TRANSPORTATION

DIMTS - Specialized Company in Urban Transport Space

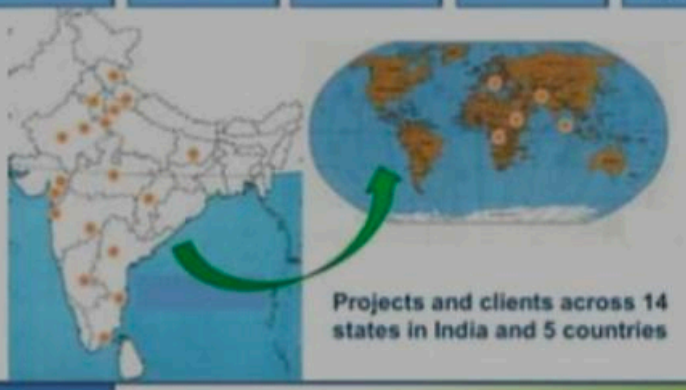
Delhi Integrated Multi-Modal Transit System Ltd. (DIMTS) is an ***urban transport*** and ***infrastructure development*** company set up in 2007 with a sharp focus **on improvement initiatives in urban transport infrastructure**

Transport Planning	Advisory Services	Engineering	Operations	Transport Technologies
• Comprehensive mobility planning • Urban Mass Transit Corridor Planning and Design • Traffic modeling and simulation • Public transit route planning, scheduling	• Feasibility Analysis • Project Structuring • PPP Advisory • Bid documentation • Bid process management	• Design • Project Management • Construction Supervision • Independent Engineering Services Railways • Alignment and Track design • Signaling	• Bus Concession Management • BRT Corridor Management • Operations Control Centre • Smart-card issuance management	• Automatic Vehicle Location • Electronic Ticketing • Passenger Information Systems • Mobile Applications • Intelligent Signaling and Traffic management systems

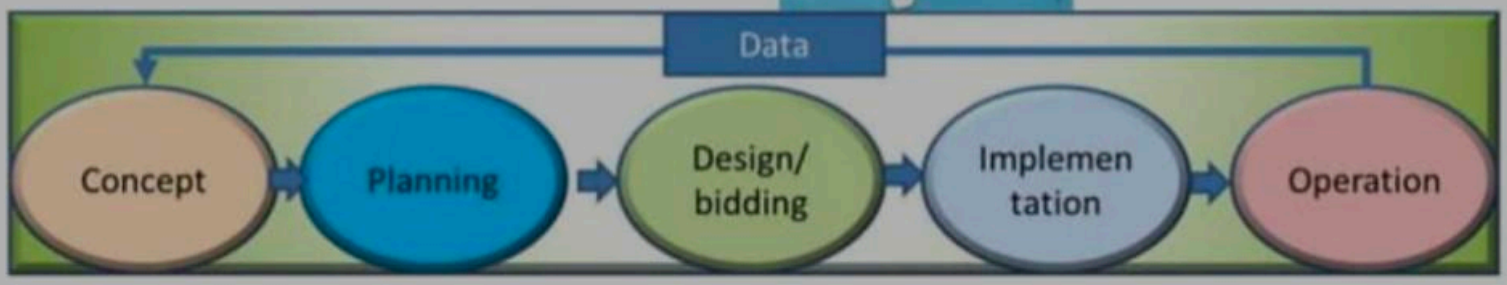
Equal equity partnership of

Government of National Capital Territory of Delhi (GNCTD)

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



Projects and clients across 14 states in India and 5 countries



City Bus Service in India

Road Transport Corporation Act (1950)

Formations of STUs (54 no.s)

National Urban Transport policy (2006 / 2014)

JnNURM Scheme (2009/13)

AMRUT Scheme (2015)

Bus procurement guidelines and Bus Funding for Cities

Focus on improvement of PT to achieve mode shift

Old Traditional methods of bus operation & management

Inadequate Service / Fleet Capacity

Low maintenance /irregular maintenance

Unreliable Service & Irregular Frequency

Poor Route Network Coverage & Inadequate stoppages

Excessive Fares

Willingness to pay

No Profitability & Viability

Poor Quality of vehicles & Poor customer satisfaction

Status of City bus service in India:

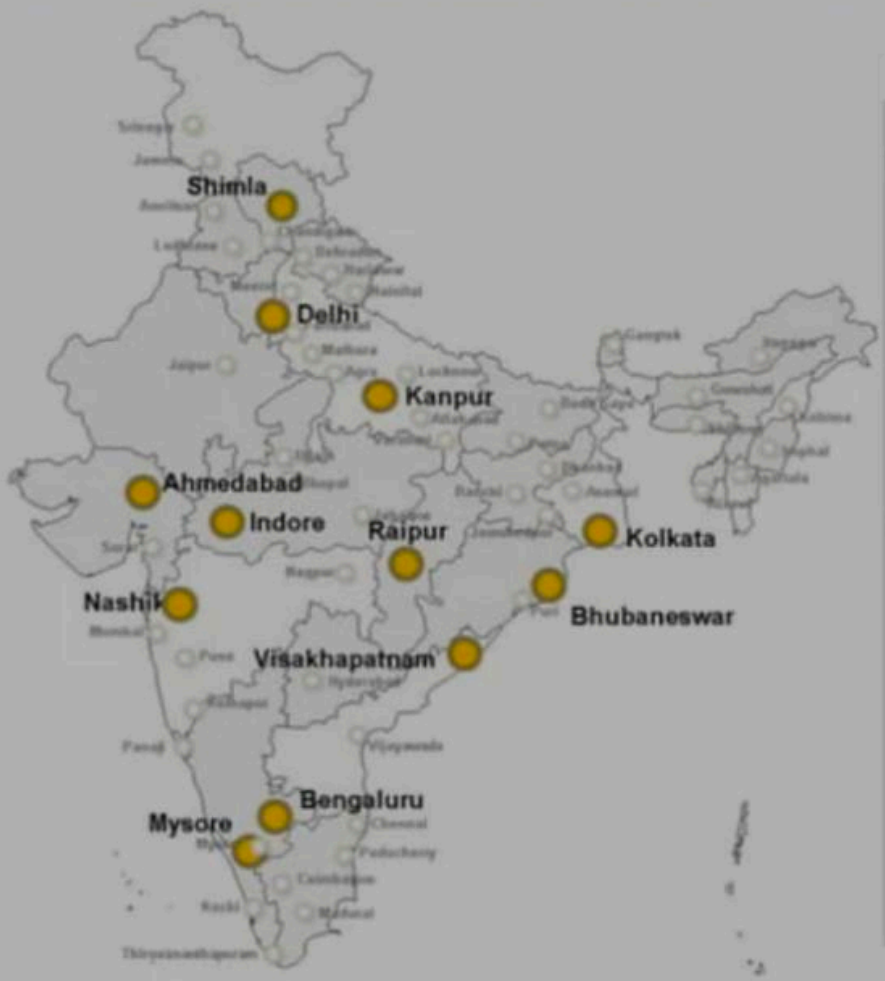
- Unable to meet the requirements of the majority of the public due to inefficient Bus transport in Cities in India.

Inefficient City Bus Transport in cities leading to:

- Imbalance in modal shift (Public preferring private mode - TWs & Cars).
- Environmental issues – Increase of energy requirements and Pollution.
- Higher costs – Improper Bus transport planning leads to higher operations costs & thereby losses.

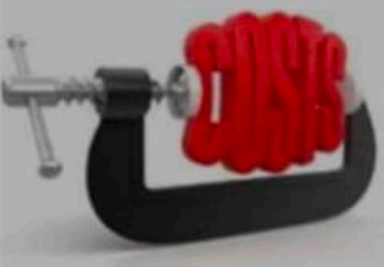
Considering this situation, Shakti Sustainable Energy Foundation has taken up this initiative to identify policy road map for improvement of city bus system in various cities.

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

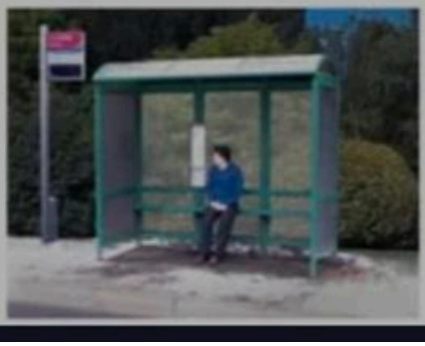
Service Deployment and Optimisation

Service Monitoring

Service Delivery and Maintaining Level of Service

Vehicle & Crew

Users

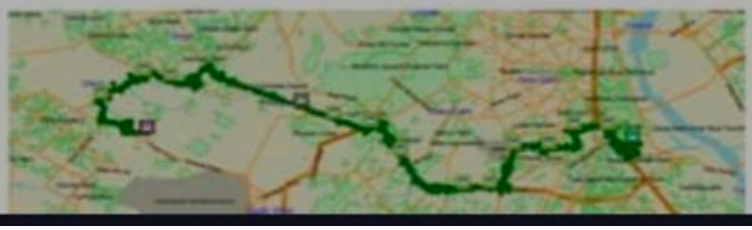


Infrastructure

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 (JnNURM)	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	Bhuwaneswwar	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

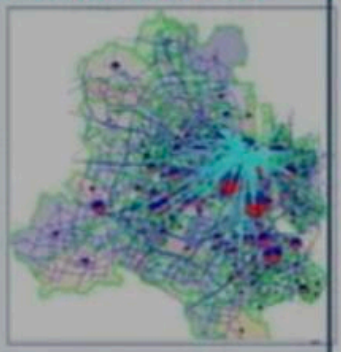
* Yes, No ** Yes, No ***Judgment/Manual or Data-Based/Software **** GPS time/Software or Manual *****Use of ETM or Manual



Use of Data in Public Transport Operations

Route Planning and Rationalization

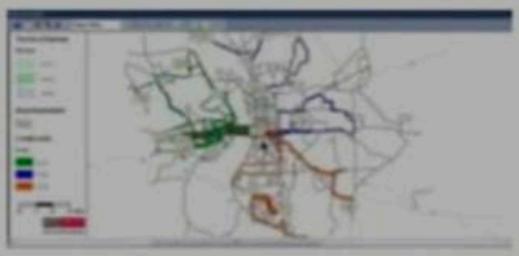
Understand Market & Users (O – D Data, Trip Characteristics and Demand Profile)

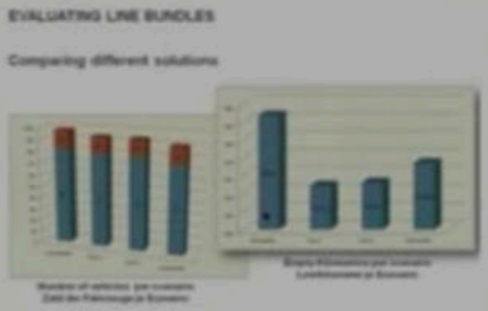


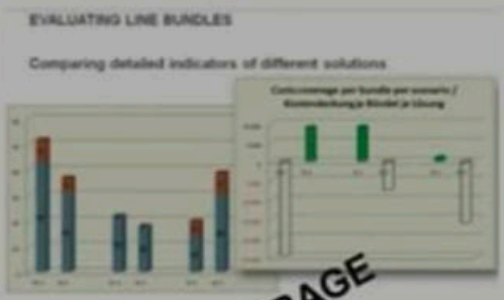
Network Structure & city generators (Route Mapping)

Route Performance

Concession Development & Award



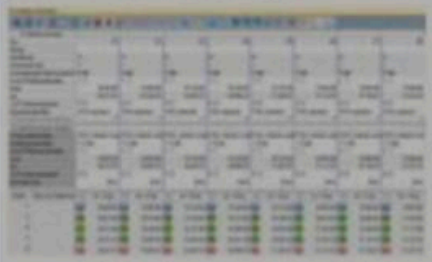




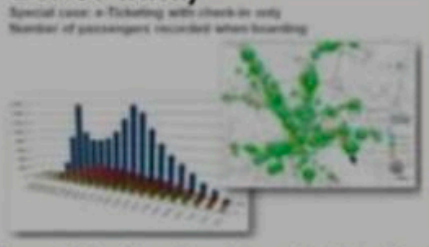
Use of Data in Public Transport Operations

Service Deployment and Optimisation

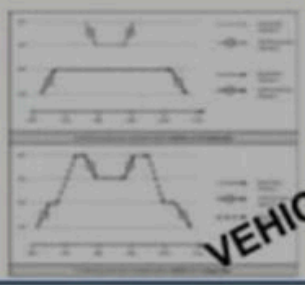
Time Table Optimisation (GPS Run Time)



Frequency Optimisation (E ticket data)



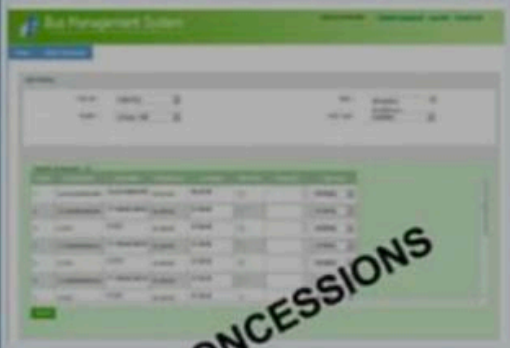
Fleet Optimisation(Interlining)



VEHICLES

Service Monitoring & Payments

Monitoring KPI in concession Agreement from GPS data and making payment



CONCESSIONS

Service Delivery & LOS

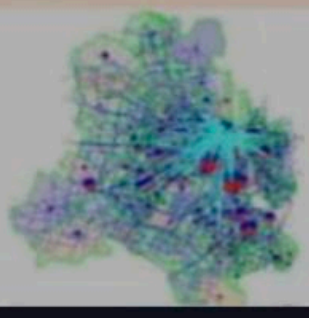
- Excess Wait Time
- Occupancy / Crowding
- Public Transport Accessibility

USERS

Route Planning 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

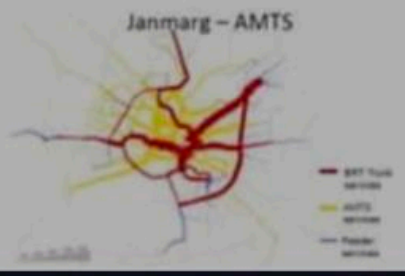
Indore

- 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

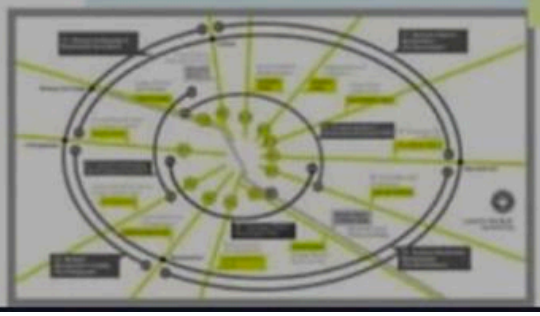
Ahmedabad

- 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

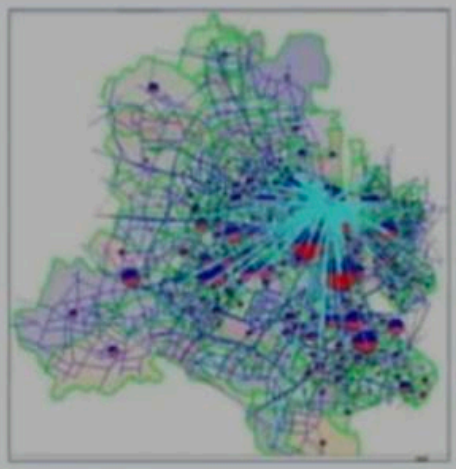


Raipur

- 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

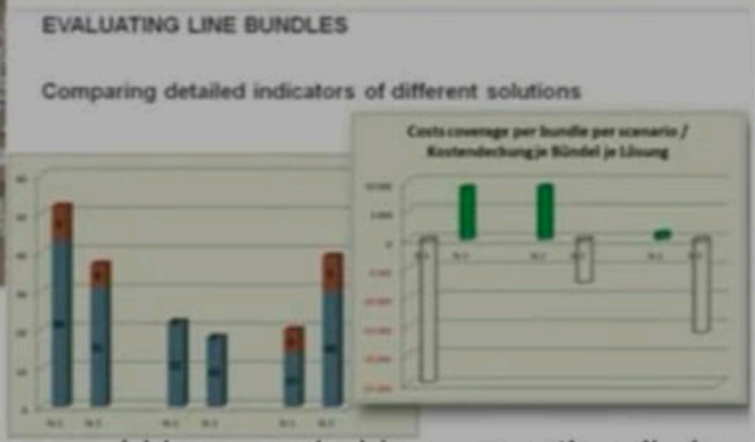
- Mysore Reported Benefits of Improvement in Route Performance using O/D Data and PT network Models. Almost 60 % routes modified got benefited after implementation.
- Delhi Cluster Routes Segment planning also reported improvement in route performance



Concession Development/Route Clusters – 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

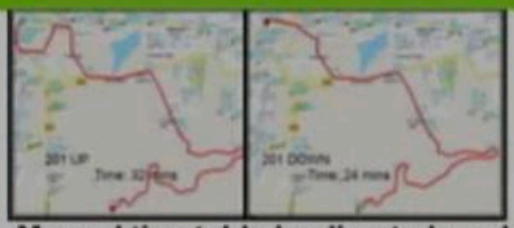
- **Most of Cities use judgement, local knowledge and limited data for route award to private concessions.**
- **Use of data provides information on likely profitability, number of buses, dead kilometres etc**



- 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

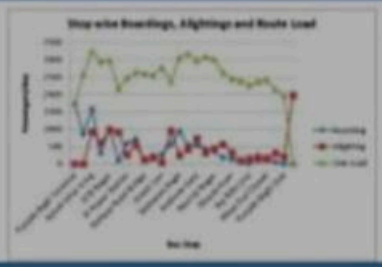
- Use of GPS Data for Realistic Trip Time for Time Table Preparation in peak and lean hours



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

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

- 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

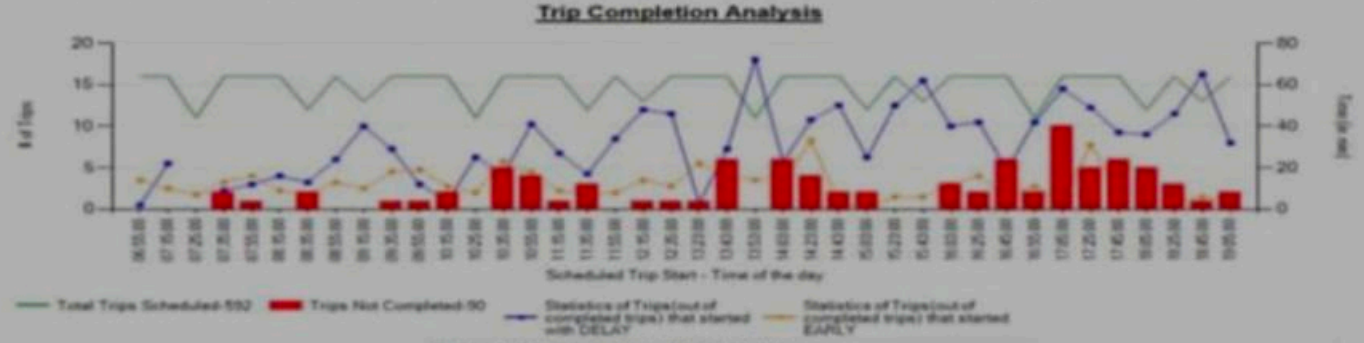
Benefits Experienced by Mysore in Schedule Optimization

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

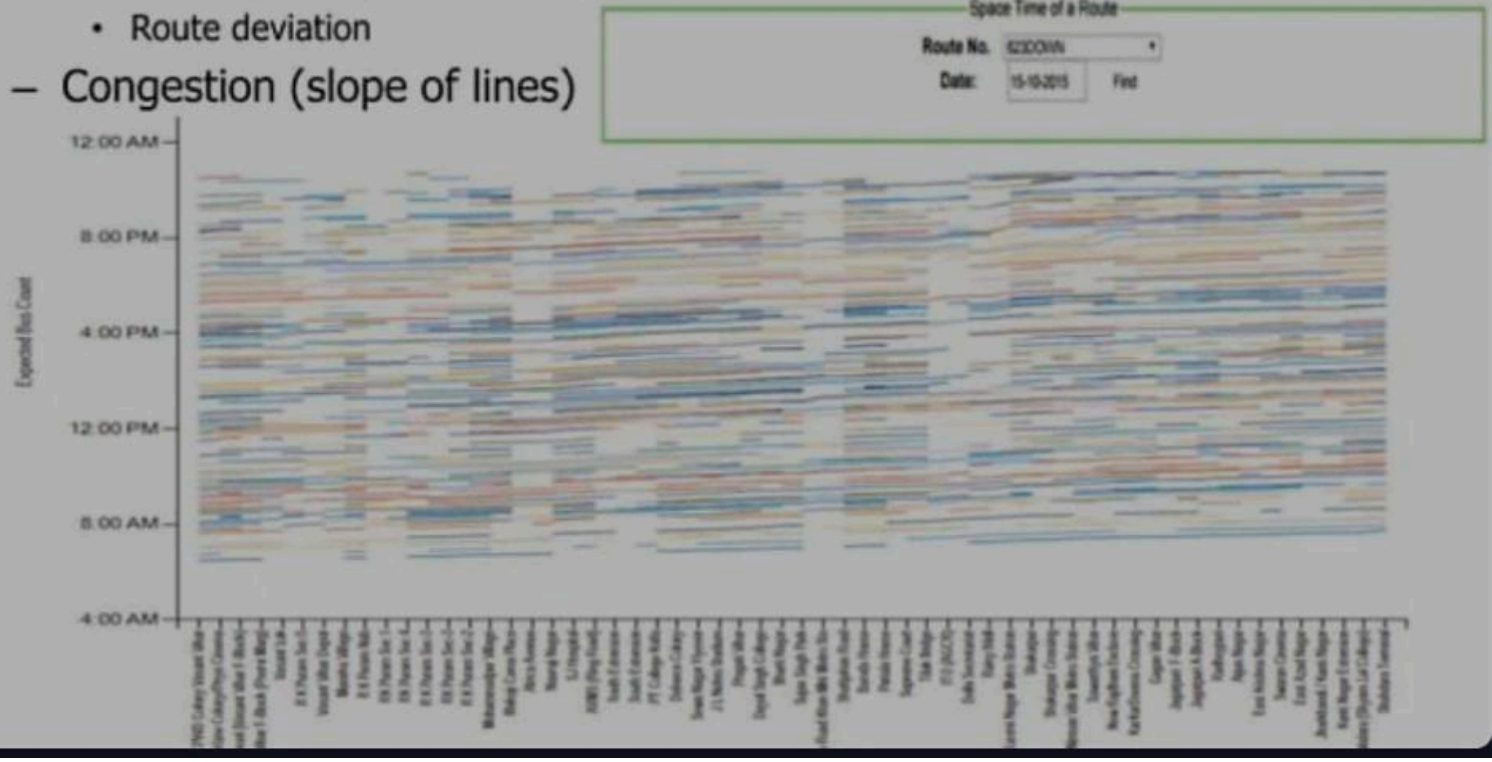
Trip Analysis: Cluster Bus Delhi

- 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



Route Bunching Analysis- Cluster Bus Delhi

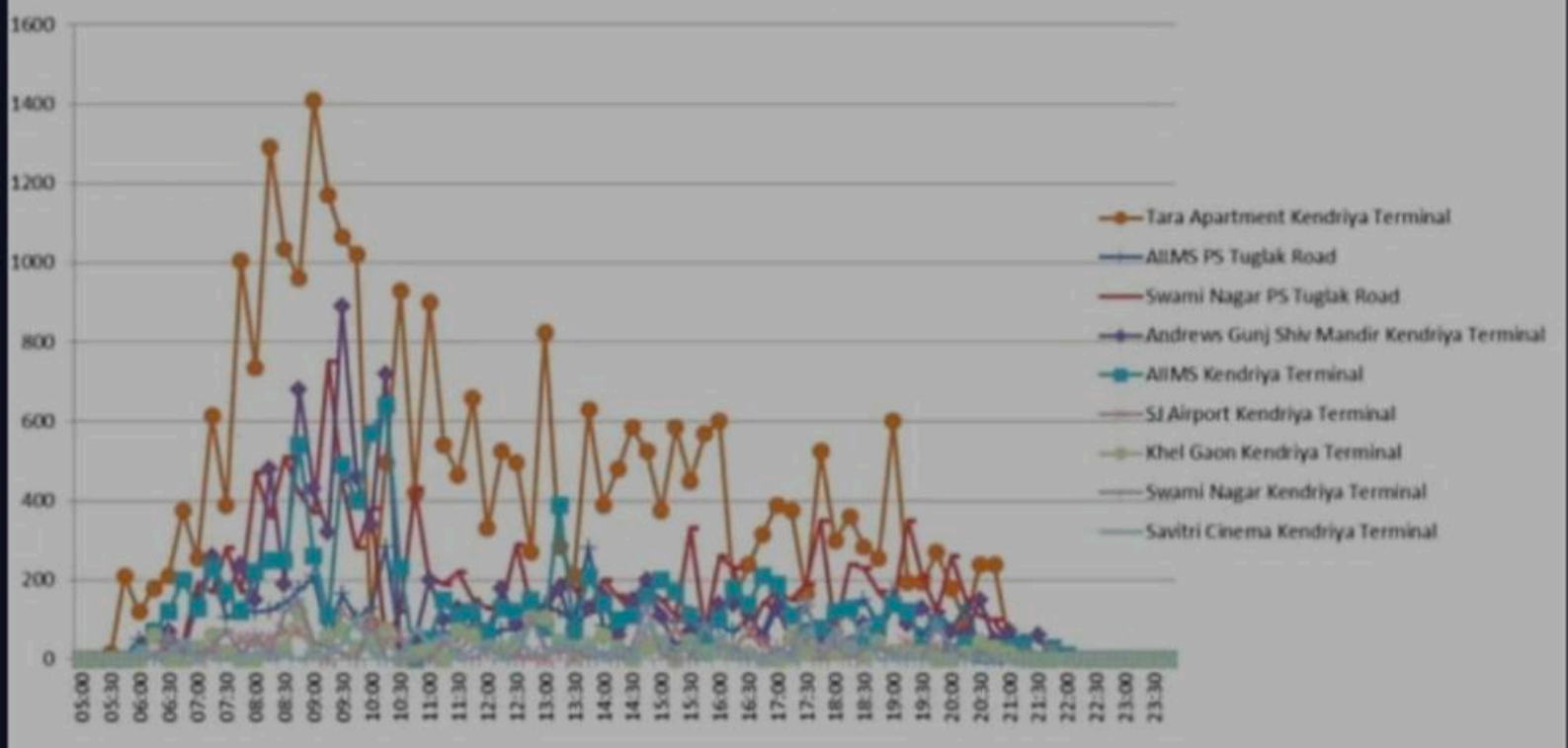
- A Graph between Route Geometry and Time of the day for all Buses of a particular Route
- Can be used for (real time)
  - Bunching Analysis
  - Gaps in graph
    - Missed bus stops
    - Route deviation
  - Congestion (slope of lines)



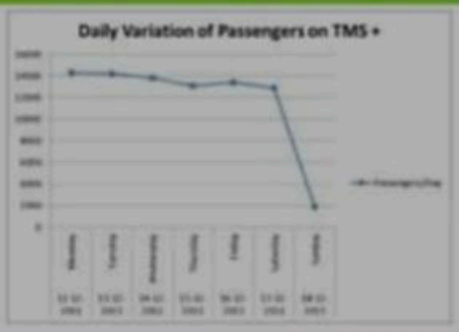
Analysis of ETM Data : Cluster Bus System

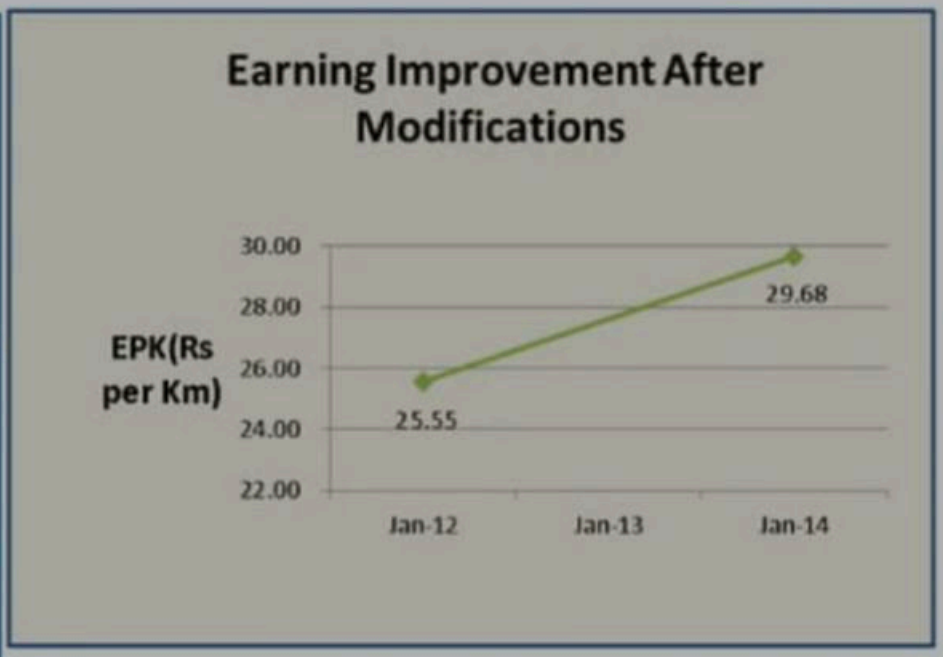
Detailed Analysis of Low Ridership Sectors

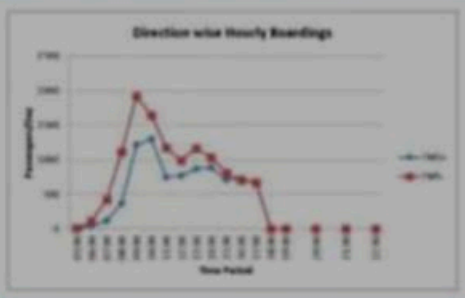
Revenue Generation Rate 540DN for O-D Pair Beyond SJ Airport to Central Secretariat segment

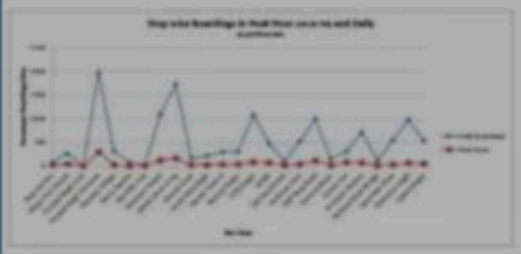


Service Optimisation Benefits - Delhi Cluster









Service Monitoring : KPI of Concessionaires (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

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

• 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.

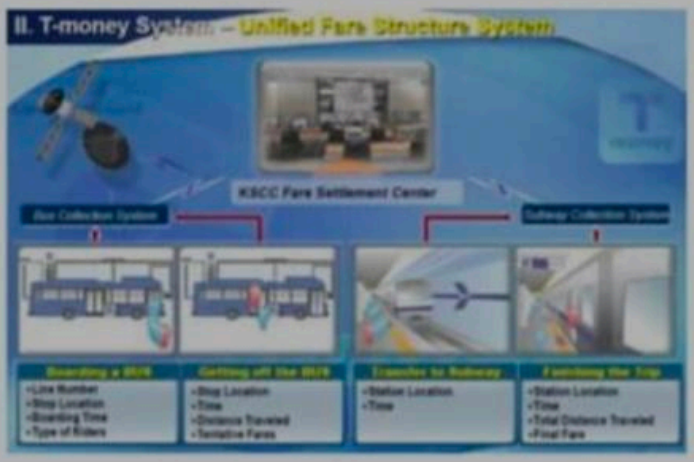
Bus Management System Seoul

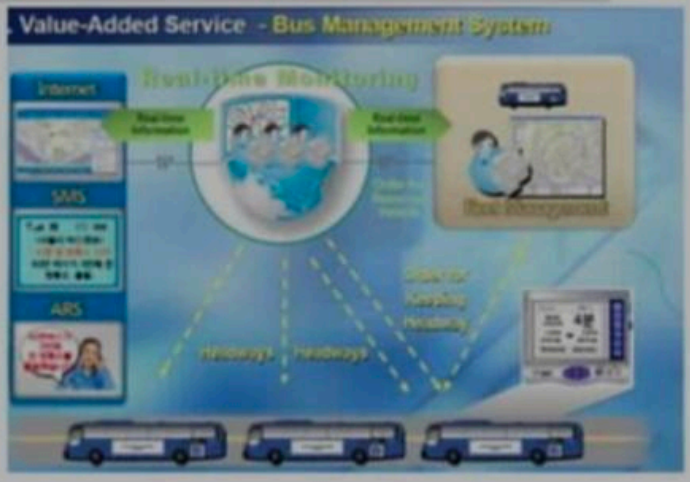
Global positioning system ("GPS") in bus & Smart Card use allow a central bus control centre to monitor all Operations and provide information.

- Conducted **Extensive Route Rationalisation** based on scientific data
- Bus locations and speeds monitoring to **enhance the punctuality**
- **Optimize service distribution** : by adjusting bus assignments and scheduling as per travel demands on different parts of bus network
- **Extra buses put during peak hours** for popular routes to reduce crowding & shorten waiting time

7851 Buses

429 Routes





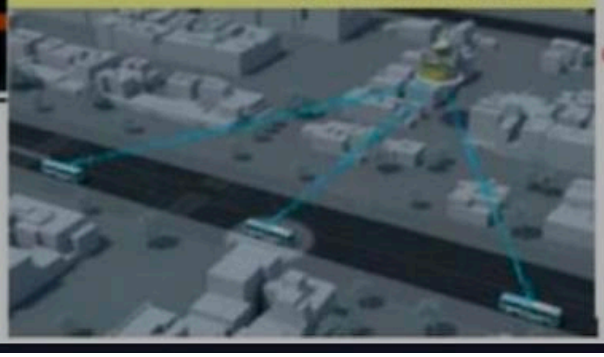
Bus Management System Seoul

Global positioning system ("GPS") in bus & Smart Card use allow a central bus control centre to monitor all Operations and provide information.

- **Bunching Control :Communicate with bus drivers to keep headway**
- BMS helps with policy analysis and O/D analysis per route, analysis of boarding and alighting passengers per bus stop, and demand analysis per route.

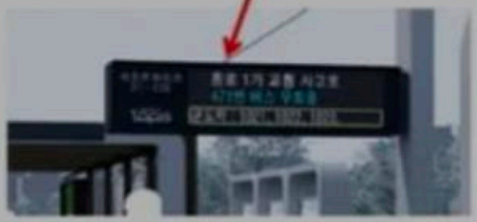
Interval between buses

Bus Management : Real-time bus location & interval between bus



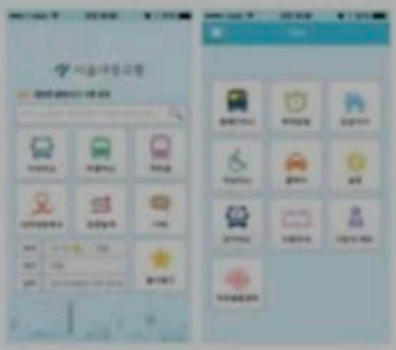
Accident and bus detour management
: Real-time detour route management

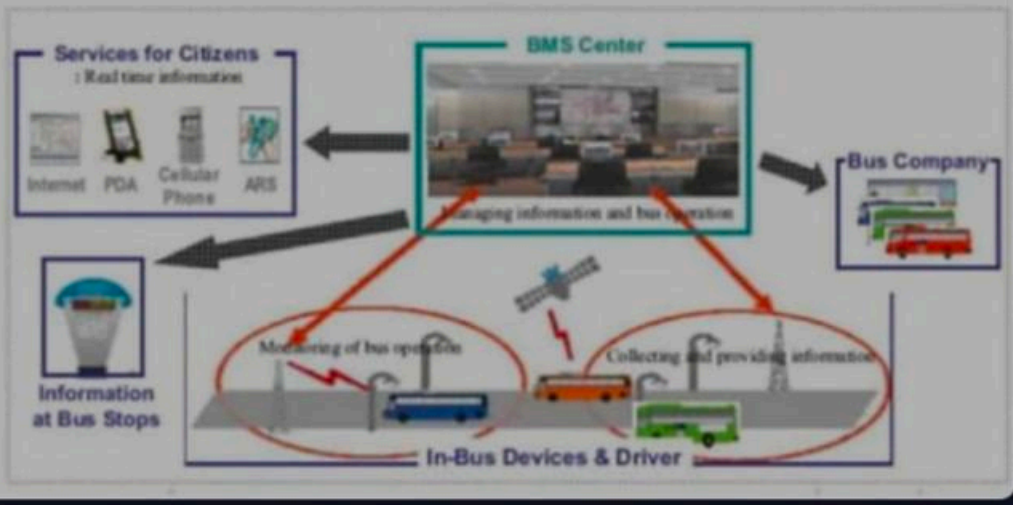
No.471 detouring
due to traffic incident at Jongro-1ga



Bus Information System Seoul

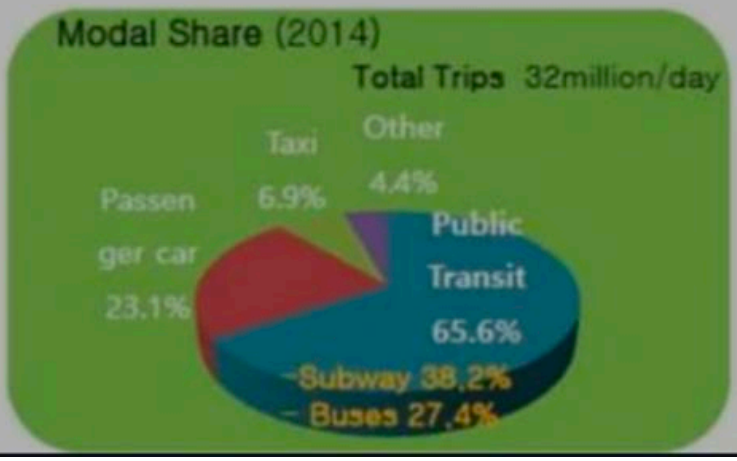
Information on all types of public Transportation (bus, subway, railway system) including the current location, Estimated Arrival Time, First and Last operation time of the day, Operation Status are available to the public via smartphone application, TOPIS website, and others.





Bus Information System Seoul- Impacts

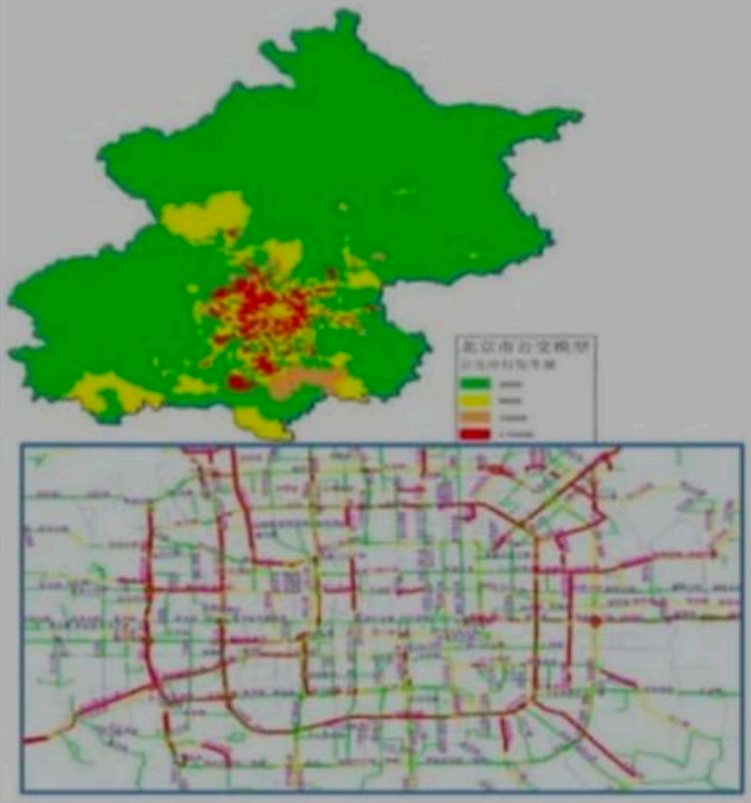
Before-after satisfaction with public transportation ('05.06)



Cities in China(Urumqi)

Analyzing Travel Patterns and PT Operation Performance

Spatial distribution of passengers



Peak Hour Passenger Flow

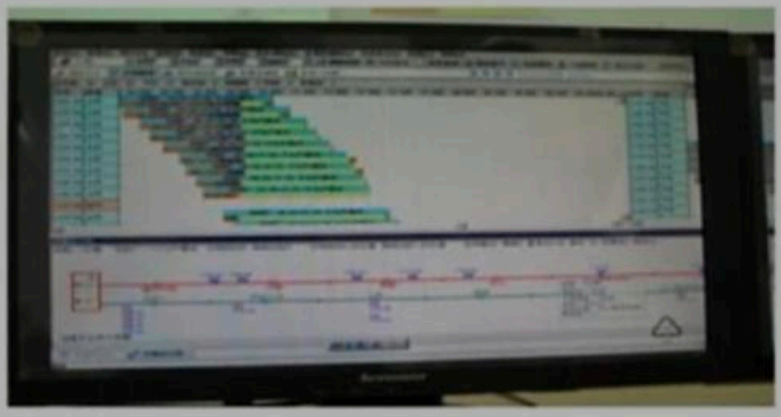
Measuring :

- Excess Waiting Time (EWT) to measure contractual performance of PT companies.
- Identify worst performing routes
- key bottlenecks on the routes, causes for dwell time at bottlenecks
- time table improvement margins

Peak Hour Corridor Bus Speed

Benefits of Data Analytics - China(Urumqi)

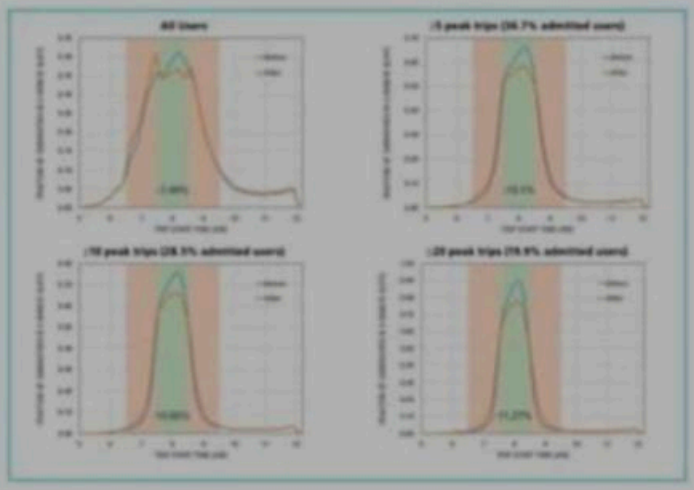
Operating Efficiency	Before (2008)	After (2012)	Reduction
Number of buses required for service level	2298 buses, 71 routes	2096 buses, 71 routes	9 % reduction



Using ITS Data to influence Transit user behavior

Singapore incentivizing Transit users to travel off-peak, through

- Tracking/analyzing people's trips by smart card reading
- Providing random rewards, social influence, (commuters are compared to their friends), and personalized offers

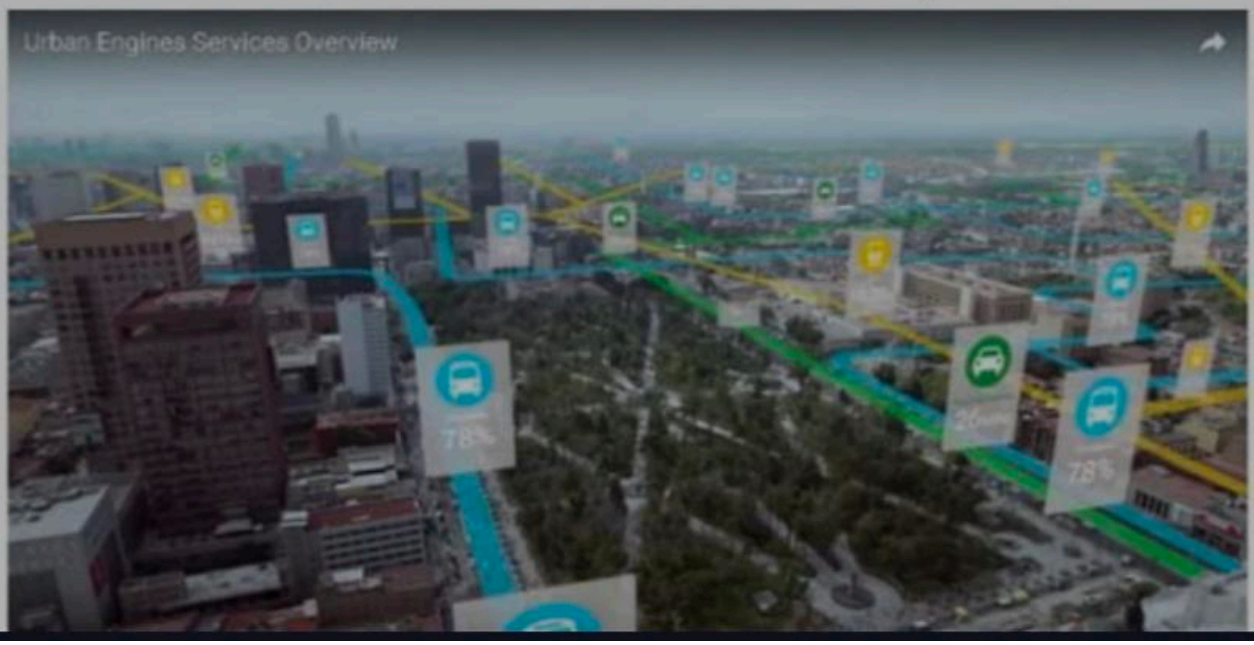


Result:
>10 % peak-hour travelers shift their trips to non peak-hour.

Cost:
7 Singapore dollar per participants in one year

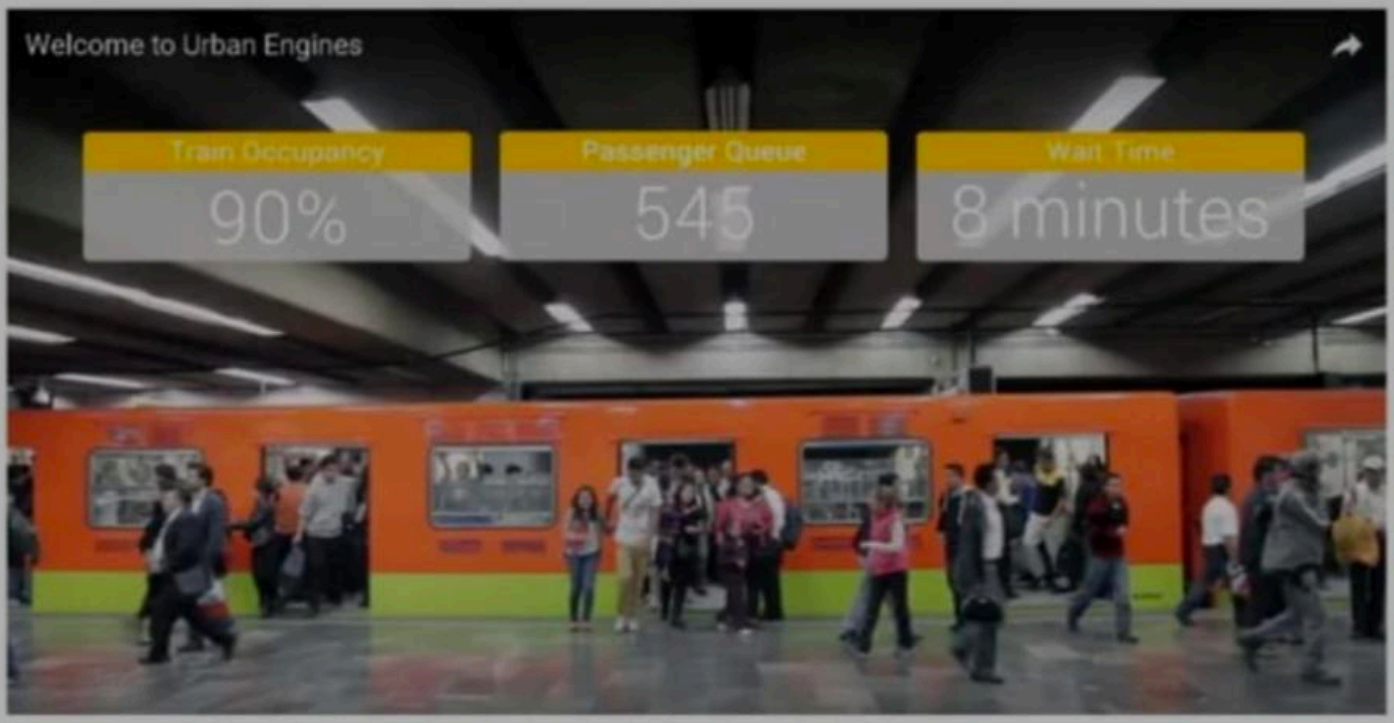
Latin America : Sao Paulo Recent Initiatives on Data Analytics

- Sao Paulo using Urban Engine for improving efficiency of Public Transport and improvement of User Satisfaction.
- Data Collected from GPS/Cards/Counters etc is used to determine public transport occupancy levels



Latin America : Sao Paulo Recent Initiatives on Data Analytics

- Station Crowding at BRT/Metro



Latin America : Sao Paulo Recent Initiatives on Data Analytics

Details of journeys from smart cards

Conclusions

- Most of the Urban Bus Agencies are implementing GPS & ETM solutions and will have good data available in coming years
- There clear benefits recorded that use of Data in operation helps in improving Efficiency.
- Data Analytics will be very important for decision making of
  - Understand user profile & Planning
  - Time Table & Fleet Optimisation
  - Improving Service Delivery to users
  - Implementing KPI & Payments to Concessionaires
- Need to better customise IT solutions to local conditions and with understanding of operations to enhance benefits

Thank You