

public transportation optimization

Mentored By

SANTHOSH S

THATCHAYINI.S

SHALINI.J

SIVAKUMAR.R

SURENDHAR.P

Talking Transit: Use of Information Technology (IT) in Modernizing City Bus Services

Presentation on

Use of IT in Data Collection and Optimization of Public Transport Operations

Samir Sharma, Vice President
Delhi Integrated Multi-Modal
Transit System Limited (DIMTS)



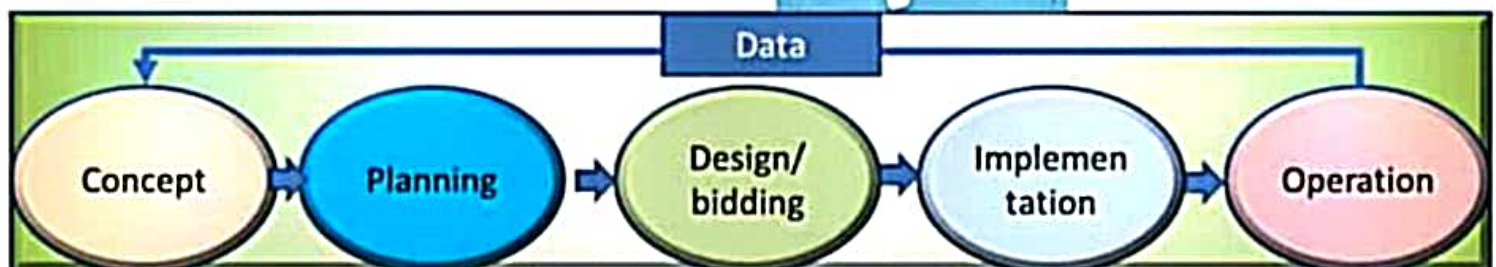
DIMTS - Specialized Company in Urban Transport Space

Delhi Integrated Multi-Modal Transit System Ltd. (DIMTS) is an *urban transport* and *infrastructure development* company set up in 2007 with a sharp focus on improvement initiatives in urban transport infrastructure

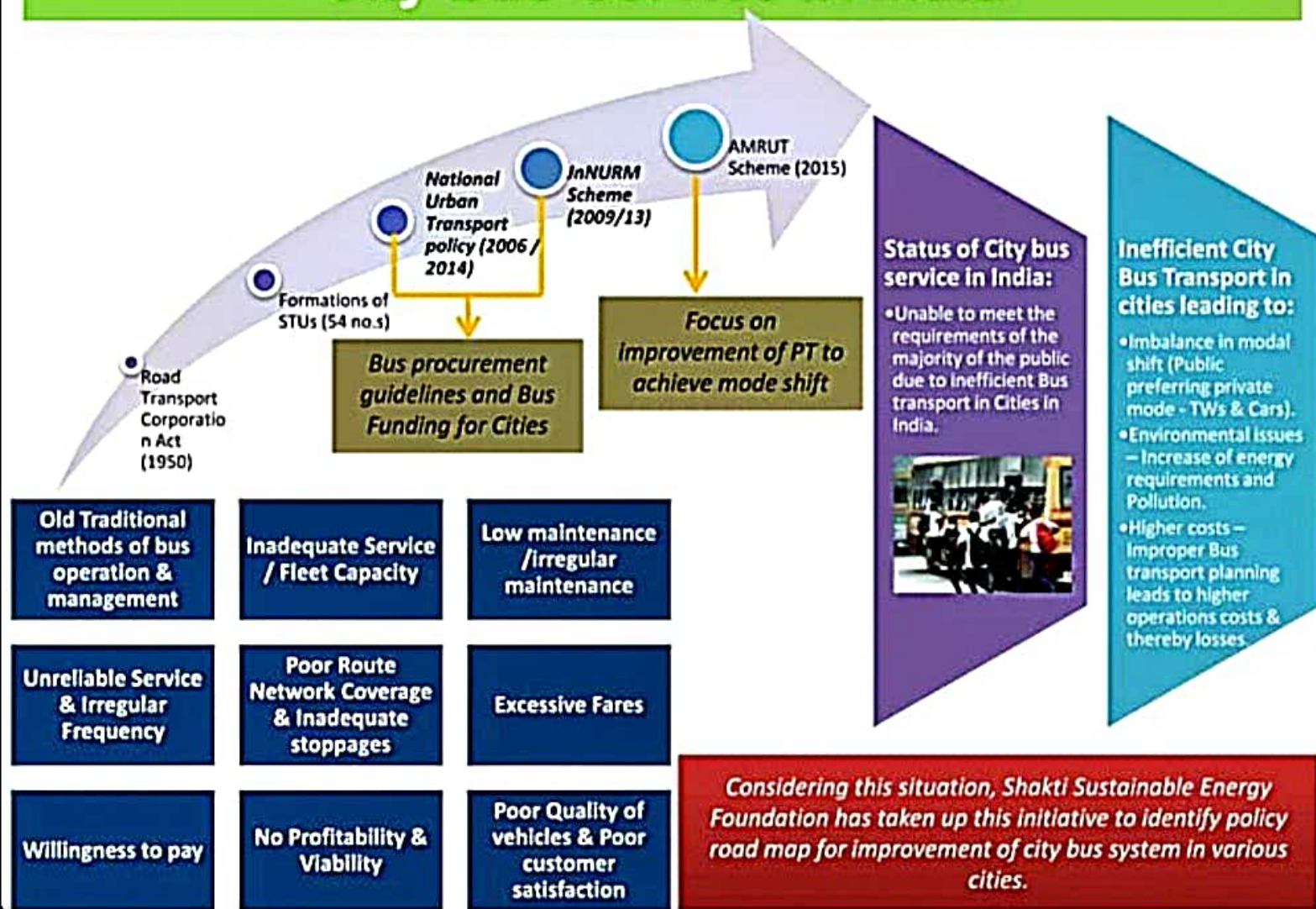
Equal equity partnership of
Government of National Capital Territory of Delhi (GNCTD)

IDFC Foundation (a not-for-profit initiative of IDFC Ltd.)

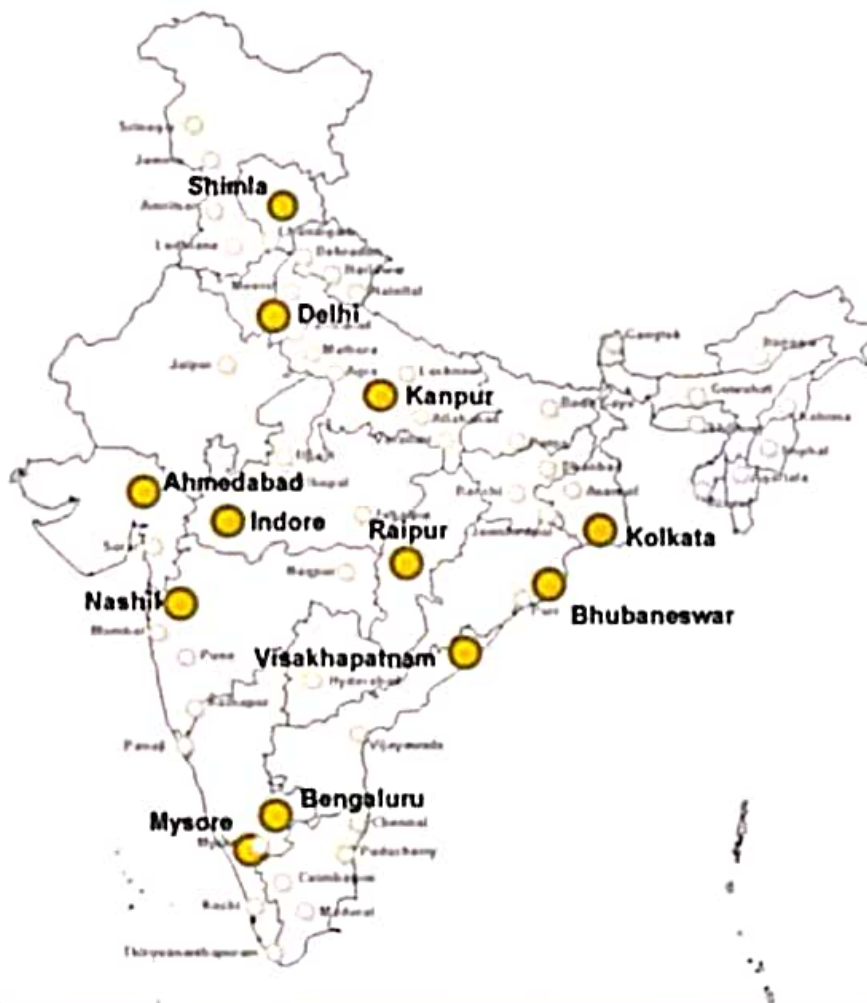
Transport Planning	Advisory Services	Engineering	Operations	Transport Technologies
<ul style="list-style-type: none"> Comprehensive mobility planning Urban Mass Transit Corridor Planning and Design Traffic modelling and simulation Public transit route planning scheduling 	<ul style="list-style-type: none"> Feasibility Analysis Project Structuring PPP Advisory Bid documentation Bid process management 	<ul style="list-style-type: none"> Design Project Management Construction Supervision Independent Engineering Services Railways <ul style="list-style-type: none"> Alignment and Track design Signaling 	<ul style="list-style-type: none"> Bus Concession Management BRT Corridor Management Operations Control Centre Smart card issuance management 	<ul style="list-style-type: none"> Automatic Vehicle Location Electronic Ticketing Passenger Information Systems Mobile Applications Intelligent Signaling and Traffic management systems



City Bus Service in India



Policy Road Map for Urban Bus System in India



- Analysis of existing processes of Bus Companies In India
- Project being done with Support From Shakti Foundation

Use of Data in Public Transport Operations



Route Planning
and Route
Rationalisation

Concession
Development &
Award

Service
Deployment and
Optimisation

Service
Monitoring

Service Delivery
and Maintaining
Level of Service



Vehicle & Crew



Users



Infrastructure



Use of Data in Public Transport Planning & Operations

Sl. No	Cities	Components						
		Population	No. of Buses	GPS availability*	ETM availability**	Route Planning***	Time Table preparation***	Schedule Optimization***
1	Delhi	16787941	5834	Yes	Yes	software	GPS	Manual
2	Kolkata	14035959	632 (JnNUR M)	No	No	Manual	Manual	Manual
3	Bengaluru	8520435	6603	Yes	Yes	Manual	GPS	Software
4	Ahemadabad	6361084	1209	Yes	Yes	Software	GPS	Manual
5	Kanpur	2920496	270	No	Yes	Manual	Manual	Manual
6	Mysore	920550	445	Yes	Yes	software	GPS	Software
7	Bhuwaneswar	885363	185	No	Yes	Manual	Manual	Manual
8	Raipur	1122555	100	Yes	Yes	Manual	Manual	Manual
9	Vishakapatanam	1730320	654	Yes	Yes	Manual	Manual	Manual
10	Shimla	169578	169	Yes	Yes	Manual	Manual	Manual

* Yes, No ** Yes, No

Judgment/Manual * GPS time/Software or Data-Based/Software or Manual *****Use of ETM or Manual



Use of Data in Public Transport Operations



Route Planning and Rationalization

Understand
Market & Users
(O – D Data, Trip
Characteristics and
Demand Profile)

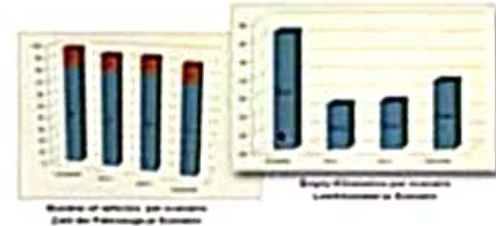


Concession Development & Award



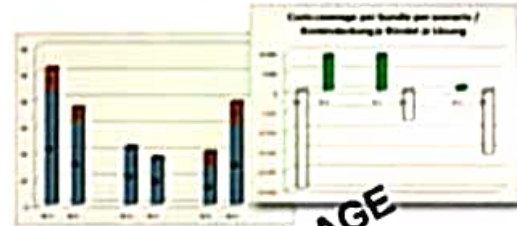
EVALUATING LINE BUNDLES

Comparing different solutions



EVALUATING LINE BUNDLES

Comparing detailed indicators of different solutions



Network
Structure &
city generators
(Route
Mapping)



Route
Performance



COVERAGE



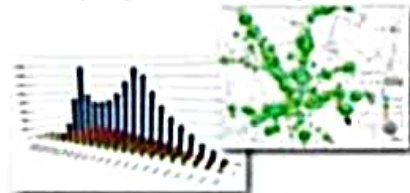
Use of Data in Public Transport Operations

Service Deployment and Optimisation Time Table Optimisation (GPS Run Time)

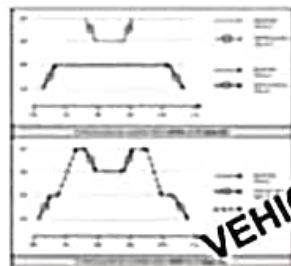


Frequency Optimisation (E ticket data)

Special case: a Ticketing with check-in only
Number of passengers recorded when boarding



Fleet Optimisation(Interlining)



VEHICLES

Service Monitoring & Payments



Monitoring KPI in
concession Agreement
from GPS data and making
payment



CONCESSIONS

Service Delivery & LOS



- Excess Wait Time
- Occupancy / Crowding
- Public Transport Accessibility

USERS

Route Planning & Rationalization



Route Planning Practices – Various Cities

Delhi

- ❑ Delhi Public Transport Model was frequently used for initiating new routes and for changing route alignment
- ❑ All Routes were mapped in GIS based transport planning software
- ❑ Origin Destination and User preference surveys done to determine
 - ❑ For New routes
 - ❑ Express routes
 - ❑ AC/ Premium Service
 - ❑ Feeder service
- ❑ Route Rationalisation : Route Modifications



Mysore

- Public Transport modelling for route rationalisation based on cube voyager. Route diversions based on desire-lines. Result of implementation was:
 - Performance of some routes improved.
 - Some routes were retained on original structure

Existing bus routes
Hub and spoke model



Indore

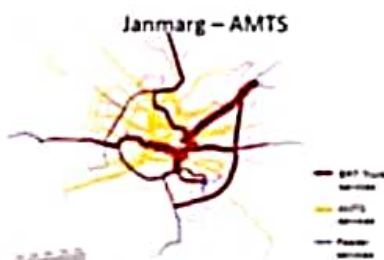
- Planning to carry out a detail review of all bus routes and route network to suggest improvements as well as new bus services, routes and route network for the city based on
 - Detail OD pattern & passenger surveys
 - Network Mapping



Route Planning Practices – Various Cities

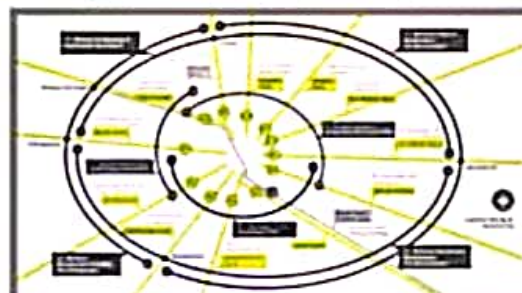
Ahmedabad

- ❑ Ahmedabad also developed a trunk – feeder bus scheme but could not implement it entirely due to public opinion on direct routes
- ❑ Jan-Marg also developed “Feeder Route system based on passenger “Origin – Destination” data for BRT system as well planning for route extensions in non – BRT segments



Bangalore

- Bangalore used passenger profiles and bus route network to develop Trunk – Feeder Bus Network named “BIG - 10” which is implemented



Raipur

- Raipur is also carrying out a route planning and service planning exercise for starting operation of BRT based on passenger profiles & related data



Route Planning Practices – Outcome & Experience

- Mysore Reported Benefits of Improvement in Route Performance using O/D Data and PT network Models. Almost 60 % routes modified got benefited after implementation.
- Delhi Cluster Routes Segment planning also reported improvement in route performance

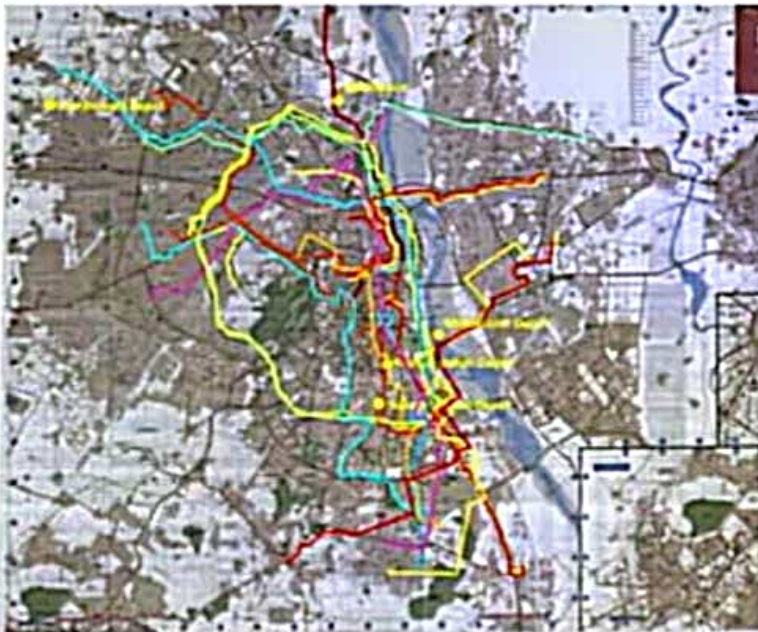


Concession Development/Route Clusters



Concession Development/Route Clusters – Various Cities

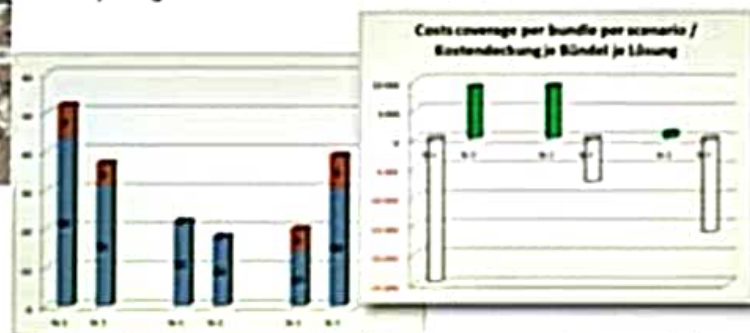
- ❑ Development of Route Clusters for Private concessions was done based on data and analysis in Delhi Cluster Scheme. Though it was done with limited database it helped to develop balanced cluster scheme



- ❑ Most of Cities use judgement, local knowledge and limited data for route award to private concessions.
- ❑ Use of data provides information on likely profitability, number of buses, dead kilometres etc

EVALUATING LINE BUNDLES

Comparing detailed indicators of different solutions



- ❑ By use of proper data, private concessions could be awarded in more rationally in our cities. **Delhi Cluster Scheme** designed using Data & Network of city

Service Deployment and Optimisation



Service Deployment and Optimisation

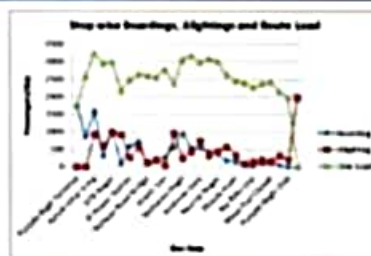
- Use of GPS Data for Realistic **Trip Time** for **Time Table** Preparation in peak and lean hours



- ❑ Manual timetable leading to bunching, unreliable operations and traffic jam

- Mysore, Delhi, Ahmedabad, Bangalore,
- (New Approach helped optimising schedule, Maintaining on ground schedule by crew, Reducing Stress to Crew)

- Use of ETM Data for **Frequency Adjustment**



- Mysore, Delhi, Ahmedabad,

- ❑ **Timetable deviation** on map can be viewed with yellow- late, red – early, Green – on time
- ❑ **Bunching** is Monitored from control centre
- ❑ Same day **Feedback** is given to Driver on his performance based on data



Driver wise analysis on speed, sudden acceleration

Mysore
Partly Delhi

Benefits Experienced by Mysore in Schedule Optimization

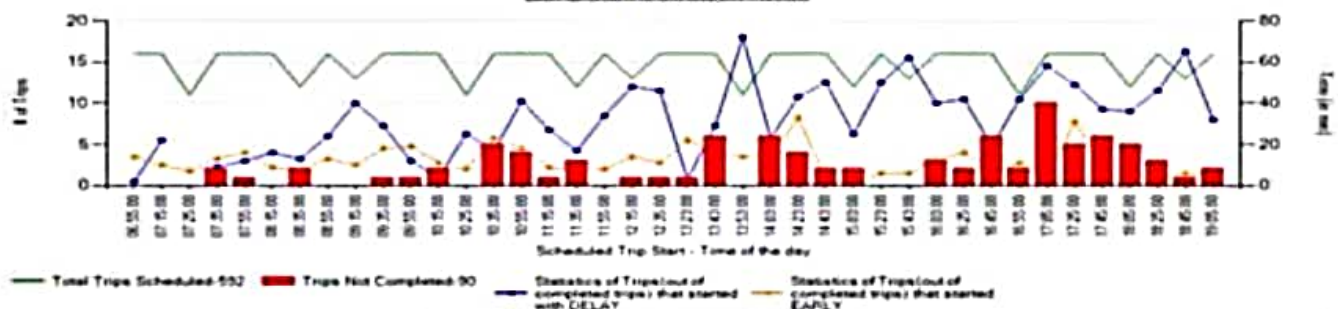
Mysore Also used certain software's to carryout these Analysis/Time Table Preparation

Volvo	Schedule	Schedule Kms	Trips	crew	Duty Hours	Ot Hours
Before	8	1344	112	23	78:00:00	14:00:00
After	8	1344	112	23	72:00:00	8:00:00
	0	0	0	0	6:00:00	6:00:00
Ordinary	Schedule	Schedule Kms	Trips		Duty Hours	Ot Hours
Before	8	1799.6	146	29	93:05:00	11:25:00
After	5	1459.2	124	21	73:20:00	0:00:00
	-3	-340.4	-22	8	20:15:00	11:25:00

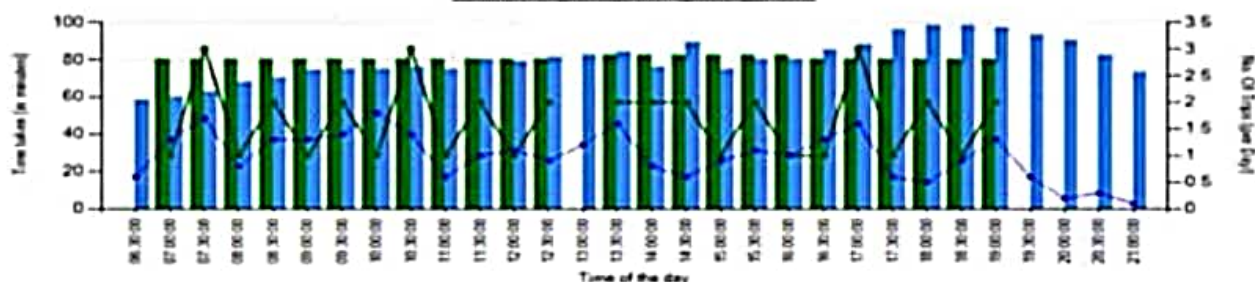
Trip Analysis: Cluster Bus Delhi

- **Actual vs. Schedule time** taken at various hours of the day by the buses plying on route
- **Actual Trips Completed vs. Scheduled no. of Trips** at various hours of the day
- Trip Completion analysis for different Duty along with Variance between Actual Start time of trips and Schedule

Trip Completion Analysis

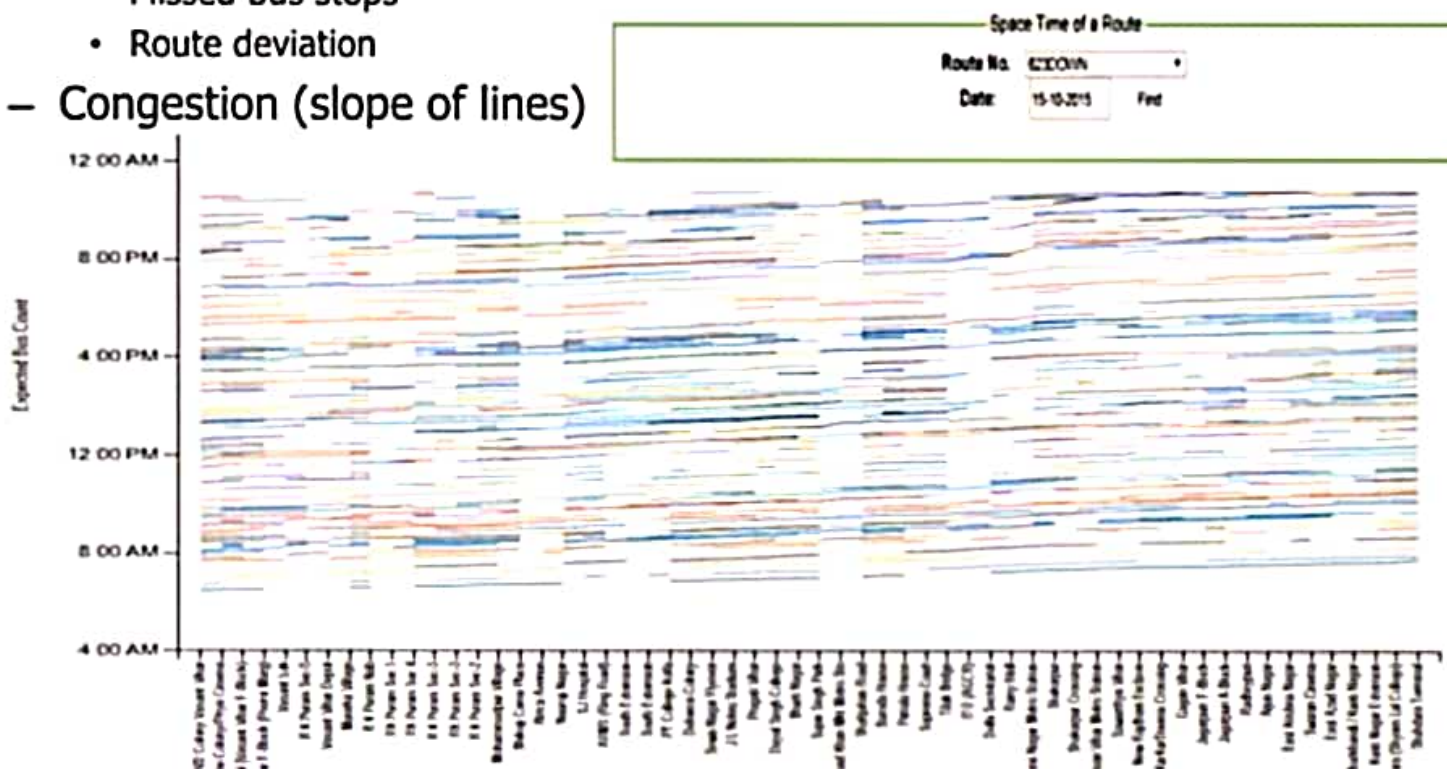


Schedule V/S Actual Time Taken



Route Bunching Analysis- Cluster Bus Delhi

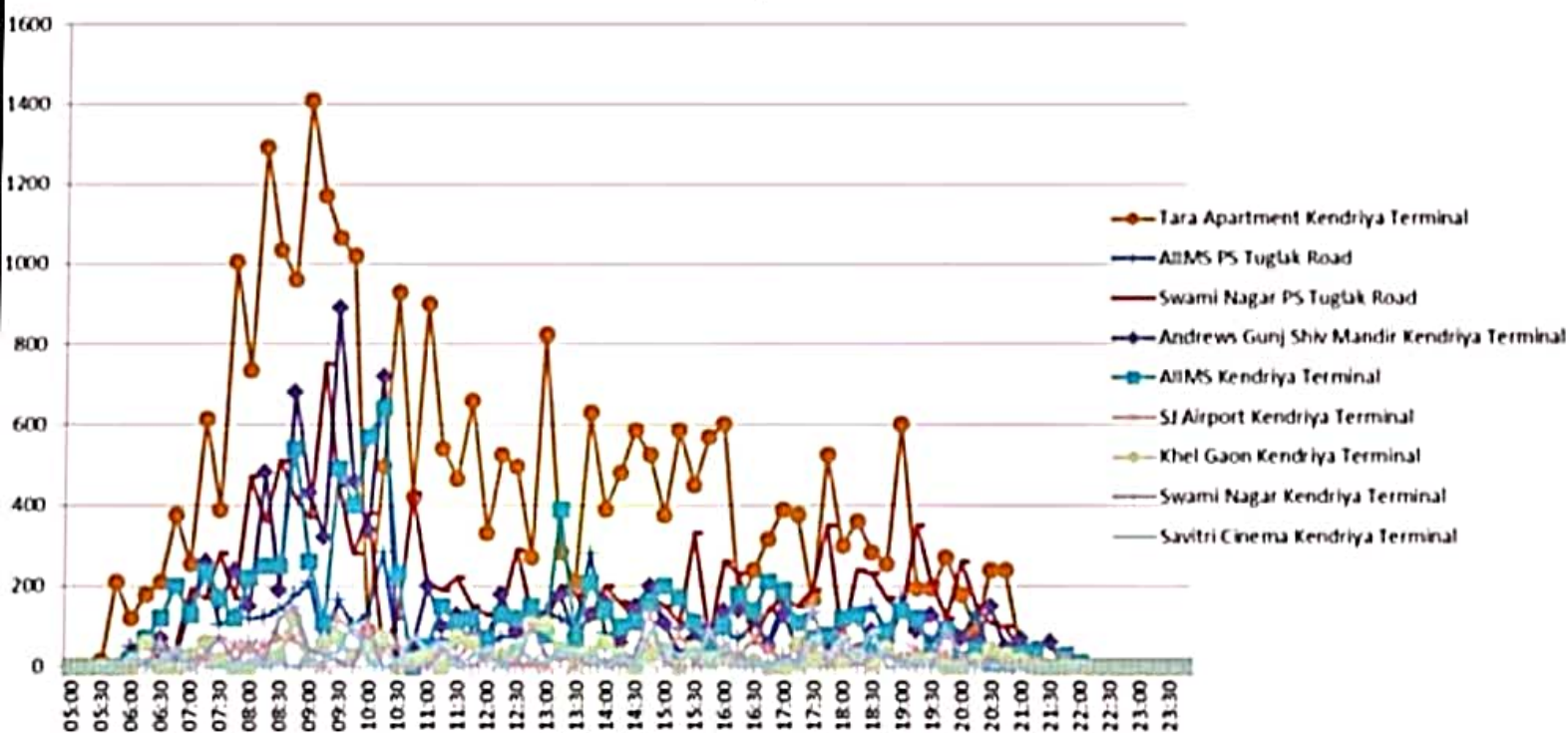
- A Graph between Route Geometry and Time of the day for all Buses of a particular Route
- Can be used for (real time)
 - Bunching Analysis
 - Gaps in graph
 - Missed bus stops
 - Route deviation
 - Congestion (slope of lines)



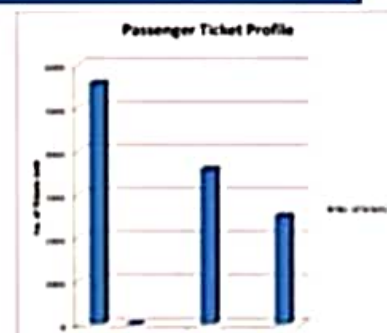
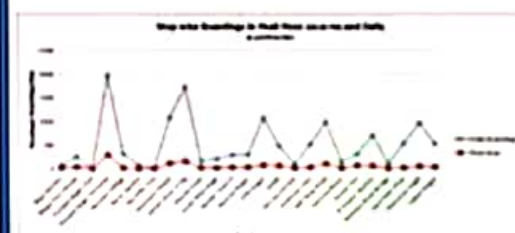
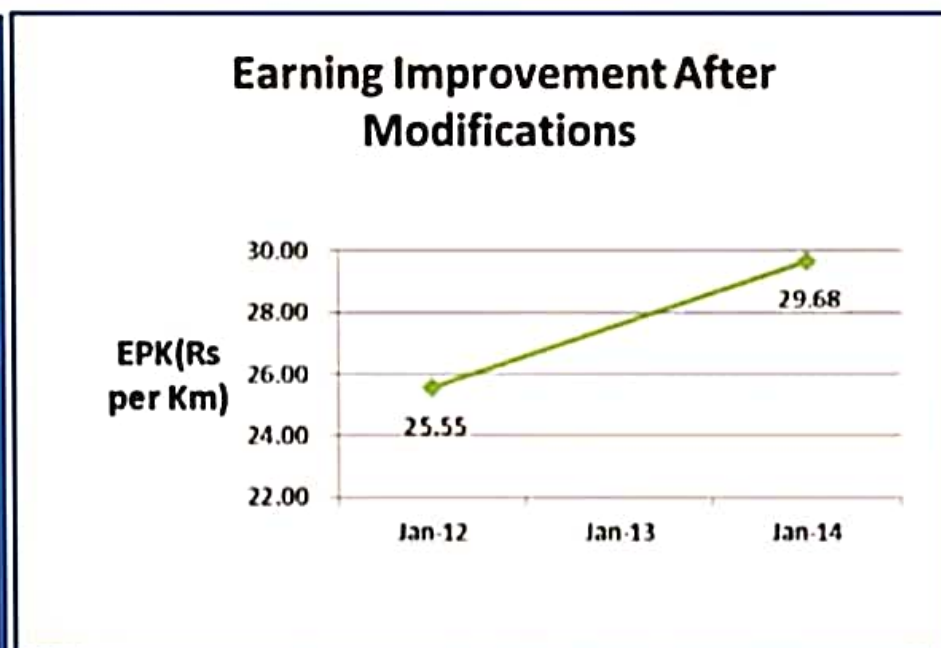
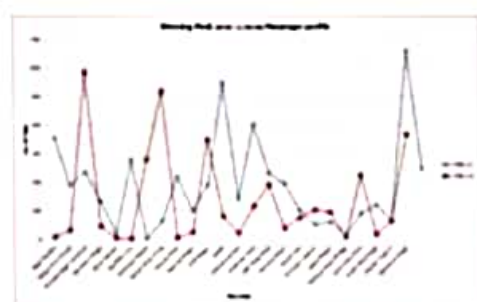
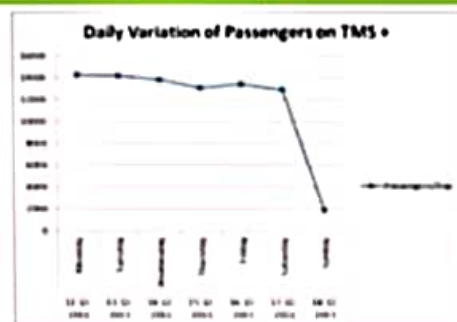
Analysis of ETM Data : Cluster Bus System

Detailed Analysis of Low Ridership Sectors

Revenue Generation Rate 540DN for O-D Pair Beyond SJ Airport to Central Secretariat segment



Service Optimisation Benefits - Delhi Cluster



Service Monitoring : KPI of Concessionaires



Service Monitoring : KPI of Concessionaires (Delhi)

GPS based Automatic Vehicle Location (AVL) System has been deployed on all the buses. System is being used to monitor operations of the fleet

Performance Incentive Regime

On-time benchmark

Payment for service exceeding minimum performance standards

+ %

Penalty Regime

Missed Trips

Deduction for service not operated due to factors within operator control

- %

Other Infractions

Deduction for proportion of service operated by vehicles meeting set standards

- %

Delayed Trips

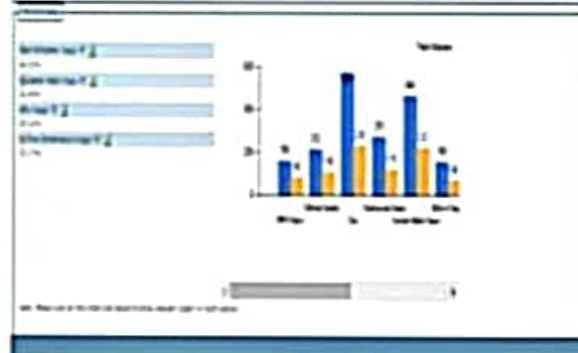
Deduction for service failing to meet minimum performance standards

- %

Alerts Dashboard manages alerts and responds to deviation/violations

- Over-speeding reports
- Depot, vehicle and route wise reports
- Missed stops reports
- Route deviation reports
- Trip status reports (Cut/Short/Missed)
- Distance travelled

Payment to Concessionaire



Route	Vehicle	Driver	Status	Time	Distance	Speed	Alerts
101	101A	101A1	Running	10:00	10.0	10.0	0
101	101B	101B1	Running	10:05	10.5	10.5	0
101	101C	101C1	Running	10:10	11.0	11.0	0
101	101D	101D1	Running	10:15	11.5	11.5	0
101	101E	101E1	Running	10:20	12.0	12.0	0
101	101F	101F1	Running	10:25	12.5	12.5	0
101	101G	101G1	Running	10:30	13.0	13.0	0
101	101H	101H1	Running	10:35	13.5	13.5	0
101	101I	101I1	Running	10:40	14.0	14.0	0
101	101J	101J1	Running	10:45	14.5	14.5	0
101	101K	101K1	Running	10:50	15.0	15.0	0
101	101L	101L1	Running	10:55	15.5	15.5	0
101	101M	101M1	Running	11:00	16.0	16.0	0
101	101N	101N1	Running	11:05	16.5	16.5	0
101	101O	101O1	Running	11:10	17.0	17.0	0
101	101P	101P1	Running	11:15	17.5	17.5	0
101	101Q	101Q1	Running	11:20	18.0	18.0	0
101	101R	101R1	Running	11:25	18.5	18.5	0
101	101S	101S1	Running	11:30	19.0	19.0	0
101	101T	101T1	Running	11:35	19.5	19.5	0
101	101U	101U1	Running	11:40	20.0	20.0	0
101	101V	101V1	Running	11:45	20.5	20.5	0
101	101W	101W1	Running	11:50	21.0	21.0	0
101	101X	101X1	Running	11:55	21.5	21.5	0
101	101Y	101Y1	Running	12:00	22.0	22.0	0
101	101Z	101Z1	Running	12:05	22.5	22.5	0
101	101AA	101AA1	Running	12:10	23.0	23.0	0
101	101AB	101AB1	Running	12:15	23.5	23.5	0
101	101AC	101AC1	Running	12:20	24.0	24.0	0
101	101AD	101AD1	Running	12:25	24.5	24.5	0
101	101AE	101AE1	Running	12:30	25.0	25.0	0
101	101AF	101AF1	Running	12:35	25.5	25.5	0
101	101AG	101AG1	Running	12:40	26.0	26.0	0
101	101AH	101AH1	Running	12:45	26.5	26.5	0
101	101AI	101AI1	Running	12:50	27.0	27.0	0
101	101AJ	101AJ1	Running	12:55	27.5	27.5	0
101	101AK	101AK1	Running	13:00	28.0	28.0	0
101	101AL	101AL1	Running	13:05	28.5	28.5	0
101	101AM	101AM1	Running	13:10	29.0	29.0	0
101	101AN	101AN1	Running	13:15	29.5	29.5	0
101	101AO	101AO1	Running	13:20	30.0	30.0	0
101	101AP	101AP1	Running	13:25	30.5	30.5	0
101	101AQ	101AQ1	Running	13:30	31.0	31.0	0
101	101AR	101AR1	Running	13:35	31.5	31.5	0
101	101AS	101AS1	Running	13:40	32.0	32.0	0
101	101AT	101AT1	Running	13:45	32.5	32.5	0
101	101AU	101AU1	Running	13:50	33.0	33.0	0
101	101AV	101AV1	Running	13:55	33.5	33.5	0
101	101AW	101AW1	Running	14:00	34.0	34.0	0
101	101AX	101AX1	Running	14:05	34.5	34.5	0
101	101AY	101AY1	Running	14:10	35.0	35.0	0
101	101AZ	101AZ1	Running	14:15	35.5	35.5	0
101	101BA	101BA1	Running	14:20	36.0	36.0	0
101	101BB	101BB1	Running	14:25	36.5	36.5	0
101	101BC	101BC1	Running	14:30	37.0	37.0	0
101	101BD	101BD1	Running	14:35	37.5	37.5	0
101	101BE	101BE1	Running	14:40	38.0	38.0	0
101	101BF	101BF1	Running	14:45	38.5	38.5	0
101	101BG	101BG1	Running	14:50	39.0	39.0	0
101	101BH	101BH1	Running	14:55	39.5	39.5	0
101	101BI	101BI1	Running	15:00	40.0	40.0	0
101	101BJ	101BJ1	Running	15:05	40.5	40.5	0
101	101BK	101BK1	Running	15:10	41.0	41.0	0
101	101BL	101BL1	Running	15:15	41.5	41.5	0
101	101BM	101BM1	Running	15:20	42.0	42.0	0
101	101BN	101BN1	Running	15:25	42.5	42.5	0
101	101BO	101BO1	Running	15:30	43.0	43.0	0
101	101BP	101BP1	Running	15:35	43.5	43.5	0
101	101BQ	101BQ1	Running	15:40	44.0	44.0	0
101	101BR	101BR1	Running	15:45	44.5	44.5	0
101	101BS	101BS1	Running	15:50	45.0	45.0	0
101	101BT	101BT1	Running	15:55	45.5	45.5	0
101	101BU	101BU1	Running	16:00	46.0	46.0	0
101	101BV	101BV1	Running	16:05	46.5	46.5	0
101	101BW	101BW1	Running	16:10	47.0	47.0	0
101	101BX	101BX1	Running	16:15	47.5	47.5	0
101	101BY	101BY1	Running	16:20	48.0	48.0	0
101	101BZ	101BZ1	Running	16:25	48.5	48.5	0
101	101CA	101CA1	Running	16:30	49.0	49.0	0
101	101CB	101CB1	Running	16:35	49.5	49.5	0
101	101CC	101CC1	Running	16:40	50.0	50.0	0
101	101CD	101CD1	Running	16:45	50.5	50.5	0
101	101CE	101CE1	Running	16:50	51.0	51.0	0
101	101CF	101CF1	Running	16:55	51.5	51.5	0
101	101CG	101CG1	Running	17:00	52.0	52.0	0
101	101CH	101CH1	Running	17:05	52.5	52.5	0
101	101CI	101CI1	Running	17:10	53.0	53.0	0
101	101CJ	101CJ1	Running	17:15	53.5	53.5	0
101	101CK	101CK1	Running	17:20	54.0	54.0	0
101	101CL	101CL1	Running	17:25	54.5	54.5	0
101	101CM	101CM1	Running	17:30	55.0	55.0	0
101	101CN	101CN1	Running	17:35	55.5	55.5	0
101	101CO	101CO1	Running	17:40	56.0	56.0	0
101	101CP	101CP1	Running	17:45	56.5	56.5	0
101	101CQ	101CQ1	Running	17:50	57.0	57.0	0
101	101CR	101CR1	Running	17:55	57.5	57.5	0
101	101CS	101CS1	Running	18:00	58.0	58.0	0
101	101CT	101CT1	Running	18:05	58.5	58.5	0
101	101CU	101CU1	Running	18:10	59.0	59.0	0
101	101CV	101CV1	Running	18:15	59.5	59.5	0
101	101CW	101CW1	Running	18:20	60.0	60.0	0
101	101CX	101CX1	Running	18:25	60.5	60.5	0
101	101CY	101CY1	Running	18:30	61.0	61.0	0
101	101CZ	101CZ1	Running	18:35	61.5	61.5	0
101	101DA	101DA1	Running	18:40	62.0	62.0	0
101	101DB	101DB1	Running	18:45	62.5	62.5	0
101	101DC	101DC1	Running	18:50	63.0	63.0	0
101	101DD	101DD1	Running	18:55	63.5	63.5	0
101	101DE	101DE1	Running	19:00	64.0	64.0	0
101	101DF	101DF1	Running	19:05	64.5	64.5	0
101	101DG	101DG1	Running	19:10	65.0	65.0	0
101	101DH	101DH1	Running	19:15	65.5	65.5	0
101	101DI	101DI1	Running	19:20	66.0	66.0	0
101	101DJ	101DJ1	Running	19:25	66.5	66.5	0
101	101DK	101DK1	Running	19:30	67.0	67.0	0
101	101DL	101DL1	Running	19:35	67.5	67.5	0
101	101DM	101DM1	Running	19:40	68.0	68.0	0
101	101DN	101DN1	Running	19:45	68.5	68.5	0
101	101DO	101DO1	Running	19:50	69.0	69.0	0
101	101DP	101DP1	Running	19:55	69.5	69.5	0
101	101DQ	101DQ1	Running	20:00	70.0	70.0	0
101	101DR	101DR1	Running	20:05	70.5	70.5	0
101	101DS	101DS1	Running	20:10	71.0	71.0	0
101	101DT	101DT1	Running	20:15	71.5	71.5	0
101	101DU	101DU1	Running	20:20	72.0	72.0	0
101	101DV	101DV1	Running	20:25	72.5	72.5	0
101	101DW	101DW1	Running	20:30	73.0	73.0	0
101	101DX	101DX1	Running	20:35	73.5	73.5	0
101	101DY	101DY1	Running	20:40	74.0	74.0	0
101	101DZ	101DZ1	Running	20:45	74.5	74.5	0
101	101EA	101EA1	Running	20:50	75.0	75.0	0
101	101EB	101EB1	Running	20:55	75.5	75.5	0
101	101EC	101EC1	Running	21:00	76.0	76.0	0
101	101ED	101ED1	Running	21:05	76.5	76.5	0
101	101EE	101EE1	Running	21:10	77.0	77.0	0
101	101EF	101EF1	Running	21:15	77.5	77.5	0

Performance of Cluster Buses

	Unit of Measurement	Cluster Buses
Km Efficiency	%	91.23
Fleet Utilization	%	93.48
Vehicle Utilization	Kms / Bus / Day	218
Gross Earning	INR / Bus/ Day	7528
Gross Cost	INR / km	40.8
Accident Rate	Number / Lakh Km	0.02

- **Use of Data Analytics Delhi Cluster Scheme is able to achieve :**
 - **Improving Efficiency**
 - **Improvement in Ridership & Revenues**
 - **Improvement in User Satisfaction**

Service Delivery and Maintaining Level of Service for Users



Service Delivery and Maintaining Level of Service for Users

- Information System Like Journey Planner, Mobile App

Most of the cities are in the process of developing Mobile App.
Delhi is having App "Poochho" which gives data on "Seat Availability"



- Analysis of Excess Wait Time

None of the city is doing it. However, some cities are conducting user satisfaction surveys

- Occupancy and Crowding

None of the city is doing it. However, some cities are conducting user satisfaction surveys

- Transfers

None of the city is doing it.

Some International Experiences

