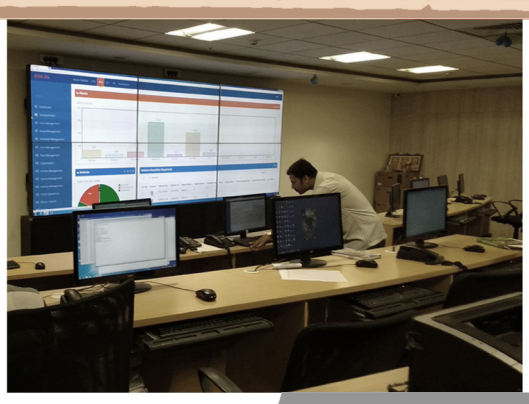
Roadmap for improving City Bus Systems in India



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Shakti Sustainable Energy Foundation works to strengthen the energy security of India by aiding the design and implementation of policies that support energy efficiency, renewable energy and sustainable mobility.

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Warm regards from the study team.

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AC	Air Conditioner
ADB	Asian Development Bank
AG	Aktiengesellschaft (Corporation)
ÄICTSL	Atal Indore City Transport Services Limited
AJL	Ahmedabad Janmarg Limited
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AMTS	Ahmedabad Municipal Transport Service
APC	Automatic Passenger Counting Systems
APSRTC	Andhra Pradesh State Road Transport Corporation
ASRTU	Association of State Road Transport Union
AVLS	Automatic Vehicle Location system
BFMS	Bus Fleet Management System
BMTC	Bangalore Metropolitan Transport Corporation
BPTSL	Bhubaneshwar Puri Transport Services Ltd
BQS	Bus Queue Shelter
BRT	Bus Rapid Transit system
CAN	Controller Area Network
CCTV	Closed Circuit Television
CDP	Comprehensive Development Plan
CEO	Chief Executive Officer
CEPT	Centre for Environmental Planning and Technology University
CGM	Chief General Manager
CIRT	Central Institute of Road Transport
CMP	Comprehensive Mobility Plan
CNG	Compressed Natural Gas
CSTC	Calcutta State Transport Corporation
CTC	Calcutta Tramways Company
CTTS	Comprehensive Traffic and Transportation Study
DIMTS	Delhi Integrated Multimodal Transit system Limited
DOS	Disk Operating System
DPR	Detailed Project Report
DTC	Delhi Transport Corporation
DTS	Dream Team Sahara
DULT	Directorate of Urban Land Transport
DVR	Digital Video Recorder
EPB	Earning per Bus
EPKM	Earning per kilometer
ERC	Expert Review Committee
ERP	Enterprise resource planning
ETA	Expected Time of Arrival
ETM	Electronic Ticketing Machine

EWT	Excess Waiting Time
FActIs	Finance and Accounting Information System
FIFO	First In First Out
GDP	Gross Domestic Product
GPS	Global positioning system
GTFS	General Transit Feed Specification
HO	Head Office
HQ	Head Quarter
HR	Human Resources
HRM	Human Resource Management system
HRTC	Himachal Pradesh Road Transport Corporation
iBus	Bus Communication and Information System
IIT	Indian Institute of Technology
IPT	Intermediate Public transport
ITS	Intelligent Transport System
IVRS	Interactive Voice Response System
JICA	Japan International Cooperation Agency
JIT	Just In Time
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
KCTSL	Kanpur City Transport Service Limited
KCTSL	Kanpur City Transport Service Ltd
KMB	Kowloon Motor Bus Company
KPI	Key Performance Indicator
KSRTC	Karnataka State Road Transport Corporation
LED	Light Emitting Diode
LIMs	Log Sheet Issue Machines
LTA	Land Transport Authority
MD	Managing Director
MIS	Management Information System
MoRTH	Ministry of Road Transport and Highways
MoUD	Ministry of Urban Development
MPS	Minimum Performance Standards
MRTS	Mass Rapid Transit system
MS	Microsoft
MSRTC	Maharashtra State Road Transport Corporation
NA	Not Available
NFC	Near-Field Communication
NGO	Non-government organizations
OBD	On-Bus Diagnostics
OD	Origin Destination
OEM	Original Equipment Manufacturer
OLTAS	Online ticket accounting system

PA	Public Address System
PIS	Passenger information system
PM	Post Meridiem
PMC	Project management consultant
PMS	Person Management System
PMU	Project Management Unit
PPP	Public Private Partnership
PT	Public Transport
PTAL	Public Transport Accessibility Level
PTV	Planung Transport Verkehr AG
RFID	Radio frequency identification
RFP	Request for Proposal
RNNTL	Raipur Nagar Nigam transport Limited
ROTA	Return On Total Assets
ROW	Right of Way
RTO	Regional Transport Office
SMS	Short Messages to be Sent
SOP	Standard Operating Procedures
SPA	School of Planning and Architecture
SPV	Special Purpose Vehicle
STA	State Transport Authority
StoInS	Stores Inventory System
STU	State Transport Undertakings
TOR	Terms of Reference
UA	Urban Agglomeration
VeMaS	Vehicle Maintenance System
VGF	Viability Gap Funding
WBSTC	West Bengal Surface Transport Corporation

Executive Summary

With rapid urbanization, Indian cities are witnessing increased travel demand combined with demand for faster, reliable and economical transport facilities. However, most of the existing urban public transport systems in India are unable to meet this demand, thereby inducing users to shift towards privatised motorised modes of transport like cars and two-wheelers for their mobility needs.

The responsibility for urban development including urban transport rests with the State and Local Governments. The State Transport Undertakings (STUs) continue to dominate the road transport services for passenger mobility in providing inter-state, intercity services. STUs also provide city transport services in few cities. On the other hand, few mega-cities have exclusive city transport corporations or special purpose vehicle (SPVs) formed for city bus operations. In smaller towns and cities, city buses are operated by unorganised/ un-regulated private players.

It is only in the recent past that few cities have received dedicated urban buses through JnNURM funding. Besides, city bus operations in most cities are financially unsustainable, one of the main reasons for which is Government's obligation to serving all sections of the society and connecting most parts of the city on subsidised rates. It is important that the passenger ridership of the city bus systems needs to be enhanced by providing faster, reliable, comfortable and safe travel to its passengers.

Towards this objective, this project carried out the following activities:

- Review of existing operational, planning and management of bus operations
- Identified gaps in five intervention areas- strategic planning, operational practices, technological deployment, contracting structure and funding
- Developed list of prioritized interventions for various classes of State Road Transport Undertaking (STU)

The case cities for this study purpose were selected through a scientific manner. The 58 cities that procured and developed bus systems through funding support from JnNURM were shortlisted in the initial phase. Secondary data for each city was collected and updated through various sources like reports available in the public domain. Based on data analysis and parameters like city characteristics, availability of public transport modes, population, geographical location, bus fleet, progressiveness and multimodality the cities were categorised into ten groups.

Out of these 10 groups, a total of 12 representative cities – namely Delhi, Ahmedabad, Mysore, Bangalore, Raipur, Kolkata, Nashik, Indore, Bhubaneshwar, Shimla, Kanpur, Vishakhapatnam – were selected for city level data collection and analysis of the current processes and operations at organizational level. The data collection in these cities was based on interviews with officials at the city bus service agency. Additionally an expert review committee comprising of transportation experts in State Transport Undertaking (STU), Special Purpose vehicle (SPV), Government departments and academics was formed and discussions/meetings was initiated from the draft stage of the project.

City wise data regarding operational and financial statistics was collected from STUs/SPVs such as fleet size, route details, staff details, revenue, expenditure and accident details and a summary of the observations are as follows:

Table 0-1: Summary of Operational and financial performance of STUs

City	City Bus Operator	Parameters					
		Population (UA) in Millions	Fleet Held (Actual)	Total Routes	Vehicle Utilization (Km/bus/day)	Revenue (Rs. Per km)	Expenditure (Rs. Per km)
Ahmedabad	Amdabad Municipal Transport Service (AMTS)	7.2	979	154	205	24.57	71.67
	Ahmedabad Janmarg Limited (AJL)	7.2	230	12	223	29.91	56.62
Bangalore	Bangalore Metropolitan Transport Corporation (BMTC)	9.5	6419	245	208	49.6	49.0
Bhubaneshwar	Bhubaneshwar-Puri Transport Services Ltd. (BPTSL)	0.9	185	9	170	Not indicated	Not indicated
Delhi	Delhi Transport Corporation (DTC)	16.7	4468	566	188	29.8	71.4
	Cluster Buses (Delhi Integrated Multimodal Transit system Limited – DIMTS)	16.7	1490	93	210	31.5	49.2
Indore	Atal Indore City Transport Services Limited (ÄICTSL)	2.1	150	14	CNG- 300, Midi - 190	32.0	Not indicated
Kanpur	Kanpur City Transport Service Ltd (KCTSL)	2.9	270	24	102**	19.5	22.7
Kolkata	Calcutta State Transport Corporation (CSTC)	14.0	820	112	230	34.8	111.6
	West Bengal Surface Transport Corporation (WBSTC) Ltd.	14.0	236	18		33.8	59.7
	Calcutta Tramways Co. (1978) (CTC) Ltd.	14.0	456	76	206	21.8	59.4
Mysore	Karnataka State Road Transport Corporation (KSRTC)	0.9	445	40	228	36.0	44.0
Nashik	MSRTC (Maharashtra State Road Transport Corporation)	1.4	264	543	235	32.3	46.6

City	City Bus Operator	Parameters					
		Population (UA) in Millions	Fleet Held (Actual)	Total Routes	Vehicle Utilization (Km/bus/day)	Revenue (Rs. Per km)	Expenditure (Rs. Per km)
Raipur	Raipur Nagar Nigam transport Limited (RNNTL)	1.1	100	11	200	17.8	14.4
Shimla	Himachal Pradesh Road Transport Corporation	0.17	169	245	98	36.0	53.3
Vishakhapatnam	Andhra Pradesh State Road Transport Corporation (APSRTC)	1.7	654	200	298*	23.4	29.4
*covers operations in long distance suburban routes **includes offloaded buses also							

Source: DIMTS Survey (2016)

Observations:

- The fleet size increases with size of the city. However, cities like Kolkata, Ahmedabad and Kanpur do not follow the trend. Based on the norms released by the MoUD to estimate the bus requirement of a city based on its size, there is a shortfall of more than 4000, 1000 and 800 buses respectively in these cities. Delhi also has a shortfall of more than 4000 buses.
- Delhi has most number of routes, but the most standout case was of Nashik (operated by MSRTC) which has 543 routes with 264 buses. This is mainly because each bus has a minimum of 3 routes to serve.

Simultaneously, the best practices followed by other peers in different parts of the world were reviewed. The best practices can lay down the foundation for Indian cities to initiate reforms. Indian cities can learn the management practices and technology implementation done in cities like Singapore, Hong Kong and London. Further, there are some other key examples of best practices in different cities around the world. Based on the review of the existing best practices in the world and their comparison with practices followed in city bus operation in India, gaps were identified.

The existing gaps identified for each of the intervention area are as follows:

1) Gaps in strategic transport planning:

- Lack of city level integrated public transport planning
- Lack of PT route mapping and infrastructure
- Lack of focus on provisioning transport infrastructure
- Absence of accessibility based planning such as using indicators to define the service delivery in terms of distance, cost waiting time etc.

2) Gaps in use of Information and Communication Technology (ICT)

- Absence or un-availability of periodically updated digital city maps
- Lack of maintenance of GPS devices installed in vehicles

- Collection of in-accurate data due to network issue and poor maintenance of the devices
- Lack of integration of on-board computer systems available on new buses procured under JnNURM with other systems in the buses
- Installation of GPS devices on a stand-alone basis, without driver consoles except in Ahmedabad and Mysore
- Lack of two-way communication system in the buses.
- Absence of panic buttons and on-stop bus request buttons in buses
- Limited use of planning and scheduling systems to prepare timetables and duty rosters for the crew and buses.
- Lack of automated systems for attendance and leave application. Currently, the process followed is manual, and suffers from favoritism and mal-practices.
- No city has implemented Bus Fleet Management System or MIS / ERP system till date
- No analysis or data analytics is done with the available data

3) Gaps in Operational Processes

- Use of local knowledge and judgement for route planning and rationalization instead of scientific data.
- Non-optimal and inefficient operations due to adoption of manual systems using parameters like journey speed and EPK for timetabling and schedule adjustments.
- Several cities have computerized some of their functions but in an isolated manner.
- The existing MIS system is outdated and requires major upgrades. In current times when data is being made available from GPS/ETM on a disaggregated level, these MIS systems require an overhaul to incorporate new data availabilities.
- Most of the cities are still struggling with maintenance due to non-availability of spare parts and technical manpower. Breakdown analysis is not done to identify the reasons of failure – Spare Parts, Driver or Workshop
- Stand-alone system for procurement (Least cost contracts system in use), inventory, fuel and store consumption is used in the depot. There is no standard quality monitoring procedure to check the material at the time of entry.
- Human resource department is setup only at HQ level. In smaller STUs (Nashik and Shimla) and SPVs (Kanpur and Indore), there is no separate HR department to manage these functions

4) Gaps in Institutional and Contracting framework

- Neglect of city bus operations as STUs that operate city bus services focus more on the inter-city bus services. For operations, old fleets are used and quality of service is poor, though they have domain experience
- Lack technical staff/knowledge in the ULBs that supervise city bus operations
- Lack of monitoring of service delivery in Net cost contracts for bus operations as there is no risk of revenues to the ULBs. Private operators are interested in only operating on profit making routes and therefore neglect several areas.

5) Gaps in funding

- In most cities, no regular fare revisions are carried out for various reasons.

- Money spent in providing concessions to various sections of users is not reimbursed by the ULBs/State government agencies
- Buses operate on low profit routes
- ULBs have to rely on central funding for procurement of buses due to lack of dedicated fund for public transport
- Commercial exploitation of assets such as terminals, BQS etc., is not aggressively done by the STUs/ULBs.

Based on the gaps identified gaps in the five intervention areas (strategic planning, technology interventions, processes, infrastructure, contracting framework and funding) and the review of the available best practices, various recommendations and an indicative roadmap is listed out for a period of next 10 years.

The general project studies which are required to carried out by STUs and SPVs before the adoption of the recommended policies or which can be taken up along with implementation of the recommendations are as follows:

- **Business plan**: - All SPVs and STUs shall prepare a business plan for the organisation for minimum 10 years and maximum 20 years. The business plan can have the future inflow of funds detailed out along with bus requirements, requirement of new departments, new recruitments, hiring policy, fare revision mechanisms, and bus procurement phasing plan
- **Detailed Project Report (DPR) / Bus Modernisation Plan**: Conduct a feasibility study along with bus requirement and modernisation plan including ITS facilities, infrastructures and funding requirements.

Roadmap Recommendations

The interventions suggested in the roadmap are divided into Short Term (0 – 2 years), Medium Term (2 – 5 years) and Long Term (5 - 10 years). The cities are categorised into progressive, moderately progressive and least progressive and accordingly suitable recommendations and road map is worked out. The priority list of interventions and general requirements of STUs and SPVs for efficient follow-up of the roadmap are also discussed in the sections below.

1) Roadmap for Strategic Transport Planning

Short Term:

- Use recommendations from the Comprehensive Mobility Plan and other transport plans prepared for the city while planning PT system
- Amend the City Master Plans to include proposals from Mobility plans/strategic plans on allocation of depot space, multimodal transit centres, bus terminals etc.
- Prepare city level maps of all the public transport networks including IPT/MRTS etc., (if any)

Medium Term:

- Develop an integrated public transport route networks along with the interchange nodes and economic nodes to help in the strategic planning and decision making related to public transport provisioning

- Form separate business units / divisions, one for planning and another for operations which are integrated within STUs/SPVs
- Modify the existing service level benchmarks (SLBs) with focus on overall mobility. For example:
    - Availability of PT modes within 500m/1000m of settlements
    - Average waiting time not more than 10 min
    - Frequency of buses 5 min during peak hour and 10 min during off-peak hours etc.

Long term:

- Use Big Data and modelling for decision making
- Develop simple mapping tools to conduct PT accessibility analysis, plot O-D desire patterns when modelling software are not used.

2) Roadmap for Technology Interventions

a) Vehicle Tracking

Short Term:

- Integrate the existing city map with layers like key destinations and other transport infrastructure
- Improve GPS reliability and calibrate the systems as per the field conditions

Medium term:

- Install key components like panic button, driver console etc.
- Integrate new buses with OBD-II with the existing system and calibrate the system to improve Expected Time of Arrival (ETA) of buses

Long Term:

- Explore the feasibility of installing driver behavior monitoring systems and if feasible, create exception reporting and alerts system for deviation from the set benchmarks like speed, route and schedule

b) Revenue Collection

Short Term:

- Use existing ETM infrastructure to introduce smart card in buses
- Introduce common mobility cards

Medium term:

- Study feasibility of restructuring the existing fare collection mechanism and introduce card validators in the buses.

Long Term:

- Introduce new payment mechanism like NFC and wallet payment for ticketing

c) Passenger Information Systems

Short Term:

- Install CCTV cameras and surveillance systems in the fleet and terminals and integrate the live feed with the operation control centre

Medium term:

- Install PIS network at key bus stops and terminals including railway stations and airports). Then integrate the journey planner tool and create a mobile app providing

real-time information. In later stages, install PA system with internal PIS boards and integrate all information channels to share traffic update, transport options and shortest routes

Long Term:

- Develop lite version indigenous planning and scheduling system for automation of timetabling of scheduling process

d) Fleet Management Systems

Short Term:

- Implement all modules of BFMS system for complete automation of HQ and all depots

Medium term:

- Streamline the existing processes and use technical tools to automate key functions such as maintenance, store & purchase, fuel, accounts and HR
- Implement biometric system for payroll and setup KPIs for each department and functional areas
- Implement Wi-Fi and infotainment systems in all buses in-lieu of advertising rights

Long Term:

- Implement APC in selected routes on pilot basis to measure the increase in revenue

e) MIS and Data Analytics

Short Term:

- Set up separate divisions for MIS and Data Analytics
- Conduct capacity building of the existing manpower and recruit specialized staff to conduct data analysis

Medium term:

- Use data to make decisions in the organization

Long Term:

- Use data for the planning of new routes and rationalization of existing routes

3) Roadmap for improving the operational process

a) Route Planning and Rationalization

Short Term:

- Compile ridership data in standard formats to estimate the demand
- Conduct passenger surveys and household surveys to assess the demand
- Digitize all bus routes and identify the overlapping routes to prepare simple network

Medium Term:

- Conduct scientific studies to analyze the passenger OD patterns for deciding alignment and frequency of route

Long Term:

- Use transport planning and route optimization software for detailed analysis and transport modelling tools such as PTV VISUM, TransCAD, Cube Voyager, EMME etc., for demand assessment for new routes
- Make ETM data available in real time (online)

b) Time tabling

Short Term:

- Use GPS data to calculate the bus running time for different times of the day (peak and off-peak hours), month and seasons in both directions

Medium Term:

- Use ETM data to create stop wise boarding profile and adjust schedule

Long Term:

- Introduce software to streamline processes as per the technology roadmap

c) Duty Roaster of Crew and Bus scheduling

Short Term:

- Prepare duty roasters for longer period (six months or more) after taking inputs from the crew

Medium Term:

- Notify the crew about duty allocation through SMS a day before the duty and/or provision for crew to accept/ decline duty allocated using SMS or IVRS
- Install Crew Management Kiosks at all depots for crew attendance (biometric) and duty allocation

Long Term:

- Introduce software to streamline processes

d) Maintenance Practices

Short Term:

- Develop an application using MS-Excel or MS-Access to keep record of maintenance schedules
- Group buses in smaller lots and introduce regular preventive maintenance schedules – daily, weekly, monthly and yearly
- Strengthen the fleet maintenance activities by hiring technical manpower or monitoring the performance of service provider
- Monitor key activities like engine oil consumption, tyre pressure, driver complaints, repeated breakdown, and spare part consumption on daily basis

Medium Term:

- Create automated tools for daily analysis of maintenance activities, breakdowns, incidents - bus-wise, driver-wise and route-wise
- Introduce special incentive schemes for workshops with lowest breakdown of vehicles
- Create digital maintenance log-books for each vehicle to keep record of maintenance activities
- Conduct capacity building of technical manpower on new technologies

Long Term:

- Set up training facilities for the technical manpower
- Implement Maintenance Management System – as part of the BFMS under Technology Roadmap

e) *Stores and Purchase*

Short Term:

- Conduct procurements through rate contracts and e-tendering to ensure transparency
- Follow 'Hub and Spoke' model of inventory management. Main store should be setup at central location (central depot) and satellite stores in depots (divisional depot)
- Generate cost sheet of spare parts on the basis of cost per km to evaluate the durability of the material
- Prepare weekly reports on spare parts on the basis of high and low consumption
- Computerize the store and inventory division and create digital record sheets for all spare parts and oil tanks for receipt and issuance

Medium Term:

- Integrate with ERP system of bus manufacturer, suppliers and OEM (Original Equipment Manufacturer) to place repeated purchase orders
- Introduce management concepts like JIT (Just in Time), FIFO (First in First Out) etc.

Long Term:

- Implement Maintenance Management System in all depots – as part of the BFMS under Technology Roadmap

f) *Human Resource*

Short Term:

- Create organizational chart and define role and responsibilities of each department
- Integrate leave management system and biometric attendance with other functions such as crew & bus scheduling, accounts and planning

Medium Term:

- Automate the payroll management system
- Create incentive policy for crew and workshop staff to improve productivity
- Set up training division for crew (drivers and conductors)
- Integrate leave management system and biometric attendance with other functions
- Provide driver skill training using 'Driving Simulators'

Long Term:

- Implement BFMS as per technology roadmap

g) *User Feedback System*

Short Term:

- Upgrade the web-portal by adding bus operation details (routes, fare, buses) for better user accessibility and add a separate user feedback section

Medium term:

- Develop mobile app to disseminate details on bus operations and receive commuter feedback
- Setup toll-free Call Center for grievance redressal and send action taken report to passengers through SMS
- Procure and install an integrated system to keep track of feedback/ suggestions received from all sources

Long Term:

- Use automated systems to identify same feedback/ suggestions received from different sources

h) MIS

Short Term:

- Prepare MIS report and table of existing information in readable formats
- Review existing MIS parameters to add new parameters and remove redundant parameters
- Conduct capacity building of existing manpower and recruitment of specialized staff to conduct data analysis

Medium term:

- Create lite application using Macros in MS-Excel or MS-Access to automate the analysis of raw data
- Generate exception reports on all key parameters (schedule adherence, out-shedded trips, missed trips, speed of buses etc.) and compare with past data on performance
- Generate revenue data on ridership, revenue collected, passengers carried etc., and integrate with route planning
- Use operation data to improve timetables, bus schedules and network plan

Long Term:

- Implement data analysis and optimization as per technology roadmap

4) Roadmap for Improving Bus Transport Infrastructure

Short Term:

- Provide modern Bus Queue Shelter (BQS) on all major routes.

Medium Term:

- Make a strong case for the development authorities for inclusion of adequate space for depots, terminals and changeovers during master plan preparation/amendment

Long Term:

- In larger cities and on major bus density corridor, demand for bus lanes for improving operational efficiency of system. To start with, a corridor carrying more than 5000 persons per hour per direction by bus could be considered for this purpose

5) Roadmap for Institutional and Contracting Framework

Short Term:

- Form SPVs for city bus operations and contract the operations to private operators preferably through Gross Cost Contracts. The SPV should have technical staff to monitor operations based on KPIs agreed between both the parties. SPV should strictly monitor the operations for provision of bonus for better operations and penalty against non-adherence in the service contracts
- In case of cities with Net Cost Contracts, improve the contract by adding KPI to the contract and provide premium/VGF to the operator on the basis of ridership and route length

Medium term:

- Hire a PMC to assist the Transport Department/ULBs/STUs with technical support and bid process management
- Test the Gross Cost Contracting options – Modify the contract type from net cost to gross cost based on market review

Long Term:

- STUs operating the buses should shift their city bus operations through formation of SPV and selection of operators based on Gross Cost Contract with KPIs/Hybrid options

6) Roadmap for Funding Options

Short Term:

- The transport department/STA must allow bus operator to have certain routes with inter-city operations to balance losses from city bus operations and also to encourage private players to participate in tender process
- Seek funding from the Government of India and multi-lateral funding agencies
- Generate revenue from commercial development and place based dynamic advertisement options

Medium Term:

- Initiate resource mobilization from CESS

Long Term:

- Introduce priced parking based on Public Transport Accessibility Level (PTAL) and utilize the revenue generated for improvement of the system

Proposed new tools for improving bus systems efficiency

Based on the above recommendations, the following tools and toolkits are proposed to be developed either by the Government, a NGO, or a commercial start-up to enable efficiency enhancement in bus system in India:

- Development of ERP based dashboard for management,
- Vehicle and Crew optimization tool,
- Time table preparation tool,
- Route rationalization tool,
- Route planning tool,
- Dead kilometer optimization tool,
- GIS-based asset management system,
- Updation of MIS parameters for Bus agencies,
- Fare revision tool, and Bus management system,
- Toolkit / Guidelines for Route Planning,
- Toolkit / Guidelines for Route numbering / Color-code system.

The institutional responsibilities to implement the proposed recommendations lie with various stakeholders, as provided in the table below:

Table 0-2: Action Plan and Stakeholder Responsibilities

Sl. No.	Area of Intervention	Action Plan	Major Stakeholder
1	Strategic Transport Planning	Periodic Amendment of PT Policy guidelines based on requirements	• MoUD
		Development of PT Master Plan / CMP	• ULBs / City Government
2	Technology Interventions	Development of model document for Bus Modernisation Plan	• MoUD / MoRTH
		Implementation of GPS, ETMs, CCTVs, PIS etc.	• STUs / SPVs / ULBs
3	Improving Operational Process	Development of Toolkit for process modernization	• MoUD / MoRTH
		Awareness campaigns on the policy roadmap recommendations with STUs and SPVs	• NGOs and Think-Tanks
		Training and Workshop sessions	• NGOs in collaboration with ASRTU / IIT / SPA / CIRT / CEPT
		Conducting Route Planning and route rationalization studies	• ULBs / STA
4	Institutional and Contracting Framework	Review of existing HR Policy	• Amendment by respective State Governments
		Development and implementation of Training Modules	• By CIRT / ASRTU
5	Funding Options	Development of PT funding policy guidelines	• MoUD / MoRTH
		Fare Revision Mechanisms and dedicated fund for PT	• State Government

It is evident that all the recommendations would have to be implemented by respective STUs and SPVs while other stakeholders provide a supportive role. The responsibility rests with the STU/SPV to improve the city bus system for users as well as for the agency in terms of operational and financial efficiency.

1. Project Background

1.1 Background

Indian cities have witnessed disproportionate growth of private vehicles (growth rate of 12% per annum in the last two decades) and reduced share of public transport modes which are often faced with issues such as inadequate route-network coverage, unreliable services, inefficient operations and unavailability of fleet for operations, overcrowding during peak hours, etc. Thus, it is critical to develop efficient and good quality public transport systems in cities. There are several types of public transport modes available which can provide various capacity levels, flexibilities to cover catchments under different cost implications.

Bus based public transport systems offer medium to high capacities to serve low to medium trip lengths with low cost and high flexibilities; and are attractive to the Urban Local Bodies (ULBs), Transport departments and State Transport Authorities (STA) for implementation. Bus systems can also be used as feeder to rail based systems for first and last mile connectivity.

To achieve a significant modal shift from private to public modes, the Government of India has launched several schemes that encourage greater use of bus based public transport system in cities. However, even after sustained efforts, the present status of city bus service in India indicates that the issues still exist in most cities, in varying extents. Some of the key issues faced in urban bus transportation system and by city bus operators are listed below:

Urban Bus Transport System	City Bus Operator
• Traditional methods of bus operations, management and control • Inadequate Bus Fleet to meet demand leading to low PT modal share (%) • Lack of integration with other modes of transport (physical, network, fare, institutional and information integration) • Unreliable Service & Irregular Frequency • Poor Route Network Coverage & Inadequate stoppages • Lower willingness to pay • Inadequate Fare Box Collection leads to no Profitability & Viability • Ill maintained vehicles & Low customer satisfaction	•Outdated / inadquate depot infrastructure for maintenance of bus fleet •Outdated Depot management and maintenance practices •No scientific methodology to create / modify routes •Revenue collection and reconciliation done manually with element of leakge on the part of conductors as well as passengers • Lack of financial resources for capital investment • Low penetration of technology in bus operations management • Shortage of trained manpower and resources • Lack of integrated database for data analytics and decision makin

1.2 Need for the project

The STUs running city bus operation continue to rely on traditional methods and old concepts based on manual systems. These methods are highly dependent on personal

judgment and local knowledge, and use limited data feed from actual operations back to making important decision on improving operations. This situation causes inefficient operations, impacts commercial viability and results in poor level of service for users. This reduces the lucrativeness of public transport system and its ability to cause mode shift from private vehicles.

Considering this situation, Shakti Sustainable Energy Foundation (SSEF) has taken up an initiative to identify a *Roadmap for improving the city bus system in India*. This project identifies the most needed interventions for improvement of bus based public transport systems in cities. For this, SSEF assigned the Consultancy Services and respective tasks to M/s Delhi Integrated Multi Modal Transit System Limited, Delhi.

1.3 Study Approach & Methodology

The following methodology was adopted for the project:

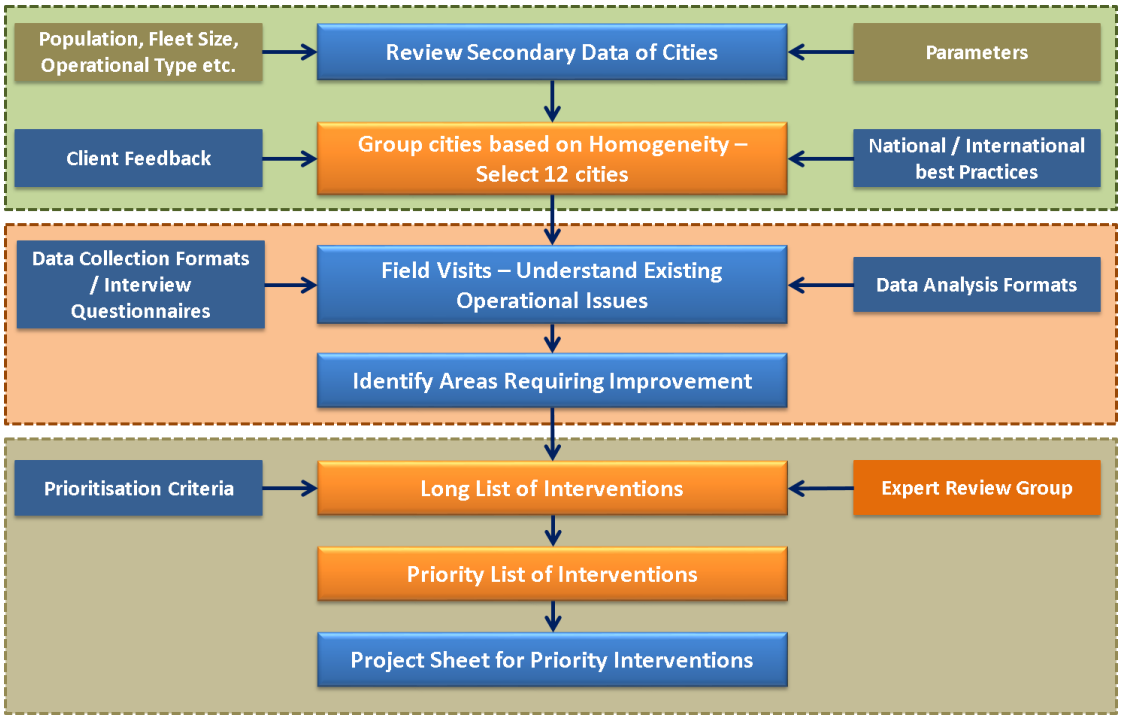


Figure 1-1: Study Approach & Methodology Chart

In order to accomplish the above task, the following scope was adhered to:

- Determine a baseline of existing city bus systems in India including operations and management practices.
- Developing a comprehensive list of interventions for cities to improve their systems
- Consultations with bus agencies for a detailed assessment of the current practices and challenges in improving the interventions identified
- Shortlisting a feasible set of interventions in consultation with cities and experts
- Priority mapping of shortlisted interventions vis-à-vis the type of city bus system
- Constituting a review committee for feedback on the proposed priority interventions
- Developing a Policy roadmap for the overall improvement of city bus systems in India

2. City Selection and Data Collection Process

2.1 Introduction

In this chapter, the city selection criteria's, selected cities and data collection process is provided in detail. The agencies/organisations visited from each of the selected city and key personal is also provided.

2.2 City Selection Process

JnNURM supported 58 cities were shortlisted and data such as population, public transport data (such as number of buses, routes, type of buses etc., ITS facilities implemented for operation) and multi-modality for all the cities were collected and updated through secondary sources like reports available in the public domain. These cities were categorised into various groups based on the city characteristics and characteristics of the city bus system. These two parameters were further sub-categorised based on five indicators as indicated in the figure below:

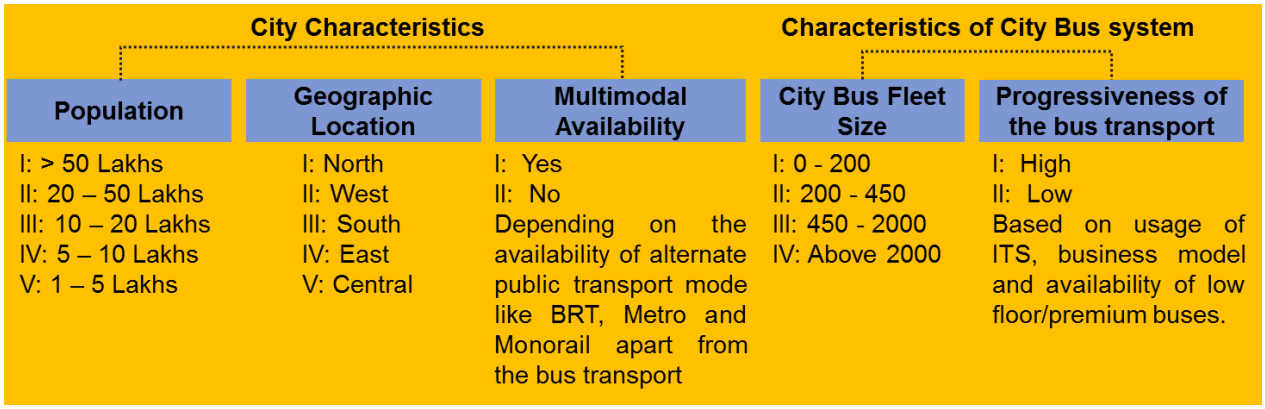


Figure 2-1: Parameters for City Selection

The five (5) indicators and their subgroups lead to around 400 numbers of different criteria combinations into which the cities can be categorised. Out of these combinations only realistic/feasible combinations were considered and analysed further.

Out of 10 feasible groups of cities identified, 12 cities representing various characteristics and spreading across the country were selected and recommended for further analysis.

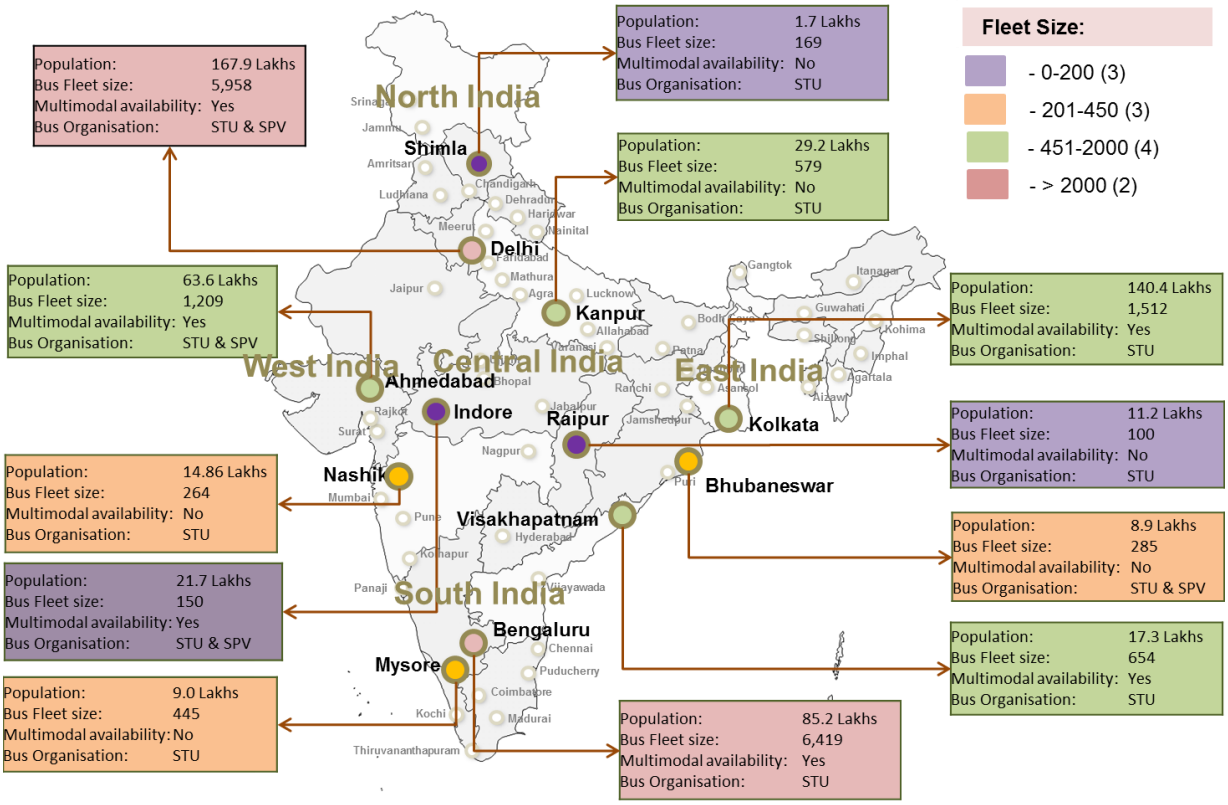


Figure 2-2: Selected Cities for Comprehensive Study

2.3 Data Collection Approach

The data collection was primarily based on Interviews with City bus service agency / organization officials. The STUs of the selected cities were identified and the personal interviews were done based on the prefixed survey questionnaire formats. Survey Questionnaire has been prepared in such a way that recorded or published data is collected as well as the internal processes of agency is determined and understood by a face to face interview. The overall data collection approach followed for the study is as follow:-

1	2	3	4	5
Selection of Cities	**Identified STUs/SPVs**	**Letter's sent for meeting permission**	**Prepared survey scheduled**	**Interviewing HOD's**
Cities are selected based on different categories	STUs and SPVs of the selected cities were identified	permission letters seeking date and time for personal interviews were sent	Based on the response from the STUs, a data collection schedule was prepared for each city and STU	One-on-one meeting with the officials (especially with HODs of various departments) of STU and technical discussions were done by the senior officials of DIMTS.

The data collected from the above mentioned process were collated and analysed to understand the process followed in operations under various functional heads of each STUs.

The departments contacted for collecting data for each city are summarised in Table 2-1.

Table 2-1: Departments and officials of STUs and SPVs contacted

Sl. No.	City	State Transport Undertaking (STU)/ Special Purpose Vehicle (SPV)	Key officials and departments contacted
1	Kanpur	Kanpur City Transport Service Limited (KCTSL)	• Mr. Neeraj Saxena M.D- KCTSL
2	Bengaluru	Bangalore Metropolitan Transport Corporation	• Mr. Bishwajit Mishra Director – Information Technology
3	Mysore	Karnataka State Road Transport Corporation	• Mr. B.C Ganganna Gowda Chief Mechanical Engineer – Production
4	Bhubaneshwar	Bhubaneshwar Puri Transport Services Ltd.	• Mr. Krishan Kumar Commissioner, BPTSL
5	Bhubaneshwar	Dream Team Sahara	• Mr. Sudhansu Jena, CEO, DTS
6	Kolkata	Calcutta State Transport Corporation (CSTC)	• Mr. N. S. Nigam, MD, CSTC
7	Kolkata	Calcutta Tramways Company (CTC)	• Mr. Nilanjan Shandilya, MD, WBSTC and CTC
8	Kolkata	West Bengal Surface Transport Corporation (WBSTC)	• Mr. Nilanjan Shandilya, MD, WBSTC and CTC
9	Shimla	Himachal Road Transport Corporation	• Mr. Raghubir Singh CGM-Operations
10	Raipur	Raipur Nagar Nigam Transport Limited	• Mr. B.L Chandrakar In-Charge Officer, Raipur Nagar Nigam
11	Ahmedabad	Amdavad Municipal Transport Service	• Mr. Arjab Shah (Additional Municipal Commissioner)
12	Ahmedabad	Ahmedabad Janmarg Limited (AJL)	• Mr. Deepak. V. Trivedi General Manager – Operations
13	Vishakhapatnam	Andhra Pradesh State Road Transport Corporation	• Mr. Sudesh Kumar Regional Manager - APSRTC
14	Delhi	Delhi Transport Corporation	• Mr. A. K. Goyal CGM, DTC
15	Indore	AICTSL	• Officials of AICTSL
16	Indore	Prasanna Purple	• Depot Manager
17	Nashik	MSRTC	• Mr. P.N Patil, R.E • Mrs. Y.K. Joshi Divisional Controller – MSRTC, Nashik

2.4 Formation of Expert Review Committee (ERC)

As per project requirements, an expert review committee with eminent transportation experts in all the fields like STU, SPV, Government departments and academics was formed and discussions/meetings was initiated from draft stage of the project. The expert committee was essential in orientation and also finalising the list of feasible interventions.

2.5 Conclusion

After visiting all the selected STUs and SPVs, data was collated and summarised to understand the performance level of each of the city bus operator. The details of the processes reviewed, analysis and city data is provided in the next chapter.

3. City Report Card

3.1 Introduction

In this chapter, a summary of the process and functioning of various STUs surveyed is provided, along with analysis of general, operational and financial statistics. This has been done to understand the performance level of each STU. Summary of the processes followed in each of STUs visited is provided in the later sections.

3.2 Practices Reviewed

During field visit, discussions with senior and concerned officials of the STUs and SPVs were done to understand the practices reviewed and data related to performance statistics was also collected. The details of the practices reviewed are provided in the figure given below:-

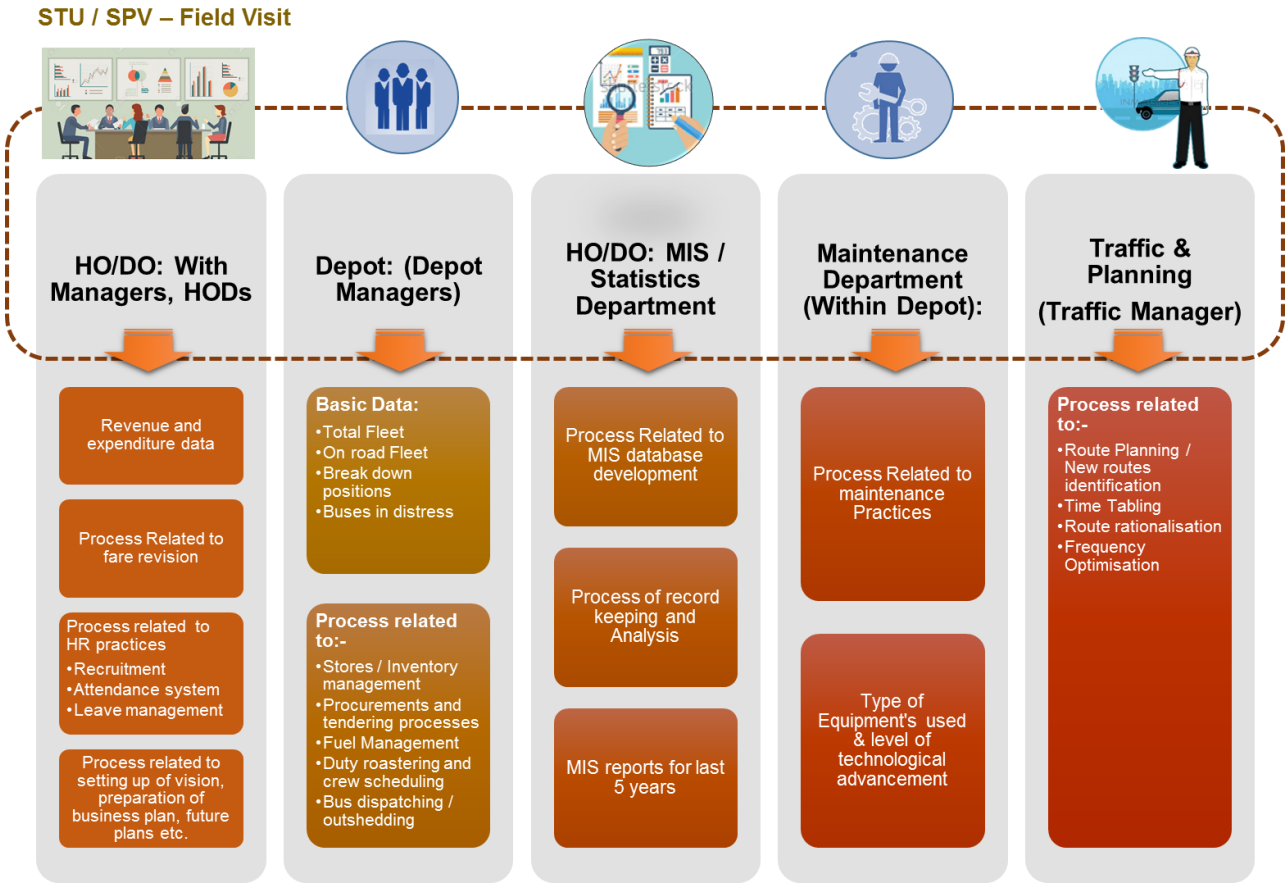
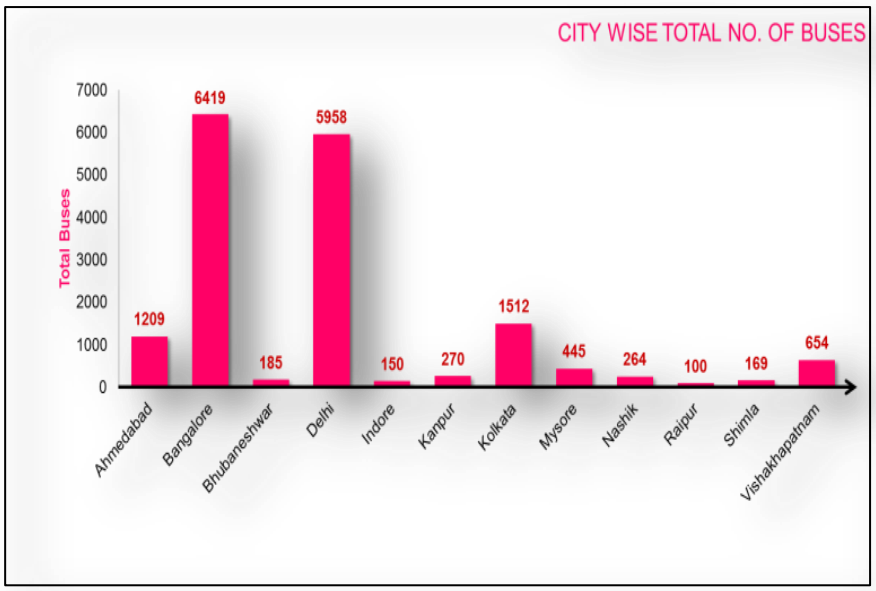


Figure 3-1: Practices Reviewed within City Bus Operator

The data was collected based on questionnaires was used to conduct comparative analysis and also to prepare summary of the processes followed by STUs (provided as city report cards).

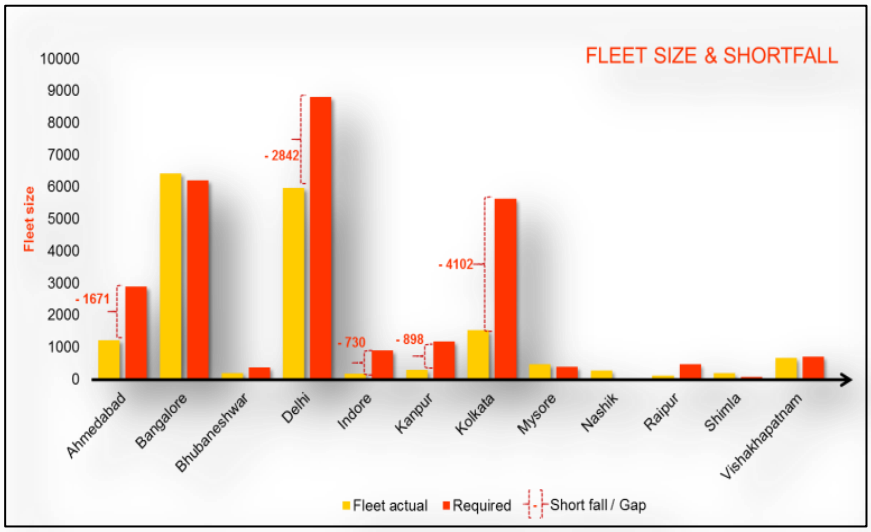
3.3 City-wise Bus Operational Characteristics

General data regarding operational and financial statistics was collected from STUs/SPVs such as fleet size, route details, staff details, revenue, expenditure and accident details through data form I. A summary of the observations are as follows:



- The fleet size increases with size of the city; however, cities like Kolkata, Ahmedabad and Kanpur do not follow the trend.
- These cities also show a shortfall of more than 4000, 1000 and 800 buses respectively. [1] Delhi also has a shortfall of more than 4000 buses as shown in the figure.

Delhi has most number of routes, but the most standout case was of Nashik (operated by MSRTC) which has 543 routes with 264 buses. This is mainly because each bus has a minimum 3 routes to serve. These details are provided in the figure below.



[1] Based on the MoUD guidelines of minimum bus requirement against population of the cities

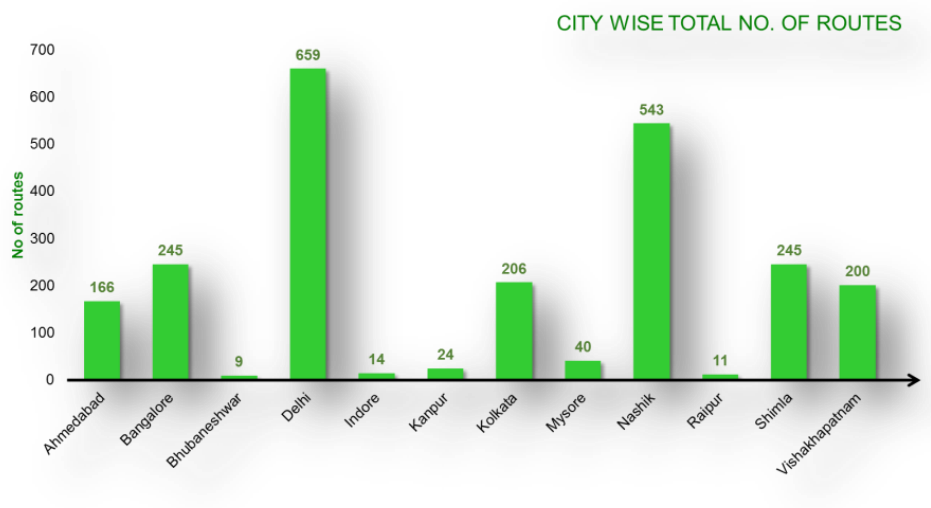


Figure 3-2: City-wise route details

- With respect to vehicle utilisation as shown in **Figure 3-3**, it is observed that Vishakhapatnam has the highest 298 Km/bus/day) followed by Indore (245 Km/bus/day) and Nashik (235 Km/bus/day). The lower values was observed with Shimla (98 km/bus/day) possibly due to the hilly terrain on which the buses operate and lower operational hours.

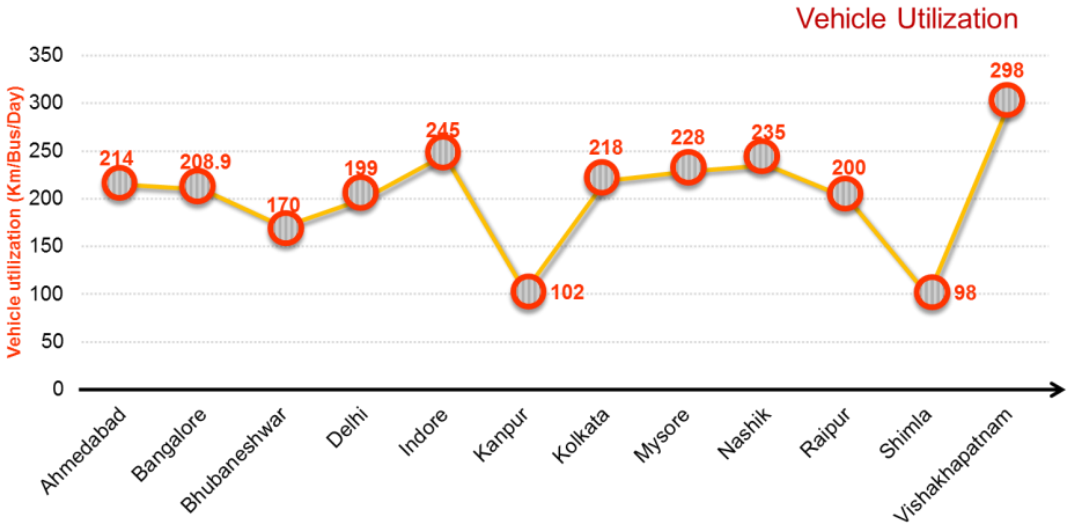


Figure 3-3: City-wise Vehicle Utilisation

A study of the financial statistics of the cities indicates the following:

- The key indicator of financial performance is the bus operating ratio. This is the ratio of total operating costs to revenue. It is estimated based on ratio of cost per kilometre (CPK) to earnings per kilometre (EPK). Ratio of below 1 indicates profits and greater than one indicate losses.
- Of the 12 cities, only Raipur performs with positive financials and Bangalore with breakeven financial performance.

- All other cities incur huge losses such as Kolkata (2.62) followed by Delhi (1.99). This is mainly due to pending fare revisions and increasing oil prices. The revenue, expenditure and the operating ratio for all cities are provided in the figure provided.

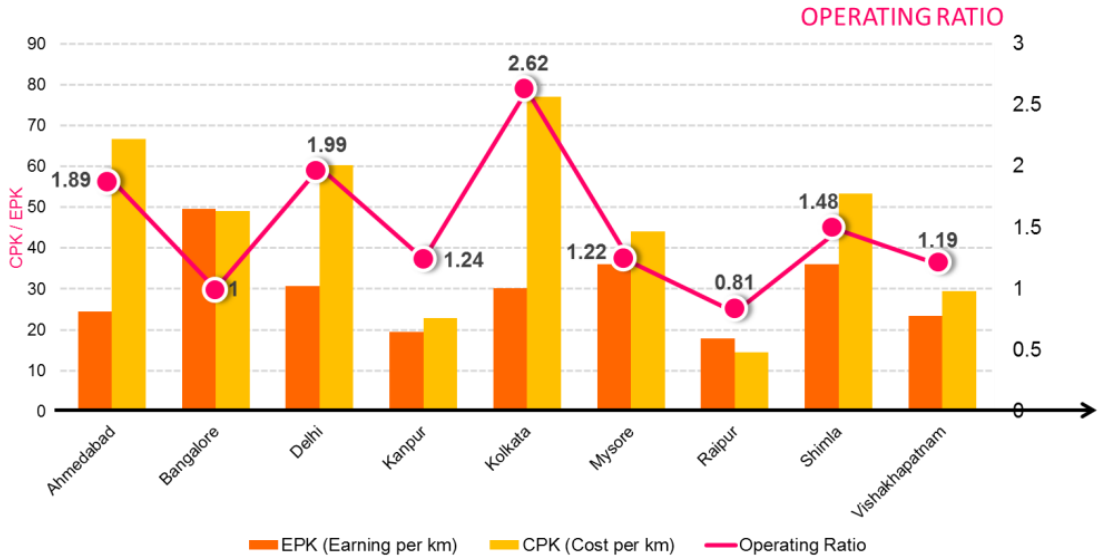


Figure 3-4: City-wise EPK, CPK and Operating ratio

The contracting model of each city has different model:

Table 3-1: City STUs and Private Operators

City	Authority / SPV / Public Operator	Private Operator	Model
Ahmedabad	Amdavad Municipal Transport Service (Municipal Corporation)	Prasana Purple Mobility Pvt. Ltd., Shyama Shyam Services Centre, Mateshwari Travels Pvt. Ltd.	Gross
	Ahmedabad Janmarg Limited (SPV)	Chartered Automotive Pvt. Ltd. Shree Maruti Travel Pvt. Ltd.	Gross
Bangalore	Bangalore Metropolitan Road Transport Corporation (STU)	-	-
Bhubaneshwar	Bhubaneshwar-Puri Transport Services Limited (SPV)	Dream Team Sahara (DTS)	Net
Delhi	Delhi Transport Corporation (STU)	-	-
Indore	Atal Indore City Transport Pvt. Ltd. (SPV)	Prasanna Purple Mobility Pvt. Ltd. Time Travel Pvt. Ltd.	Net Gross
Kanpur	Kanpur City Transport Services Limited (SPV)	-	-

City	Authority / SPV / Public Operator	Private Operator	Model
Kolkata	Calcutta State Transport Corporation Calcutta Tramways Company West Bengal Surface Transport Corporation (STU)	-	-
Mysore	Karnataka State Road Transport Corporation (STU)	-	-
Nashik	Maharashtra State Road Transport Corporation (STU)	-	-
Raipur	Raipur Nagar Nigam Transport Limited (SPV)	Sri Durgamba Transit Pvt Ltd.	Net
Shimla	Himachal Road Transport Corporation (STU)	-	-
Visakhapatnam	Andhra State Road Transport Corporation (STU)	-	-

3.4 City-wise Report Cards

The city-wise report cards summarised from data form II, discussions and site visits are provided below:-

3.4.1 City Report Card - Ahmedabad

<table>
<tr><th colspan="7">CITY REPORT CARD - AHMEDABAD</th></tr>
<tr><td>Bus operations:</td><td colspan="6">Ahmedabad Municipal Transport Service (AMTS) / Ahmedabad Janmarg Limited (AJL)</td></tr>
<tr><td>Parameters</td><td colspan="5">Existing Conditions</td><td rowspan="3">Status</td></tr>
<tr><td>Population (UA) (2011)</td><td>Fleet Held (Actual) (December 2015)</td><td>Total Routes (December 2015)</td><td>Vehicle Utilization (Km/bus/day) (2014-15)</td><td>Revenue (Rs. Per km) (2014-15)</td><td>Expenditure (Rs. Per km) (2014-15)</td></tr>
<tr><td rowspan="2">7.2 millions</td><td>AMTS-979</td><td>154</td><td>205</td><td>24.47</td><td>66.59</td></tr>
<tr><td>AJL – 230</td><td>12</td><td>223</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Route Planning</td><td colspan="5">- Traditional method of route planning</td><td>Moderate</td></tr>
<tr><td>Route Rationalization</td><td colspan="5">- Ahmedabad followed scientific approach to design the route network based on scientific studies and used public transport modelling tools - cube voyager software.
- CEPT University had conducted study to rationalize the routes for both AMTC and AJL in the year 2014 utilizing passenger origin – destination profiles and desire lines.
- The proposal was to introduce direction based trunk feeder route system. However, the proposal was not implemented.</td><td>Good</td></tr>
<tr><td>Time Tabling</td><td colspan="5">- In Ahmedabad, although timetable preparation is done manually, speeds measured from ground are utilized for estimating travel times.
- Also separate time tables are prepared for peak and off periods on BRT routes.</td><td>Moderate</td></tr>
<tr><td>Frequency Adjustment</td><td colspan="5">- AMTS: Manual ticketing system – frequency adjustment is done based on performance, speed, passenger loading etc.
- AJL: Currently Electronic ticketing machines (ETMs) are offline, so reports of ETM data is prepared manually and used for adjustment of frequency of services periodically.</td><td>Moderate</td></tr>
<tr><td>Duty Roster of Crew and Bus scheduling</td><td colspan="5">- Bus & Crew Scheduling Management is done by a manual process. The Duty Roster or ROTA is prepared manually on a daily basis and released in morning to staff.
- Duty management of drivers and conductors is handled by the duty clerk based on his personal memory.</td><td>Poor</td></tr>
<tr><td>Level of ITS implementation</td><td colspan="5"></td><td rowspan="4">Good</td></tr>
<tr><td>Ticketing</td><td colspan="5">- AMTS: Manual ticketing system.
- AJL: Offline ETMs, Automatic Fare Collection system.</td></tr>
<tr><td>Passenger Information</td><td colspan="5">- AMTS: No Passenger information system.
- AJL: PIS boards, Audio Announcement system.</td></tr>
<tr><td>Monitoring</td><td colspan="5">- AMTS: No GPS devices are installed in the buses.
- AJL: GPS and two way communication systems are implemented in buses. But AVLS is not utilized for further analysis.</td></tr>
<tr><td>Security and</td><td colspan="5">- AMTS: No CCTV provision in the buses.</td></tr>
</table>

Surveillance	- **AJL**: CCTV cameras are installed in 22 buses.	
Maintenance Practices	- **AMTS**: Buses are procured by private operators and are responsible for operation and maintenance. - **AJL**: Buses are procured by the authority and private operators are managing the operation and maintenance of the buses. Preventive Maintenance is done - daily, monthly and docking.	
MIS & Data Analytics	- **AMTS/ AJL:** MIS section compiles all the key operation statistics from different departments and prepares daily and monthly report. The MIS at depot as well as HO level are being generated manually. - **AMTS:** Standard data analytics is performed based on GPS data available on various routes. Broad analysis is done of vehicle breakdowns - **AJL:** The detailed analysis is carried out for out shed trips, missed trips, stop wise ridership, route wise revenue analysis, ridership analysis and bunching analysis.	Good
Stores and Purchase	- **AMTS:** Follow e-tendering process based on L1 basis**.** - **AJL:** There is no computerized stores and purchase system installed.	Moderate
Modern Equipment	- **AMTS / AJL**: Equipment are procured by the private operators.	
Other sources of revenue generation	- Commercial development at terminals and depots. Advertisement inside and outside buses	Good
Fare revision	- No fare revision formula.	
User Feedback system	- **AJL:** Complaint register at stations, Toll free number of call center, Facebook, Twitter.	Good
Human Resource Management		Moderate
Leave Management	- Manual leave management system is available.	
Attendance	- Biometric system is used for marking attendance.	

3.4.2 City Report Card - Bangalore

CITY REPORT CARD - BANGALORE						
Bus operations:	Bangalore Metropolitan Transport Corporation (BMTC)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
9.5 millions	6419	245	208.9	49.61	49.00	
Route Planning	**Traditional method** of route planning [2]					Moderate
Route Rationalization	- Rationalization/ simplification of routes has been done scientifically to some extent from passenger origin destination data, demand and local knowledge. - EMBARQ/ DULT have carried out rationalization of routes in Bangalore. A system of direction oriented route has been implemented, called Big 10.					Good
Time Tabling	- Time table optimization is done based on **GPS recorded travel time** in peak and off peak hours. Time table and Crew optimization is initiated on pilot basis using Lumiplan optimization software. - Lumiplan uses GPS speed data in timetables for assessing realistic travel time in peak and off peak periods.					Good
Frequency Adjustment	- Broadly based on **EPKM (Earning per kilometre)** data, overall route ridership and missed trips extracted from MIS. - In future, frequency adjustment is likely to be based on ETM data, looking into stop wise boarding and alighting profiles.					Good
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done manually. - The Duty Roster or ROTA is prepared manually on a daily basis and released in morning to staff. Duty management of drivers and conductors is handled by the duty clerk based on his personal memory.					Poor
Level of ITS implementation						Good
Ticketing	- ETMs are used in most the buses now. BMTC has launched Smart mobility card in partnership with Axis Bank and it will be launched for public in near future.					
Passenger Information	- PIS inside buses and at terminals are implemented.					
Monitoring	- GPS and two way communication systems are implemented in buses. But not utilized for further analysis, or monitoring.					
Security and Surveillance	- CCTV cameras are installed in 500 buses.					
Maintenance Practices	- Preventive Maintenance is done - daily, monthly and scheduled docking.					Good

[2] Based on judgment and local knowledge of major city generators, accessibility of various areas, public requests and request made by local political leaders.

MIS & Data Analytics	- BMTC plans to utilize detailed data analytics for optimization of operations. Some analysis modules to be included are Revenue, Cost, Routes, Load factor, Fleet utilization, Crew efficiency, Operational efficiency analysis etc. - MIS section compiles all the key operation statistics from different departments and prepares daily and monthly reports manually.	Good
Stores and Purchase	- Central Store inventory management system is fully computerized with e-tendering. However the depot inventory module is in pilot stage in one depot.	Good
Modern Equipment	- Automatic washing is used but traditional equipment for maintenance.	Moderate
Other sources of revenue generation	- Commercial development at terminals and depots, Advertisement inside and outside buses.	Good
Fare revision	- Revision done based on oil prices and staff salary revision.	Good
User Feedback system	- BMTC use multiple channels for User feedback. It has setup a toll free helpline through call centre, provided e-mail address; establish a website, facebook account and mobile application.	Good
Human Resource Management		Good
Leave Management	- Automatic leave management system is available.	
Attendance	- Biometric system is used for marking attendance.	

3.4.3 City Report Card - Bhubaneshwar

CITY REPORT CARD - BHUBANESHWAR						
Bus operations:	**Bhubaneshwar-Puri Transport Services Ltd. (BPTSL)**					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (March 2016)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
0.9 millions (2011)	185	9 city routes	170	Not indicated	Not indicated	
Route Planning	- **BPTSL** has adopted routes suggested in mobility plan prepared for the city, to which modifications are implemented based on local knowledge of major city generators, and accessibility of various areas, public requests and request made by local political leaders. - There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- ETM data is reviewed to rationalize routes.					Moderate
Time Tabling	- Time tabling is done **manually**, but not followed strictly. The operator tweaks the services based on demand levels.					Moderate
Frequency Adjustment	- Frequency adjustment is done **manually** and Electronic ticketing machines (ETMs) are offline, so reports of ETM data is prepared manually and used for adjustment of frequency of services.					Moderate
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done by a **manual** process in Bhubaneshwar. - The Duty Roster or **ROTA** is prepared **manually** on a daily basis and released in morning to staff. Leave management system is handled as per Govt. laws.					Poor
Level of ITS implementation	- GPS is installed in buses, but feeds are not used for tracking or travel time estimation. Vehicle Tracking was initially done, but later discontinued. - Few buses, especially those deployed on intercity routes, have CCTV cameras fitted in them. ETMs are introduced in all buses.					Poor
Ticketing	- Offline ETMs are fully implemented					
Passenger Information	- PIS boards are not installed currently.					
Monitoring	- GPS is not installed currently.					
Security and Surveillance	- CCTVs are not installed currently.					
Maintenance Practices	- BPTSL is doing **Preventive maintenance** – daily, monthly and docking (3 months). - The maintenance processes and records are done **manually** at present. Maintenance was responsibility of the vehicle manufacturer. All repair and maintenance inventory is done **manually** and no software is used for the purpose. Instead, log books and registers are maintained.					Moderate

MIS & Data Analytics	- **MIS** reports at depot level are being generated **manually** and later data entry done through computers by the statistical department. - The statistician in the Head Office prepares **daily, monthly** and **yearly** operational reports for the management to review. Weekly reports are generated, based on requirements of the management. - **Data analysis** is done by statistical department (**in house**) based on **ETMs data, route ridership and ticket sold, operation and maintenance cost, customer feedback and local knowledge** and then performance report are generated to review the route-wise performance in terms of earnings and operational efficiency.	Moderate
Stores and Purchase	- **Rate contract** procurement process is done at the central office level. - The request for purchase is sent from the divisional level to the central office and tendering process is done **manually** on the basis of rate contract by the central office. The store inventory is done **manually** at the depot / divisional level.	Moderate
Modern Equipment	- Standard depot equipment are being used.	
Other sources of revenue generation	- Advertisement inside and outside buses. The revenue sharing model is that **20%** share has to be given to **BPTSL**, while the rest is retained by the operator (**DTS**).	
Fare revision	- No fare revision formula.	
User Feedback system	- Customer feedback can be submitted using Email, Website, Mobile SMS and Telephone. - Feedback complaint tracking redressed is done by these systems.	Moderate
Human Resource Management		Poor
Leave Management	- Manual leave management system is available.	
Attendance	- Bio-metric are used.	

3.4.4 City Report Card - Delhi

<table>
<tr><th colspan="7">CITY REPORT CARD - DELHI</th></tr>
<tr><td>Bus operations:</td><td colspan="6">Delhi Transport Corporation (DTC) – Public Operator
Delhi Integrated Multimodal Transit system Limited (DIMTS) – Cluster Buses</td></tr>
<tr><td>Parameters</td><td colspan="5">Existing Conditions</td><td rowspan="3">Status</td></tr>
<tr><td>Population (UA)</td><td>Fleet Held (Actual)</td><td>Total Routes</td><td>Vehicle Utilization (Km/bus/day) (2015-16)</td><td>Revenue (Rs. Per km) (2014-15)</td><td>Expenditure (Rs. Per km) (2014-15)</td></tr>
<tr><td rowspan="2">22 millions (2011)</td><td>DTC – 4468 (March 2016)</td><td>566</td><td>188</td><td>29.8 (non AC, city services only)</td><td>71.4 (non AC, city services only)</td></tr>
<tr><td>Cluster- 1490 (March 2016)</td><td>93 (March 2016)</td><td>210</td><td>31.5</td><td>49.24</td></tr>
<tr><td>Route Planning</td><td colspan="5">- DTC: The operator adopts Traditional method of route planning which is based on origin destination of route, operational feasibility and alignment, identification of designated bus stops, assessing route length data by physical survey.
- Cluster: The agency adopts Scientific method of route planning or evaluation process for operation. There are 657 registered routes identified for operation under the cluster scheme.</td><td>Moderate</td></tr>
<tr><td>Route Rationalization</td><td colspan="5">- DTC: Rationalization of routes has been done scientifically, based on Route rationalization study commissioned by Transport Department, Government of NCT of Delhi in which extensive surveys were done and route mapping and analysis was done in Cube Voyager software. Modifications to routes are done also based on public requests. Cluster buses are operated on congruent alignment with that followed by DTC.
- DIMTS carries out periodic survey to obtain public feedback and suggestions pertaining to cluster services. Route performance is monitored on weekly basis.</td><td>Good</td></tr>
<tr><td>Time Tabling</td><td colspan="5">- DTC: The duty operational plan is based on flat average running time per km during peak and off peak hours. The time table is fixed without taking in to account the actual travel demand on the route.
- Cluster: Currently time tabling is prepared manually, but implementation of differential scheduling is in progress.</td><td>Moderate</td></tr>
<tr><td>Frequency Adjustment</td><td colspan="5">- DTC: Adjustments are done based on review of performance of a route and passenger feedback.
- Cluster: This is presently done broadly based on passenger demand or route ridership (ground data) through Automatic Vehicle Location System software (AVL).</td><td>Moderate</td></tr>
<tr><td>Duty Roster of Crew and Bus scheduling</td><td colspan="5">- DTC: Route & Crew Scheduling Management is done by a manual process across all the depots of DTC. The Duty Roster is prepared manually on a daily basis and released everyday around 4:00 PM for the next day.
- Cluster: Duty allocation of a bus on a particular route is done on the AVL system. Drivers and conductors are issued memos and waybills only after reporting to the depot and biometric verification.</td><td>Moderate</td></tr>
<tr><td>Level of ITS implementation</td><td colspan="5"></td><td rowspan="2">Moderate</td></tr>
<tr><td>Ticketing</td><td colspan="5">- DTC: Manual preprinted tickets are being used. Currently, ETM has been introduced on pilot basis.
- Cluster: Online ETMs are used in all buses, with the provision of fall</td></tr>
</table>

	back on manual preprinted tickets in case of any issue with ETM.	
Passenger Information	- **DTC / Cluster:** LED display boards inside buses (DTC, DIMTS)	
Monitoring	- **DTC**: Monitoring through GPS devices is under progress. - **Cluster:** Monitoring of operations is done through GPS based AVL systems.	
Security and Surveillance	- **DTC:** CCTV has been implemented in 200 buses - **Cluster:** CCTVs are not installed in the buses.	
Maintenance Practices	- **DTC:** DTC has **outsourced** the maintenance and repairs of JnNURM buses to the manufacturers – Tata Motors Limited and Ashok Leyland Limited. The bus-wise logs of kms and maintenance work is **computerized** with daily check list of due buses earmarked for **preventive maintenance** in sync with preventive maintenance schedules as laid down by vehicle manufacturers. - **Cluster:** Maintenance of buses is done by **concessionaires**. **Annual Maintenance Contract (AMCs)** is done by vehicle manufacturer in some cases.	Moderate
MIS & Data Analytics	- **DTC: Route wise EPK** and **EPB** and route wise average no of passengers reports are developed **manually** for monitoring of productivity of crew and operations planning at depot and corporate level. There is no data analytics reported except using MIS reports for making decisions on route performance. - **Cluster:** Daily operation statistics are prepared and monitored through **scientific methods**.	Moderate
Stores and Purchase	- **DTC:** Materials are procured through Lowest cost contract (L1) at the central office level. - **Cluster:** Stores and purchase management is done by concessionaire or vehicle manufacturer.	Moderate
Modern Equipment	- **DIMTS**: Modern equipment's are used by the private operators.	
Other sources of revenue generation	- **Cluster:** Display of advertisement on Cluster buses is in progress.	
Fare revision	- Fares are decided by the Transport Department, applicable both in DTC and Cluster services.	
User Feedback system	- **DTC**: Call center and Website - **Cluster:** Mobile app, OCC, Mail, Letters, Feedback forms on website	Moderate
Human Resource Management		Moderate
Leave Management	- **Cluster:** Concessionaire/ Man power agency (Conductor)	
Attendance	- **DTC:** Presently both biometric and manual systems exist. - **Cluster:** Biometric attendance system is being used.	

3.4.5 City Report Card - Indore

CITY REPORT CARD - INDORE						
Bus operations:	Atal Indore City Transport Services Limited (ÄICTSL)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
2.17 millions	150	14	CNG - 300 Midi – 190	32	Not indicated	
Route Planning	- The city bus route network system has been planned and designed in a **scientific** manner. **Direction oriented Hub and Spoke pattern** of routing has been adopted. - Also AICTSL undertakes passenger loadings in deciding the routes apart from the traditional method of route planning.					Moderate
Route Rationalization	- Rationalization/simplification of routes has been done **scientifically** based on passenger origin destination, demand and local knowledge and using **public transport modelling tool.**					Moderate
Time Tabling	- Time tabling is done **manually** based on the expected passenger loadings in the peak, normal and off peak hours.					Moderate
Frequency Adjustment	- This is presently done broadly based on **EPKM (Earning per kilometre)** data and route ridership and cancelled trips extracted from MIS.					Moderate
Duty Roster of Crew and Bus scheduling	- In the current process, Route & Crew Scheduling Management is done by a **manual** process. The Duty Roster is prepared **manually** on a daily basis for the next day. - Daily earning report and monthly route wise performance reports are prepared and used in bus scheduling.					Moderate
Level of ITS implementation						Moderate
Ticketing	- Offline ETMs are fully implemented.					
Passenger Information	- PIS inside buses are implemented.					
Monitoring	- GPS are implemented in buses.					
Security and Surveillance	- CCTVs are installed in BRT buses at present.					
Maintenance Practices	- City buses operation is operated on Net Cost model. The buses are procured and maintained by the operators. - BRT buses are owned by AICTSL and operated by private operator under Gross Cost Model. Maintenance is being carried out by the private bus operators and buses are having **Annual Maintenance Record (AMCs)** with the bus manufacturer.					Moderate
MIS & Data Analytics	- Currently, the MIS is being generated **manually** and digitalized by the operator for the MIS purpose in which data is fed from the **ETMs** and **GPS** devices. - **AICTSL** is currently carrying out the data analytics for the reconciliation of payments to be made to the private bus operators and other performance reports as mentioned above through a technology vendor **Ärya Omnitalk**					Moderate

Stores and Purchase	- A separate store and purchase room is there at the bus depots, which are used for the replacement of the bus parts. Stores and purchase records are computerized.	Poor
Modern Equipment	- Equipment are procured by the private operators.	
Other sources of revenue generation	- Only farebox collection.	
Fare revision	- No fare revision formula.	
User Feedback system	- Customer feedback can be submitted using Toll free helpline through call centre, email, website, Facebook, Mobile app	Moderate
Human Resource Management		Moderate
Leave Management	- Manual leave management system is available	
Attendance	- Biometric system is used for marking attendance.	

3.4.6 City Report Card - Kanpur

CITY REPORT CARD - KANPUR						
Bus operations:	Kanpur City Transport Service Ltd (KCTSL)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
2.9 millions	270	24	102	19.5	22.78	
Route Planning	- **KCTSL** adopts **Traditional method** of route planning. There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- No periodic route rationalization study is carried out to improve the existing network. - New routes are evaluated based on **political influence** or **public demand**.					Moderate
Time Tabling	- Time tabling is **manually** done based upon **origin destination route length, passenger demand, road condition, average speed, layover time and number of buses.**					Moderate
Frequency Adjustment	- Frequency adjustment is done **manually** and Electronic ticketing machines (ETMs) are offline, so reports of ETM data is prepared manually and used for adjustment of frequency of services periodically.					Moderate
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done by a **manual** process in Kanpur. The Duty Roster or **ROTA** is prepared **manually** on a daily basis and released in morning to staff.					Poor
Level of ITS implementation	- Not implemented ITS facilities in buses. Only ETMs are introduced on all buses.					Poor
Ticketing	- Offline ETMs are fully implemented					
passenger Information	- PIS boards are not installed currently.					
Monitoring	- GPS is not installed currently.					
Security and Surveillance	- CCTVs are not installed currently.					
Maintenance Practices	- KCTSL carries out **Preventive maintenance** as per manufacturing schedules. The maintenance processes and records are done **manually** at present. Repair & Maintenance activities are out sourced to a service provider. - Software are under development. Fuel management is maintained by software. The data of earned and missed km are fed into software, developed in house by service provider, which automatically updates driver wise, bus wise earned km and fuel average achieved.					Moderate
MIS & Data Analytics	- **MIS** at depot as well as Head Office level are being generated **manually** and later data entry done through computers by the statistical department.					Moderate

Stores and Purchase	- **Rate contract** procurement process is done at the central office level by service provider. Limited Tender is done for day today urgent requirements to be procured from local market. - Service provider has in place a **software based inventory control** system. Quality control management is done **manually** and visually respectively. They do not have material testing facility.	Moderate
Modern Equipment	- Standard depot equipment are being used.	
Other sources of revenue generation	- Only farebox collection.	
Fare revision	- No fare revision formula.	
User Feedback system	- No customer feedback system is available.	
Human Resource Management		Poor
Leave Management	- Manual leave management system is available.	
Attendance	- Manual system to record attendance.	

3.4.7 City Report Card - Kolkata

<table>
<tr><th colspan="7">CITY REPORT CARD - KOLKATA</th></tr>
<tr><td>Bus operations:</td><td colspan="6">Calcutta State Transport Corporation (CSTC) / West Bengal Surface Transport Corporation (WBSTC) Ltd. / Calcutta Tramways Co. (1978) (CTC) Ltd.</td></tr>
<tr><td>Parameters</td><td colspan="5">Existing Conditions</td><td rowspan="5">Status</td></tr>
<tr><td>Population (UA)</td><td>Fleet Held (Actual) (December 2015)</td><td>Total Routes (December 2015)</td><td>Vehicle Utilization (Km/bus/day) (2014-15)</td><td>Revenue (Rs. Per km) (2014-15)</td><td>Expenditure (Rs. Per km) (2014-15)</td></tr>
<tr><td rowspan="3">14 millions (2011)</td><td>CSTC - 820</td><td>112</td><td>230</td><td>34.87</td><td>111.67</td></tr>
<tr><td>CTC - 456</td><td>76</td><td>206</td><td>21.83</td><td>59.4</td></tr>
<tr><td>WBSTC – 236</td><td>18</td><td>-</td><td>33.87</td><td>59.76</td></tr>
<tr><td>Route Planning</td><td colspan="5">- CSTC, CTC and WBSTC adopt Traditional method of route planning.</td><td>Moderate</td></tr>
<tr><td>Route Rationalization</td><td colspan="5">- In the absence of any travel data, existing routes are evaluated based on public demand.</td><td>Moderate</td></tr>
<tr><td>Time Tabling</td><td colspan="5">- CSTC: Time tabling is computerized using a spreadsheet tool is developed in Excel based on number of vehicles to be put, average speed that can be achieved depending upon traffic congestion and number of stops, halt time at the destination.
- Time tables are revised whenever required (approx. twice a year).</td><td>Moderate</td></tr>
<tr><td>Frequency Adjustment</td><td colspan="5">- There is no scientific method of frequency adjustment.</td><td></td></tr>
<tr><td>Duty Roster of Crew and Bus scheduling</td><td colspan="5">- CSTC: Through Online Ticket Accounting System
- CTC / WBSTC: Crew and bus scheduling is done by manual process.</td><td></td></tr>
<tr><td>Level of ITS implementation</td><td colspan="5"></td><td rowspan="4">Moderate</td></tr>
<tr><td>Ticketing</td><td colspan="5">- CSTC: Introduction of ETMs is in progress (60% complete) . Online Advanced Ticket reservation system for long distance services
- CTC/ WBSTC: Manual, pre-printed tickets are used</td></tr>
<tr><td>Passenger Information</td><td colspan="5">- CSTC: Route information are available on the website
- CTC: Route information are available on the website
- WBSTC: Website is under preparation</td></tr>
<tr><td>Monitoring</td><td colspan="5">- CSTC: In progress
- CTC: Done manually
- WBSTC: GPS are implemented in buses.</td></tr>
<tr><td>Security and Surveillance</td><td colspan="5">- CSTC/ CTC/ WBSTC: CCTV cameras are installed in Volvo bus</td><td></td></tr>
<tr><td>Maintenance Practices</td><td colspan="5">- CSTC/ CTC: Both Preventive and Corrective maintenance is done daily and after completion of 20 thousand km periodicity.
- WBSTC: Both Preventive and Corrective maintenance is done with weekly, monthly, yearly and Km based as per manufacturers recommendations.</td><td>Moderate</td></tr>
</table>

MIS & Data Analytics	- **CSTC**: Compilation and MIS report generation is done at the Central Statistical Section, which compiles data generated in different depots. - **CTC**: The **MIS** at depot level are being generated through softwares, which are later submitted to the Head Office. The depot level systems are not connected to the central system. - **WBSTC**: MIS reports are prepared manually.	Moderate
Stores and Purchase	- **CSTC**: Materials are procured through **open** and **limited tenders** as well as **rate contracts** at the central office level. The request for purchase is sent from the divisional level to the central office and tendering process is done through **e-tenders** also **manually** by the central office. The **store inventory** is done by **software (Central store and purchase system)** at the depot / divisional level and **quality control management** is done through **visual** and lab testing of equipment. - **WBSTC**: Materials are procured through **Rate contract** and **Limited Contract** at the central office level. The request for purchase is sent from the divisional level to the central office and tendering process is done through **e-tenders** also **manually** by the central office. **Inventory Management** is done **manually** at depot level only and and **quality control management** is done through **visual** and lab testing of equipment. - There is no software for Fuel management system in **WBSTC** but in **CSTC** Fuel management system is software based.	Moderate
Modern Equipment	- No modern equipment are used, except ETMs.	
Other sources of revenue generation	- Only farebox collection.	
Fare revision	- As decided by State Government	
User Feedback system	- **CSTC**: Through website, Emails, Posts, Social media, Toll free helpline - **CTC:** Through website, Emails, Posts - **WBSTC**: Emails, Posts, toll free helpline number	Moderate
Human Resource Management		Poor
Leave Management	- **CSTC**: Software - **CTC**: Software - **WBSTC**: Manual	
Attendance	- **CSTC/ CTC / WBSTC**: Biometric	

3.4.8 City Report Card - Mysore

CITY REPORT CARD - MYSORE						
Bus operations:	Karnataka State Road Transport Corporation (KSRTC)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
0.9 millions	445	40	228	36	44	
Route Planning	- **Traditional method** of route planning.					Moderate
Route Rationalization	- Scientific approach to design the route network. - Have attempted to rationalize bus routes based on scientific studies and public transport modelling with Cube Voyager.					Good
Time Tabling	- Timetable optimization is done using GPS recorded travel time in peak and off peak hours. Lumiplan software has been used for timetable preparation.					Good
Frequency Adjustment	- ETM data is taken from depot for adjustment of frequency of services periodically by 6-monthly review. - ETM data is analysed and used for route adjustment. - Automatic scheduling is also done by Mysore.					Good
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management done manually. The Duty Roster or ROTA is prepared manually on a daily basis and released in morning to staff. - Duty management of drivers/conductors is handled by the duty clerk based on his personal memory.					Poor
Level of ITS implementation						Good
Ticketing	- Offline ETMs are fully implemented.					
Passenger Information	- PIS inside buses and at terminals are implemented.					
Monitoring	- GPS and two way communication systems are implemented in buses.					
Security and Surveillance	- CCTV cameras are installed in 10 buses.					
Maintenance Practices	- Preventive Maintenance is done - daily, monthly and scheduled docking.					
MIS & Data Analytics	- MIS section compiles all the key operation statistics from different departments and prepares daily and monthly report. MIS reports are generated using data entries in depots. - Data analysis is done manually based on timetable deviation, driver wise analysis, real time feedback, local knowledge, GPS km, ITS data etc. MIS analysis for trend etc. is done in Excel and then sent to higher authorities.					Moderate
Stores and Purchase	- Central Store inventory management system is fully computerized with e-tendering. However the depot inventory module is in pilot stage in one depot.					Good
Modern Equipment	- Standard depot equipment are being used.					

Other sources of revenue generation	- Commercial development at terminals and depots, Advertisement inside and outside buses.	Good
Fare revision	- No fare revision formula.	
User Feedback system	- KSRTC has good passenger feedback systems which consist of following: Web Portal, SMS alerts, IVRS.	Good
Human Resource Management		Moderate
Leave Management	- Automatic leave management system is available.	
Attendance	- Biometric system is used for marking attendance.	

3.4.9 City Report Card - Nashik

CITY REPORT CARD - NASHIK						
Bus operations:	MSRTC (Maharashtra State Road Transport Corporation)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
1.48 millions	264	543	235	32.38	46.60	
Route Planning	- **Traditional method** of route planning. There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- No periodic route rationalization study is carried out to improve the existing network. In the absence of any travel data, existing routes are evaluated based on political influence or public demand.					Moderate
Time Tabling	- Time tabling is done **manually**, based on **assumption of an average running time**, layover time and dwell times. - The **travel times are estimated based on field surveys using manual methods**. The timetables are updated once in a year (during month of June).					Moderate
Frequency Adjustment	- Frequency adjustment is done **manually** and it is need based. Currently Electronic ticketing machines (ETMs) are offline, so reports of ETM data are prepared manually and used for adjustment of frequency of services.					Moderate
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done by a manual process in Nashik. The Duty Roster or ROTA is prepared manually on a daily basis and released in morning to staff. - Duty management of drivers and conductors is handled by the duty clerk based on his personal memory.					Poor
Level of ITS implementation	- MSRTC does not have any immediate plans to implement the ITS facilities in buses. Only ETMs are introduced in all buses.					Poor
Ticketing	- Offline ETMs are fully implemented					
Passenger Information	- PIS boards are not installed currently.					
Monitoring	- GPS is not installed currently.					
Security and Surveillance	- CCTVs are not installed currently.					
Maintenance Practices	- **Preventive maintenance** is done with three periodicity; daily, monthly and docking (3 months). - All repair and maintenance inventory is done manually and no software is used for this purpose. Instead, log books and registers are maintained.					Moderate
MIS & Data Analytics	- Currently, MIS at depot as well as divisional level is generated manually and later data entry done through computers by the statistical department. - Data analysis is done by statistical department (in house) and performance reports are generated to review the route-wise performance in terms of earnings and operational efficiency.					Moderate

Stores and Purchase	- **Rate contract** procurement process is done at the central office level. The request for purchase is sent from the divisional level to the central office and tendering process is done on the basis of rate contract (through **e-tenders**) by the central office. - The store inventory is done **manually** at the depot / divisional level and quality control management is done through visual and lab testing of equipment.	Moderate
Modern Equipment	- Standard depot equipment are being used.	
Other sources of revenue generation	- Only farebox collection.	
Fare revision	- No fare revision formula.	
User Feedback system	- Customer feedback can be submitted using Email, Website, Post and Telephone. - Feedback complaint tracking redressed system is **manual.**	Moderate
Human Resource Management		Poor
Leave Management	- Manual leave management system is available	
Attendance	- Manual system for attendance	

3.4.10 City Report Card - Raipur

CITY REPORT CARD - RAIPUR						
Bus operations:	**Raipur Nagar Nigam transport Limited (RNNTL)**					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
1.12 millions	100	11	200	17.85	14.44	
Route Planning	- **RNNTL** adopts **Traditional method** of route planning. There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- No periodic route rationalization study is carried out to improve the existing network. In the absence of any travel data, existing routes are evaluated based on **political influence** or **public demand**.					Moderate
Time Tabling	- Time tabling is done **manually** but at centralized level.					Poor
Frequency Adjustment	- Frequency adjustment is done **manually** and ETM data is downloaded after completion of shift. Based on the information from the ETM for few days, which is analysed to understand the demand for each route through which the frequency of buses is modified. - Frequency is fixed based on demand as high frequency and low frequency bus routes.					Moderate
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done by a **manual** process in Raipur. The Duty Roster or **ROTA** is prepared **manually** on a daily basis and released in morning to staff. - Crew scheduling is done at centralized level (operator's office) on weekly basis and based on arrival times of conductor and drivers. - The ETMs are handed over to the conductor along with the vehicle number and route on which to be operated by the operations manager.					Poor
Level of ITS implementation						Moderate
Ticketing	- Offline ETMs are fully implemented. Smart card based ticket system was launched on pilot basis.					
passenger Information	- PIS inside buses are implemented.					
Monitoring	- GPS are implemented in buses.					
Security and Surveillance	- CCTV cameras are installed in 100 buses.					
Maintenance Practices	- RNNTL is done **Preventive maintenance**. Repair & Maintenance activities are out sourced to vehicle manufacturer. - Operations and Maintenance contract was a part of the bus procurement from the manufacturer as these buses were procured as part of the **JnNURM**.					Moderate
MIS & Data Analytics	- **MIS** is being generated **manually** and a spreadsheet tool is developed by the operator for the MIS purpose in which data is fed from the ETMs. - **Data analysis** is done based on **ETMs data, GPS devices data, route ridership and ticket sold, operation and maintenance cost, customer feedback and local knowledge** and then					Moderate

	performance report are generated to review the route-wise performance in terms of earnings and operational efficiency.	
Stores and Purchase	- RNNTL are using **manual** system to manage the stores and purchase.	Poor
Modern Equipment	- Equipment are procured by the private operators.	
Other sources of revenue generation	- Advertisement inside and outside buses and bus terminals.	Good
Fare revision	- No fare revision formula.	
User Feedback system	- No customer feedback system is available.	
Human Resource Management		Poor
Leave Management	- Manual leave management system is available	
Attendance	- Manual system to record attendance.	

3.4.11 City Report Card - Shimla

CITY REPORT CARD - SHIMLA						
Bus operations:	Himachal Pradesh Road Transport Corporation (HRTC)					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
0.17millions	169	245	98	36.07	53.32	
Route Planning	- **HRTC** adopts **Traditional method** of route planning. There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- No periodic route rationalization study is carried out to improve the existing network. - In the absence of any travel data, existing routes are evaluated based on **political influence** or **public demand**.					Moderate
Time Tabling	- Time tabling is done **manually** by **Regional Transport Office (RTO)**					Poor
Frequency Adjustment	- Frequency adjustment is done **manually** and ETM data is downloaded after completion of shift. Based on the information from the ETM for few days, is analysed to understand the demand for each route through which the frequency of buses is modified.					Moderate
Duty Roster of Crew and Bus scheduling	- Bus & Crew Scheduling Management is done by a **manual** process in Shimla. The Duty Roster or **ROTA** is prepared **manually** on a daily basis and released in morning to staff.					Poor
Level of ITS implementation						Moderate
Ticketing	- Offline ETMs are fully implemented.					
Passenger Information	- PIS inside buses are implemented.					
Monitoring	- GPS are implemented in buses.					
Security and Surveillance	- CCTV cameras are installed in 169 buses.					
Maintenance Practices	- Himachal Pradesh City Transport bus stands Management & Development authority (HPCTBSMDA) carries out **Preventive maintenance** with **weekly** periodicity. - Repair & Maintenance activities are done in-house by Himachal Road Transport Corporation which is entrusted operation of city buses, on weekly basis at depot level.					Moderate
MIS & Data Analytics	- **MIS** is being generated **manually** and a spreadsheet tool is developed by the operator for the MIS purpose in which data is fed from the ETMs. - **Data analysis** is done based on **ETMs data, GPS devices data, route ridership and ticket sold, operation and maintenance cost, customer feedback and local knowledge** and then performance report are generated to review the route-wise performance in terms of earnings and operational efficiency.					Moderate
Stores and Purchase	- All three procurement process, **Open tenders, Limited tenders and Rate Contract** are done at the central office level by service provider. - The request for purchase is sent from the divisional level to the					Moderate

	central office and tendering process is done on the basis of rate contract (**through e-tenders**) by the central office. The **store inventory** is done by **software** at the depot / divisional level and **quality control management** is done through **visual and lab testing of equipment**.	
Modern Equipment	- Standard depot equipment are being used.	
Other sources of revenue generation	- Advertisement inside and outside buses and bus terminals.	Good
Fare revision	- No fare revision formula.	
User Feedback system	- No customer feedback system is available.	
Human Resource Management		Poor
Leave Management	- Manual leave management system is available	
Attendance	- Manual system to record attendance.	

3.4.12 City Report Card - Vishakhapatnam

CITY REPORT CARD - VISHAKHAPATNAM						
Bus operations:	**Andhra Pradesh State Road Transport Corporation (APSRTC)**					
Parameters	**Existing Conditions**					**Status**
Population (UA) (2011)	Fleet Held (Actual) (December 2015)	Total Routes (December 2015)	Vehicle Utilization (Km/bus/day) (2014-15)	Revenue (Rs. Per km) (2014-15)	Expenditure (Rs. Per km) (2014-15)	
1.7millions	654	200	298	23.47	29.4	
Route Planning	- **APSRTC** adopts **Traditional method** of route planning. There is no standard system for analysing any passenger demand profiles by conducting scientific surveys.					Moderate
Route Rationalization	- Route rationalization or improvement of existing services and starting of services on a new alignment is initially proposed by the Depot manager based on various inputs such as **public demand and physical survey**. - The same is reviewed and approved by the Regional Manger before implementation.					Moderate
Time Tabling	- Time tabling is done **manually**, based on assumption of an **average speed** of 20 kmph (3 minutes per km) for ordinary services and 24 kmph (2.5 minutes per km) for express services. The timetables are updated on the website. - Frequency of Time table is changed based on **passenger need or demand**					Moderate
Frequency Adjustment	- Frequency adjustment is done **manually** and ETM data is downloaded after completion of shift. - Information from the ETM for few days is analysed to understand the demand for each route through which the frequency of buses is modified.					Moderate
Duty Roster of Crew and Bus scheduling	- Online **ticket accounting system (OLTAS)** is used for automatic allocation and information to staff. The system sends the duty information in advance through SMS to the crew. - The crew can also confirm or decline the duty through SMS. Duty sheets are printed through computers for the staff					Good
Level of ITS implementation						Moderate
Ticketing	- Offline ETMs are fully implemented.					
Passenger Information	- PIS inside buses are implemented.					
Monitoring	- GPS are implemented in buses.					
Security and Surveillance	- CCTVs are installed currently in low floor buses (Tata Marco Polo) and Volvo buses.					
Maintenance Practices	- **APSRTC** carries out **Preventive maintenance** with **daily, weekly, KM based and Yearly** periodicity. - **Vehicle Maintenance System (VeMaS)** software is used for maintenance of buses. There is no software for Fuel management system. Standard practices as common in all STUs are followed.					Moderate
MIS & Data Analytics	- Outputs of **ETMs** and other ITS software like **AVLS, VeMaS, StoInS, OLTAS, FActIs, and LIMs** etc from each depot is manually compiled at the Regional Office, which is later sent to Zonal level. - **Data analysis** is done based on **ETMs data, GPS devices data, customer feedback and local knowledge** and then performance					Moderate

	report are generated to review the route-wise performance in terms of earnings and operational efficiency.	
Stores and Purchase	- **ASRTU Rate Contract** is done at the central office level. The request for purchase is sent from the divisional level to the central office and tendering process is done on the basis of rate contract (**through e-tenders**) by the central office. - The **store inventory** is done by **StoInS software** at the depot / divisional level and **quality control management** is done through **visual and lab testing of equipment**.	Moderate
Modern Equipment	- Standard depot equipment are being used.	
Other sources of revenue generation	- Advertisement inside and outside buses and bus terminals.	Good
Fare revision	- No fare revision formula.	
User Feedback system	- Customer feedback can be submitted using Call centre, Toll free number, Emails, Website, Post, Written, SMS and WhatsApp	Moderate
Human Resource Management	- **HRM is maintained by Person Management System (PMS)**	Moderate
Leave Management	- Software based system is developed for leave management.	
Attendance	- Manual system to record attendance.	

3.5 Conclusion

After analysing the operational characteristics of each STUs in 12 cities, the operational process, ITS deployment and contracting structure is compared with the international best practices. In the next chapter, international best practices followed worldwide for each of the operational characteristics and ITS deployment is provided.

4. International Best Practices

4.1 Introduction

Government of India is keen to revive all loss making public bus operators and also to open up the sector for the private players. As highlighted above, some of the bus operators are following good practices, which can be adopted by their peers.

It is equally important to understand the best practices followed by other peers in different parts of the world. These best practices can lay down the foundation for Indian cities to setup reform. Indian cities can learn the management practices and technology implementation done in cities like Singapore, Hong Kong and London. Further, there are some other key examples of best practices in different cities around the world. In this chapter, a brief of the best practices followed worldwide for city bus operations are provided.

4.2 Existing International Best Practices

Strategic Transport Planning

It is important to involve **customer feedback** in the planning stage. TfL London is operating 700 bus routes in the city and around 15% to20% bus routes are revised every year. TfL reviews the routes thoroughly to increase the patronage and efficiency. The authority also solicits feedback from public, user advocacy group (TravelWatch) and other stakeholders. The consultation process helps the authority to understand local opinion about the proposed changes to a number of bus routes. The communication is sent to registered Oyster Card holders who use local routes in the area through email. The questionnaire for customer feedback from the public users consists of 13 questions (10 general and 3 specific).

Further, the **route network** should be simple and understandable. For example, Barcelona modified its route network based on orthogonal grid scheme – vertical, horizontal and diagonal routes. Similarly, Seoul designed 4 new types of routes with color coding – Trunk Lines (Blue), Feeder Lines (Green), Circular Lines (Yellow) and Wide Area Lines (Red).

LTA Singapore has recently introduced on-demand bus service based on **crowdsourcing principle**. The authority has launched a mobile app – Beeline. The commuters can indicate and suggest Origin, Destination and Arrival time at destination using this app. The authority analyses the crowd-sourced data with existing transport data to identify popular routes. In case of sufficient demand, the route is launched and the customer can do the booking to reserve the seat using the same app.

Technological improvement in Bus Operations

Technology plays a key role is public transport operation. It is important for all stakeholders – authority, operator, employee and commuters. KMB Hong Kong has implemented **vehicle and crew scheduling** to automate the process. The scheduling engine uses algorithms to create cost-saving vehicle and crew schedules, as well as multi-day rosters. Scheduling system is integrated with vehicle maintenance system and human resource system to take

automatic inputs related to availability of buses and staff members. Similarly, START ROMAGNA in Ravenna (Italy) adopted Intelligent Garage Solution to optimized preventive and predictive maintenance.

It is equally important to have **vehicle monitoring and fare collection system**. TfL London introduced implemented bus communication and information system (iBus) to install equipment in 8,500 buses, 90 depots and 42 service control centres. The system records kms operated on bus routes by the operators. The information is used to calculate kms and reliability performance payments to the bus operators, as well as, public performance statistics. Further, it helps to monitor key KPIs - kms operated; percentage of schedule operated and excess wait time. The same information is used to share information with passengers using Web, SMS, 2500 signs and supports over 60 smartphone apps.

London also has integrated fare solution known as Oyster Card. Similarly, Hong Kong has equally good fare collection system - Octopus card, a rechargeable contactless stored value smart card used to transfer electronic payments in online or offline systems. The commuters can travel in any modes of public transport using this card. The card is also used for payment at convenience stores, supermarkets, fast-food restaurants, on-street parking meters, car parks, and other point-of-sale applications such as service stations and vending machines.

Improving the Operational processes

Bus route planning and modification is backbone of any bus system. The good route network increases the coverage of bus service, as well as, patronage. KMB, Hong Kong is one of the best examples of bus route planning and modification. The operator conducted the route audit and followed 'area approach' network restricting approach. The entire route network was reviewed using transport planning software packages. Some key measures taken included *straighten circuitous routings* to enable faster and more direct services, introduce express routes, and integration of bus routes using interchanges by following "*Hub and Spoke*" model.

Most of the bus operators in India are facing two key challenges:

a) Availability of bus depots,and,
b) Poor maintenance facilities.

KMG Hong Kong can be good learning case for **depot management and maintenance practices**. Owing to space shortage, the operator constructed multi-level depots to increase the capacity. All these depots are 2 stories (Ground + First Floor + Rooftop). Ground area is mainly used for fuelling, washing and maintenance of buses. First Floor and Rooftop are used for the parking of the buses. Rooftop is also used for training of drivers in the day time. KMB categorized depot size as the depot capacity to carry out maintenance of the buses, rather than parking of the buses. The company has devised a system to ensure that the buses are maintained at centralized locations and parking of the buses can be done at satellite depot and bus terminal.

Technology tools are generating tons of data on every hour basis for transport companies. These data can be used to draw meaningful conclusion and improve decision making. TfL London uses data analytics to reach a much deeper understanding of customer behaviour and provide better and more efficient services to meet customers' needs. The authority is doing 'Journey Mapping', 'Bunching Prediction' and other analysis using vehicle location and ticketing data.

Likewise, Sao Paulo is using data analysis to estimate the passenger occupancy in the vehicles. The take data mostly from commuter transit cards - the bus card, the subway card and use algorithms to infer information about how commuters and the transportation flow are behaving. The authority does not require huge investment in hardware and other infrastructure.

Institutional and Contracting Framework

To increase the participation of private players, it is important to design good contracting model to create win-win scenario. Singapore also introduced **quality based gross cost system for bus contracting**. All buses and bus infrastructures are owned by the authority, and the operator is paid fees to operate the services. Evaluation of the tender was done using Analytic Hierarchial process. Tender documents are evaluated in two aspects: Quality and Financial cost. However, the emphasis was given to quality score over the financial.

Similarly, TfL London introduced **Quality Incentive Contracts** in the year 2000 to increase the participation of private players. This is Gross Cost Contract, where operators submit bids based on total operating cost of a route plus profit margins. Under this model, all buses and infrastructure is owned by the bus operator. TfL specifies and monitors Minimum Performance Standards (MPS) as per the service contract. Operators get a bonus of 1.5% of the annual contract price for every 0.1 minute improvement in Excess Waiting Time (EWT) above a set baseline standard, up to 15%. This helps to ensure the quality and reliability of bus service.

Funding Options for city bus operations

One of key issues faced by the bus operators in India is low fares. In the absence of **automatic fare revision mechanism**, the operators are dependent on political approval. Bangalore has managed to devise a fare revision formula. However, the operator still cannot raise the fare. Singapore has one of the best fare revision mechanisms as fare review is done by independent authority – Public Transport Council. The fare adjustment is done with respect to change in consumer price index, wage index and energy index. The authority follows the principle of affordability, i.e. fare level should be affordable for consumer.

Similarly, Hong Kong has good mechanism to revise public transport fare. The fares of franchised buses are determined by the Chief Executive in Council (CE-in-Council). Fare is calculated on the basis of change in cost, forecast of future fares, and public acceptability and affordability. If the bus operator achieved rate of return of 9.7% or more, the same is shared between operator and passengers.

4.3 Summary of Key Best Practices and Learnings

As stated above, the learning from key cities has been summarized below:

Table 4-1: City-wise key area and learning

Singapore	Hong Kong	London
• Crowdsourcing of bus routes • Innovative approach to promote PPP • Regulatory Environment • Travel Demand Management	• Fare Collection System • Route Planning and Time-tabling • Vehicle and Crew Scheduling • Multi-level Depot and Maintenance Practices • Driver Training • Customer Listening Program	• Route Rationalization • Bus Communication and Information System • Tendering process and KPI monitoring • Use of Data Analytics and Customer information

In addition to above mentioned cities, the following are best practices followed in other cities around the world:

Table 4-2: City-wise key area and learning

Key Area	Division	City (Country)	Learning
Strategic Transport Planning	Route Rationalization	Barcelona (Spain)	Redesigning the route network
	Route Rationalization	Seoul (South Korea)	Categorizing bus routes
Technology Interventions	Technology	Dresden (Germany)	(un)coupling bus articulations
	Technology	Lyon (France)	Energy Strategy and Auxiliaries
Improving operational processes	Route Planning	Rio de Janeiro (Brazil)	Building network of BRT System
	Maintenance Practices	Ravenna (Italy)	Intelligent Garage System
	Data Analytics	Urumqi (China)	Analysing Travel Patterns
	Data Analytics	Sao Paulo (Brazil)	Partnership with Urban Engine
	Operations and Planning	Madrid (Spain)	Redesigning PT Interchanges

Key Area	Division	City (Country)	Learning
	Customer Information	Nantes (France)	Customer friendly Bus Network
	Customer Information	Madrid (Spain)	Using Open data for information
Institutional & Contracting framework	Driver Training	Madrid (Spain)	Driver Assistance System
Funding	Fare Revision	Dusseldorf (Germany)	Fare setting and adjustment practices

4.4 Conclusion

Based on the review of the existing practices in the world, the best operational practices are compared with the practices being followed in city bus operations in Indian cities to identify the existing gaps. The existing practices followed in India, best practices worldwide and the identified gaps are provided in the next chapter.

5. Gap Analysis

5.1 Introduction

In this chapter, a comparison of the city-wide performance in various areas against the best and available practices has been done to understand the gaps in city bus operations in India. Based on the identified gap areas, a Roadmap is recommended for each of the parameters which are discussed in the later chapters:-

5.2 Identified Gaps in Strategic Transport Planning

The existing planning practices followed in India, identified gap areas in strategic transport planning related to public transport planning and best practices followed for the same are as provided in the table below:-

Table 5-1: Gap Assessment of Strategic Transport Planning

Sl No.	City Level Parameters	Existing Practices	Gap Analysis	International Best Practices

1	Strategic Public Transport Planning at City level	• Master Plans
		  ○ Provides hierarchy to road networks
		  ○ parking facilities and mass rapid transit systems
		  ○ Allocate suitable spaces for terminal, depots, BQS, changeover etc.
		• CDPs:
		  ○ The CDPs rarely adopt a scientific approach to assess transportation needs
		  ○ Provides requirement of buses and their related funding requirements based on crude assessment
		• Comprehensive Mobility Plans
			• Lack of city level integrated public transport planning which identifies need of various systems such as bus routes, IPT routes, interchanges and terminals for developing integrated public transport system
			• Lack of PT route mapping and infrastructure (depot space, terminals etc.) to facilitate integrated planning
			• Lack of focus on provisioning transport infrastructure (such as
				• **Los Angeles:** in Los Angeles Metro group looks after the public transport provisions and prepares short and long range transportation plans along with Bicycle master plan. All requirements for city bus operations along all PT routes are detailed out in this

Sl No.	City Level Parameters	Existing Practices	Gap Analysis	International Best Practices
		○ Optimizes mobility patterns of people and goods with focus on PT, NMVs and pedestrians ○ Provides a recognized and effective platform for integrating land use and transport planning • CTTS: ○ Focuses on vehicle flows, ○ CTTS does not develop scenarios	depot space, terminals etc.) in the Master Plan. At present done on the basis of crude assumptions (based on population) • Accessibility based planning such as using indicators to define the service delivery in terms of distance, cost waiting time etc., is not used	Master Plan.

5.3 Technology Interventions in Bus Operations and Gap Identification

The below table provides the different technologies available globally for improving the efficiency of the public transport. This is then compared with the technological deployment in Indian cities for bus operations and gaps has been assessed. The identified gap assessment is provided below:-

Table 5-2: Gap Assessment in technology deployment in bus operations in India

Components	Existing Technologies	Gap Analysis	International Examples
 **GIS (Geographical Information**	• GIS Map of cities with minimum scale of 1:2000 and accuracy +/- 5 metres • Digital route map of bus routes, bus stops, road inventory (depot, terminal etc), landmark locations and layers of metro and railways network and stations in the city	• Digital city maps are not available or are not updated on periodic basis • Lack of updated layers of other transports infrastructure like railway, metro and other modes • Lack of updated layers of key destinations and landmarks in the city, along with future development	• **London** – The city has created digital map with all key infrastructure and landmarks • Cities like Hong Kong, Singapore, Seoul etc have fully digital map of city bus routes and other key landmark

Components	Existing Technologies	Gap Analysis	International Examples
System)		plan	
Vehicle Tracking System			
 **GPS (Global Positioning System)**	• GPS devices with GPRS connection and latency of 10 seconds to send real-time location • Devices have inbuilt antenna and battery storage to operate when the vehicles are turned off • Vehicle location data helps to monitor tracking of buses and generate alerts in case of any deviation from standard parameters	• Vehicles are fitted with GPS devices but the maintenance of the devices are poor • The data accuracy is an issue owing to network issue and maintenance of the device	• **London** – The authority has installed GPS devices in all the buses, called iBus system • Cities like Singapore, Seoul, and Madrid have installed GPS in all the buses
 **Operation Control Centre**	• The control centre is the beating heart of a public transport provider. Vehicle tracking system without operation control centre cannot work efficiently • Vehicles are monitored, deviations to the timetable are recognized, necessary dispatching measures are executed and drivers are supported • The control centre consists of screens to display vehicle location, data centre and specialized staff	• The control centres installed in a few cities are not fully functional, restricting the monitoring and tracking of buses • Only Ahmedabad, Bangalore, Delhi, Indore and Mysore has fully functional control centre to monitor over-speeding, route diverting and service delay owing to some incidents	• **London** – The authority has setup Surface Transport and Traffic Operation Centre to monitor buses

Components	Existing Technologies	Gap Analysis	International Examples
 **On Board Computer**	• On-board computer integrated with other on-board elements (passenger displays, CCTV, traffic signal priority, PA system, passenger counting, etc.) • Allow voice announcement for passengers about approaching stops • Interfaces with CAN network and PIS Board in the buses	• On-board computer available on new buses procured under JnNURM but not integrated with other systems in the buses • Only Ahmedabad and Mysore use on-board computer system with vehicle tracking device	• London, Singapore, Seoul, and Madrid have made on-board computers mandatory on buses
 **Driver Console**	• Helps automate Driver & Bus Service Login. There is no requirement to make entry in the backend to connect bus detail with GPS • Helps exchange messages with Control Centre in real time. The control centre can send message related to advance or delays. Can raise alarms in case of any violation	• GPS devices are installed on a stand-alone basis, without driver consoles except Ahmedabad and Mysore • The duty entry system is manual, i.e. allocating bus and drivers on the route and trip	• London, Singapore, Hong Kong, Seoul, and Madrid have installed driver console in the buses to automate the process
 **Driver Behaviour Monitoring**	• In such systems, hardware is used to monitor driver performance in real time including speed, acceleration/ breaking, engine idling, fast turns etc. • The control centre can review drivers performance in real time • There is option to install display unit indicating the driving	• No hardware is used to monitor the drivers' behaviour in real-time like sharp turn, acceleration etc. • Training is provided to drivers for better fuel efficiency (Vizag) and low accident driving but there is no hardware to evaluate the improvements	• **Lyon** – The operator has installed Driver Assistance system in the buses to monitor driver behaviour and fuel consumption in real-time

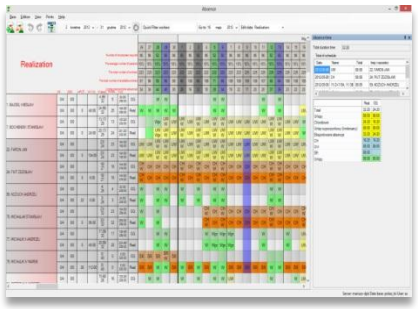
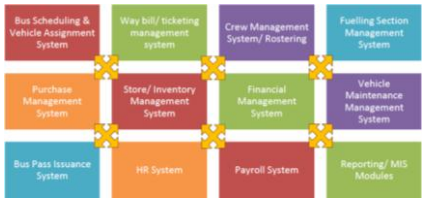
Components	Existing Technologies	Gap Analysis	International Examples
	behaviour in relation to defined threshold values in front of driver		
 **Two-way Communication**	• Audio Interface Equipment (microphone/speaker) for voice communications between control centre, dispatchers and driver • Helps control centre to exchange message with the driver in case of any emergency, road block or deviation and vice versa	• There is no two-way communication system in the buses and normally instructions are given to drivers using mobile phone or after the duty • Only Ahmedabad, Bangalore (Volvo) and Mysore has installed two-way communication system in the buses	• Cities including London, Singapore, Seoul, Madrid etc have two-way communication system in the buses to speak with drivers
 **Panic Button**	• Panic buttons installed in the buses for passengers to send distress message to control room in case of emergency • Button is integrated with GPS system to send the location of the bus to control centre • In some cases, panic buttons are connected with CCTV camera and centre receives live footage inside the bus panic button is pressed	• No city has installed panic button in the buses yet. On-stop bus request buttons are also not working in any cities • Ministry of Road Transport & Highway (MoRTH) has issued directive to install the same in all public transport vehicle	• **Istanbul -** The Istanbul Electric Tram and Tunnel Company (IETT), the city's public bus authority installed panic buttons on their buses. The IETT centre would alert the security forces and a company official would arrive on the scene once they receive the panic signals.
Ticketing & Fare Collection System			

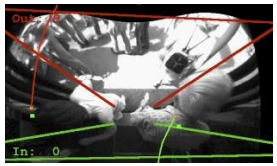
Components	Existing Technologies	Gap Analysis	International Examples
 **ETM (Electronic Ticketing Machines)**	• ETMs are used to print tickets for the passenger. There are two types of ETM machines - Offline vs. online. In Offline ETM, the data is stored in the machine and downloaded in the night at depot. In Online ETM, the data is send to backend in real-time. • ETMs help digitise records and can generate reports. They can be used to issue group ticket and passes. Some machines also have card readers. Lastly, they can help to collect OD data of the users and demand patterns	• Most of the cities are using offline ticketing machines only and store data in the depot system at the end of the trip, except Delhi and Bangalore • No centralized server is used to store ticketing data to do passenger OD analysis and crew performance	• N.A.
 **Fare Gate Validator**	• Off-board ticketing, similar to metros, improves boarding time. The commuters can check-in and check- out using fare cards or journey tokens; reduces revenue leakage and manpower required to collect the revenue. The system is used for closed stations at BRT Corridor.	• Only Ahmedabad has implemented the same. Technology does not work at full efficiency and require upgrading	• Trans-Milenio, the BRT systems of Bogota, Colombia uses fare gates

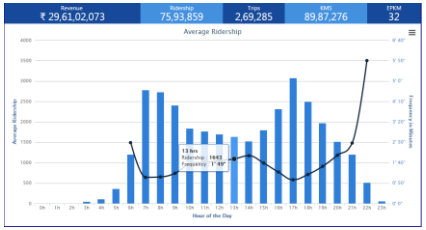
Components	Existing Technologies	Gap Analysis	International Examples
 **Ticket Vending Machines**	• Ticket vending machines automate ticket purchase. Can be used at stations or placed at bus stops for issuing off-boarding ticket • Ticket vending machines are being used widely now to reduce the boarding time	• No city has installed ticket vending machines to promote off-board ticketing for buses. The system can be used for cities with BRT operation like Ahmedabad and Indore	• The BRT system of Taichung in Taiwan used ticket vending machines
 **Card Validators**	• For open bus-stops, validators are installed in the buses to validate the mobility card but requires high penetration of smart cards as single journey passengers need to pay cash or get single journey RFID ticket • Normally, they are used for fixed fare rather than distance based fare as tap-in and tap-out is difficult. However, validation at the entry and exit point give accurate OD data	• No city has installed or experiment with card validators in the buses owing to heavy passenger load • The same can be explore with single tapping option or can use existing ETM machines to read the card	• Cities including London, Hong Kong, Singapore etc. has installed card readers in the buses (near driver's area) to read passengers' card
	• Smart cards store information to process monetary transactions and card holder's details for security purposes. There are two categories of smart cards - A single purpose transit pass and an electronic purse (e-purse) card • The smart card can be used for	• No city has implemented mobility card system for bus transport except Ahmedabad BRT only. Further, the integration of different modes of transport in city is no done yet • No integrated fare has been proposed for the city, i.e. the	• **London** – The authority has introduced 'Oyster' card – a multi-modal smart card for payment in all modes • **Hong Kong** – The different operators

Components	Existing Technologies	Gap Analysis	International Examples
Mobility Card	Multimodal transportation ticketing or Integrated Transport e-ticketing, combining all modes on a single ticket	commuters can take any modes to complete the journey	formed the organization to introduce 'Octopus' card in the city
 **CCTV and Surveillance System**	• CCTV and surveillance system monitor the passengers inside the bus, either locally in DVR or in real-time to the control room for live monitoring • The cameras can also record the demand of service in real-time through rush inside buses and used for any post-accident analysis	• Most cities do not have CCTV cameras in the buses. Some cities has installed CCTV partially; ex – Bangalore (500), Mysore (10), Ahmedabad (22), Shimla (169) and Raipur (100) • The buses procured under JnNURM-II will be equipped with CCTV cameras but the integration will be challenge owing to poor supporting infrastructure	• Cities including London, Singapore, Madrid etc. have CCTV in the buses and monitor the bus in real-time
Passenger Information System			
 **Display Boards**	• Information display boards are installed at key locations like bus terminal and stops. PIS boards are equipped with GPRS or Wifi to receive data from the data server • Boards display the expected time of arrival (ETA) of the next buses. Boards are also installed inside buses for next approaching stop information	• Most of the cities have not able to install passenger display boards at key locations • Mysore and Ahmedabad are currently using PIS boards at bus stop to display next bus information. Delhi has installed display boards at bus stops but these are not fully functional owing to lack of GPS in DTC buses	• **London** – The authority has installed passenger information board at bus stops

Components	Existing Technologies	Gap Analysis	International Examples
 **Information Kiosks**	• Touch Screen Kiosks serve as an interactive medium for information services at key locations like bus terminal and are integrated with the operator web portal, for dissemination of information about its services • The Kiosks are available 24x7 and provide route information, journey planner and other details about the city	• No city has invested in information kiosks for bus transport, except Bangalore • Coordination among different agencies is also a critical challenge to find space for the same	• **London** – The authority has installed touch screen at bus stops and inside the buses to allow commuters to explore bus routes and timetable
 **Journey Planner and Mobile App**	• Journey planner apps are an efficient tool to provide information to commuters. Commuters can add O/D points to find out the various trip options and integrated with vehicle tracking system for real-time information • Most of the authorities are using open data policy which allows to integrate the real-time bus information with third-party app	• Most of the cities does not have journey planner application and mobile app to disseminate information to public • Delhi has created a real-time journey planner and mobile app for buses but the system does not have DTC buses details. Bangalore and other cities are still in the transition phase	• **Madrid** – The authority follows an open data policy and allows third-party apps to show bus information

Components	Existing Technologies	Gap Analysis	International Examples
 **Planning & Scheduling System**	• Software modules are available for planning timetables, which help to optimize deployment and management of vehicles and drivers – from creating rosters to transferring data for payroll accounting • Similarly, the vehicle deployment process ensures high availability of the vehicles and preventive and corrective maintenance schedules	• A few cities like Mysore and Mumbai use planning and scheduling system to prepare timetables and duty rosters for the crew and buses • In most cities, timetables and duty rosters are created manually and leads to under-utilisation of assets and manpower. Similarly, leave application process is manual, and suffers from favouritism and mal-practices	• **Hong Kong** – The operator has introduced the system to automate bus and crew schedule
 **Bus Fleet Management System (BFMS)**	• BFMS increase efficiency in operation and management of depot infrastructure, bus service efficiency and other resources by integrating all core operations – Planning, Scheduling, Crew, Maintenance, Store & Purchase, Fuel, Account, HR etc. • It works like ERP for transport organization and automate the all manual process	• No city has implemented Bus Fleet Management System or MIS / ERP system till date • Some organizations have developed in-house systems to manage internal operations. Bangalore, Mysore and Vizag, use isolated systems for fuel and store management. • Other cities are struggling to define the basic processes and operation management system	• **Hong Kong** – The operator is using ERP based system to integrate all depot operators

Components	Existing Technologies	Gap Analysis	International Examples
 **WiFi and Infotainment System**	• WiFi systems are provided in bus systems allow passengers to utilise their journey time and enhance service experience and at bus stations or terminals, as well as, on long distance buses. Some cities use this facility to improve customer service. • Similarly, the operators are installing infotainment system to provide free entertainment contents	• No bus transport has implemented WiFi facility at bus station and inside the buses. Delhi and Bangalore are planning to install the same in the city buses • Some of inter-city buses has implemented basic WiFi and Infotainment system in the buses	• N.A.
 **Automatic Passenger Counting Systems (APC)**	• APC systems use sensors to determine the number of passengers boarding/de-boarding the buses, thus determining the occupancy level of passengers in the buses in real-time and reduce revenue leakage.	• No city has implemented passenger counting system in India yet. This is also due to high patronage in the buses • In the absence of APC, it is difficult to find out the occupancy level in the buses at given time	• **Norway** – APC systems are used in cities like Oslo and Akershus in Norway • **Los Angeles:** it is also used in Los Angeles County Metropolitan Transportation Authority buses
 **On-Bus Diagnostics (OBD)**	• OBD systems help capture vehicle health information related to electrical system, safety, engine and transmission. • The system also monitors the functioning of ITS components	• The average age of the current fleets in Indian cities ranges from 2 to 11 years. Hence, most of these buses do not have any OBD systems • Buses under JnNURM-II mandate OBD-II. Some cities are procuring new buses with these systems	• N.A.

Components	Existing Technologies	Gap Analysis	International Examples
 **Data Analysis and Optimization**	• Data analytics can be used to understand systems and make decision to improve service delivery. For example, ticketing data can provide information related to demand and used for service optimization. • Similarly bus arrival, time spent at stops, unexpected delays, passenger numbers etc, are a valuable asset that help identify inefficiencies in vehicle and staff deployment, as well as, potential routing improvements	• Only Ahmedabad, Delhi and Mysore are using data analytics software to analyse vehicle tracking and ticketing data • Most of the cities are not using any data analysis tools to review the raw data and do not have specialized manpower to carry out these tasks	• **London** – The authority is extensively using data analytics tools for ‘Journey Mapping’ and ‘Bunching Prediction’

5.4 Existing Operational Processes and identified gaps

The existing bus operational process followed in India and identified gap areas in city bus operations as compared to best practices regarding key process are provided in the table below:-

Table 5-3: Gap Assessment in operational processes of city bus services

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
1	Route Planning and Rationalisation	• Planning of new routes, change in alignment or route extension is based on local knowledge, ground survey to assess adequate right of way (ROW) on road, parking space at nodes, feasibility of taking a turn for vehicles inter-alia with catchment area • In the absence of travel data, new routes are based on destination concept instead of direction based approach. New routes are also based on political influence or public demand • No periodic route rationalization study are done to improve the existing network. In most cities, routes are evaluated only on EPK (Earning per km). For low earning routes, authorities shift the buses to profitable routes • Ahmedabad, Indore and Mysore follow scientific approach to design the route network. Similarly, Delhi	• The authorities do not analyse the OD data of users and boarding/alighting data at each point regularly to understand the demand pattern • High demand routes are not connected through direct or express service • There is no crowdsourcing options which allow commuters to submit route suggestions • Vehicle requirements are not assessed based on the demand and expected ridership of each route • The authority do not conduct the consultation process to collect feedback from the existing and prospective commuters in the particular areas • Route planning is not done using software packages like PTV VISUM, TransCAD, Cube	• **London** – The authority revised 15-20% of its routes every year. Besides data analytics, the authority followed consultation process with the public • **Hong Kong** – The operator followed 'Area Approach' to review the entire network of a particular district, rather than performance of individual routes • **Barcelona** - The city has introduced a new bus network based on an orthogonal grid scheme – Vertical, Horizontal and Diagonal Routes

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		and Mysore have tried to rationalize bus routes based on scientific studies and transport modelling with Cube Voyager software	Voyager, EMME etc.	
2	Timetabling	• Timetables are prepared for different routes based on average speed, i.e. static timetable. The scheduler calculates numbers of duties for each route based on distance and average speed. Each trip is allocated equal time irrespective of time of the day and demand of passengers • In Ahmedabad, although timetable preparation is done manually, speeds measured from ground are utilised for estimating travel times for peak and off periods on BRT routes • In Mysore, time table optimization is done based on GPS recorded travel time in peak and off hours using Lumiplan software.	• No pattern/ profile of travel time or demand data is used for optimum duty planning of a route based on differential scheduling of time table, which is based on travel time analysis of GPS data • Route categorization is done on the basis of EPK rather than ridership and expected potential • Same timetables are used for peak and non-peak hours trip without considering the journey time	• **Hong Kong** – The operator introduced differential timetable with above 90% reliability, along with clock faced frequencies (e.g. 15, 20 and 30 minutes intervals) • **Seoul** – The authority used Bus Management System to identify optimal bus operation intervals during peak and non-peak hours
3	Duty Roster of Crew and Bus scheduling	• Bus & Crew Scheduling Management is done manually in most cities. The Duty Roster or ROTA is prepared manually on a daily basis and released in morning to the staff. Duty management of drivers and conductors is handled by a duty clerk based on his memory.	• Scheduling is not done scientifically to allocate the buses on the routes, based on available fleet. There are delay at the time of outshedding owing to non-availability of buses owing to lack of integration • Crew schedule are not prepared	• **Hong Kong** – The operator introduced Bus Scheduling and Planning System to automate crew and bus scheduling

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		• Any deviations from the ROTA (for example, change in driver, conductor, etc.), is noted by the out-shedder in the sub-yard register and subsequently updated in the daily Duty Register by the record-keeper • Due to manual system, last moment changes are very high, resulting in delay in outshedding of buses • In Vishakhapatnam, Online ticket accounting system (OLTAS) is used for allocation and information to staff through SMS. The crew can confirm/decline the duty through SMS. Duty sheets are printed through computers	and disseminated in advance. In some STUs, the duty roaster are changed on daily basis • No software is used to prepare crew duty roaster to allocate the resources based on availability and statutory laws. The crew scheduling is important to ensure that good drivers are used optimally • Owing to manual system, the operator needs extra float for driver / conductor / bus for the outshedding of the buses	
4	Maintenance Practices	• Buses while operating require three types of maintenance – (a) Preventive, (b) Maintenance for defects developed on route and reported by drivers after coming back to the depot, and (c) Maintenance of defects that lead to breakdown • Maintenance records are kept manually through registers. In most of STUs, odometers of the buses malfunction and kms are recorded on the basis of daily schedule operation and maintained by adding schedule and idle kms	• The preventive maintenance work is planned and carried out based on the kms travelled. Odometers of the buses are working properly in most of the cities. The kms are estimated based on daily operation and idle run • Except few STUs, most of the cities are still struggling with maintenance due to non-availability of spare parts and technical manpower • Bus logbook are not maintained	• **Hong Kong** – The operator followed 'Hub and Spoke' maintenance model, i.e. developing main depots as maintenance hub

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		• In workshops, mechanics fills the defect card mentioning the problem in vehicle. After submission of defect card, indent is generated by the store and after entering details in bin card, the items are issued. The ledger section maintains vehicle wise details of expenditure • Tyre Management is also a manual process. A tyre card is maintained and managed for every tyre which keeps the record of mileage and Resoling / Retreading history of every tyre • The documents and records pertaining to Fuel Management are also manual. In some STUs, the fuelling stations are setup by oil companies which manage the delivery and inventory of diesel. Mysore has implemented advance filling and dispensing system using RFID.	properly or updated regularly to monitor the key activities performed • Breakdown analysis is not done to identify the reasons of failure – Spare Parts, Driver or Workshop • Tyre management is a challenge as it is difficult to maintain the health card of each tyre in the depot	
5	Store and Purchase	• Most STUs use manual systems to manage the store and purchase. The items are issued to depot store based on manual demands raised by them. The purchase orders are created manually • The department manages all the	• Stand-alone system for procurement (e-tendering), inventory, fuel and store consumption is used in the depot • There is no standard quality monitoring procedure to check the material at the time of entry	• **Ravenna (Italy)** – The operator introduced automated system to manage the maintenance tasks and introduce the concept of 'Predictive

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		aspects of procurement cycle i.e. Inventory Stock Management, Purchase Order Processing, Receipt/Issuance of Material from Central Store, Payment Processing, Local Purchase and Issue of Items in the depots with no visibility to HO. The key challenge is exchange of information among departments. • A proforma is sent by the Central Store to depot on periodic basis. The depots send their demand for all items based on last year's consumption after deducting the stock-in-hand • The Purchase Assistant prepares the agenda by making comparative list (by using the ASRTU rate contracts and tender rates kept in files) of approved available source • The material is received at the Central Store. The store keeper records all materials received in a ledger. The material is issued to depots as per their demand every week and issued to workshop staff on the basis of requisition slip and the entry is done in the register at depot level. The consumption of all spare parts is recorded in the separate	• There is also problem of obsolete parts as the spare parts is stored for buses which are out of active fleet • Owing to manual system, new management techniques like JIT (Just in Time), FIFO (First in First Out) cannot be followed • The selection of vendor is done based on lowest cost of items instead of cost per km on actual consumption of item, except Mysore • The manual system is used for fuel dispensing and filling which can lead to pilferage and waster	Maintenance'

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		register to maintain the inventory list.		
6	Human resources	• The recruitment of quality manpower is one of the key challenges for STUs. There is shortage of manpower in most of the organization and existing manpower is not skilled with latest technology • Attendance and leave records are managed manually at depot level. The officer compiles all the records at the end of the month and the records are sent to HQ for the compilation • In bigger STUs, the recruitment is managed centrally through HQ. The depot requires to send requisition for manpower. After the approval, the recruitment process is started. For SPVs, the recruitment process is governed as per government policy. The department needs to send request to state government or STUs for put staff on deputation • In Bangalore and Mysore, kiosk-based Leave Management System is installed to sanction leaves of crew and maintenance staff	• Human resource department is setup only at HQ level, which is responsible for recruitment, training and deployment of the manpower. However, there is no resources at depot level • In smaller STUs (Nashik and Shimla) and SPVs (Kanpur and Indore), there is no separate HR department to manage these functions • The roles and responsibilities of each role are not clearly defined and no written SOPs are available for the staff	• **Hong Kong** – The operator has installed ERP system to automate different departments including Human Resource and Finance. HR System is integrated with crew scheduling system
7	User Feedback	• Passengers can submit their feedback / suggestions / complaints though complaint book available in	• In developed cities, the commuters can use various channels including toll number, website, email, social	• **Singapore** – The authority has a mobile app to get route

Sl No.	Process	Existing Practices	Gap Analysis	International Best Practices
		the buses. Further, they can write to the operator or authority • In some STUs, toll-free call centre is setup to receive passengers' complaints. Some other modes include email, website and mobile app • Social media channels like Facebook and Twitters regularly suggestions from passengers	media channels (Facebook, Twitters etc.) to submit their feedback to the authority or operators • Automated incident number or track number is not generated for registering the complaints	suggestions from users • **Hong Kong** – The operator has 'Customer Listening Program' for customer feedback • **London** – A Commuter Group - TravelWatch has been created to give regular feedback to authority • **San Francisco** - Commuters can rate their journey experience
8	MIS	• MIS compiles all the key operation statistics from different departments and prepares daily and monthly reports • The reports are prepared on daily basis and the monthly report is prepared for the top management for the review	• MIS executives use old techniques and software to manage and compile data. Data analysis is not used to understand trends • Most decisions are taken on judgmental basis without any scientific backing	• **London** – The authority has introduced iBus system to collect operational data • **Sao Paulo** – The authority uses data from GPS/Cards/ Counters etc to determine public transport occupancy levels

5.5 Institutional and Contracting Structure and Identified Gaps

The existing practices followed in India, identified gap areas in city bus operations and best practices regarding institutional and contracting structure are as follows:-

Table 5-4: Gap Assessment of Institutional and Contracting Structure

Sl No.	City Level Parameters	Existing Practices	Gap Analysis	International Best Practices
1	Institutional and Contracting Reform	• In most cities, the operations are done by the STU directly with few of the maintenance and security outsourced. No Contract or legal binding with the private operators are involved and city bus operations are done by divisional / zonal offices. • For bus operations and maintenance of fleet, private sector participation has been explored by local urban bodies - Municipal corporations by forming SPVs through either the Gross Cost or Net Cost contracting models	• City Bus operations are presently carried out by STUs directly or by Municipal Corporations (without or without a Special Purpose vehicle (SPV)) through Net Cost Contract and Gross Cost Contracts. Major issues are: ○ The STUs that operates city bus services have more focus on the inter-city bus services neglecting the city bus operations. For operations, old fleets are used and quality of service is poor, though they have domain experience ○ The ULBs that supervise the city bus operations lack technical staff/knowledge in bus operations ○ With Net cost contract as there is no risk of revenues to the ULBs, strict monitoring of service delivery is not done. Private operators is interested in only profit making routes and neglect several areas • Strict monitoring of KPIs required	• **London –** TfL introduced Quality Incentive Contracts in 2000 based on Gross Cost Model. The capital investment is done by the operator • **Singapore –** LTA has adopted new modified contracting model in 2015, where capital investment will be done by LTA and will pay management fee to the operator

5.6 Funding Options and Identified Gaps

The existing practices followed in India, identified gap areas in city bus operations and best practices regarding institutional and contracting structure are as follows:-

Table 5-5: Gap Assessment of Funding Options

Sl No.	City Level Parameters	Existing Practices	Gap Analysis	International Best Practices
1	Funding Options	• Most of the states have negligible funds allocated for STUs • One of the main sources of revenue is fare box revenue • Few cities also uses their infrastructure such as terminal space, BQS and buses for advertisements • Few cities have developed commercial spaces at bus terminals on PPP basis	• At present, city bus operations are loss making for various reasons including:- ○ In most cities, no regular fare revisions are carried out for various reasons. This results in lower fare box revenues even when ridership increases ○ Money spent in providing concessions to various sections of users is not reimbursed ○ Buses operate on low profit routes • ULBs have to rely on central funding for procurement of buses due to lack of dedicated fund for public transport • Commercial exploitation of assets such as terminals, BQS etc., is not aggressively done by the STUs/ULBs ○ In few cities revenue is generated from advertisements ○ In-vehicle advertisement occurs in most the places but in the terminal area and few cities generate revenue at BQS • Till date no city generates revenue from the parking • Few STU's are providing rental/ lease for commercial/ office spaces in the terminal area	• Proximity tax • Employers tax • Cross-utility Funding

6. Policy Roadmap Recommendations

6.1 Introduction

Having identified gaps and available best practices policy roadmap for strategic planning, in this chapter technology interventions, processes, infrastructure, contracting structure and funding are listed out based on categorisation of cities as progressive, moderately progressive and least progressive. The priority list of interventions and general requirements of STUs and SPVs for efficient follow-up of the policy Roadmap are also discussed in the sections below.

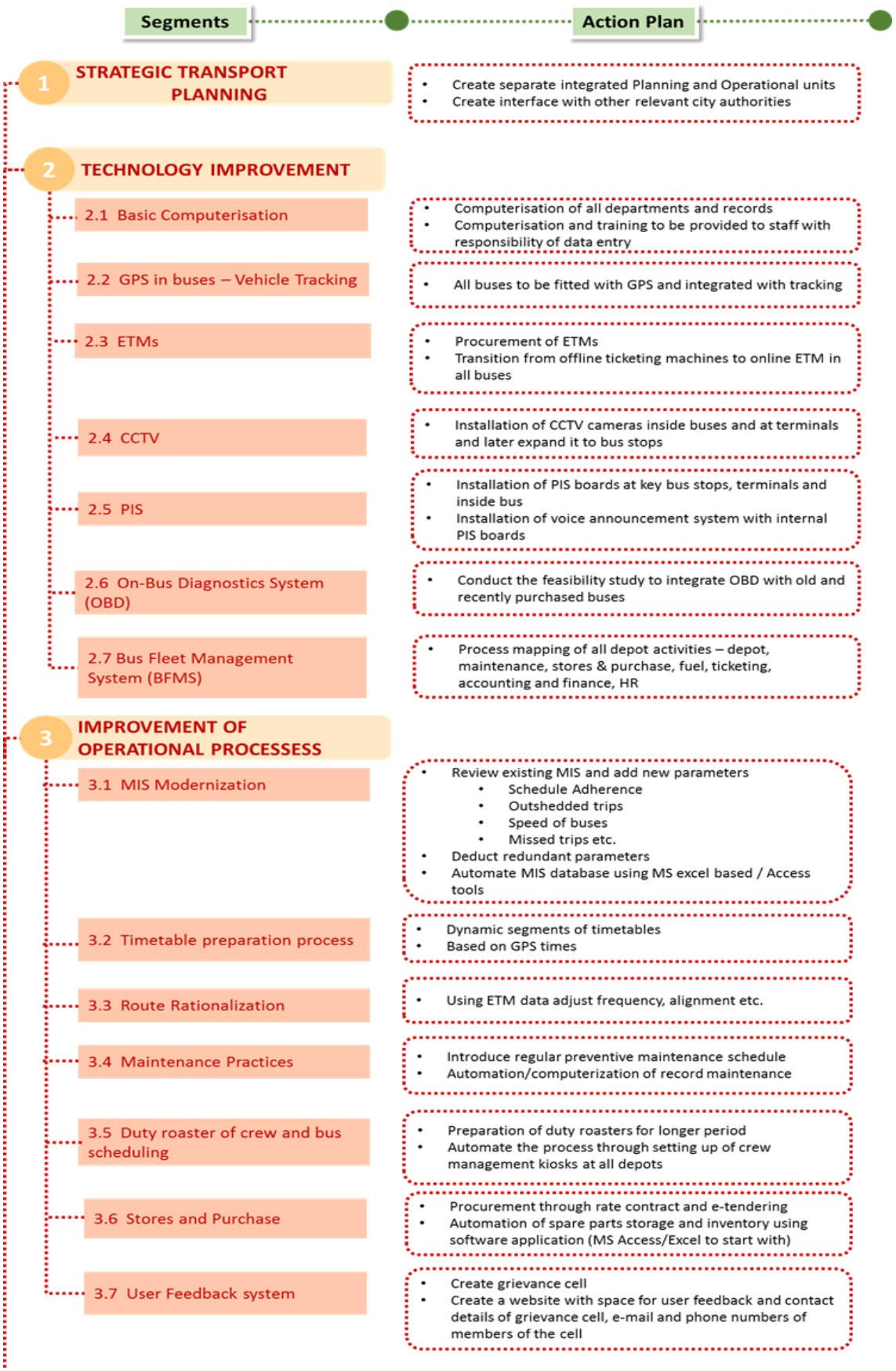
6.2 Preparatory Work to be done by STUs/SPVs

The general project studies, which are required to carried out by STUs and SPVs before the adoption of the recommended policies or which can be taken up along with implementation of the recommendations are as follows:-

- **Business plan:** - All SPVs and STUs shall prepare a business plan for minimum 10 years and maximum 20 years. The business plan can have the future inflow of funds detailed out along with bus requirements, requirement of new departments, new recruitments, hiring policy with roles and responsibilities for each positions, fare revision mechanisms, funding and bus procurement phasing plan.
- **Detailed Project Report (DPR) / Bus Modernisation Plan:** a feasibility study along with requirement of buses and modernisation plan with implementation of ITS facilities, infrastructures and funding requirements and sources to be prepared.

6.3 List of major interventions

The order of initiation of policy roadmap by the STUs/SPVs is provided in the figure given below. The basic requirement to bring about change in process and their requirements are listed in priority order.


Segments
Action Plan
1 STRATEGIC TRANSPORT PLANNING
• Create separate integrated Planning and Operational units
• Create interface with other relevant city authorities
2 TECHNOLOGY IMPROVEMENT
2.1 Basic Computerisation
• Computerisation of all departments and records
• Computerisation and training to be provided to staff with responsibility of data entry
2.2 GPS in buses – Vehicle Tracking
• All buses to be fitted with GPS and integrated with tracking
2.3 ETMs
• Procurement of ETMs
• Transition from offline ticketing machines to online ETM in all buses
2.4 CCTV
• Installation of CCTV cameras inside buses and at terminals and later expand it to bus stops
2.5 PIS
• Installation of PIS boards at key bus stops, terminals and inside bus
• Installation of voice announcement system with internal PIS boards
2.6 On-Bus Diagnostics System (OBD)
• Conduct the feasibility study to integrate OBD with old and recently purchased buses
2.7 Bus Fleet Management System (BFMS)
• Process mapping of all depot activities – depot, maintenance, stores & purchase, fuel, ticketing, accounting and finance, HR
3 IMPROVEMENT OF OPERATIONAL PROCESSESS
3.1 MIS Modernization
• Review existing MIS and add new parameters
◦ Schedule Adherence
◦ Outshedded trips
◦ Speed of buses
◦ Missed trips etc.
• Deduct redundant parameters
• Automate MIS database using MS excel based / Access tools
3.2 Timetable preparation process
• Dynamic segments of timetables
• Based on GPS times
3.3 Route Rationalization
• Using ETM data adjust frequency, alignment etc.
3.4 Maintenance Practices
• Introduce regular preventive maintenance schedule
• Automation/computerization of record maintenance
3.5 Duty roaster of crew and bus scheduling
• Preparation of duty roasters for longer period
• Automate the process through setting up of crew management kiosks at all depots
3.6 Stores and Purchase
• Procurement through rate contract and e-tendering
• Automation of spare parts storage and inventory using software application (MS Access/Excel to start with)
3.7 User Feedback system
• Create grievance cell
• Create a website with space for user feedback and contact details of grievance cell, e-mail and phone numbers of members of the cell

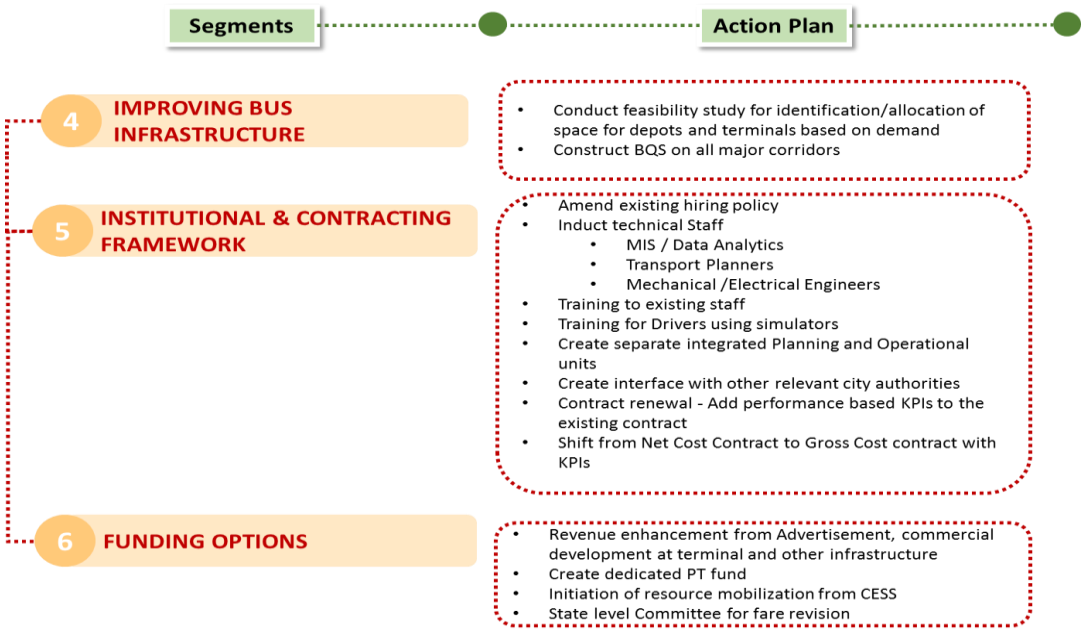


Figure 6-1: List of major interventions

6.4 Policy Roadmap for Strategic PT Planning

6.4.1 Status of Strategic PT Planning studies in India

In most of the cities, some planning documents are prepared. The status of availability of strategic public transport planning report is provided in the table provided below:-

Table 6-1: Status of Strategic PT Planning studies in India

Cities	Master Plan	CDP	CMP	CTTPs	Others Studies
Bangalore	✓	✓		✓	✓ (Implementation of BRTs in Bangalore, Implementation of Sub-urban Rail system for Bangalore, Bangalore Mobility Indicators study)
Mysore,	✓	✓		✓	.
Ahmedabad,	✓	✓			✓ (Integrated Mobility Plan, Ahmedabad)
Delhi	✓	✓		✓	
Kolkata,	✓	✓	✓		✓ (Citizen's report on Air quality and Urban Mobility, Kolkata)
Vishakhapatnam	✓	✓	✓		✓ (Urban Transport requirements, Andhra Pradesh)
Bhubaneswar	✓	✓	✓		✓ (Feasibility studies for Metro rail, Mono Rail and Light rail systems)
Kanpur	✓	✓	✓		✓ (Level of service classification for Urban Heterogeneous Traffic: a case study of Kanpur Metropolis, Citizen's report on Air quality and Urban Mobility)
Shimla	✓	✓	✓		

Cities	Master Plan	CDP	CMP	CTTPs	Others Studies
Raipur	✓	✓			✓ (Detailed Project report for Bus funding under JnNURM, Capacity Building for Urban Development Project- Rapid Base line assessment- Raipur city, Sustainable mobility plan for Naya Raipur, Short Term Traffic and Long Term Traffic and Transportation Plan Raipur - Ongoing)
Nashik	✓	✓			✓ (Nashik Rapid Mass Transport Feasibility study,)
Indore	✓	✓	✓ (On-going)		✓ (Comprehensive Reporting Of Traffic Management System With Planning & Execution Of Bus Rapid Transit Network In Indore City (M.P), India)

On the basis of the above chart, the cities are grouped into three categories as given below:

Table 6-2: City Categories

Category "A" (Progressive)	Category "B & C" (Moderate Progressive)
Delhi	Raipur
Ahmedabad	Nashik
Indore	Kanpur
Mysore	Shimla
Bangalore	
Visakhapatnam	
Bhubaneshwar	
Kolkata	

Category A – The cities have CMPs, Transport Demand Forecast Study, Route rationalisation studies, prepared that includes proposals related public transport provisions and future routes. These cities should also have city-wide PT route map

Category B – The cities have conducted traffic studies and have basic understanding of the travel characteristics (prepared CTTS) and Master Plans.

Category C – In these cities, no traffic studies has been conducted and only CDPs are prepared.

6.4.2 Roadmap Recommendations for Strategic Transport Planning

Policy Roadmap for strategic transport planning are as follows:-

Table 6-3: Policy Roadmap Recommendations for Strategic Transport Planning

Sl No.	City Level Parameters	Existing Gap Areas	Short term (Upto 2 Year)	Medium Term (2 – 5 years)	Long Term (5 - 10 years)
1	Strategic Public Transport Planning at City level	• Lack of city level integrated public transport planning • Lack of PT route mapping • Little focus on provisioning transport infrastructure (depot space, terminals etc.) in the Master Plan • Accessibility based planning such as using indicators to define the service delivery in terms of distance, cost waiting time etc., is not used	**Category 'A' Cities** • Use CMP recommendations in planning PT system • An integrated public transport route networks along with the interchange nodes and economic nodes to be developed in each city prepared that helps in the strategic planning and decision making related to public transport provisioning • Modify existing service level benchmarks (SLBs) with focus on overall mobility. For ex – ○ PT availability within 500m/1000m of settlements ○ Average waiting not more than 10 min ○ Frequency of buses 5 min during peak hour and 10 min during off-peak hours etc. **Category 'B & C' Cities** • Prepare City level maps of all the public transport networks – all the cities should map all the PT routes including IPT/MRTS (if any)	**Category 'A' Cities** • Amend the City Master Plan with proposals from Mobility plans/strategic plans to allocate space for depot, multimodal transit centres, Bus terminal etc. • Monitor and evaluate SLBs and modify routes based on assessments/ periodic PT surveys • Develop of multimodal transit centres **Category 'B & C' Cities** • Strategic public transport plan to be prepared under the supervision of ULBs/STUs and route modification/new route requirement be refined accordingly.	**Category 'A' Cities** • Development of an Integrated traffic data centre • Use of Big Data and modelling for decision making • Develop simple mapping tools to carry out PT accessibility analysis, plot O-D desire patterns when modelling software not used. **Category 'B & C' Cities** • Implement city bus services and routes, multimodal transit centres, depots etc., based on the strategic plan proposals • Monitor SLBs through periodic surveys and modify routes based on assessment studies

6.5 Roadmap for Technology Interventions

6.5.1 Status of ITS in City Bus Transport

Most of Indian cities are still in the transition phase. Some cities have already implemented ITS system and trying to optimize the service. On the other hand, some of the cities are still trying to implement the system. While many cities still lack technology required to enhance the bus service.

Cities	Planning and Scheduling / Despatching	Vehicle Tracking and Operation Control Centre	Ticketing and Fare Management	MIS / ERP System (BFMS)	Analysing and Optimizing
Ahmedabad	×	✓	✓	×	✓
Bangalore	In process	✓	✓	×	✓
Bhubaneshwar	×	×	✓	×	×
Delhi	×	✓ (35%)	✓ (35%)	×	×
Indore	×	✓	✓	×	×
Kanpur	×	×	✓ (34%)	×	×
Kolkata	×	×	×	×	×
Mysore	In process	✓	✓	×	✓
Nashik	×	✓	✓	×	×
Raipur	×	✓ (37%)	✓	×	×
Shimla	×	✓	✓	×	×
Visakhapatnam	✓	✓ (75%)	✓	✓ (Partial)	×

On the basis of above chart, we can categorize these cities in three groups as given below:

Category A – The cities has implemented vehicle tracking and fare collection system. The cities are using ERP and Data analysis tool. Further, the cities are taking advance measures to adopt new technologies.

Category B – The cities are implementing ITS components and are looking to stabilize the system.

Category C –These cities still have a long way to go as the basic systems are not fully functional. The cities are struggling to maintain the basis bus service.

All cities require to improve he infrastructure and resources. However, the level of development is different in each city and would require intervention at different level.

Category "A" (Highly Progressive)	**Category "B"** (Moderate Progressive)	**Category "C"** (Low Progressive)
Ahmedabadi, Delhi Mysore Visakhapatnam	Bangalore Indore Kolkata	Bhubaneshwar Kanpur Nashik Raipur Shimla

6.5.2 Roadmap Recommendations for Technology Interventions

The following Roadmap is proposed for cities to upgrade bus transport in the cities.

Table 6-4: Policy Roadmap for technology interventions

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
1	GIS Mapping	• Good quality city GIS map are not available with city administration • Lack of updated city information and route network • Lack of integration with other agencies like transport, housing etc.	**Category "A"** • Integrate existing city map with other layers like key destinations and other transport infrastructure **Category "B"** • Improve existing city map by plotting all bus routes and infrastructure – bus stops, depot etc. **Category "C"** • Create city transport map with all road inventory and transport infrastructure like bus stops and terminal	**Category "A"** • Improve the map and integrate with other service like para-transit **Category "B"** • Integrate existing city map with other layers like key destinations and other transport infrastructure **Category "C"** • Improve existing city map by plotting all bus routes and infrastructure – bus stops, depot etc.	**Category "A" and "B"** • Improve the map based on change in city profile **Category "C"** • Integrate existing city map with other layers like key destinations and other transport infrastructure
2	Vehicle Tracking System and Operation Control Centre	• Low cost GPS devices with less reliability are not available • Absence of central control centre to monitor the buses • Basic GPS are provided but without key components like driver console, two-way communication etc	**Category "A"** • Improve GPS reliability and calibrate the system as per the field condition • Install other key components like panic button, driver console etc. • Create exception	**Category "A"** • Install advanced components like driver behaviour monitoring system **Category "B"** • Calibrate system to improve Expected Time of Arrival (ETA) of buses	**Category "A", "B" & "C"** • Integrate new buses with OBD-II and with the existing system

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		• Non-availability of manpower and infrastructure to allocate buses before the starting of the shift • No key technical reports related to bus tracking are generated	reporting/alerts system for the deviation from benchmarks like speed, route and schedule **Category "B"** • Set up/operationalize the control centre to monitor buses • Install of key components like panic button, driver console, two-way communication etc. **Category "C"** • Install GPS with driver console in all buses and calibrate system to match ground conditions • Set up/operationalize the control centre to monitor buses • Install of key components like panic button, driver console, two-way communication etc.	• Explore the feasibility for the installation of driver behaviour monitoring system • Create exception report and alerts system for the deviation from the set benchmarks like speed, route and schedule **Category "C"** • Improve the GPS tracking system by maintaining the hardware infrastructure • Do Capacity building to use the available information for better planning and monitoring	
3	Ticketing and Fare Management	• ETM machines used are not dynamic and basic offline ETM machines are being used for the service • Absence of Smart cards in the buses and integration	**Category "A"** • Use existing ETM infrastructure and introduce smart card in the buses • Introduce Common mobility card	**Category "A"** • integrate common mobility card with other services • Install card validators in the buses to reduce the use of single journey tickets	**Category "A"** • Introduce new payment mechanism like NFC and wallet payment for fare collection

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		with other modes of transport • High issuance of single journey ticket is leading to revenue leakage	• Conduct feasibility study for restructuring of existing fare mechanism and to introduce card validators in the buses **Category "B"** • Do Transition from offline ticketing machines to online ETMs in all the buses • Introduce smart card for the commuters in the buses **Category "C"** • Procure online ETM machines for the city bus service • Introduce smart card for the commuters in the buses • Set up data centre or using cloud technology to store the data • Do capacity building for the staff for using ticketing machines	• Introduce off-board ticketing like gates and ticket vending machines in the closed system **Category "B" and "C"** • Introduce common mobility card which is integrated with other modes and other service like department stores • Make commuters use smart card to reduce single journey ticket • Conduct feasibility study for restructuring of existing fare mechanism and to introduce card validators in the buses	**Category "B" and "C"** • Install card validators in the buses to reduce the use of single journey tickets • Introduce off-board ticketing like gates and ticket vending machines in the closed system
4	CCTV and Surveillance System	• Non-availability of funds to meet capital and operating cost of the system • Streaming of content is delayed / stopped due to observed lower bandwidth	**Category "A"** • Install CCTV cameras in pilot buses either in offline or online mode to improve the service monitoring • Integrate CCTV cameras available in the newly procure buses under	**Category "A"** • Install CCTV cameras and surveillance system in the fleet and terminal • Integrate live feed with the operation control centre **Category "B" and "C"**	--

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
			JnNURM-II • Evaluate accident / incident and crew productivity based on new system **Category "B" and "C"** • Conduct feasibility study to install CCTV in old buses and integrate cameras in new buses	• Install CCTV cameras in the buses and at bus terminal • Integrate live feed with the operation control centre	
5	Passenger Information System	• Non-availability of GPS devices in the vehicle • Non-availability of raw data to calculate ETA of the buses • No investment in the passenger information system owing to lack of fund • Lack of supporting infrastructure like modern bus stops or terminal facility	**Category "A"** • Expand PIS network at key bus stops and terminal (including railway and airport) • Integrate journey planner tool and creation of mobile app with real-time information • Adopt open data policy and integrate real-time bus location • Install PA system with internal PIS boards **Category "B" and "C"** • Install PIS boards at key bus stops in the city • Introduce PIS with mobile app application • Adopt open data policy (including GTFS standard)	**Category "A"** • Integrate with payment gateway to allow people to book ticket through mobile app • Integrate passenger feedback system in the mobile app to receive customer feedback • Set up information kiosks at the bus stops or inside the buses • Create social media account (twitter etc.) to share latest updates with commuters • Integrate seat availability and expected journey time features **Category "B" and "C"** • Expand PIS network at key bus stops and terminal	**Category "A"** • Integrate all information channels to share traffic update, transport options and shortest route **Category "B" and "C"** • Integrate seat availability and expected journey time features • Set up information kiosks at the bus stops or inside the buses • Integrate with payment gateway to allow people to book ticket through mobile app

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
			and integrate with third-party transport app	• Integrate journey planner tool and creation of mobile app with real-time information • Integrate passenger feedback system in the mobile app to receive customer feedback • Install PA system with internal PIS	
6	Planning and Scheduling	• Lack of investment by STUs in transit modules for time-tabling and scheduling • Available international software's are very costly - Only international packages are available which charge on the basis of per bus per month • Flexible work schedule is restricted due to Motor Transport Workers Act 1961 • Lack of specialized manpower available to implement the technology	**Category "A"** • Evaluate existing scheduling and planning system in the market (Xerox, Trapeze, Giro etc.) • Develop lite version for indigenous planning and scheduling system for automation of timetabling of scheduling process • Implement leave management kiosks and SMS based facility for drivers attendance **Category "B"** • Process mapping for existing bus and crew scheduling practices • Computerize existing manual process for control centre, dispatching and	**Category "A"** • Implement shortlisted system for planning and scheduling • Implement schedule optimization module by using available assets and manpower for the network • Set up biometric system and kiosks for drivers and conductors to print duty roster • Integrate system with other system for further network optimization • Evaluate and improve reliability and on-time performance of existing route network • Create express route and shorter service during peak	**Category "A"** • Implement planning and scheduling system for the full network **Category "B" and "C"** • Set up biometric system and kiosks for drivers and conductors to print duty roaster • Integrate the system with other system for further network optimization

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
			printed memo • Implement leave management kiosks and SMS based facility for drivers for attendance **Category "C"** • Review and adopt best practices followed by other STUs (A and B) • Train manpower for route and service planning • Computerize existing manual process for control centre, dispatch and printed memo	hours **Category "B" and "C"** • Implement "lite" version of planning and scheduling system for the preparation of timetable, crew schedule and duty roster • Conduct feasibility study to implement the advance version of planning and scheduling system for the organization (the organization should have at least 500 buses and more than 5 depots) • Create express routes and shorter service during peak hours	
7	Bus Fleet Management System (BFMS)	• Lack of funds available to implement BFMS system as it will require computerization of all the department • Lack of trained manpower to define the system requirement and implementation • Inability to migrate database of DOS-based system • Absence of standard operating procedure (SOP)	**Category "A" and "B"** • Create SOP documents to streamline key activities – Depot, Maintenance, Store & Purchase, Fuel, Ticketing, Account and Human Resources • Process mapping to implement BFMS system • Streamline existing process and use of technology tools to automate key functions • Implement biometric system	**Category "A" and "B"** • Prepare System Requirement and bid document for the procurement of the system • Select the bidder (Trapeze, INIT AG, IVU Traffic Technologies AG, Lumiplan and any other) • Do Capacity building of internal manpower for the transition and recruitment of specialized manpower	**Category "A" and "B"** • Implement all modules of BFMS system for complete automation of HQ and all depots **Category "C"** • Do Capacity building of internal manpower for the transition and recruitment of specialized manpower • Evaluate and Implement of

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		in the organization • Lack of will for change in management for implementation of BFMS in the organization	for payroll • Setup KPIs for each department and functional area **Category "C"** • Process mapping of all depot activities - Depot, Maintenance, Store & Purchase, Fuel, Ticketing, Account and HR • Do Capacity building and computerization of the existing process • Implement biometric system for staff payroll management	• Implement BFMS system to automate the key process – Depot, Maintenance, Store & purchase and fuel **Category "C"** • Create SOP documents to streamline all key activities – Depot, Maintenance, Store & Purchase, Fuel, Ticketing, Account and Human Resources • Process mapping to implement BFMS system to automate the operation • Prepare System Requirement and bid document for the procurement of the system • Set up KPIs for the performance of each department and functional area	BFMS system (Trapeze, Giro Inc., INIT AG, IVU Traffic Technologies AG, Vix Technologies, Lumiplan, Goal System and any other) to automate the operation
8	WiFi and Infotainment System	• Lack of funds available to implement Wifi and infotainment system in the buses and at bus stations • Low advertising potential is found in smaller cities	**Category "A", "B" and "C"** • Float EoI to find potential bidders to implement the solution • Implement wifi and infotainment system in buses in-lieu of advertising on pilot basis	**Category "A", "B" and "C"** • Implement wifi and infotainment system in all buses in-lieu of advertising rights	--

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
9	Automatic Passenger Counting Systems (APC)	• Inability to calculate the benefit of the system – Investment Vs. Revenue realization • Lack of funds available for the investment in these system • Lack of will and resistance from the staff for implementation of these measures	**Category "A"** • Conduct feasibility study to increase revenue by reducing leakage and investment • Implement APC on pilot basis to measure the increase in revenue • Improve service planning based on boarding and alighting pattern at each bus stop **Category "B" and "C"** • Study cost benefit analysis of implementation of APC – Investment Vs. Increase in revenue (5%, 10%, 20% or more)	**Category "A"** • In case of significant improvement in revenue realisation, the system can be roll out for the fleet **Category "B" and "C"** • Implement APC in selected routes on pilot basis to measure the increase in revenue • In case of significant improvement in revenue realisation, the system can be roll out for the fleet	--
10	On-Bus Diagnostics System (OBD)	• The system cannot be implemented in old buses owing to non-availability of hardware • Procurement of new buses is very slow owing to non-renewal of NURM	**Category "A", "B" and "C"** • Study feasibility to integrate OBD system with other system like vehicle tracking, control centre etc. • Integrate vehicle sensors and emergency response system	**Category "A", "B" and "C"** • Use OBD data to monitor and evaluate the health of the vehicles	--
11	Data Analysis	• Lack of availability of accurate raw data for the	**Category "A"**	**Category "A"**	**Category "A", "B" and "C"**

Sl No.	City Level Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
	and Optimizing	vehicle location, passenger boarding and alighting, load factor, passenger • Lack of trained manpower to carry out the job	• Set up separate division for MIS and Data Analytics • Do capacity building of existing manpower and recruit specialized staff to conduct data analysis • Calibrate raw data to improve accuracy level • Share key insights with management **Category "B" and "C"** • Install GPS and ticketing devices to collect the raw data • Prepare MIS report and tabling of information in readable formats • Recruitment of specialized manpower for data management and analysis	• Use operational data to improve timetable, route network, crew deployment and vehicle utilisation • Use ticketing data to improve the route network, service coverage and load factor • Use maintenance data to evaluate performance of buses, vehicle health, breakdown analysis • Use driver behaviour data to conduct customized training program for fuel efficiency and incentive systems • Cost analysis of all incidents, and potential measures to increase the service quality and revenue **Category "B" and "C"** • Setup separate division for MIS/ Data Analytics • Calibration of raw data to improve the accuracy level by using analytical tools • Use operation, ticketing, maintenance and driver behaviour data to improve the service quality	• Decision making process should be data-driven in the organization • Evaluation of service delivery performance based on data • Use of data for the planning of new routes and rationalization of existing routes

6.6 Roadmap for Improving the Operational Process

The following is the current status of systematic process followed in different cities:

Table 6-5: Current Status in Different Organizations

City	Route Planning & Rationalisation	Time Tabling	Duty Roaster of Crew and Bus scheduling	Maintenance Practices	Store and Purchase	Human resources	User Feedback	MIS
Bangalore	Average	Average	Average	Good	Good	Average	Good	Average
Mysore	Good	Good	Average	Good	Good	Good	Good	Good
Ahmedabad (City)	Poor	Poor	Average	Average	Average	Poor	Poor	Average
Ahmedabad (BRT)	Good	Good	Good	Average	Average	Average	Good	Average
Delhi (Public)	Poor	Poor	Poor	Good	Good	Average	Poor	Poor
Delhi (Cluster)	Good	Poor	Average	Good	Good	Good	Good	Good
Kolkata	Poor	Poor	Average	Average	Average	Average	Poor	Poor
Vishakhapatnam	Good	Good	Good	Good	Good	Good	Average	Good
Bhubaneshwar	Average	Poor	Poor	Poor	Poor	Poor	Poor	Average
Kanpur	Poor	Poor	Poor	Average	Average	Poor	Poor	Poor
Shimla	Poor	Poor	Poor	Average	Average	Poor	Poor	Poor
Raipur	Poor	Poor	Poor	Average	Average	Poor	Poor	Average
Nashik	Poor	Poor	Poor	Average	Average	Average	Average	Average
Indore	Good	Average	Average	Average	Average	Poor	Good	Average

On the basis of above table, we can be categorized the cities as follows:

Category "A" (Highly Progressive)	**Category "B"** (Moderate Progressive)	**Category "C"** (Low Progressive)
Mysore	Indore	Bhubaneshwar
Visakhapatnam	Nashik	Raipur
Ahmedabad (BRT)		Kanpur
Delhi (Cluster)		Kolkata
Bangalore		Shimla

Category A – The cities have developed good system to manage the task and is using technology to improve the system, as well as, utilizing data received to optimize their services. Some of the cities have developed independent software for crew rosters, vehicle maintenance, inventory management, etc but there is no integration between these systems

Category B – The cities are in transition phase and are using modern practices to improve the functional areas

Category C – In these cities, different processes are primarily done manually and inconsistently. There has been no major initiative to improve the existing practices to bring efficiency

6.6.1 Roadmap for Improving the Operational Processes

The following policy roadmap is proposed for improving the operational processes.

Table 6-6: Policy Roadmap for operational process

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)

1	Route Planning and Rationalisation	• Lack of standard procedure to introduce new routes
		  ○ Based on local knowledge of trip generator nodes
		  ○ Destination based, and not direction oriented
		• Lack of scientific route planning or analysis based on OD matrix and line load
		• Limited Market segmentation: introduction of Express Services, Premium services, etc
		• Nomenclature of route is not reflective of Origin and Destination
		• No periodic review and rationalization of routes
		• Overlaps with other
			Category "A" and "B"
			• Conduct Scientific studies to analyse OD pattern of passengers for deciding alignment and frequency of route
			• Integrate crowdsourcing application with website and mobile app to get suggestions from the public
			• Passenger feedback to be reviewed in conjunction and necessary modifications to be done
			
			Category 'C' Cities
			• Compile ridership data in standard format to estimate the demand
			• Conduct passenger surveys and household surveys to assess the demand
				Category "A" and "B"
				• Categorize services into AC premium services, Express services, etc.
				• Nomenclature of routes to be done in a scientific manner so that it reflects Origin and Destination of routes
				• Create and strengthen separate Route Planning team
				• Use transport planning and route optimization software for detailed analysis – transport modelling tools such as PTV VISUM, TransCAD, Cube Voyager, EMME etc. to be used for demand assessment for new routes
				
				Categories "C"
				• Integrate crowdsourcing
					Category "A" and "B"
					• Create integrated transport plan with bus routes
					
					Category "C"
					• Create and strengthen separate Route Planning
					• Use transport planning and route optimization software for detailed analysis – transport modelling tools such as PTV VISUM, TransCAD, Cube Voyager, EMME etc. to be used for demand assessment for new routes

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		routes and transport systems such as metro • Routes are evaluated primarily by its average EPK and not by service level to commuters	• Digitize all bus routes and finding out the overlapping with other routes to prepare simple network • Strengthen of route planning team	application with website and mobile app to get suggestions from the public • ETM data should be available in real time (online)	
2	Timetabling	• Average speed on the network is used. Static schedules are prepared based on distance and speed throughout the day, irrespective of time of day and passenger demand • Timetables are prepared manually without using any network optimization tools • Scheduling is done on the basis of EPK	**Category "A"** • Use of GPS data to calculate running time for different times of the day (peak and off-peak hours), month and seasons in both directions • Use of ETM data to basis of stop wise boarding profile to adjust schedule • Introduce software to streamline process as per Technology Roadmap **Category "B" and "C"** • Different schedules (static) for peak and off-peak hours should be prepared initially, based on average speed in different time slots; and also for both directions	**Category "A"** • Implement Planning and Scheduling Module as per Technology Roadmap **Category "B" and "C"** • Use GPS data to assess running times for different times of the day (peak and off peak hours), month and seasons in both directions • Prepare differential timetable for peak and off-peak hours based on analysis of GPS and ETM data	**Category "A", "B" and "C"** • Implement Planning and Scheduling Module as per Technology Roadmap

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
3	Duty Roaster of Crew and Bus scheduling	• Duty roster is prepared manually on daily basis and released in morning • Due to manual system, last moment changes are high, which results in delay in outshedding. • Additional reserve of drivers and conductors have to be maintained	**Category "A" and "B"** • Crew Management Kiosks to be installed at all depots, wherein crew attendance (biometric) can be done. He gets notified of duty allocated • Introduce software to streamline process as per Technology Roadmap **Category "C"** • Prepare duty roasters for longer period (six months or more) after taking inputs from the crew • Notification of duty allocation to be sent to crew through SMS a day before the duty and/or provision for crew to accept/ decline duty allocated using SMS or IVRS	**Category "A" and "B"** • Use Advanced algorithm based system to prepare duty memo for crew including changeover between shifts • Implement Planning and Scheduling Module as per Technology Roadmap **Category "C"** • Crew Management Kiosks to be installed at all depots, wherein crew attendance (biometric) can be done. He gets notified of duty allocated to him there itself	**Category "A", "B" and "C"** • Implement Planning and Scheduling Module as per Technology Roadmap
4	Maintenance Practices	• Preventive maintenance is done on the basis of recorded kms, rather than actual odometer reading • In the absence of automated notifications,	**Category "A"** • Introduce regular preventive maintenance schedules – daily, weekly, monthly and yearly • Use of simple IT	**Category "A"** • Implement Maintenance Management System – as part of the BFMS under Technology Roadmap • Do Capacity building of	**Category "A", "B" and "C"** • Implement Maintenance Management System – as part of the BFMS under Technology Roadmap • Set up training facility for

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		chances are that maintenance may be missed • Maintenance records are maintained manually and it is difficult to check vehicle history • Separate records are maintained for key aggregates like engine, transmission, tyre, battery etc.	applications instead of manual recording to generate notifications for maintenance • Create automated tools to do daily analysis of maintenance activities, breakdowns, incidents and - Bus-wise, Driver-wise and route-wise • Introduce special incentive scheme for workshop for lowest breakdown of vehicle • Creategital maintenance log-book for each vehicle to keep record of all maintenance related activities **Category "B" and "C"** • Development of small application using MS-excel or Access to keep the record of all maintenance schedule • Grouping of buses in smaller lots and Introduce regular preventive maintenance schedules – daily, weekly, monthly and	technical manpower to update them with new technology **Category "B" and "C"** • Create automated tools to do daily analysis of maintenance activities, breakdowns, incidents and - Bus-wise, Driver-wise and route-wise • Implement Maintenance Management System – as part of the BFMS under Technology Roadmap • Do Capacity building of technical manpower to update them with new technology	the technical manpower

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
			yearly • Strengthen maintenance activities by hiring technical manpower or monitor the performance of service provider • Monitor key activities on daily basis – engine oil consumption, Tyre pressure, drivers complaints, repeated breakdown, and spare part consumption		
5	Stores and Purchase	• Vendor selection or procurement process is not standardized. Contracts are usually awarded on L-1 basis • Procurement process is time consuming – approval is needed from central, zonal levels, etc. • Quality checks of materials and correct practices of handling / storing them may not be known by local manufacturers • Bulk inventory is not possible – tie up with Original Equipment	**Category "A"** • Procurement must be done through rate contract and e-tendering to ensure transparency • Automate spare parts storage and inventory using software application to record the entry and issue of all spare parts • Storage of items (filters etc.) in separate boxes as per the maintenance schedule • Create digital record sheet of all spare parts and oil tanks for receipt and	**Category "A"** • Implement BFMS as per Technology Roadmap • Integrate ERP system of bus manufacturer, suppliers and OEM (Original Equipment Manufacturer) to place repeated purchase order • Introduce management concept like JIT (Just in Time), FIFO (First in First Out) etc. **Category "B" and "C"** • Automate spare parts storage and inventory	**Category "A"** • Implement Maintenance Management System in all depots – as part of the BFMS under Technology Roadmap Category "C" • Integrate ERP system of bus manufacturer, suppliers and OEM (Original Equipment Manufacturer) • Introduce management concept like JIT (Just in Time), FIFO (First in First Out) etc.

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		Manufacturer (OEM) is needed for Just-In-Time (JIT) delivery	issuance • Generate cost sheet of spare parts on the basis of cost per km to evaluate the durability of the material **Category "B" and "C"** • Following up 'Hub and Spoke' model of inventory management. Main store should be setup at central location and satellite stores in depots • Generate cost sheet of spare parts on the basis of cost per km to evaluate the durability of the material • Weekly reports on spare parts on the basis of high and low consumption • Computerise store and inventory division. Creating digital record sheet of all spare parts and oil tanks for receipt and issuance	using software application to record the entry and issue of all spare parts • Storage of items in separate boxes as per the maintenance schedule • Create digital record sheet of all spare parts and oil tanks for receipt and issuance	• Implement Maintenance Management System in all depots – as part of the BFMS under Technology Roadmap
6	Human Resource	• Lack of written roles and responsibilities of staff member	**Category "A"** • Create organization chart, and defining role and	**Category "A"** • Implement BFMS as per Technology Roadmap	**Category "A", "B" and "C"** • Implement BFMS as per Technology Roadmap

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
		• Lack of standardized procedures or SOPs • Recruitment process is generally slow and lack of independence	responsibilities of each department • Integrate leave management system and biometric attendance with other functions • Automate payroll management system • Create incentive policy for crew and workshop staff to improve productivity • Set up training division for crew (drivers and conductors) **Category "B" and "C"** • Create organization chart, and defining role and responsibilities of each department • Do Gap analysis to find out the required manpower to carry out the essential tasks • Create of incentive policy for crew and workshop staff to improve productivity	**Category "B" and "C"** • Set up training division for crew (drivers and conductors) • Implement BFMS as per Technology Roadmap	

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
7	User Feedback System	• Limited options available to raise issues to concerned officials • Records are maintained manually with limited facility to do analysis • Difficult to keep track of complaints received and action taken	**Category "A", "B" and "C"** • Upgrade web-portal by adding all operation details (routes, fare, buses) for better accessibility and user feedback section • Develop mobile app to disseminate details and to receive commuters' feedback • Setup toll-free Call Center and generation of tracking number to send action taken report to passengers through SMS	**Category "A", "B" and "C"** • Procurement and installation of an integrated system to keep track of feedback/ suggestions received from all sources • Automate system to identify same feedback/ suggestions received from different sources	**Category "A", "B" and "C"** • Implement Passenger Information System as per Technology Roadmap
8	MIS	• Records are maintained manually and data is entered in the compute r • Information is compiled related to - Manual records of vehicle performance, route performance, etc. • Monitoring is not done centrally • Parameters are outdated and aggregated for several critical items and need updation.	**Category "A"** • Review Existing MIS parameters and add new parameters and deduct redundant • Do Capacity building of existing manpower and recruitment of specialized staff to conduct data analysis • Create lite application using Macros in MS-Excel or Ms-Access to automate the analysis of raw data • Generate exception	**Category "A"** • Use operation data to improve timetable, bus schedule and network plan • Implement Data Analysis and Optimization as per Technology Roadmap **Category "B" and "C"** • Create lite application using Macros in MS-Excel or Ms-Access to automate the analysis of raw data received from vehicle	**Category "A", "B" and "C"** • Implement Data Analysis and Optimization as per Technology Roadmap

Sl no.	Parameters	Key Gap Areas	Short Term (First 2 Years)	Medium Term (3-5 Years)	Long Term (6-10 Years)
			reports on all key parameters (schedule adherence, outshedded trips, missed trips, speed of buses etc.) and comparison with past data • Generate revenue data on ridership, revenue collected, passengers carried etc., and integrate with route planning **Category "B" and "C"** • Prepare MIS report and tabling of existing information in readable formats • Do Capacity building of existing manpower and recruitment of specialized staff • Use ETM data to analyse OD pattern of passengers	tracking and ticketing machines	

6.7 Roadmap for Improving Bus Transport Infrastructure

For efficient operation of bus system in various cities, the following recommendations are made related by transport infrastructure provisions and equipment's:

(a) **Modern Bus Queue Shelter (BQS)** to be provided on all major routes. Delhi provides a good example of using advertisement space for funding good BQS which could be adopted by various cities.

(b) Non availability of **adequate depot space** is a major issue in various cities. It is therefore recommended that bus agency make a strong representation to development authorities during master plan preparation/modification to include adequate space for depots, terminals and changeovers. A norm of about 25 buses per acres could be considered for allocating depot space in city.

(c) In larger cities, and **major bus density corridor**, bus agency shall also represent for having bus lanes for improving operational efficiency of system. A corridor carrying more than 5000 persons per hour per direction by bus could be considered for this purpose to start with.

(d) Most of the cities must adopt for **modernization of their existing depot**, adding equipment like automatic washing facility, Leave applying Kiosk, Smart Card based fuel pumps (for fuel management functions), biometrics for attendance and surveillance system in depot premise.

All above recommendations are relevant for short term implementation.

6.8 Roadmap for Institutional and Contracting Framework

6.8.1 Status of Contracting Structure in City Bus Operations in India

In most of the cities, the city bus operations are done by STUs which are incurring huge losses from operations of city buses. Few Indian cities have tried net cost contract and gross cost contract with modifications. The status of operations and structure are summarised in the table provided below:-

Table 6-7: Status of Contracting Structure in City Bus Operations in India

Cities	By STU Directly	Net Cost Contract	Gross Cost Contract	Hybrid Option
Ahmedabad - AMTS	✓	×	×	×
Ahmedabad - AJL (BRTS)	×	×	✓ (O&M Contract)	×
Bangalore	✓	×	×	×
Bhubaneshwar	×	✓ (bus procured by ULB)	×	×
Delhi - DTC	✓	×	×	×
Delhi - Cluster Bus	×	×	✓ (with managing agency for Transport Department - for Monitoring performance)	×
Indore - BRTS	×	×	✓ (O&M Contract)	×
Indore - City Bus	×	✓ (with premium for Operator)	×	×
Kanpur	✓	×	×	×
Kolkata	✓	×	×	×
Mysore	✓	×	×	×
Nashik	✓	×	×	×
Raipur	×	✓ (bus procured by ULB)	×	×
Shimla	✓	×	×	×
Visakhapatnam	✓	×	×	×

On the basis of the above chart, the cities are grouped into three groups as given below:

Category "A" (Highly Progressive)	**Category "B"** (Moderately Progressive)	**Category "C"** (Low Progressive)
Delhi (Cluster)	Bangalore	Kanpur
Ahmedabad	Mysore	Nashik
Indore	Visakhapatnam	Kolkata
	Bhubaneshwar	Shimla
	Raipur	

Category A – The cities have implemented Gross Cost Contract with or without monitoring and if Net Cost Contract is adopted, have modified to provide VGF or premium to the Operator.

Category B – The cities that followed Net Cost Contract or operated by STU directly which has capability to operate large fleet and have better operational efficiency.

Category C – In these cities, the city bus operations re done by STU directly that incur large losses and does not have full capability.

6.8.2 Roadmap for Institutional and Contracting framework in city bus operations

Table 6-8: Policy Roadmap for Institutional and Contracting reforms in city bus operations

Sl No.	City Level Parameters	Existing Gap Areas	Short term (Upto 2 Year)	Medium Term (2 – 5 year)	Long Term (5 - 10 year)
1	Institutional and Contracting Reform	• STUs focus on the inter-city bus services neglecting the city bus operations. For operations, old fleets are used and quality of service is poor, though they have domain experience • ULBs lacks technical staff/knowledge skills in bus operations • With Net cost contract, strict monitoring of service delivery is not done. Private operators interested only on profit making routes and neglecting large areas • Though Gross Cost Contract is the better option, strict monitoring of KPI is key for its success	**Category 'A & B' Cities** • In terms of institutional structure, formation of SPV for city bus operations contracting the operations to private player through Gross cost contract is preferred - the SPV to have technical staff to monitor operations based on KPIs agreed between the both parties. Strict monitoring to be done by the SPV with provision of bonus for better operations and penalty against non-adherence in the service contracts • In case of cities with Net Cost Contract, improve the contract by adding KPI to the contract and providing premium/VGF to the operator on the basis of ridership and route length studies • Hiring of PMC consultants to assist Transport Department/ULBs/STUs with technical support and bid process management **Category 'C' Cities** • Strengthen the technical departments through training to all key operational and administration staff along with computerization	**Category 'A & B' Cities** • Testing of Gross cost options - Modification of contract type from net cost to gross cost based on market review **Category 'C' Cities** • City bus operation to be by Gross Cost Contract with KPI • Hiring of PMC Consultants	**Category 'A, B & C' Cities** • The STUs operating the buses must shift their city bus operations through formation of SPV and selection of operators based on Gross Cost Contract with KPI/Hybrid options

6.9 Policy Roadmap for Funding and Implementation of City Bus Service

Policy Roadmap recommendations for funding are as follows:-

Table 6-9: Policy Roadmap for funding

Sl No.	City Level Parameters	Existing Gap Areas	Short term (Upto 2 Year)	Medium Term (2 – 5 year)	Long Term (5 - 10 year)

1	Funding Options	• Fare revisions not carried out regularly with direct implication on lower fare box revenues increasing ridership increasing.
		• Money spent in providing various concessions not reimbursed
		• Operations on low profit routes
		• ULBs rely on central funding for bus procurement due to lack of dedicated PT fund
		• Commercial exploitation of assets such as terminals, BQS etc., are not aggressively done by the STUs and ULBs.
		  ○ In few cities revenue is generating form the advertisement.
		  ○ In vehicle advertisement is happening in most the
			Category 'A, B & C' Cities
			• More aggressive outlook advertisement revenue by adopting place based dynamic advertisement options
			• Revenue from parking charges at terminals and stations can be utilized for
			  ○ PT development /operations in city – one Commercial development at terminals should be developed on PPP basis (on lease)
			  ○ Initiation of resource mobilization from CESS
			• Cess on one time tax being levied on motorized vehicles
			• Cites can integrate various other revenue to city bus operations as under
			  ○ If SPV is formed with
				Category 'A, B & C' Cities
				• Cess in the form of Green Tax
				• Introducing PT cess on petrol and diesel
				• Revenue from congestion charging by ULBs can be utilized for PT improvement - congestion charging can be imposed on heavy commercial vehicles entering the CBD during peak hours
				• Funding sought from central and multi-lateral agencies - AMRUT and from JICA/WB/ADB
					Category 'A, B & C' Cities
					• Proximity Tax - Property tax revision based on proximity to public transport
					• Employers tax – tax on employment
					• Cross-utility financing

Sl No.	City Level Parameters	Existing Gap Areas	Short term (Upto 2 Year)	Medium Term (2 – 5 year)	Long Term (5 - 10 year)
		places but in the terminal area and at the BQS few cities are generating revenue. • Till the date no city is generating revenue from the parking area. • Few STU's are providing rental/ lease for commercial/ office spaces in the terminal area. • Nowhere PPP model is developed to have a real estate model in the air space of the terminal area.	municipal corporation, Adv. Revenue, revenue from parking, terminals etc., can be utilized for improving/subsidizing bus service ○ If STU is operating, Adv. Revenue from buses and commercial development at terminals can be utilized for bus service improvement • Allow bus operator to have certain routes with inter-city operations to balance losses from city bus operations; to encourage private players to participate in tender process • Introduce priced parking based on PTAL and revenue generated to be used for improvement of PT		

7. Proposed New Tools for Improving Bus System Efficiency

7.1 Introduction

Based on the recommendations made in the earlier chapter, various tools and toolkits are proposed in this chapter which could be developed either by the Government, an NGO, or by any commercial start-up to enable efficiency enhancement in bus system in India. Brief information of these proposals is included which is refered as 'project sheets' and provided below. The selected areas are as follows:

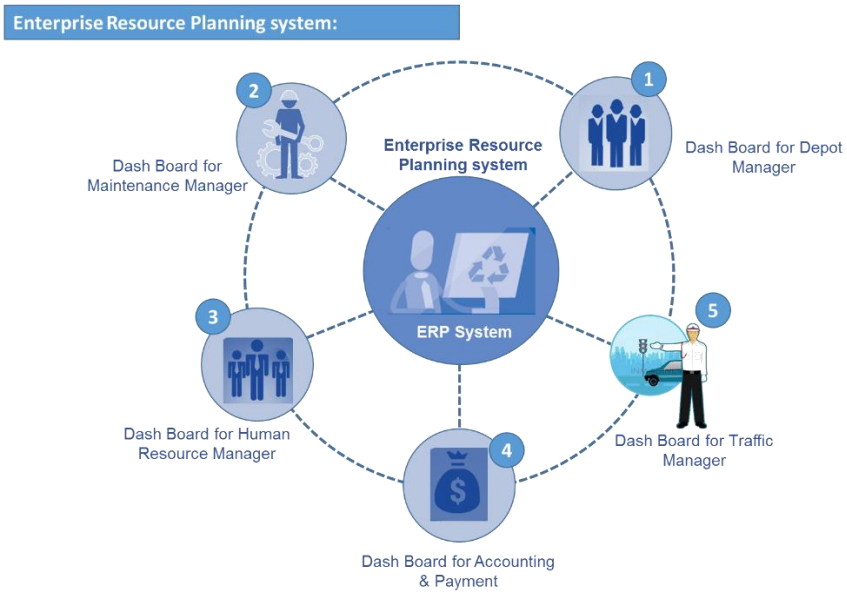
i. Development of ERP based dashboard for management
ii. Vehicle and Crew optimization tool
iii. Time table preparation tool
iv. Route rationalization tool
v. Route planning tool
vi. Dead kilometer optimization tool
vii. GIS-based asset management system
viii. Updation of MIS parameters for Bus agencies
ix. Fare revision tool
x. Bus management system
xi. Toolkit / Guidelines for Route Planning
xii. Toolkit / Guidelines for Route numbering / Colour-code system

The details of each are provided in the sections below as project sheets with project ID.

7.2 Project Sheet (PS)

7.2.1 PS1: Development of ERP based dashboard for management

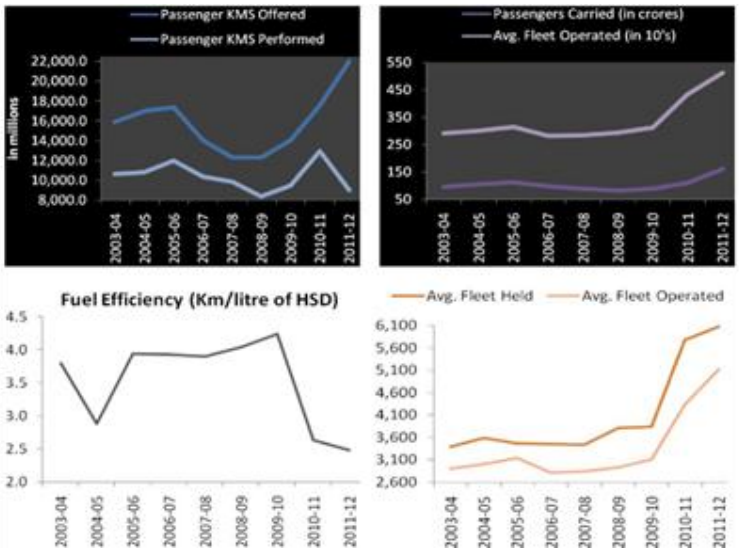
An Enterprise resource planning system (ERP) based dashboard for each of the management functions shall be developed. The main functions that shall be integrated with ERP as shown in the figure given below:-



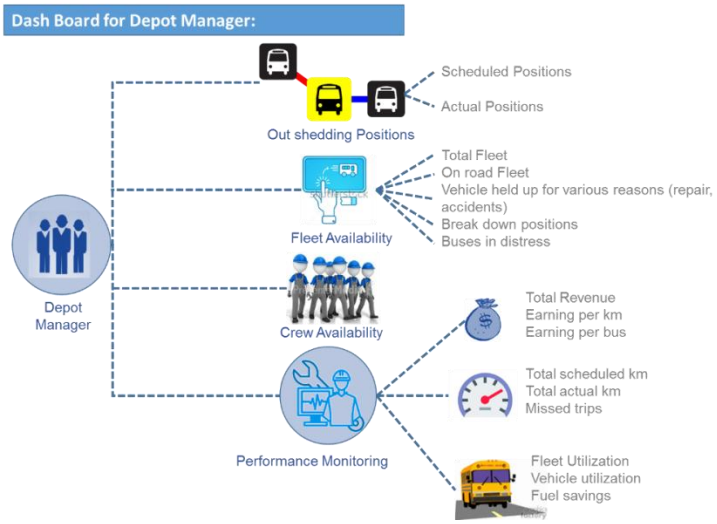
The proposed ERP system will have multiple dashboards which will display the key health of system under various functions, as follows:

Dash board for Depot Manager

The dashboard for Depot Manager shall have the various data made available as shown in below figures. The outputs may be in the form of pie-charts, line graphs, bar charts etc.

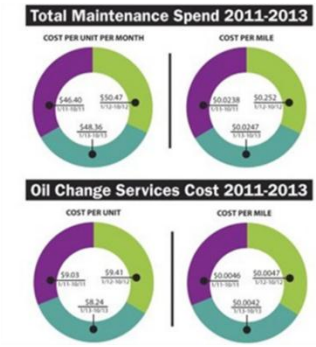


The system may have following components for Depot manager in the Dashboard:-

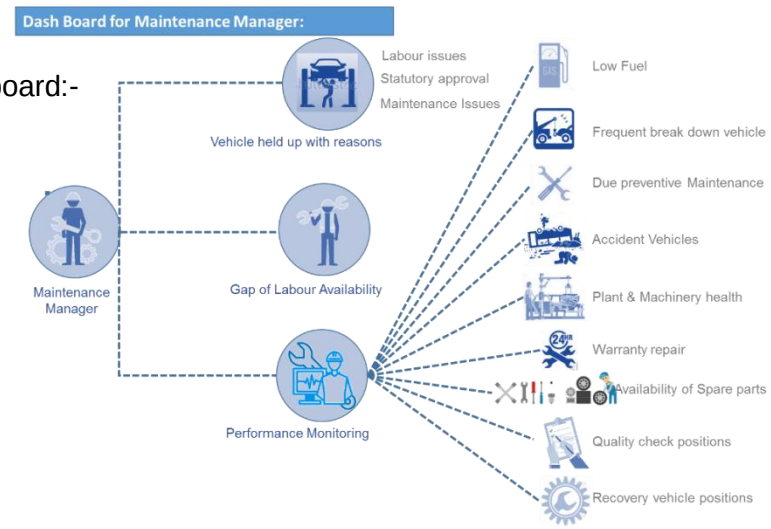


Dashboard for Maintenance Manager

The dashboard for Maintenance Manager shall have the various outputs made available for performance review of maintenance function as shown below in figures. The outputs may be in the form of pie-charts, line graphs, bar charts etc.

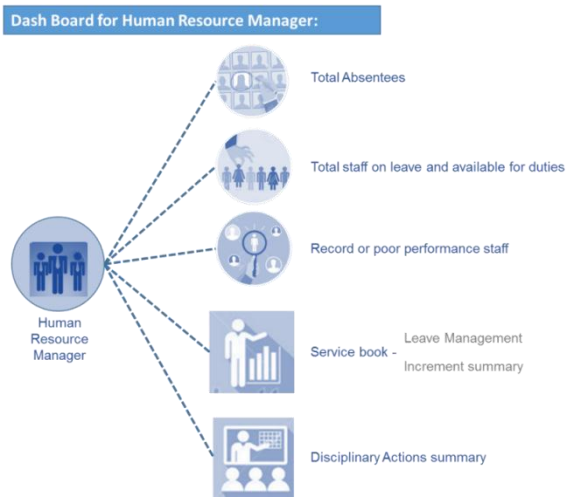


The ERP may have the following components associated with the dashboard:-



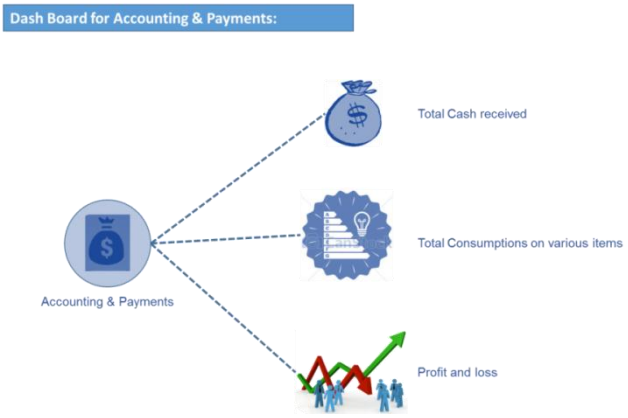
Dashboard for HR Manager

The dashboard for Human Resource Manager shall have the following outputs made available through ERP:-



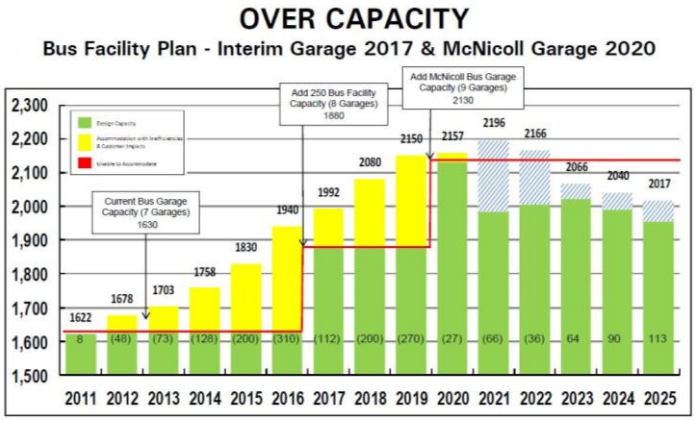
Dashboard for finance & Accounts Team

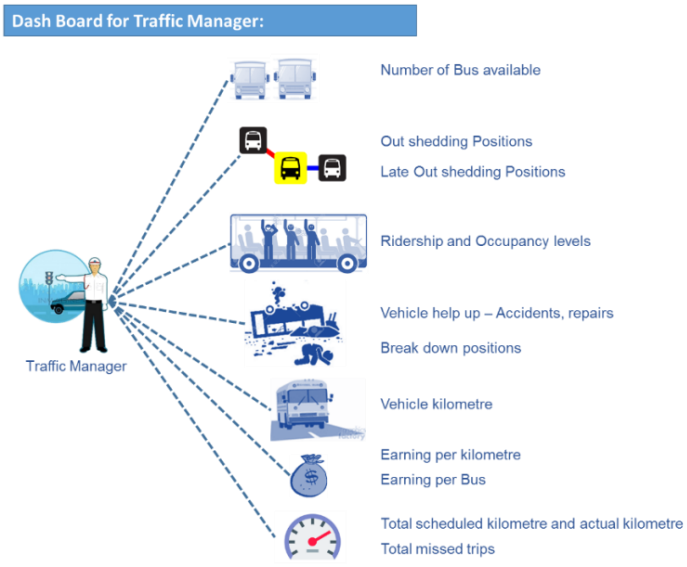
The dashboard for F&A Manager shall have the following outputs made available through ERP:-



Dashboard for Traffic Manager

The dashboard for Traffic Manager shall have the following outputs made available through ERP. The outputs may be in the form of pie-charts, line graphs, bar charts etc. as shown.





The system may have following components for Traffic manager in the Dashboard

7.2.2 PS2: Vehicle and Crew optimisation tool

Presently duty rosters are prepared manually in most of the agencies. This could create lack of optimization of vehicles and staff in bus agencies where large number of vehicles and staff are handled. While there are “off the shelf” software available, these are costly, complex and lack customization of local labour laws/condition.

It is therefore important to develop a very simple crew optimization tool which can assign crew duties automatically within constrain of number of vehicles and labour laws (rest time, maximum number of duty hours etc.). This tool will greatly help bus agencies in modernization of their existing system and is depicted below.

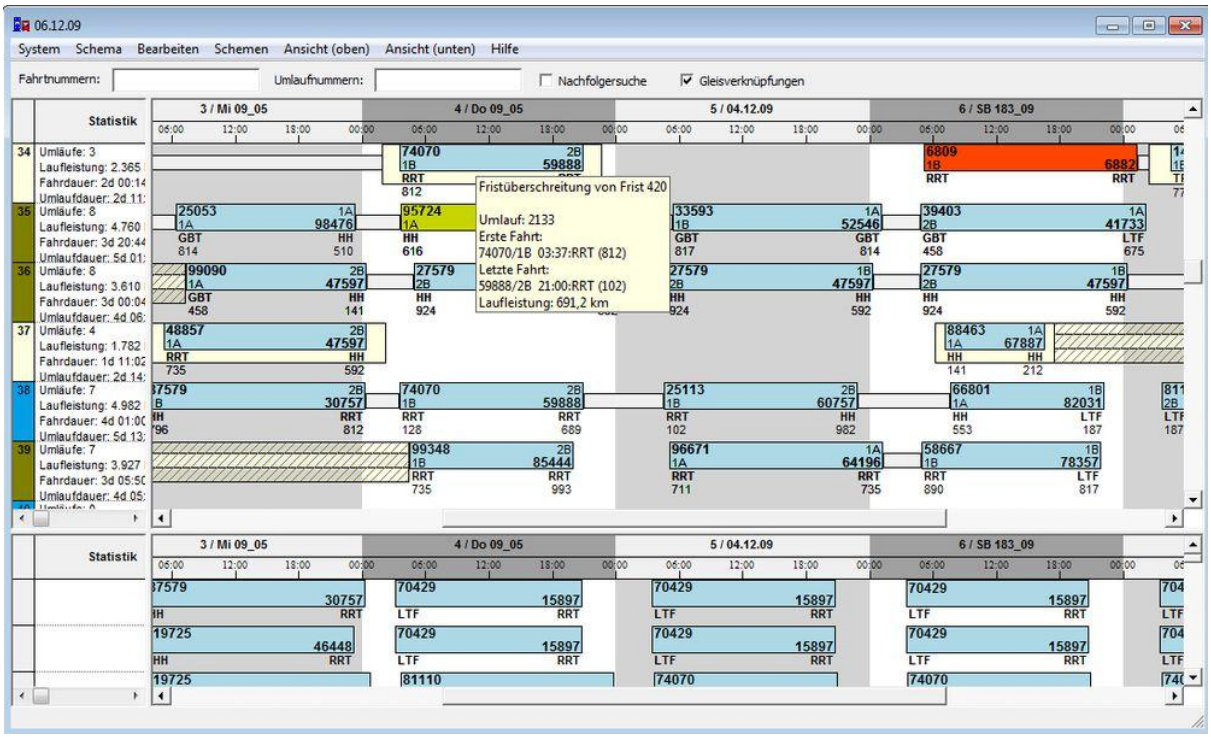


Figure 7-1: Vehicle and crew Optimization Tool

7.2.3 PS3: Time Table Preparation Tool

Presently time tables are prepared manually based on the average speed of network and for limited number of time segments due to complex number of combinations involved.

The purpose is to automate this process with an indigenously developed simple tool which could be handled by bus agencies. Available proprietary software are very costly and very complex for handling Indian requirement.

The proposed system will have following modules:

1) Line data preparation module: In this module section-wise/direction-wise journey speeds of all routes will be inputted either by GPS feed or through route survey
2) Time segmentation Module: this module will define time segmentation of peak/ off-peak/ early morning/ late night/ weekdays/ weekends/ monthly etc. This could either be done by judgment or using historical ticketing data of ETM or ticket records.
3) Frequency calculations and vehicle requirement module: In this module, the system will access travel time data and ticketing data for deciding bus frequency and number of buses in order to meet travel demand and maintain minimum frequency levels

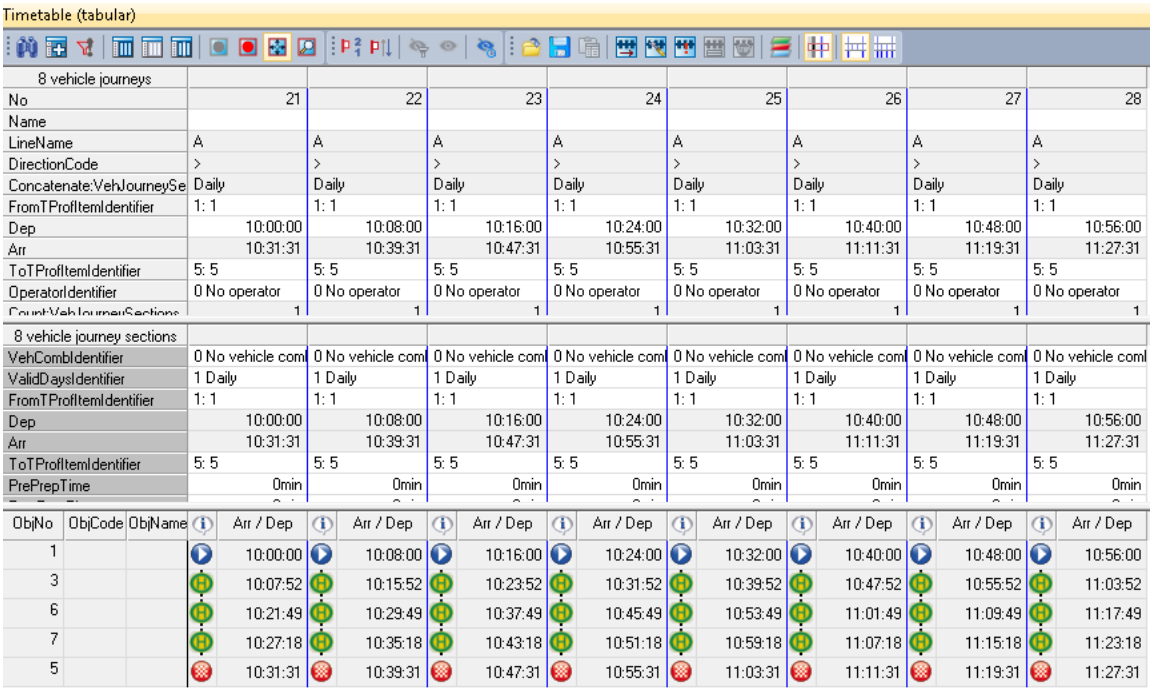


Figure 7-2: Time Table Preparation Tool

Time table module: Based on above analysis of fleet and time segmentation, this module will generate time tables (stop-wise) for various periods and for various routes

Frequency Refinement Module: Auto generated timetables could be checked by supervisors in this module and refinement/ revisions could be done.

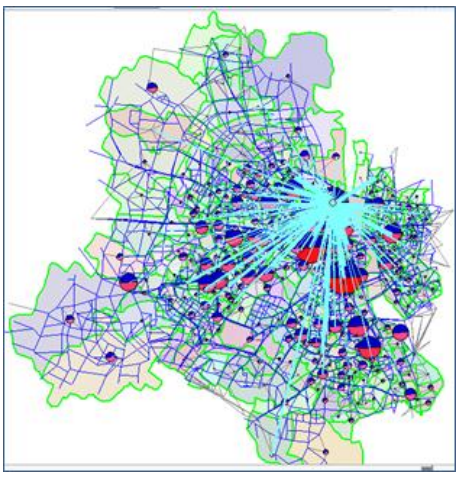
7.2.4 PS4: Route Rationalisation Tool

There has been a need for a simple route rationalization tool for assisting bus agencies. Presently, it is done through judgment and local knowledge with limited data and scientific analysis

The proposed system will have following elements**:**

1) Integrated Route Mapping tool for services overlap analysis: This tool will map all the existing routes of buses, mini buses, Gramin Sewa, metro, monorail and any other public transport systems in the city. This will facilitate in
   - Route overlaps analysis and rationalization
   - Simplifying and integrating public transport system

2) Route Efficiency analysis Module: This module will have data of route-wise/segment-wise/time-wise ridership data and earning per Km data, occupancy data, bunching data etc. This will facilitate identification of efficient and inefficient routes



3) Optional Module – Trip Desire line plotter: This module (as optional) can assist cities to plot passenger desire lines and assist bus agencies to match route profile and passenger demand.

7.2.5 PS5: Route Planning Tool

Most cities lack route planning tools which analyse public transport demand and accessibility of public transport on a city level. Route planning can be done using transport planning software's such as VISUM, CUBE, EMME etc., however these can be too complicated for bus agencies lacking specialised personnel. It is therefore recommended that a simple solution be developed on which the city transport network can be plotted and information can be superimposed to determine the need for new routes through Passenger desires lines, Trip generation nodes, Passenger accumulation (based on shortest paths) on routes and accessible/inaccessible areas of public transport based on isochrones.

The proposed system will have following elements, as depicted in the schematic below:

1) Network Module: This module holds details of transport network and major economic nodes
2) Demand Module: This module will hold data on transport demand
3) Analysis Module: which analyses data to determine the demand area, services deficit area and potential new routes

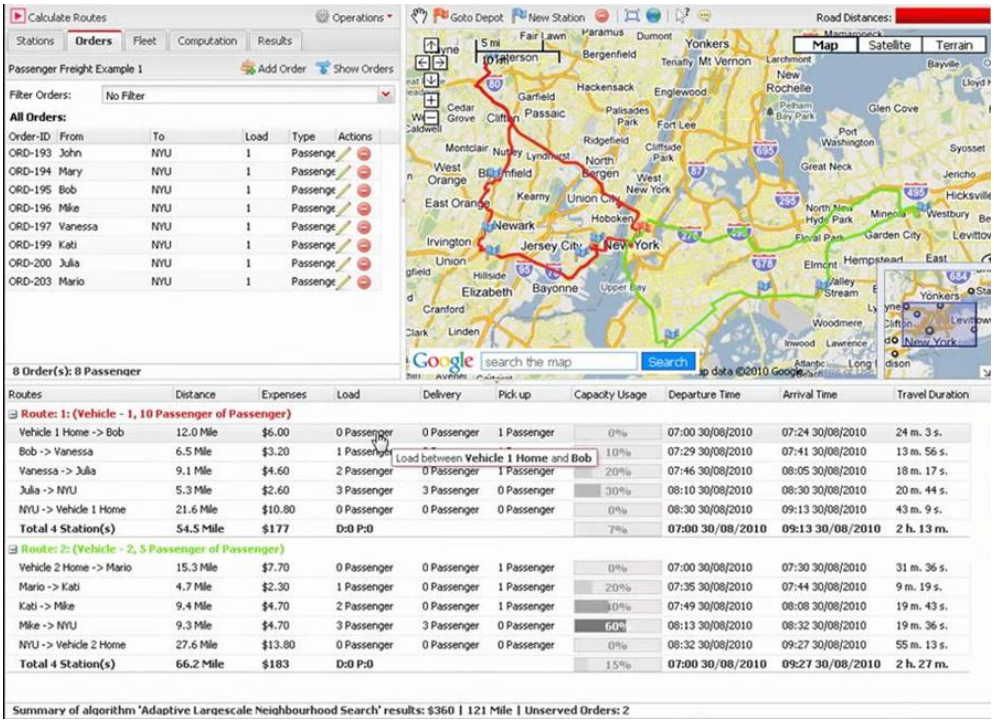


Figure 7-3: Route planning tool

7.2.6 PS6: Dead Kilometre Optimisation Tool

At present, allocation of routes to depot is done purely on the basis of judgment. No analysis of dead-km is done to determine optimum solution of route allocation of buses to depot or identification of suitable depot space with respect to route network. The proposed tool will help cities determine optimum depot locations or route allocation if depots already exist in city.

Development of this tool will require an operation research based optimization algorithm which can calculate dead–km on assigning various bus routes to various depots or locating various depots at various places with reference to the bus routes structure.

7.2.7 PS7: GIS based Asset Management System

Bus agencies hold several assets such as bus queue shelters, PIS boards, stop sign boards, advertisement panels, land for depot, terminals etc. However record of these assets is kept by manual method which is not the best system for asset management.

We recommend that agencies develop a GIS based asset management tool which will house information on:-

- Location of asset
- Type of asset
- Conditions and life of asset
- Other details

This tool will help in maintaining proper records of assets as well as developing up-gradation/ replacement plans for their asset for each agency

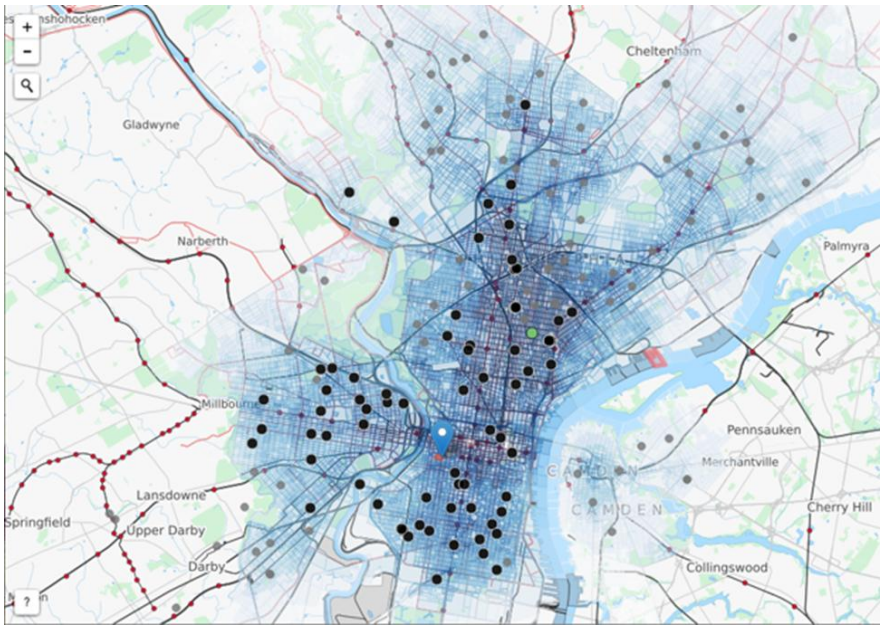
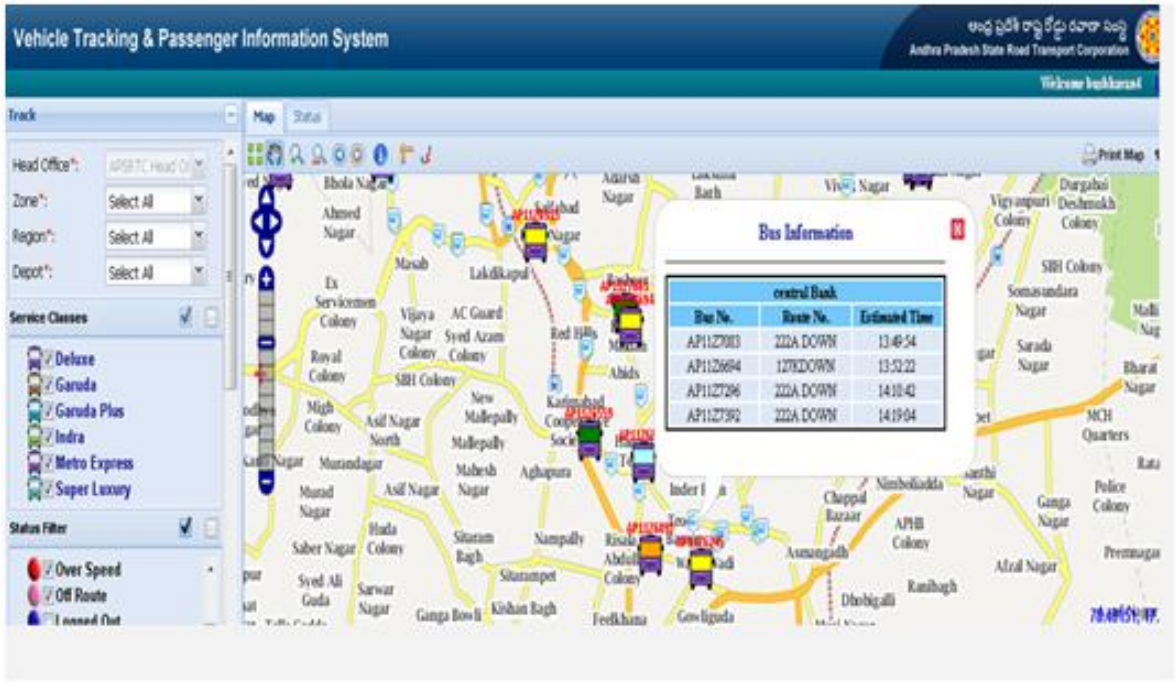


Figure 7-4: Bus management system web page



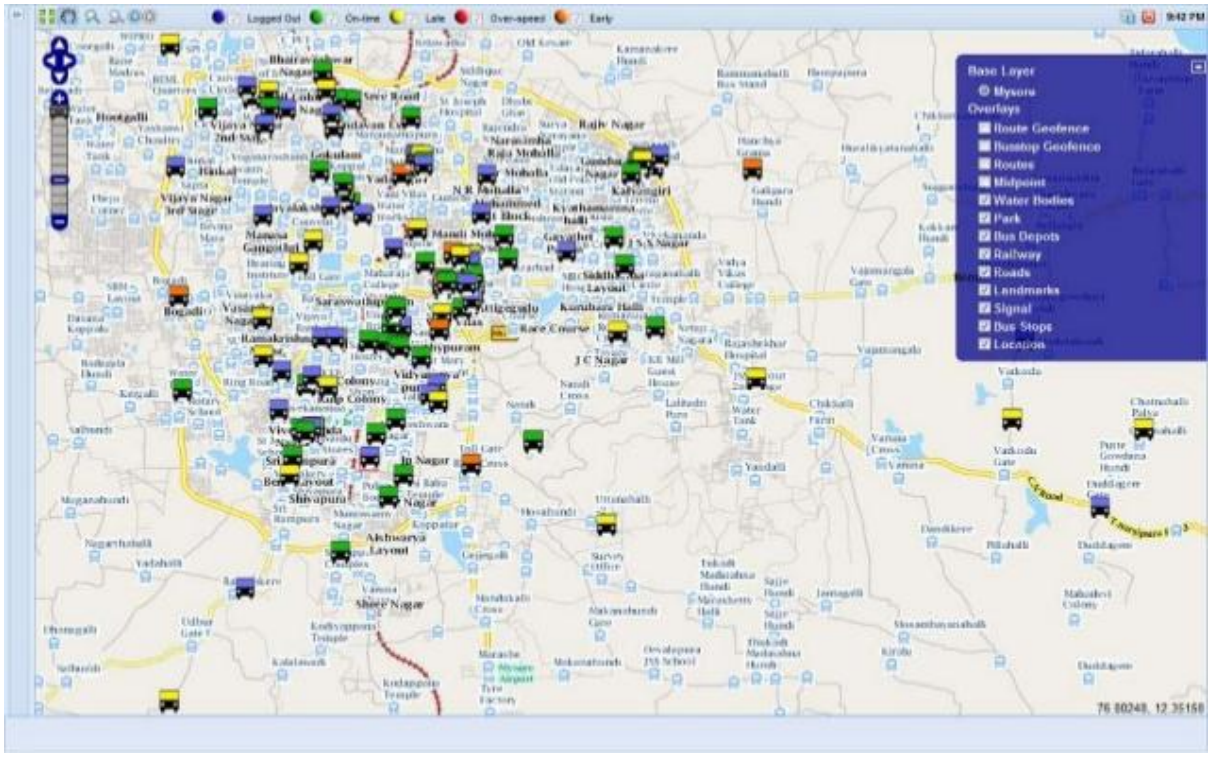


Figure 7-5: example of GIS based assets management system- Location assets

7.2.8 PS8: Updation of MIS Parameters for Bus Agencies

The MIS systems adopted by many cities are old and not much work has been done to upgrade it periodically or making it dynamic to suit the changing needs of organisations. Some of the issues in the existing MIS systems are:

- It captures operators efficiency parameters but does not capture public services delivery parameters such as crowding, wait times, accessibility etc.
- Rapid changes observed in last few years through use of technology (such as GPS, ETM etc.,); various indicators could be analysed at more disaggregated level for decision making.
- There is need to add certain new parameters and remove certain redundant parameters for modernization of MIS system as per present needs.

7.2.9 PS9: Fare Revision tool

There is a need for developing a standard tool for fare revisions which takes into account; capital cost, operation cost and increase in key inputs on a regular (ex – yearly) basis.

The tool will be based on mathematical procedures in which the user can input key parameters and get fare revision every year. This tool will help agencies to scientifically represent need for periodic revision of bus fare taking into account of various relevant parameters in transparent manner.

7.2.10 PS10: Bus Management System

(Performance monitoring tool of contracting)

Many cities are moving towards adopting gross cost contract where concessionaire payment is made based on agreed key performance indicators. Currently, except DIMTS, most of agencies do it based on manual/ semi-automatic methods which are not efficient enough and not sustainable with increasing operations.

Thus, there is need to develop a standard tool which could monitors “key performance indicators” based on data collected by GPS/ETM/MIS system of bus agency and make recommendations of

- Concessionaire payment
- Penalties (with details of deviation)
- Bonuses (with areas of good performance)
- Comparison of concessionaire performance.

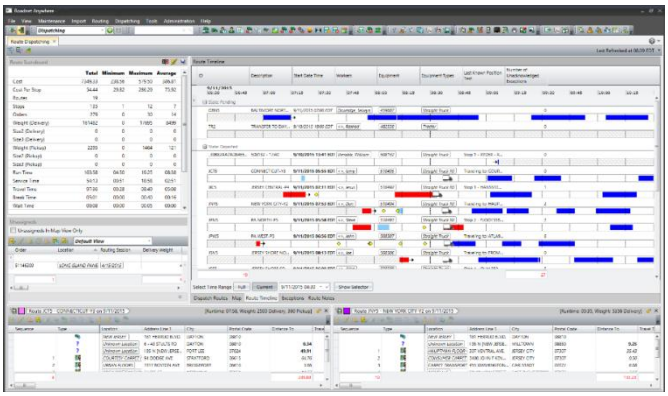


Figure 7-6: Bus management system web page

7.2.11 PS11: Toolkit / Guidelines for Bus Route Planning

Present bus route planning is done mainly based on local knowledge and judgements by bus agencies. Due to the lack of any guidance in this area, most of the agencies rely on knowledge of staff to deliver these functions.

Therefore, it is recommended that a toolkit of route planning be created which can provide various methods of route planning considering various levels of data analysis. This toolkit on one hand shall recommend “Rapid Assessment technique” while on other hand it can also provide detail methods driven by large data & modern software.

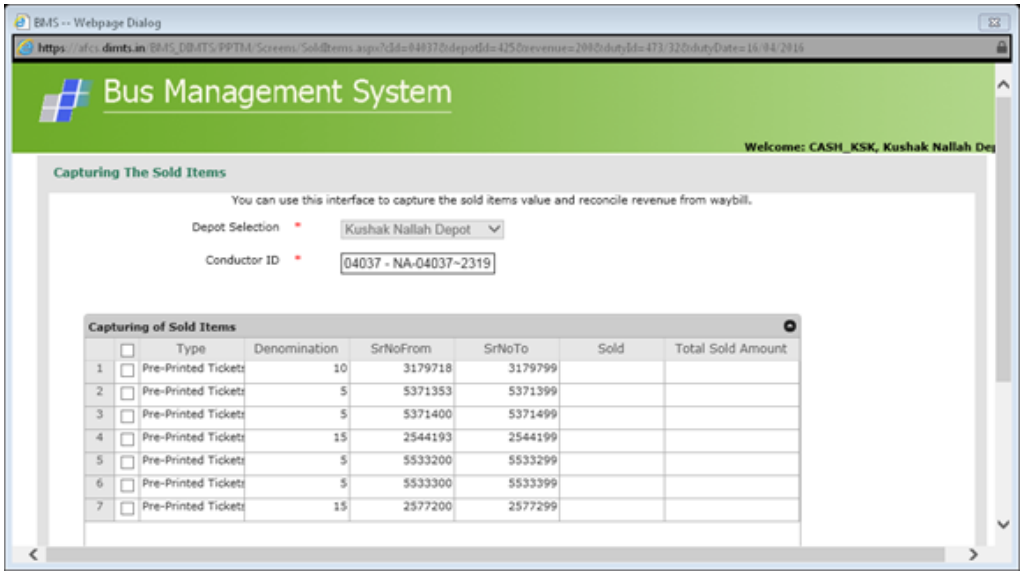


Figure 7-7: Bus fleet route planning software

Figure 7-8: New Jersey Transit Bus route planning

7.2.12 PS12: Toolkit / Guidelines for Route numbering / Colour-code system

Bus route numbering systems in most of the cities are developed on an ad-hoc basis. In the small cities with limited service, it does not make much difference; however in medium to large cities, a logical route numbering systems and differential colour code of services would help users to differentiate various routes and improve user's convenience.

It is therefore recommended that a toolkit could be developed in which various principles of route numbering / colour system could be explained. This toolkit will be helpful for cities to reorganize bus numbering and colouring system.

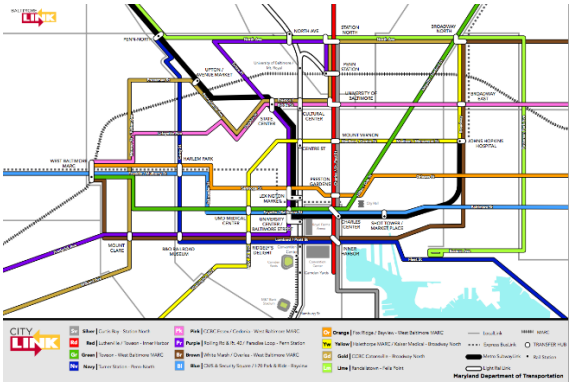


Figure 7-9: Example of Route colour coding system – Maryland, U.S.A.

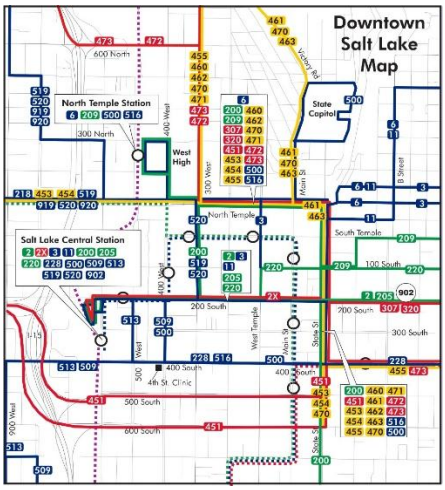


Figure 7-10: Example of Route numbering - Downtown Salt Lake map

8. Conclusions and Way Forward

Various cities in India were grouped into categories based on city characteristics, viz., population, geographical location, multimodal availability and characteristics of city bus system, viz., city bus fleet size, progressiveness of the bus transport system in order to carry out baseline analysis of the urban bus system of the cities.

A total of 12 representative cities – namely Ahmedabad, Bangalore, Bhubaneshwar, Delhi, Indore, Kanpur, Kolkata, Mysore, Nashik, Raipur, Shimla, Vishakhapatnam – were selected for city level data collection to study the organizational processes and prevailing practices. The data collected and the findings from these cities on existing processes are provided in the report.

The study observed the following:

a) Ahmedabad, Bangalore, Delhi (cluster system), Indore, Mysore and Vishakhapatnam have elements of progressive approach in operations management and public service delivery.

b) Rest of the cities, viz., Bhubaneshwar, Delhi (STU), Kanpur, Kolkata, Nashik, Raipur and Shimla follow traditional and suboptimal processes in operations management and public service delivery.

The areas of deficit in existing systems have been identified and compared with examples from other countries, where large scale reforms in road based public transport systems have been implemented, in order to formulate benchmarks for each area.

Both national and international practices have been studied to present best cases for various functions to optimize bus planning, operations and management system.

Further, based on discussions with stakeholders, a detailed activity wise Roadmap (short term, medium term and long term) has been prepared for adoption and implementation of best practices in respective cities.

The summary of findings/activities is listed below:-

1) **Route Planning and Rationalization** is being done using local knowledge, requirements and judgment. This process needs to be strengthened by incorporating scientific data and simple tools to assist bus agencies in scientific planning.
2) **Timetabling and schedule adjustments** are manually done in most cities using parameters like flat average journey speed, both in peak and non-peak hours, and average route EPK which result in suboptimal and inefficient operations. A simple timetabling tool has been proposed to be developed for Indian conditions to offset the high cost and complexity of available international software.
3) Several cities have computerized some of their functions, although in an isolated manner. A serious need has been observed to develop an **Integrated Enterprise Resource Planning (ERP)** at the organizational level to improve efficiency and to build an integrated data source. The proposed ERP system will have various modules such

as Operations, Maintenance, Accounts & Payments, HR etc., with multiple dashboards for each organizational unit to monitor performance of their operations. This is explained in detail in the project sheet section.

4) The **existing MIS system** is outdated and requires major upgrades. In current times when data is being made available from GPS/ETM on a disaggregated level, these MIS systems require an overhaul to incorporate new data yielded by GPS/ETM. The existing MIS system also needs to be reviewed on performance monitoring parameters which are primarily designed from the operator's perspective and completely ignores the user perspective. The modernization of MIS system has been proposed as part of recommendations and detailed in the project sheet section.
5) On the technology front, a Roadmap has been presented in the report. Most cities have **GPS & ETM capabilities** (or are in the process of procuring them). The first challenge is to adapt these systems to existing operations and then look for second generation technological reforms. There is a need to develop simple optimization/data analytics tools and connect all this information to the proposed ERP module so that all data collected from GPS/ETM applications can be used for operations/monitoring of systems.
6) Agencies can collect useful data using **crowd sourcing** by adding option to user to suggest routes and other elements at their website/mobile app. This data will be valuable for planning new routes and making adjustments to existing routes, to provide demand responsive and dependable service to passengers while reducing travel time/cost in comparison to private modes.
7) Some agencies could also consider adding **modern devices** such as Automatic Washing, **Leave Kiosks**, Smart Card enabled fuel pumps, Biometrics based attendance and Depot surveillance system which will help them improve efficiency.
8) Review of **institutional arrangement** indicates that city bus operations are run by STUs, municipal corporations or SPVs. In case of STU run operation, except some cases (BMTC, Mysore), largely it is observed that STUs pay less attention to city operation as their main focus is on intercity operations, although STUs are the most experienced in handling operations. Municipal corporations have inadequate capacity to run bus services and consequently experience challenges. SPVs mainly work on an outsourced model and are able to manage operation though they also face challenges due to lack of experience of this sector. In terms of contracting options, gross cost, net cost and some form of hybrid options have been observed for managing bus operations. The advantages/disadvantages and experiences of bus agencies and operators has been recorded to recommend suitable option on above areas. Based on various analysis and interviews, it has been found that SPV run bus service with gross cost contracting (strongly driven by KPI) is the preferred mode. However, in the present form it will require some moderations as suggested below:
    a. **SPVs require capacity building** by imparting training to staff with sector knowledge. At the very least a Public Transport Planner, Bus operations and monitoring expert and ITS expert should be inducted for dynamic planning and monitoring functions.

b. In **Gross Cost model, KPI shall link incentives** for operators for passenger carried so that the crew is more attentive toward public service delivery and enhances the level of service of the public transport system

9) While many of bus agencies planning to adopt **gross cost** in the future, many others are likely to continue to with existing Net Cost system. In such case, more emphasis is needed on KPI-based monitoring and introduction of cross subsidization model for rural/ unviable routes for operators. Indore presents a very interesting example under this model. In all cases capacity building of staff is key issue which shall be resolved by setting up technical PMU (preferably through PPP route) by which bus agency can have access to specialized manpower for enhancing their bus operations, adopting new software's and techniques and installation of new technologies.

10) **Funding** is major issue for most bus companies, as bus operation is not self-sustained, if considered for providing good service to cities as several of routes in less populated areas and off peak hours run with low occupancies. Consultants view is that following options could be considered by cities:

a. A public transport cess could be considered on diesel/petrol which can fund public transport subsidy.

b. Revenue from advertisement and parking should be utilized for filling this gap

c. In certain cases, revenue from developing commercial spaces at terminal & depots could be considered.

d. In some states, premium collected from intercity operations on long routes can be used to subsidize city bus service. This model is successfully working in Indore city.

11) A tool for standardization of **fare revision mechanism** has been suggested to facilitate automatic revision of bus fares (upward/downward) based on key input parameters in transparent manner as being done by government for petrol/diesel prices.

12) There are several other suggestions made to **modernize bus system** by adopting modern practices of route numbering and bus colouring which could be considered by cities

8.1 Way Forward

The roadmap recommendations and their actions plans are to be taken up by various stakeholders in implementing and the responsibilities with stakeholders/institutions are as provided in the table below:

Table 8-1: Action Plan and Stakeholder Responsibilities

Sl. No.	Area of Intervention	Action Plan	Major Stakeholder
1	Strategic Transport Planning	Periodic Amendment of PT Policy guidelines based on requirements	• MoUD
		Development of PT Master Plan / CMP	• ULBs / City Government

Sl. No.	Area of Intervention	Action Plan	Major Stakeholder
2	Technology Interventions	Development of model document for Bus Modernisation Plan	• MoUD / MoRTH
		Implementation of GPS, ETMs, CCTVs, PIS etc.	• STUs / SPVs / ULBs
3	Improving Operational Process	Development of Toolkit for process modernization	• MoUD / MoRTH
		Awareness campaigns on the policy roadmap recommendations with STUs and SPVs	• NGOs and Think-Tanks
		Training and Workshop sessions	• NGOs in collaboration with ASRTU / IIT / SPA / CIRT / CEPT
		Conducting Route Planning and route rationalization studies	• ULBs / STA
4	Institutional and Contracting Framework	Review of existing HR Policy	• Amendment by respective State Governments
		Development and implementation of Training Modules	• By CIRT / ASRTU
5	Funding Options	Development of PT funding policy guidelines	• MoUD / MoRTH
		Fare Revision Mechanisms and dedicated fund for PT	• State Government

It is also evident that all the recommendations would have to be implemented by respective STUs and SPVs while other stakeholders provide a supportive role. The responsibility rests with the STU/SPV to improve the city bus system for users as well as for the agency in terms of operational and financial efficiency with the policy roadmap.

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