. Value of the assets as on _____ **Nil Procured** _____
9. Purpose for which utilised at present _____ **Not Applicable** _____
10. Encumbered or not _____ **Not Applicable** _____
11. Reasons, if encumbered _____ **Not Applicable** _____
12. Disposed of or not _____ **Not Applicable** _____
13. Reasons and authority, if any, for disposal_____ **Not Applicable** _____
14. Amount realised on disposal _____ **Not Applicable** _____

Any Other Remarks: _____

_____

(PROJECT INVESTIGATOR) **(FINANCE OFFICER)**

(Signed and Stamped) **(Signed and Stamped)**

(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Annexure-IV

List or Inventory of Assets/ Equipment/ Peripherals

S. No.	Name of Equipment	Quantity	Sanctioned Cost	Actual Purchased Cost	Purchase Details
Nil Procured					

(PROJECT INVESTIGATOR) **(FINANCE OFFICER)**

(Signed and Stamped) **(Signed and Stamped)**

(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Annexure-V

Letter of Head of Institution/Department confirming Transfer of Equipment Purchased under the Project to the Institution/Department

NOT APPLICABLE

To,

The Convener, Mountain Division
Ministry of Environment, Forest & Climate Change (MoEF&CC)
Indira Paryavaran Bhawan
Jor Bagh, New Delhi-110003

Sub.: Transfer of Permanent Equipment purchased under Research Project titled "...." funded under the NMHS Scheme of MoEF&CC – reg.

Sir/ Madam,

This is hereby certified that the following permanent equipment purchased under the aforesaid project have been transferred to the Implementing Organization/ Nodal Institute after completion of the project:

1. …….
2. …….
3. …….
4. …….
5. …….
6. …….
7. …….

Head of Implementing Organization:

Name of the Implementing Organization:

Stamp/ Seal:

Date:

Copy to:

1. The Nodal Officer, NMHS-PMU, National Mission on Himalayan Studies (NMHS), G.B. Pant National Institute of Himalayan Environment (NIHE), Kosi-Katarmal, Almora, Uttarakhand-263643

Annexure-VI

Details, Declaration and Refund of Any Unspent Balance

Please provide the details of refund of any unspent balance and transfer the balance amount through RTGS (Real-Time Gross System) in favor of **NMHS GIA General** and declaration on the official letterhead duly signed by the Head of the Institution.

Kindly note the further Bank A/c Details as follows:

Name of NMHS A/c:	NMHS GIA General
Bank Name & Branch:	Central Bank of India (CBI), Kosi Bazar, Almora, Uttarakhand 263643
IFSC Code:	CBIN0281528
Account No.:	3530505520 (Saving A/c)

In case of any queries/ clarifications, please contact the NMHS-PMU at e-mail: nmhspmu2016@gmail.com