Case Study

Intelligent Transport Project (ITS) - an initiative to accelerate a shift from personal use of vehicles to public transport system and lowering of pollution levels by the Karnataka State Road Transport Corporation (KSRTC).

URL - http://mitra.ksrtc.in/MysoreMBus/abti.jsp

1. EXECUTIVE SUMMARY

Building intelligence into the transport system brings in the convergence of technologies, thus providing a synergetic transformation in the commuter experience. Karnataka State Road Transport Corporation (KSRTC) has successfully implemented the Intelligent Transport Project (ITS), first of its kind, covering the entire city fleet in Mysore. Implementation of Intelligent Transport Systems at Mysore City is a pioneering effort by the KSRTC to accelerate a shift from personal use of vehicles to public transport system and lowering pollution levels, by offering high-class services through state-of-the-art technologies. Working towards this goal on priority, KSRTC has implemented Intelligent Transport System (ITS) project at Mysore City covering 500 buses, 2400 bus stops, 6 bus terminals and 45 platforms.

2. INTRODUCTION

The Intelligent Transport System Project, implemented at Mysore, addresses the critical issue of road congestion by offering state-of-art technologies as well as attractive, convenient, comfortable and value added services to encourage the usage of bus services against individual personal vehicles.

Key Objectives identified to address the business needs are:

➢ To establish an intelligent system to improve quality and convenience of the public transport system in Mysore city and ensure the delivery of a safe, fair, reliable and environment-friendly transport system;
➢ Establishing a centralized traffic control center to handle the bus operations effectively;
➢ Introducing GPS services in the city's bus fleet to monitor and track the movement of buses in real time;
➢ Introducing LED display boards at all bus stations/platforms and major bus-stops of the city to provide real time information regarding bus operations and disseminating the bus arrival and departure timings;
➢ Introducing public information system (announcement system) inside all city buses;
➢ To promote use of sustainable transport modes and enable commuters to make informed choices on travel modes by developing an integrated network in an effort to reduce passenger wait times;
➢ To optimize operations, improve fleet utilization, schedules, and vehicle availability with accurate information.

The main subsystems of the project are:

• Automatic Vehicle Location Information system (AVLIS)
• Passenger Information System (PIS)
   ✓ Information Display services: in vehicle
   ✓ Information Display services: Bus stops
   ✓ Information Display services: Bus Stations / Terminals / Stands & platforms
   ✓ Information Display Services: Special locations
• Automated Voice Announcement System
• Central Control Station (CCS)
• Enterprise Management System
• MIS Reports Mobile App: As per the original plan of ITS, arrival and departure of bus timings (Estimated Time of Arrival/Estimated Time of Departure) was provided through Passenger Information System Display Boards, SMS, IVRS and Commuter Website-mitra.ksrtc.in.

Going with the current technology trend, KSRTC has introduced a highly useful Mobile Application for the exclusive use of commuters offering all information pertaining to ITS. The Mobile Application is the end result of an appathon exercise carried out by KSRTC.

Post-Implementation of ITS project has enabled the following features which were not there earlier: Control Room Monitoring, IT based and systematic traffic operations, Operational MIS Reports, Real Time Bus Tracking with alert features, Bus arrival/departure real time information to commuters, SMS, PIS, Commuter Portal, IVRS, Mobile App, Incident Management in Real Time (Bus breakdown, accidents etc.), IT based Bus Station Management, Considerable reduction in Passenger Waiting Time, Trip planner option, Two way communication between bus and control room, In-bus display, Audio announcement, Bus shelter/platform display systems, Tool to rationalize schedules, optimize schedules, crew management, OT reduction Schedule Replay, Tool to defend Motor Vehicle Cases, Control over schedule adherence.

3. OVERVIEW OF THE CHAMPION

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4. PROJECT OVERVIEW/HISTORY OF THE PROJECT

The City of Mysore needs to achieve a conscious shift towards public transportation. The ITS project is aimed at offering Real-time monitoring and tracking of buses and help reduce road congestion and other transport issues; Dynamic passenger information system (PIS) based on Geographical Positioning System (GPS); Advanced display and communication technologies, Central Control Station (CCS) and intelligent display boards. Overall, the ITS project improves passenger safety and services, fleet efficiency, as well as traffic situation through transmission of real time information.

The core proposition is to improve the usage of ITS information, thereby gaining new users from private transport and retaining existing users. Provision of easily accessible relevant travel information to passengers before and during their journeys through mobile application is seen as a major reason for increasing attractiveness of the public transport offer. With this background, KSRTC introduced the Mobile Application for Intelligent Transport System Project at Mysore City conforming to Standard Practices and addressing commuter requirements related to bus services.

Prior to introduction of ITS-

- Inadequate Infrastructure
- Very rapid increase in motorization
- Substantial increase in traffic congestion
- Relative decline of public transport usage and services
- Increased Waiting Time, Unpredictability & Uncertainty
- Risk to safety of Road Users
- Increased Fuel Consumption and Emission
- Increased Operational Costs
- Decreased Traffic Efficiency

- Higher Traffic Congestion
- Decline in Economic Productivity
- Non availability of Real Time Information for Passengers about Bus Arrival and departure
- Lack of Decision enabling MIS Reports
- No control over bus operations
- No monitoring system of bus operations since control room was not there
- ETA and ETD information to passengers in real time was not available
- Manual dispatch of buses
- Bunching of buses, no system to cross check the public grievances/complaints
- No tools for schedule rationalisation were available
- Digitalisation of transport operational records were not available
- No system to track the dynamic status of bus operations nor on GIS map

5. SITUATION IN CHAMPION's STATE/ DISTRICT

5.1. Beneficiaries: Commuters (around 3 lakh passengers daily travel by city buses in Mysore), Public of Mysore (10 lakh population), KSRTC Crew (around 2000) KSRTC Management, Mysore Police, Tourists/Visitors, ECO Partners and other State Transport Undertaking replicating this kind of project are the beneficiaries.

According to the 2011 national census of India, the population of Mysore is 887,446. The total Population of Urban Agglomeration (U/A) is 9,83,893. The population is increasing at a compounded annual rate of 2.5%. The population of Mysore has experienced a spike in the last 4 decades with the population increasing to 7.86 lakhs in 2001. Since Mysore is a major tourist destination attracting tourists all over the world, the city's bus services and project covers floating tourist population including World Famous Dasara attracting over one million visitors. The city bus services have occupancy of around 80%. Currently 422 schedules are open on 349 routes covering around 97,000 kms per day and carrying around three lakh passengers covering 6348 trips per day thereby encompassing 2400 bus shelters.

Benefits

Commuters: Real Time Information on bus arrival and departure, Next stop bus announcement and display within the bus, Reduced waiting time at bus shelters, Comfortable Trip planning, Value added SMS and IVRS Services, Exclusive Commuter Portal mitra.ksrtc.in/ with salient features, Ridership increase due to ITS @1.69%. Average wait time reduced from 20 minutes in 2012 to 15.2 mins in 2015, 14 mins in 2016.

Management: Real time Tracking of Buses, Dynamic scheduling of Buses, Schedule rationalization and Overtime reduction, Digitalisation of operations, Decision enabling MIS Reports, Driving behaviour analysis, Tool to defend Motor Vehicle Claim Cases.

Society: Promotes Public Transport usage environment friendly initiative, immediate access to accident/incident information, Brings down traffic congestion, enable safety of commuters & pedestrian.

5.2. Problems identified:

- A significant trend amongst many urban road users is a willingness to use the public transport in the face of increasing traffic congestion and increasing 'road-rage' behaviour on the roads. Many would shift to the public transport on cost considerations. Time is of essence and a conscious shift will occur only if the new mode offers time improvements, while for others it is mostly a matter of costs.
- KSRTC aimed to bring about this modal shift in the city of Mysore by improving the perceived image of KSRTC services. The project aimed to improve the reliability of KSRTC city services through effective Travel Demand Management measures and Emergency Management System as well as reduction in the waiting time of its passengers.
- Given the critical success factors of availability, reliability, accessibility, security, low costs and comfort (acceptance), the increase in the use of public transport is defined to occur. ITS with its state-of-art technology, convergence of different technologies, such as the network, GPS, display systems and Information systems would contribute to meeting the critical success factors in the Intelligent Transport system.
- IT and decision enabling Tool to monitor, control and analyse the bus operations to meet the commuter requirements was not available.

5.3. Strategy Adopted-

5.3.1. Details of base line study done: Detailed Project Report (DPR) was prepared before floating of the tender. Professionals from Central Institute of Road Transport (CIRT), Pune assisted KSRTC in publishing the DPR. KSRTC appointed Monitoring and Evaluation Consultants through a global tender for documenting the baseline benchmarks/KPIs, examining the implementation of the system/service performance and the long-term impacts.

5.3.2. Roll out/implementation model:

- Bilingual Commuter Portal
- Real time tracking (GIS)
- Search functionality
- Bus Stop details
- Route details for a bus stop
- Bus fare and Route information
- 'Lost and Found' feature
- Complaints / Feedback capturing

- PIS Display – 2/4/8/10/16 lines
- Expected Time of Arrival / Departure Display
- Special Message to commuters
- Bilingual feature
- In Bus Services
  - ✓ Bilingual Display of Stops
  - ✓ Bilingual Announcement of Stops
- IVRS functionality
- Bus Stop based information
- Estimated Time of Arrival (ETA) information
- Route based information
- Lost and Found information
- SMS Services
- Route based information
- Scheduled Auto messages
- Mobile Application

5.3.3. Overall model structure-

- Design, develop, supply, commission, operate and maintain an Intelligent Transport System to track vehicles on real time basis and provide accurate positioning information (location, speed, time, etc.) as also monitor bus drivers.
- 500 buses, 2400+ bus stops, 193 passenger information displays in - Bus Terminals, Bus platforms, Bus stops and special locations
- Facilitate Aids in case of vehicle break downs/Accidents and other incidents through incident and Emergency Management System
- Inform commuters about the bus routes and arrival timings of buses at the bus stops/terminals and notify commuters about schedule changes through appropriate display systems
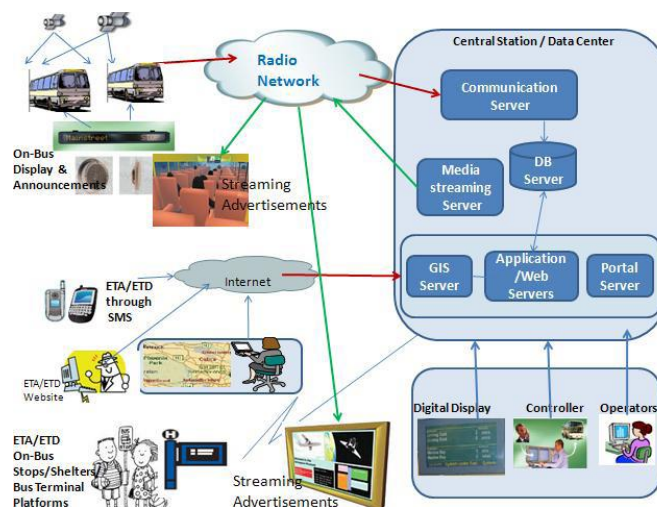
CCS / Data Centre

- ✓ Video Wall
- ✓ Application / Database Servers
- ✓ Network Firewall / Routers / Switches

Applications

- ➤ ITS
    - ➤ ETA
    - ➤ MIS Reports
- ➤ GIS
- ➤ EMS

Power

- ✓ DG Set – 82.5 KVA
- ✓ UPS – 20 KVA x 2

Training

- ✓ Crew Training
- ✓ Officials Training

ITS

PIS Display Boards

- ✓ Shelters - 2" 2 Line – 59
- ✓ Shelters – 2" 4 Line - 63
- ✓ Platforms – 4" 4 Line – 45
- ✓ Terminals – 10 Line – 20
- ✓ Terminals – 16 Line – 6

Commuter Related

- ➤ Commuter Portal
- ➤ SMS
- ➤ IVRS

In-Bus Equipments

- ✓ VMUs - 500
- ✓ In-Bus Displays – 500
- ✓ Voice Announcement System

ITS Components – Control Room

GPRS Network

Communication Server
• Receives information from VMU

Application Server
• Processes the Data
• Provides real time information to Dispatchers
• Calculates ETA
• Reports

IVRS Server
Provides ETA & other Information to Commuters on Request

Commuter Portal
• Commuters to track the Real Time bus on Map
• Provides other valuable information to commuters

DB Server

GIS Server
• Provides Map Services
• Provides real time Bus Positions in a Map
• Helps Commuters to search & Track the Bus

Display Server
• Provides ETA / ETD Information to Shelter / Terminal Displays

Internet

SMS Server
• Provides ETA & other Information to Commuters on Request

GPRS Network

5.3.4. Communication and dissemination strategy and approach used:

- Survey Conducted to assess commuter requirements before creation of RFP
- Dissemination workshop organised in Mysore City giving wide press coverage. The meeting was well attended by citizens of Mysore City, NGOs & Associations, Media, Students, Public Representatives (Ministers, MLAs, Corporations etc.), Representatives of Mysore City Administration, KSRTC project stakeholders (Management, Drivers, Controllers, Conductors, Mechanics etc.), Govt. of India Representatives, Govt. of Karnataka Representatives (KUIDFC) Dept. of Urban Development, Project Consultants, Project Implementation Agency etc.
- Knowledge Exchange Workshops conducted
- Appathon was organised as prelude to launch of Mobile App
- Articles and press coverage were made in print and electronic media
- Commuter Website was created exclusively for the usage
- District Administration is involved in promoting ITS
- An exclusive and massive public outreach campaign will be launched towards the same
- Procurement of a consultant through global tender to carryout communications and outreach is underway. The exercise is proposed to commence shortly.

6. MODALITIES OF THE NEW SYSTEM (SOLUTION)

6.1. Technology Platform used:

6.1.1. Description- Applications used-ETA, MIS Reports, Enterprise Management Software, GIS
- Operating system(s): Suse Linux Enterprise server Version 11
- Network software: HP networking devices with HP OS
- Firewall - Fortinet
- Communication Software: Part of ITS application
- DBMS/RDBMS: MySQL Ver 5
- Front end tool: Java, Structs & Hibernate (part of ITS application)
- Programming Language(s) : Java, JSP
- Bespoke (Vendor developed) : Vendor Developed
- Utility Software: GIS Map tools

6.1.2. Interoperability- The application is designed with this objective. The standard guidelines and procedures are used in order to meet this objective. Shortly, the application will be integrated with KSRTC's ongoing centralised web application. Currently no interfaces outside the Department for delivery of services have been provided. The process of including CEG SMS Services is in progress.

6.1.3. Security concerns-

- VMU (vehicle mounted unit) tampering proof alert is generated in the application
- Exclusive Enterprise Management Software application is deployed
- SOS feature is enabled in the application
- Mobile App-Women Safety Feature is included. Send emergency SMS and call service are the two features included in the app

6.1.4. Service Level Agreements (SLAs)-

CATEGORY	SERVER & NETWORK	SLA	Availability for week ending 24-07-2016	Availability for week ending 31-07-2016	Availability for week ending 07-08-2016	Availability for week ending 14-08-2016
Data & Control Centre	Availability of internet	100%	100%	100%	100%	100%
	Data availability(MySQL)	100%	100%	100%	100%	100%
Availability of systems at Data centre & Resumption of online ITS service & Time to restore back office servers from failure	1. Back office Servers	99%	100%	100%	100%	100%
	2.ITS Application	99%	100%	100%	100%	100%
	3. Workstations	99%	100%	100%	100%	100%
	4.Video Wall	99%	100%	100%	100%	100%
	5.IVRS Server,	99%	83.92% (IVR Hardware SMPS found faulty and issue closed)	100%	100%	100%
	6.Commuter Portal	99%	100%	100%	100%	100%
Data & Control Centre	Network Availability at CCS SLA Band	99%	100%	100%	100%	100%
	Network Latency at CCS	>75ms/ month	100%	100%	100%	100%
	Concurrent Connection at Control Centre	500	100%	100%	100%	100%
	ITS Portal Page loading in 64 kb	10 Sec	100%	100%	100%	100%

CATEGORY	EQUIPMENTS	SLA	Availability for week ending 24-07-2016	Availability for week ending 31-07-2016	Availability for week ending 07-08-2016	Availability for week ending 14-08-2016
Field Equipments	i. Per VMU data availability at control centre	>98%	98.78%	99.27%	99.83%	99.92%
	i. In bus display Availability	>98%	98.84%	99.64%	99.76%	100%
	ii. Announcement system availability	>98%	100%	100%	100%	100%
Field Equipments (PIS)	i. LED Display Availability	95%	98.69%	98.35%	97.34%	97.34%
	iii. Samsung Display Availability	95%	93.76%	94.57%	94.57%	94.57%
Field Equipments (Power Supply)	i. UPS	>99%	100%	100%	100%	100%
	ii. Genset	>99%	100%	100%	100%	100%

Server/network and Equipment availability

6.2. Enhancement of Productivity

- On implementation of ITS project at Mysore City, there has been a reduction in the traffic controllers managing the city bus station and other prominent bus stations. Prior to introduction of ITS, there was manual dispatch of buses and through entry in books. TCs were deployed on each platform to control the arrival and departure of buses. With the introduction of ITS, computerised dispatch of buses takes place from the Central Control.

- Station and one traffic controller is enough to manage the entire bay. For eg. the Traffic Controllers in central bus stand were reduced by 13. Since there is a system of monitoring of bus movements through Central Control Station with advanced customised applications, productivity improved drastically in respect of bus operation parameters like - bunching of buses, arrival and departure regularity, schedule adherence, driving habits (harsh acceleration/braking etc.), speed violations, bus-stops skipped incidences, public complaints etc.

- Bunching reduced from 346 in April 2013 to 8 in April 2016. Since ITS application provides MIS reports and real time alerts to depot managers, these depot managers have complete control over bus operations and crew monitoring.

6.2.1. MIS reports available through ITS application: Based on bus operations, ITS application generates 12 value added reports which are being used by depot managers and traffic operations team for analysis and continuous improvements.

- ✓ bunching of buses
- ✓ schedule adherence report
- ✓ bus break down report
- ✓ route deviation report
- ✓ missed trips report

- ✓   schedule departure daily
- ✓   schedule arrival daily
- ✓   daily departure punctuality
- ✓   daily arrival punctuality
- ✓   schedule performance report
- ✓   daily operational summary
- ✓   control chart

6.2.2. Control Room Functions:

- ✓   Understand Operations
- ✓   Monitor Service Performance
- ✓   Analyze, Identify & Address Issues
- ✓   Arrive at most effective model
- ✓   Enhance & Improve Efficiency
- ✓   Provide most Optimal Service

6.2.3. Performance Improvements:

- Major improvements in Trip Origin – Proportion of trips departing ± 5 minutes from scheduled time
- Trip Midpoint – Proportion of trips between -1 to +5 minutes of scheduled time
- Trip Endpoint – Headway coefficient (headway standard deviation/mean headway)
- Average wait time at bus stop reduced from 20 minutes in April 2012 to 14 minutes in April 2016, i.e. reduction is time is 6 minutes. (Considering around 3 lakh passengers travel daily in Mysore city buses, 18 lakh minutes of economically productive time saved)
- Crew ratio per schedule and staff ratio has reduced considerably.
- Improvements in load factor, reduction in dead kms, cancellation reduction kms due to late departure and early arrival, reduction in unscheduled stoppages, reduction in over time, etc.

6.3.   Efficiency Enhancement

6.3.1   Volume of transactions processed-

Year	No of People Queried	No of SMS received	SMS Sent	IVRS calls	USERS	PAGE VIEWS
2013-14	5969	29209	44241	12272	43328	140662
2014-15	5871	16791	33064	16491	65809	199731
2015-16	5340	24197	29027	28691	65070	187074

The software application caters more in respect of disseminating Real Time Bus Arrival/Departure information system through PIS boards. Each bus provides its location every 10 seconds. The data is processed and based on the algorithm deployed, the real time information is flashed to PIS boards. The enquiries through SMS and IVRS are also attended to. Alternatively, commuters also have the option to check ETA/ETD through

commuter website. On 30-05-2016, mobile app has been launched and within a month, the app was downloaded by around 1500 users.

6.3.2 Coping with transaction volume growth- The architecture/systems sizing is made keeping in view the growth of concurrent users. Currently 430 buses are in operation and can take easily the load of 500 buses.

6.3.3 Time taken to process transactions-

CATEGORY	SERVER & NETWORK	Achievement
Data & Control Centre	Availability of internet	100%
	Data availability(MySQL)	100%
Availability of systems at Data centre & Resumption of online ITS service & Time to restore back office servers from failure	1. Back office Servers	99%
	2.ITS Application	99%
	3. Workstations	99%
	4.Video Wall	99%
	5.IVRS Server,	99%
	6.Commuter Portal	99%
Data & Control Centre	Network Availability at CCS SLA Band	99%
	Network Latency at CCS	>75ms/ month
	Concurrent Connection at Control Centre	500
	ITS Portal Page loading in 64 kb	10 Sec

Every bus is fitted with a GPS unit which sends data packets once in 10 seconds throughout the movement of bus. Earlier, one could crosscheck whether the bus has completed all trips only on arrival to depot, say after 10 hours. The time difference of 10 seconds from 10 hours is the major achievement. Suppose, if a driver skips a bus stop, KSRTC used to know about only if there was a public complaint made to depot. Now, since it is real time tracking system which generates in real time thus giving a scope for KSRTC to tackle the situation. Similarly, all the key performance parameters like getting breakdown information, road block, accident, traffic jam etc. are known in real time, thus helping the Corporation to take suitable action. Thus, the power of technology has changed the productivity and efficiency of operations.

6.3.4 Accuracy of output

Mysore ITS won many national and international awards, the basic reason being project innovation and its accuracy of output. The algorithms are written with professional expertise and based on huge historical data. The Estimated time of Arrival (ETA) and Estimated Time of Departure (ETD) are accurate and updating in real time. Accuracy of output is 100%.

6.4 Service Delivery

Tracking	- Dynamic status reports – GIS map tracking - Schedule replay - Line diagram - Alerts monitoring
Route Settings	- Add, delete, cancel trips - Reschedule trips - Reason for breakdowns - Create and upload files to VMU required for scheduling
VMU Management	- VMU ID configurations - GSM/GPRS Parameters - VMU health check - Send command messaged to VMU
MIS Reports	- Generate various MIS reports - TC/ KSRTC supervisors can analyze and enhance operational efficiencies - Reports are downloadable in different formats
Administration	- User creations and management - Role based access - Master data management - Alert configurations

Commuters: Web portal, PIS, SMS, IVRS, Mobile App, Control Room helpline etc.

Year	No of People Queried	No of SMS received	SMS Sent	IVRS calls	USERS	PAGE VIEWS
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PIS Boards – 193 boards are there across Mysore City. Mobile App – Currently around 1500 users are making use of mobile app. The app enjoys star rating of 4.8.

6.5 Citizen Centricity

6.5.1 <u>Impact on effort, time and cost incurred by user:</u> The reduction in average passenger waiting time by 6 minutes

- Commuter is not being charged for any of the services-Web portal, PIS, SMS, IVRS, Mobile App, Control Room helpline.
- Bus provides information after every 10 seconds about its location and ETA/ETD are displayed continuously.
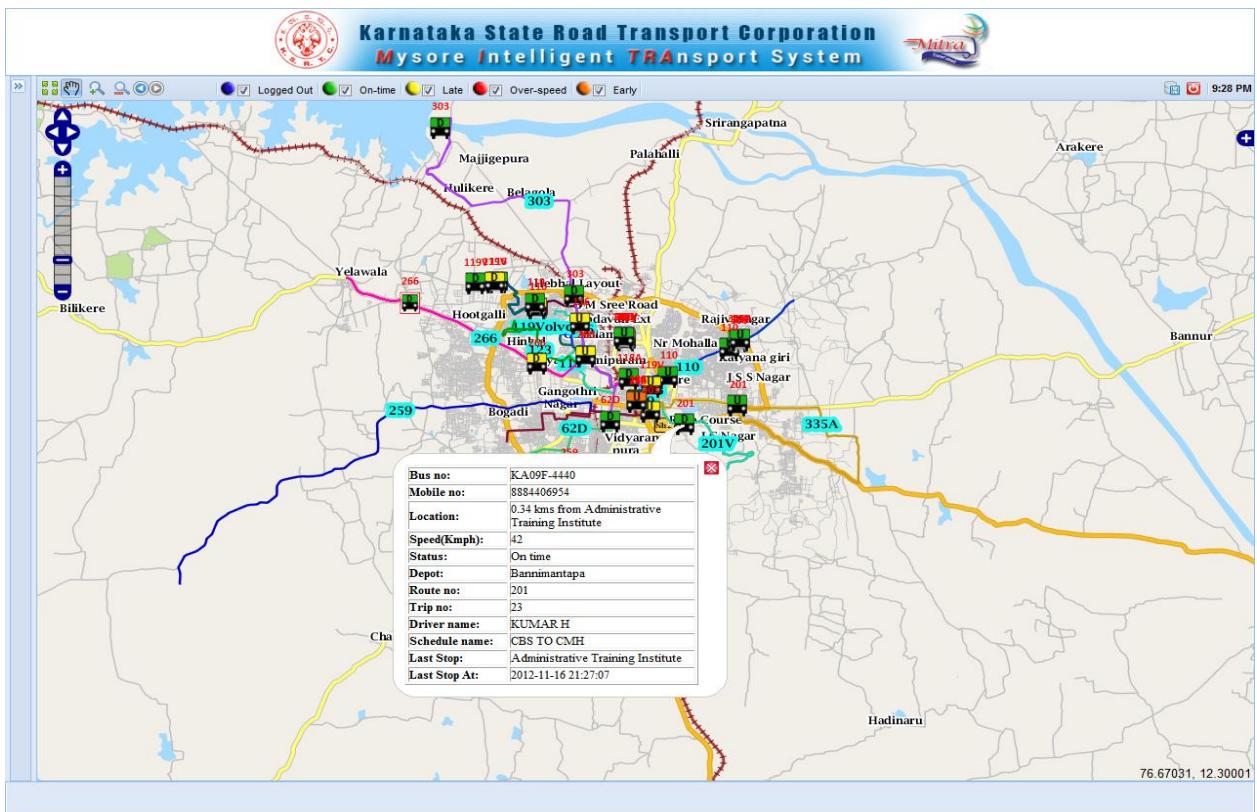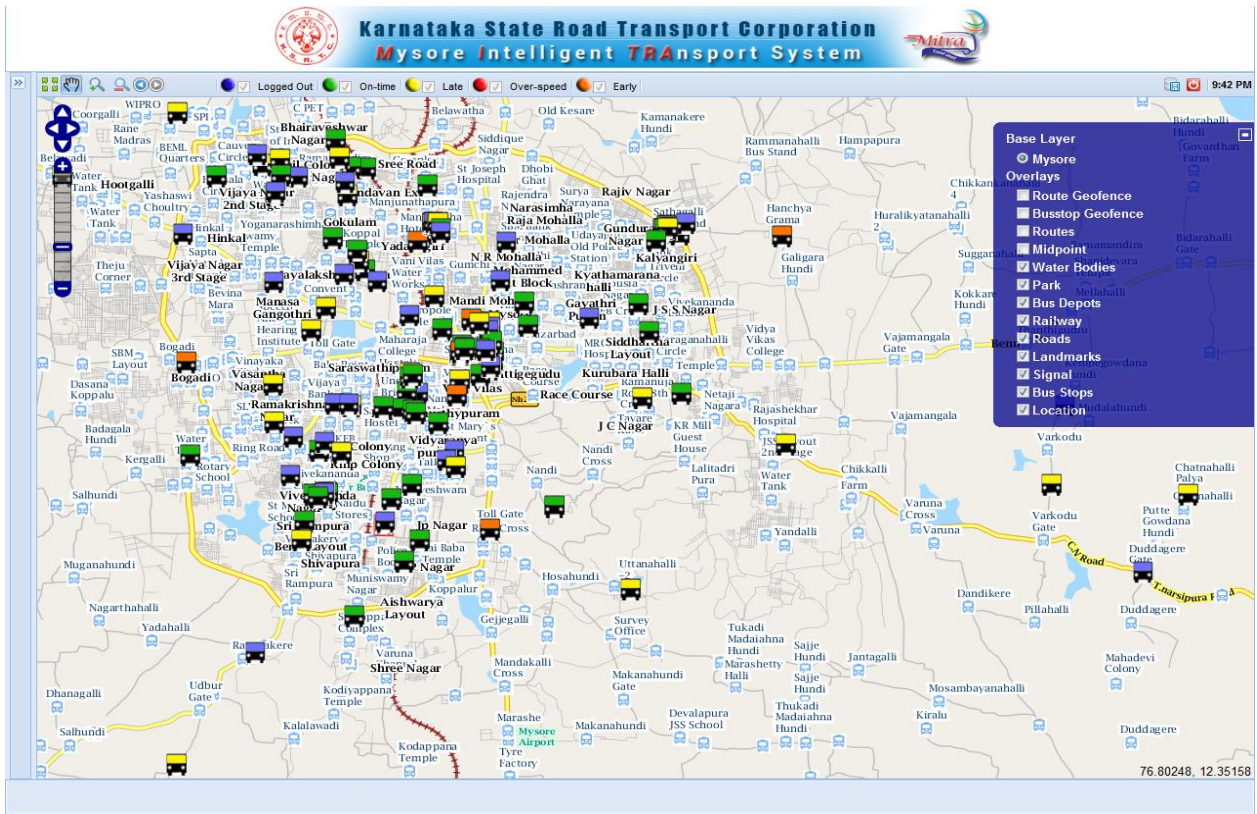
6.5.2   <u>Grievance mechanism:</u>

- Commuter Portal - mitra.ksrtc.in provides the helpline numbers, a separate section under contact directs user to –

  - ✓ Reach Us
  - ✓ Lost and Found
  - ✓ Feedback
  - ✓ Concerned KSRTC officials will immediately respond

- IVRS – 18004255220 (toll free), 4255220 (Mysore local-BSNL)
- SMS – 9870011012
- Helpline- Central Control Station Operators
- Mobile App – Special Features are there with respect to

  - ✓ Women Safety
  - ✓ Alerts
  - ✓ Complaints/Feedback
  - ✓ Rate Us
  - ✓ Offline Services (Two customer care numbers are available in the app, the user must only click on one of the buttons to call the customer care and get the required information)
  - ✓ Offline Message Services (If the user doesn't know the stop code of the stop)
  - ✓ Here he/she can enter just the first three letters of the stop and click on send, the user will get the text message of the codes of the stop. Then that stop code is needed to be entered in the next textbox to find the next available buses from that particular bus stop. There is also a button to unsubscribe from these offline message services)
  - ✓ Website- By pressing this button, the official MITRA website opens within the app, where the user can get his/her required information from the website

6.5.3   <u>Audit Trails:</u> The project was implemented with professional support from M/s IBI Group, Project Management Consultants. Services of IT consultants were utilised extensively for audit trails of ITS applications. The project monitoring is through Project Management Unit of Sustainable Urban Transport Project, MoUD, GoI and World Bank. Regular review meetings and site inspections are being carried out. KSRTC appointed Monitoring and Evaluation Consultants through global tender to capture the project implementation and reach results.

6.5.4   <u>Interactive platform for service delivery:</u>

- ✓ Website – Reach us, Lost and Found, Feedback
- ✓ IVRS
- ✓ Helpline
- ✓ Mobile App

6.5.5 Stakeholder consultation:

- KSRTC has consulted all stakeholders before and during implementation of the project.
- Dissemination Workshops were organised to elicit views, opinions and suggestions
- Mobile App has been developed through Appathon exercise and events, inviting the suggestions of all concerned.

6.6 Innovation
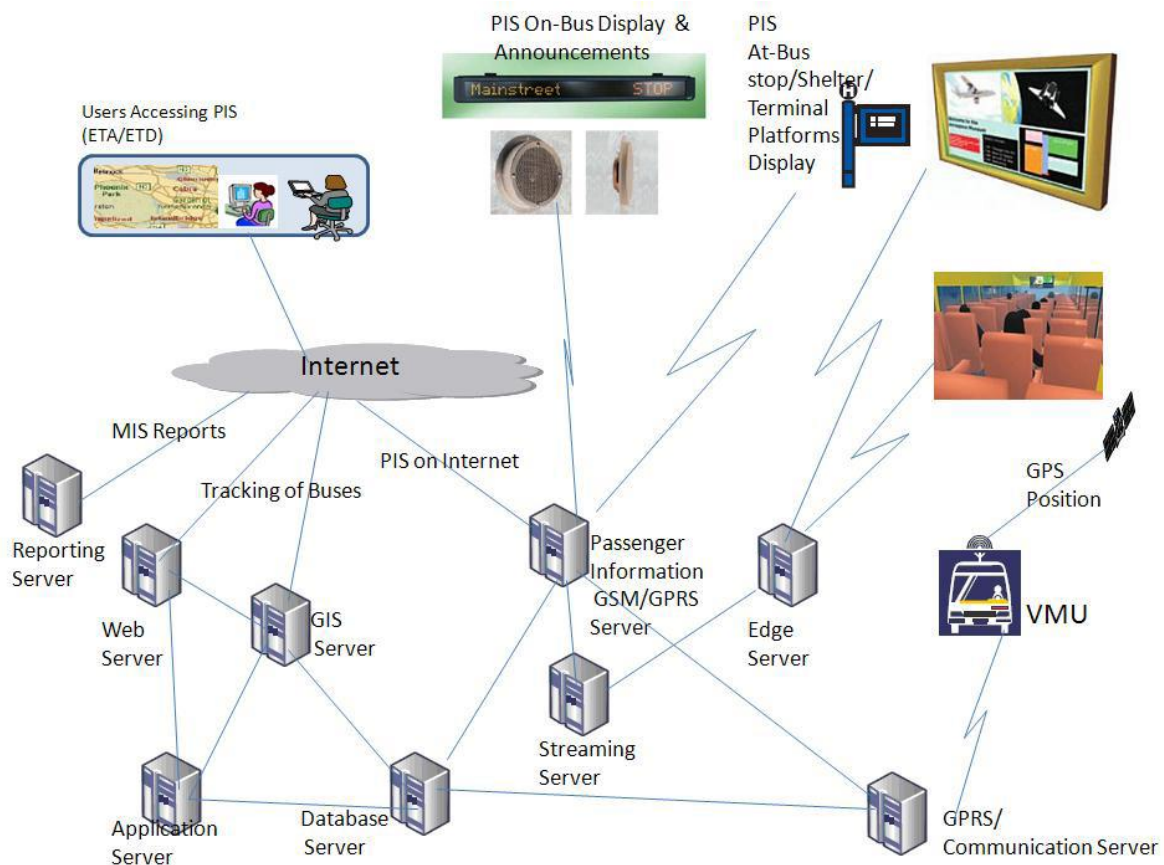
Core Technologies Deployed - Embedded Systems, GPRS / GSM, Web Technologies, Database, JAVA and GIS. Innovativeness of the project with respect to matching functional requirements with technological solutions:

- Bus Stop Mapping
- Exact Travel Time Data
- Rescheduling and route rationalization based on field travel times, route optimization KSRTC was able to first time map all the bus stops across the city. The bus stops went from 900 stops to 2400 stops. Each stop has been numbered in the system which enabled to rationalize our routes. Effectively, after many years, based on ground situation impacts and ITS data, the system was rationalized.
- Commuter Portal with Static & Real-Time Data, Passenger Friendly Commuter Website –http://mitra.ksrtc.in in English and Kannada

- Operations Management –Computers Aided dispatch, Schedule adherence, Incident management Traveller Information-Channels-> Web, Mobile, In-bus, Bus Station, IVRS Services-> Real Time, Online, Alert Services
- Security of equipments and infrastructure, incident management, driver aids
- Fully fledged SMS and IVRS
- Capacity Development – Exposure to KSRTC officers and staff for handling Project
- Management professionally
- Decision enabling MIS Reports
- Multi-functioning of Central Control Station
- Instructions Manual for Crew and Staff
- High end Video-wall with value added GIS Map
- Two way communication between driver in bus and Central Control Station
- Voice announcements of current and next stops in English and Kannada
- Alerts from Buses during emergency situations
- Effective route diversion
- Re-scheduling of buses
- Create and upload files over the air to Vehicle Mounted Unit (VMU)
- Generate reports and make informed decisions
- Effective monitoring of software and hardware components
- Streaming video to terminal display units

6.7   Adaptability Analysis-

6.7.1   <u>Measures to ensure adaptability and scalability</u>: Project has been well defined, designed and developed meeting adaptability and scalability. Team of KSRTC and Project Management Consultants conducted software functionality acceptance testing of Vehicle Tracking software, GIS Map, Commuter Portal, and Commute Portal GIS Map. User Interface validations, functional scenarios, internal user validations etc. have been carried out with proper and standard testing and quality control practices. Architecture is well designed and tested to withstand the scalability requirements. KSRTC so far has not faced any issues with performance of the application. The test cases in respect of EMS software, ITS application, GIS application, SMS and IVRS interfacing software systems, commuter portal etc. have been carried out and well documented. Various tests under "Software/System Factory Acceptance Tests" have been comprehensively carried out to ensure adaptability and scalability.

6.7.2   <u>Measures to replicate the project:</u>   Project has been implemented with a well designed implementation approach-

- Building Knowledge Base – In-depth study, thread-bear discussions, consultations
- Multi-lateral Co-ordination – City Administration, PMU, WB, Consultants, State Govt. etc.
- Acquaintance with World Bank Procedures – Finance, Procurement
- Team Work – KSRTC, Vendor, Consultants etc.

- Detailed Project Planning and Documentation
- Sound Management Review Techniques – Weekly Meetings, Monthly Steering Committee Meetings, Field visits, Adhoc meetings, and consultations with PMC etc.
- Comprehensive Training Program
- Procured Professional Project Management Consultants and key experts

Involvement of Stakeholders at all levels to ensure the sustainability of the project - Traffic Police, Local Administration, NGOs, Urban Planners, students, commuters, KSRTC crew, traffic controllers officials, depot managers etc.

Public Outreach Measures – Extensive Public Outreach Campaign has been planned to increase the ridership of ITS enabled buses.

The city of Mysore will serve as an example for sustainable transport solution of Intelligent Transport System (ITS) that is expected to be replicated across India. Based on Mysore ITS, KSRTC has been implementing Vehicle Tracking and Monitoring System project covering 2000 long route buses and KSRTC has planned to shortly launch Appathon/Hackathon on the lines of Mysore ITS. All the executives of State Transport Undertakings have visited KSRTC for better understanding of the project which would help them in implementing the same in their respective organisations. KSRTC officers have been invited and have made many presentations at various events/locations/training institutes/forums. World Bank had also organised Knowledge Sharing Workshop in May 2016 at Mysore inviting all STUs to assist in replicating such projects. The documentation on learning and key challenges was circulated to all participants. More than 200 visitors have visited Mysore to study and document the learning. KSRTC has organised information exchange sessions for Big Data Experts from World Bank with various government agencies, app developers and professional institutes. Based on the recommendations of the same, KSRTC will shortly be opening up its travel data thus enabling emergence of better products and usage in the days to come.

6.7.3 Restrictions, if any, in replication and/or scalability – The application is customised for meeting KSRTC's city bus operational requirements. With required customisation, the system can be replicated in meeting the protocols of tracking and communication devices.

6.7.4 Risk Analysis -Interface-Programs and frameworks that facilitate communication between programs and/or systems. Though currently, no external system is interfaced with ITS application, the standard practices are adopted for easy and convenient interfacing with any external system. However, the applications like IVRS and SMS have been comfortably interfaced with ITS system. KSRTC is planning to interface this system with its proposed centralised software system. Data-Static and Real Time – As the data exists in both Static and Real time basis, KSRTC is handling the data effectively since all measures have been taken in respect of design, security and communication. KSRTC is planning to convert the data in GTFS format, a global practice followed in respect of transport domain. Process-Modules and programs that control and manipulate the data. Various sub-systems of ITS application have been designed and structured well, which pose no difficulty in

achieving this objective. The software application has been vigorously tested for interface, data and process. Since the project involves dissemination of the real time data (including alerts systems), proper risk analysis has been taken up. During May-June 2016, experts from Big Data Team of World Bank have conducted a study on opening up the data and have submitted their Report with recommendations to KSRTC on how to open up the data

6.8   User Convenience

6.8.1. Service delivery channels (Web, email, SMS etc.)-
✓   Web - mitra.ksrtc.in
✓   SMS – 9870011012
✓   IVRS - 18004255220 (toll free), 4255220 (Mysore local-BSNL)
✓   Mobile App – Google Store - MITRA - KSRTC

6.8.2. Completeness of information provided to the users-

- The SMS system will provide real-time bus arrival information and scheduled bus availability for the convenience of customers. In this way customers will be able to plan their trip according based on real-time information.
- The purpose of the Mysore ITS Interactive Voice Response (IVR) system is to provide responses to the KSRTC bus customer queries through pre-recorded messages to the extent possible. The IVR System is expected to save time, manpower and money for KSRTC. The system will provide information in Kannada and English specific to Mysore bus operations and will be accessible from mobile or landline phones.
- Visit - http://mitra.ksrtc.in/MysoreMBus/faq.jsp to know about the services of ITS. Mitra.ksrtc.in/ provides information to public on bus services, track the bus services, time table, route details, tourist places, how to use SMS/IVRS services etc.
- Mobile App – Mitra-KSRTC provides complete information on Mysore City bus services with many value added features which is first of its kind.

6.8.3. Accessibility (Time Window)- Instantaneous and in real time. The details provided in the SLA columns along with the results demonstrate this feature.

6.8.4. Distance required to travel to Access Points- By sitting at home/office, one can access the information through SMS, IVRS, Portal, Mobile App. PIS boards are displayed at all major bus shelters/traffic generating points (193 across city). If an user registers for the SMS Service to know the expected time of arrival of bus at any particular bus shelter, he will be sent daily information on the same without sending SMS on a daily basis.

6.8.5. Facility for online/offline download and online submission of forms – Not applicable. However, to provide feedback the online application, facility is made. Commuters can fill the simple form through commuter website mitra.ksrtc.in/or call Helpline (IVRS).

6.8.6. <u>Status tracking-</u> For the use of KSRTC, application is built to track the bus status. Both Dynamic Status Report and on graphic GIS map, the status of bus location is there. For a commuter to track his grievance/complaints, there is no online facility. This system is proposed to be introduced shortly.

7. **BENEFITS & IMPACT ON THE STAKEHOLDERS/BENEFICIARIES**

7.1. Benefits: Independent Monitoring & Evaluation (M&E) Consultants were hired and the results of M&E surveys indicated:

- 14.5% increase in ridership over year and 47% from baseline data
- Ridership increase due to ITS @1.69% of total growth – 21.5 lakhs
- Average wait time reduced from 20 minutes in 2012 to 15.2 mins in 2015, 14 mins in 2016
- Overall user satisfaction of ITS system has exceeded benchmark levels

The project has covered all the planned beneficiaries – Commuters, Traffic Police, Visitors to Mysore City, District Administration, KSRTC operational managers/staff/crew etc.

- Optimization of available resources like Crew, Buses
- Reliable and increased commuter satisfaction
- Fixed frequency of operations to match commuters demand
- Exploring new routes with the resources saved after optimization
- Easing traffic congestion in city's prime density areas
- Attracting more commuters towards public transport by increasing frequency of operations

Commuters	Management	Society
✓ Real Time Information on bus arrival and departure ✓ Next stop bus announcement and display within the bus ✓ Reduced waiting time at bus shelters ✓ Comfortable Trip planning ✓ Value added SMS and IVRS Services ✓ Exclusive Commuter Portal – mitra.ksrtc.in/ with salient features	✓ Real time Tracking of Buses ✓ Dynamic scheduling of Buses ✓ Schedule rationalization and Overtime reduction ✓ Decision enabling MIS Reports ✓ Driving behavior analysis ✓ Tool to defend Motor Vehicle Claim Cases	✓ Promotes Public Transport usage ✓ Environment friendly initiative ✓ Immediate access to accident/incident information ✓ Brings down traffic congestion ✓ Safety of commuters & pedestrians

Karnataka State Road Transport Corporation has implemented Intelligent Transport Systems (ITS) in Mysore city covering its entire fleet. This is the first of its kind demonstrative project in India. This innovative system has offered multi-fold benefits to all the stakeholders – commuters, operators, eco partners, and technology providers. Commissioning of this project enabled fulfilment of the three broad objectives –

✓ Improvement of ridership
✓ Providing better fleet management
✓ Enhancement of operational efficiency

This pioneering initiative addressed many critical issues in the use of public transport. The integrated efforts have enabled well informed operational and strategic decisions with the help of an elaborate Management Information System (MIS). The ITS deployment also answered to the issues related to road congestion, convenience, comfort; value added services and many other aspects within the realms of public transportation.

7.2. To organization/Government-

• By using ITS application, all the schedules optimized which resulted in reduction of 2314 km daily (844610km annually)

• Savings on lubricants & filters of preventive maintenance is 2.19 lakh (Avg cost of lub 20 ps and filter 5 ps per km)

- Same effective km and revenue achieved with 8 less buses considering average cost of operation as 25 lakhs per bus per year, approximately 200 lakhs has been saved on operating cost

- Reduction of staff in central bus station resulted in approximately 60 lakhs savings on staff cost per annum

- Based on optimization and effective usage of ITS application reduction in Over Time of Rs. 124 lakhs

7.3. To citizens-

- Commuter average waiting time for bus reduced by 6 minutes in April 2016 as compared with the project commencement time. Given around 3 lakh passengers travel daily in Mysore by KSRTC City bus services, the economic productivity has been very huge.

- Benefited hugely by access to information and systematic bus operations.

7.4. Other stakeholders-

- Many State Transport Undertakings have started introducing ITS in their cities convinced by the first and successful project implemented by KSRTC in Mysore City.

- Traffic Police are taking data from KSRTC for deciding one-way or two-way traffic implementation in the city.

- Dussehra traffic management to district administration is a huge challenge. ITS is helping for better management.

- Public transport is gaining momentum with introduction of such technologies/facilities. Many educational institutes, offices, colleges, IT-firms are patronising to ITS enabled bus services.

8.   FUTURE ROADMAP/SUSTAINABILITY

A well documented Operations Manual exists which in turn emphasises on business continuity plan. The training has been imparted to all the staff (including refresher trainings) for efficiently carrying out works. Training Manual has been provided. Staff is being deputed to various training programs.

Since GPS/GPRS/GIS is an established technology and the same has been incorporated in ITS project, the same is sustainable. The project has been professionally implemented with reputed solution provider and professional Project Management Consultant agency

through global tender. In order to obtain the feedback and sustenance of similar project, an independent Project Monitoring and Evaluation Agency has been engaged. Since the project has evolved huge public appreciation and has transformed the way public transport facility is being used, the system will sustain. KSRTC has taken special initiatives in bringing out professional training and capacity building for its staff-

- Additional revenue accruals to KSRTC due to shift from the existing population using other modes of transport. As the shift is primarily due to the ITS and its benefit accruals, the revenue increase is attributed to the project at the current marginal revenue per passenger.

- Revenues through Advertisements are yet another benefit from the Project. There are three type of advertisement revenues viz., Revenues from Advertisements in the buses - termed Bus Advt Revenues, revenues from advertisements at the Bus stops - termed Bus Stop Advt Revenues and revenues from Advertisements at Bus terminus - termed Bus Terminus Advt Revenues.

9. Mysore ITS - Performance Parameters (Before and After)

	Before		After		
	2013-14	2014-15	2014-15	2015-16	2016
	Apr-Mar	Apr-Sept	Oct-Mar	Apr-Mar	Apr-Oct
Schedules	438	437	430	422	427
Effective Kms	340.55	171.44	171.76	340.07	191.66
No. of accidents					
Death	6	4	10	8	5
Major	2	3	3	0	1
Minor	36	11	19	31	11
TOTAL	44	18	32	39	17
Rate of accidents/lakh kms	0.13	0.10	0.19	0.11	0.09
% dead kms	6.2	6.5	6.5	6.4	5.6
Cancellation kms due to late departure	55329	12311	12020	11456	2877
Cancellation kms due to early arrival	76246	27384	14904	18195	4491
Staff ratio	5.1	5.2	5.2	5.1	4.9
Crews on roll	1691	1679	1670	1615	1561
Crew Ratio per schedule(running staff)	3.86	3.84	3.88	3.83	3.66
Per day eff.kms	93301	93683	94374	94202	95353
Earning per bus (Rs)	7166.00	8196.00	7131.00	7625.00	7829.00

10.   Teaching Notes

Intelligent Transport Project (ITS) - an initiative to accelerate a shift from personal use of vehicles to public transport system and lowering of pollution levels by the Karnataka State Road Transport Corporation (KSRTC).

1.   OVERVIEW

The Intelligent Transport System Project implemented at Mysore addresses the critical issue of road congestion by offering state-of-art technologies and attractive, convenient, comfortable as well as value added services to encourage the usage of bus services against individual personal vehicles. The project objectives include: To establish an intelligent system to improve quality and convenience of public transport system in Mysore city and ensure the delivery of safe, fair, reliable and environment-friendly transport system; Establishing a centralized traffic control center to handle the bus operations effectively; Introducing GPS services in the city bus fleet to monitor and track bus movements in real time; Introducing LED display boards at all bus stations/platforms and major bus-stops of the city to provide real time information about bus operations for disseminating the bus arrival and departure timings; Introducing public information system (announcement system) inside all city buses; To promote use of sustainable transport modes and enable commuters to make informed choices on travel modes by developing an integrated network in an effort to reduce passenger waiting time; to optimize operations, improve fleet utilization, schedules and vehicle availability with accurate information.

2.   TEACHING OBJECTIVES

➢   **Learning Objectives**
- As-is situation analysis and identification of pain points in the existing labour laws and their implementation.
- Importance of innovation and technology to bring transparency and proper accountability.
- Expected outcomes and ease in business due to the project.

➢   **Challenges/Issues Faced**

- Inadequate Infrastructure
- Very rapid increase in motorization
- Substantial increase in traffic congestion
- Relative decline of public transport usage and services
- Increased Waiting Time, Unpredictability and Uncertainty
- Risk to safety of Road Users
- Increased Fuel Consumption and Emission

- Increased Operational Costs
- Decreased Traffic Efficiency
- Increase in Traffic Congestion
- Decline in Economic Productivity
- Non availability of Real Time Information for Passengers about Bus Arrival and departure
- Lack of Decision enabling MIS Reports
- No control over bus operations
- No monitoring system of bus operations, control room was not there
- ETA and ETD information to passengers in real time was not available
- Manual dispatch of buses
- Bunching of buses, no system to cross check the public grievances/complaints
- No tools for schedule rationalisation available
- Digitalisation of transport operational records not available
- No system to track the dynamic status of bus operations nor on GIS

➤ **Ways to Improve the Situation**
- Automatic Vehicle Location Information system (AVLIS)
- Passenger Information System (PIS)
  - ✓ Information Display services: in vehicle
  - ✓ Information Display services: Bus stops
  - ✓ Information Display services: Bus Stations / Terminals / Stands & platforms
  - ✓ Information Display Services: Special locations
- Automated Voice Announcement System
- Central Control Station (CCS)
- Enterprise Management System
- MIS Reports Mobile App: As per the original plan of ITS, arrival and departure of bus timings (Estimated Time of Arrival/Estimated Time of Departure) was provided through Passenger Information System Display Boards, SMS, IVRS and Commuter Website-mitra.ksrtc.in.

3.   SUGGESTED QUESTIONS & ANALYSIS

a)   What changes were brought in the system using ITS?

- Establish an intelligent system to improve quality and convenience of public transport system in Mysore city and ensure the delivery of safe, fair, reliable and environment-friendly transport system
- Promote use of sustainable transport modes and enable commuters to make informed choices on travel modes by developing an integrated network in an effort to reduce passenger waiting times
- Optimize operations, improve fleet utilization, schedules, and vehicle availability with accurate information

b)   What were the problems identified in the region?

- A significant trend amongst many urban road users is the willingness to use the public transport in the face of increasing traffic congestion and increasing 'road-rage' behaviour on the roads. Many would shift to the public transport on cost considerations. Time is of essence and a conscious shift will occur only if the new mode offers time improvements, while for others it is mostly a matter of costs.
- KSRTC aimed to bring about this shift in preferences in the city of Mysore by improving the perceived image of KSRTC services. The project aimed to improve the reliability of KSRTC city services through effective Travel Demand Management measures, Emergency Management Systems and reduction in the waiting time of its passengers.
- Given the critical success factors of availability, reliability, accessibility, security, low costs and comfort (acceptance), the increase in the use of public transport is definite to occur. ITS, with its state-of-the-art technology, convergence of different technologies, such as the network, GPS, display systems and Information systems, would contribute to meeting the critical success factors in the Intelligent Transport system.
- IT and decision enabling Tool to monitor, control and analyse bus operations to meet the commuter requirements was not available.

c)   How has ITS helped in increasing efficiency and effectiveness in the system?

- Decline in Incidents of bunching – (April 2013-346, 2014-135, 2015-46, 2016-8)
- Decline in % of dead kms – (6.4% in 2015-16 and 5.6% upto Oct-2016)
- Reduction in cancellation of kms due to late departure (24331 kms in 2014-15, 11456 kms in 2015-16 and 2877 kms upto Oct-2016)
- Reduction in cancellation of kms due to early arrival (42288 kms in 2014-15, 18195 kms in 2015-16 and 4491 kms upto Oct-2016)
- Decline in unscheduled stoppages (Alerts received 2045 in July-2015, 494 in Oct-2015 and 363 in Oct-2016)

Increased Efficiency of processes and effectiveness of outcome

S. No.	Parameter	OCT 15	NOV 15	DEC 15	JAN 16	FEB 16	MAR 16	APR 16	OCT 16
1	No of bus stops skipped	5	3	2	2	2	1	1	1
2	No of speed violations	6	3	3	1	2	2	2	1
3	No of sudden acceleration	15	9	8	3	3	3	2	2
4	No of harsh brakes	7	4	3	1	2	1	2	3

	11-12	12-13	13-14	14-15	15-16	Upto Oct 2016
Schedules	400	400	438	430	422	427
Per day effective kms	94842	92209	93301	94027	94202	95353
Earning per bus	6210	6676	7166	7665	7625	7829
Crew on roll	1629	1589	1691	1670	1615	1561
Staff ratio	5.5	5.3	5.1	5.2	5.1	4.9
Crew Ratio/ schedule	4.07	3.97	3.86	3.88	3.83	3.66

Outcome

	Dec 2015	In percent (%)	APRIL 2016	In percent (%)	October 2016	In percent (%)
In Time	12643	87	12784	88	14350	89

4. Classroom Management

➢ Group Discussion

Divide the participants in groups of 4-5 and discuss the case on following aspects. Each group should take one aspect:

1. Discuss Change management and Communication as some of the key factors to project success.
2. Challenges, issues and risks if the project is to be rolled across other States.
3. What is next in the project?

Please have an open brainstorming session regarding how this project can be evolved and replicated in other States. Each group should present their findings in a short 5-10 minutes presentation afterwards.

➢ Group Activity (30 -40 minutes)

Make two groups of participants. One group has to act as major stakeholders, i.e. citizens that will be using the application and other to act as Government.

Major Stakeholders: The task of the stakeholder group is to come up with novel and different (but realistic) service requirement that they want from a project like ITS. They should consider all the problems they face or they can face in future and build up a suggestion around them. They should also build a justifiable timeframe against each service they want to build in the system.

Government: The task of the Government group is to see how they can provide such services within shortest possible time and the manpower required to serve the system of the project. They should hold discussion with stakeholders to devise roadmap and implementation plan.

The objective of this exercise is to highlight expectations of stakeholders and the readiness of Government in meeting them. It is a role play type of exercise which offers plenty of flexibility in the way services can be further augmented.

Hands On/Field Training (if required): Training to employees for effective adoption of the system and maintenance of the system. Within Group activity, workshops and group training to be incorporated to ensure ease of use of application by citizens and the employees.

➢ **Summary- Key lessons learnt (15 minutes)**

Each participant shall write down a summary in not more than 500 words highlighting the key learning from the case.

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ABBREVIATIONS

ITS	Intelligent Transport Project
KSRTC	Karnataka State Road Transport Corporation
SLAs	Service Level Agreements
AVLIS	Automatic Vehicle Location Information system
PIS	Passenger Information System
CCS	Central Control Station
GPS	Geographical Positioning System
DPR	Detailed Project Report
CIRT	Central Institute of Road Transport
ETA	Estimated Time of Arrival
VMU	vehicle mounted unit
ETD	Estimated Time of Departure
IVR	Interactive Voice Response
M&E	Monitoring & Evaluation