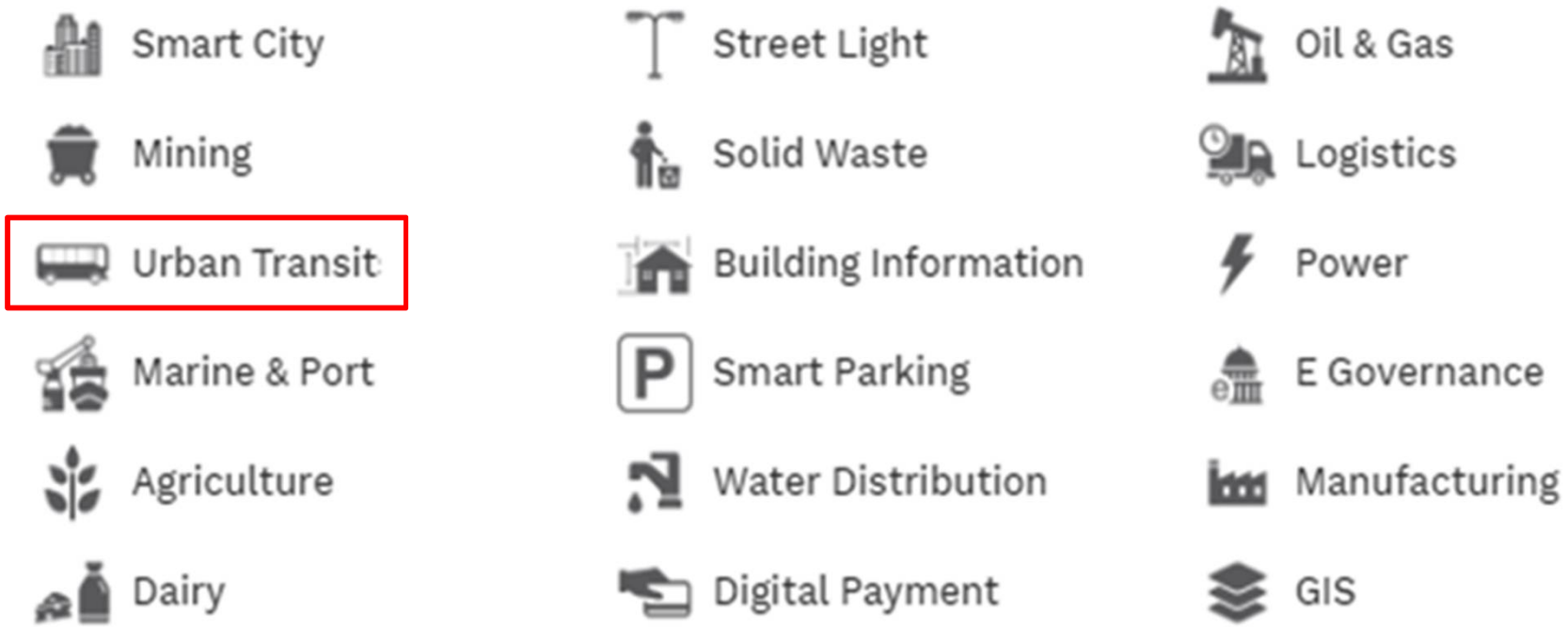
Increasing Productivity Through ITS Implementation

Aneesh Chinubhai
CTO, Infinium Solutions

About

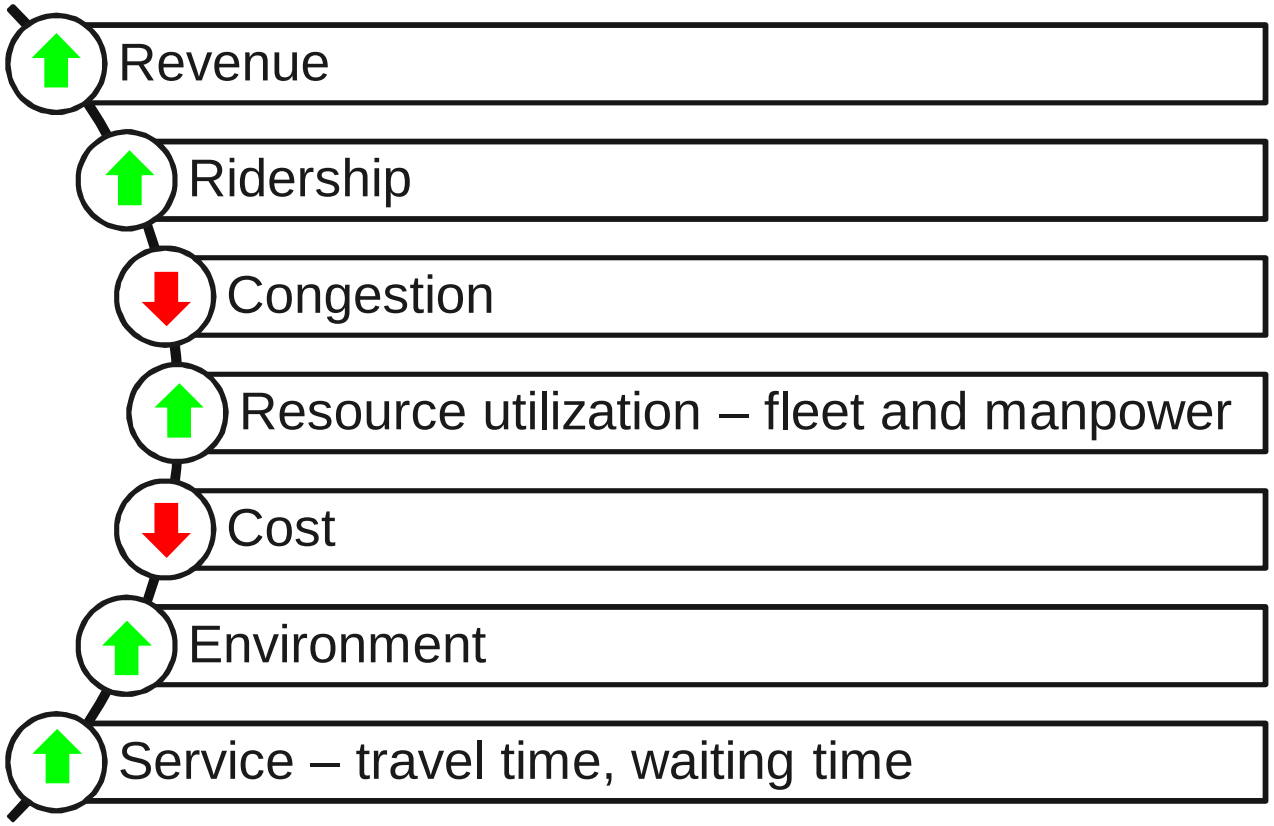
- Established January 1, 2008.



Involved in...

- Gujarat State Road Transport Corp. (GSRTC) – State Transport
- Indore (AICTSL) – BRT
- North Bengal (NBSTC) – State Transport
- Navi Mumbai (NMMT) – City Bus
- Ahmedabad Janmarg Limited (AJL) - BRT
- Others...

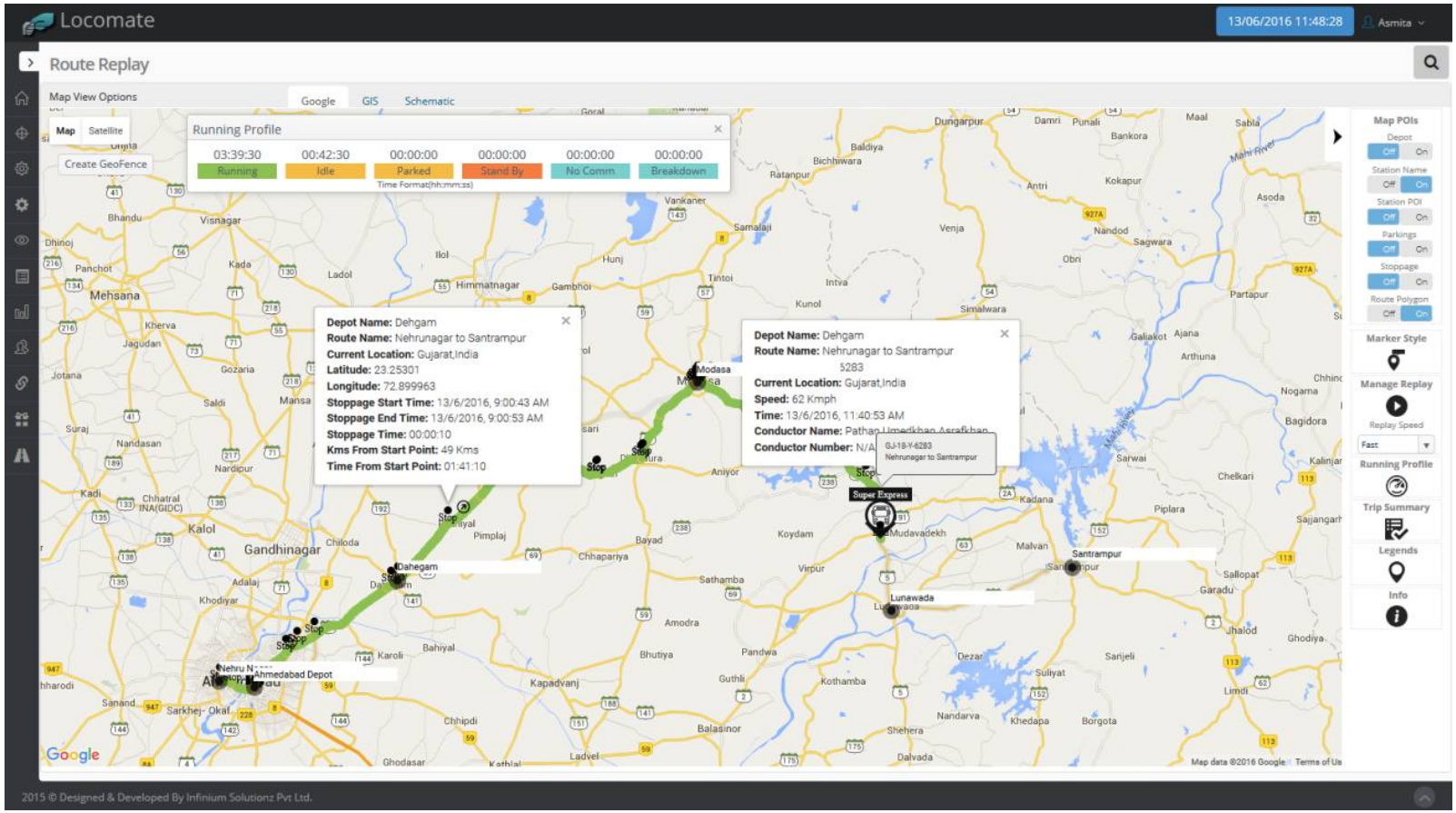
What does productivity improvement mean?



ITS – The Usual Components

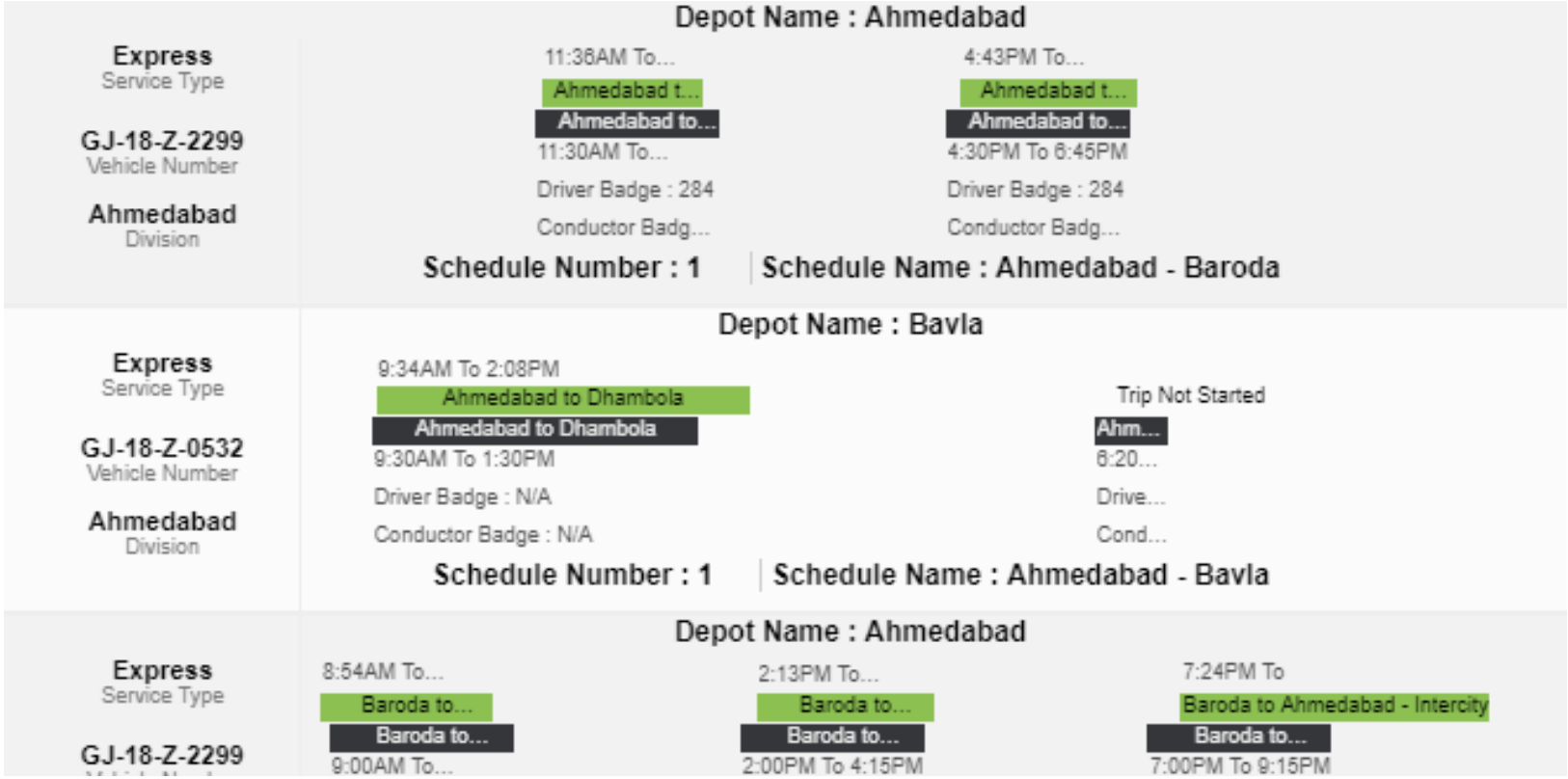
- Automated Vehicle Location
- Automated Fare Collection System
- Passenger Information System
- Planning, Scheduling and Dispatching
- Incident Management
- Command and Control Centre
- Financial Management System
- Depot Management System
- Business Intelligence

AVLS


Locomate
13/06/2016 11:48:28
Asmita
Route Replay
Map View Options
Google
GIS
Schematic
Map
Satellite
Create GeoFence
Running Profile
03:39:30
Running
00:42:30
Idle
00:00:00
Parked
00:00:00
Stand By
00:00:00
No Comm
00:00:00
Breakdown
Time Format(hh:mm:ss)
Depot Name: Dehgam
Route Name: Nehrunagar to Santrampur
Current Location: Gujarat,India
Latitude: 23.25301
Longitude: 72.899963
Stoppage Start Time: 13/6/2016, 9:00:43 AM
Stoppage End Time: 13/6/2016, 9:00:53 AM
Stoppage Time: 00:00:10
Kms From Start Point: 49 Kms
Time From Start Point: 01:41:10
Depot Name: Dehgam
Route Name: Nehrunagar to Santrampur
5283
Current Location: Gujarat,India
Speed: 62 Kmph
Time: 13/6/2016, 11:40:53 AM
Conductor Name: Pathan Umedkhan Asrafkhan
Conductor Number: N/A
GJ-18-Y-6283
Nehrunagar to Santrampur
Super Express
Dehgam
Santrampur
Lunawada
Ahmedabad Depot
Map POIs
Depot
Station Name
Station POI
Parkings
Stoppage
Route Polygon
Marker Style
Manage Replay
Replay Speed
Fast
Running Profile
Trip Summary
Legends
Info
Google
Map data ©2016 Google
Terms of Use
2015 © Designed & Developed By Infinium Solutionz Pvt Ltd.

AVLS – Bus Bunching

AVLS – Schedule Performance

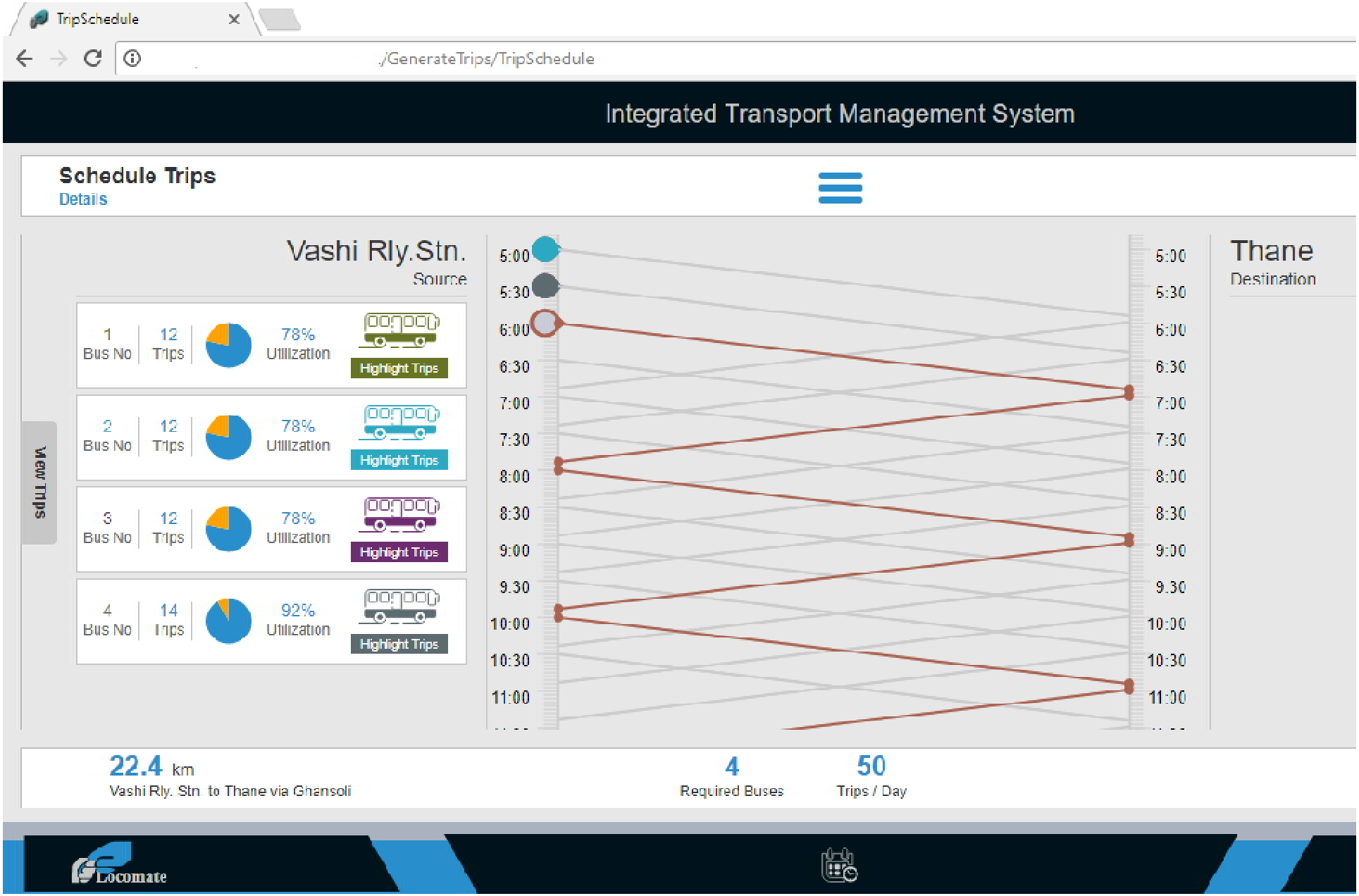


PIS

GUJARAT STATE ROAD TRANSPORT CORPORATION

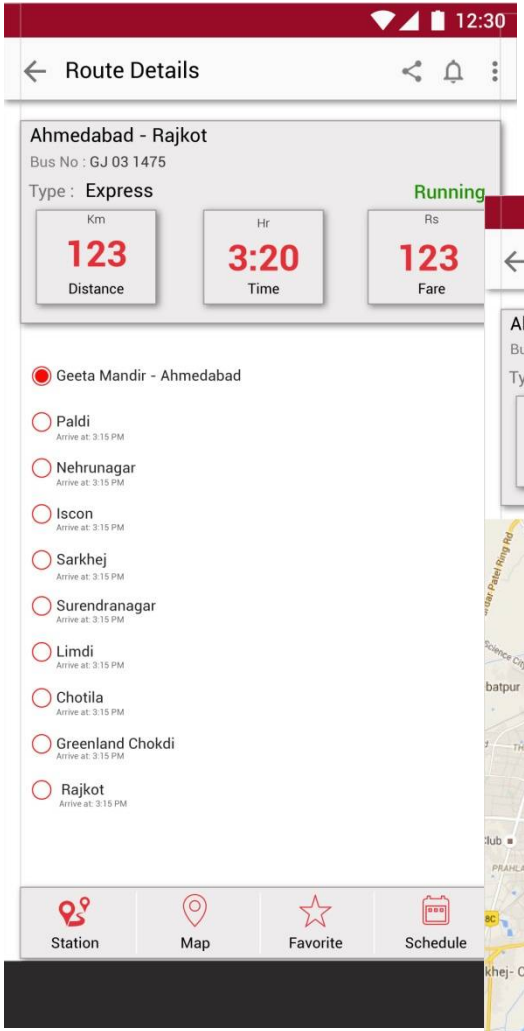
DEPOT NAME : AHMEDABAD DEPOT | DATE : 11/05/2016 | TIME : 08:39 PM

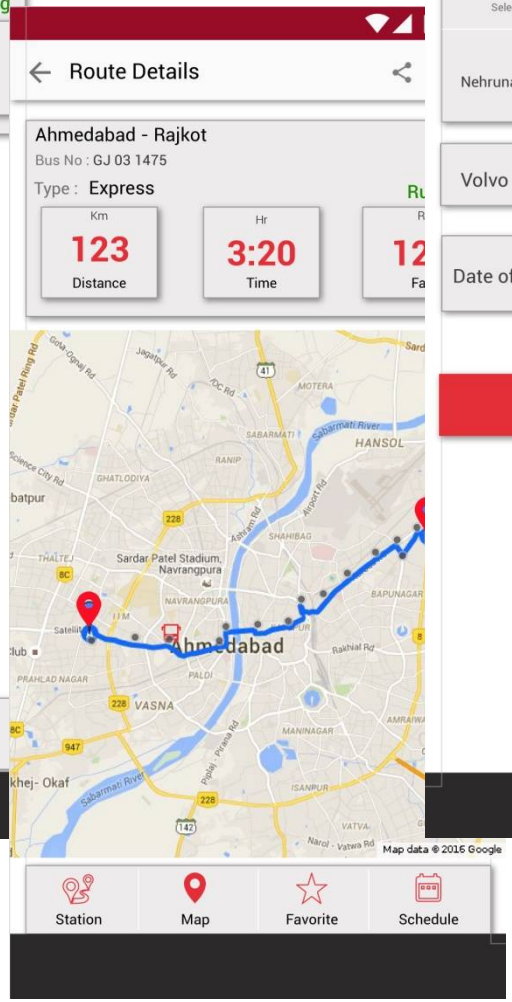
BUS ROUTE	SERVICE TYPE	ETA	ETD	LAST LOCATION	VEHICLE	PF	Current Location	Trip Type	Last Updated
Radhanpur to Ahmedabad	Super Express	20:48	-	Nehru Nagar Cross Road - Ahmedabad	GJ-18-Y-9511	12	Nehru Nagar Cross Road - Ahmedabad	RUNNING	11/May/2016 08:39 PM
Zalod to Ahmedabad	Super Express	21:00	21:05	-	GJ-18-Y-8430	21	Gujarat,India	SCHEDULE	10/May/2016 11:00 PM
Baroda to Nehrunagar via Express Highway	Volvo	21:00	21:05	-	GJ-01-DV-1057	24	Gujarat,India	SCHEDULE	11/May/2016 08:40 PM
Ahmedabad to Indore Via Nadiad	Super Express	-	21:00	-	GJ-18-Y-6141	28	Gujarat,India	SCHEDULE	11/May/2016 08:39 PM

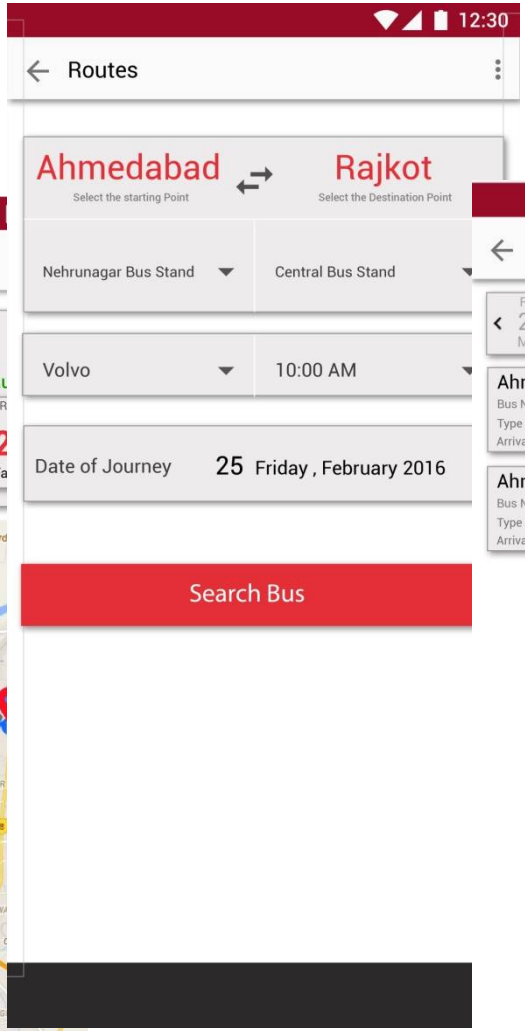


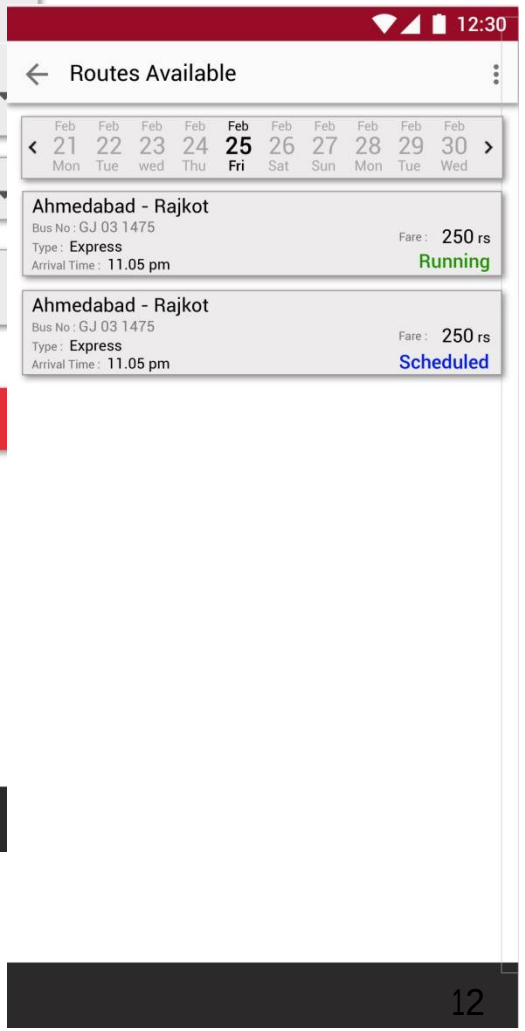
Scheduling of Buses and Crew

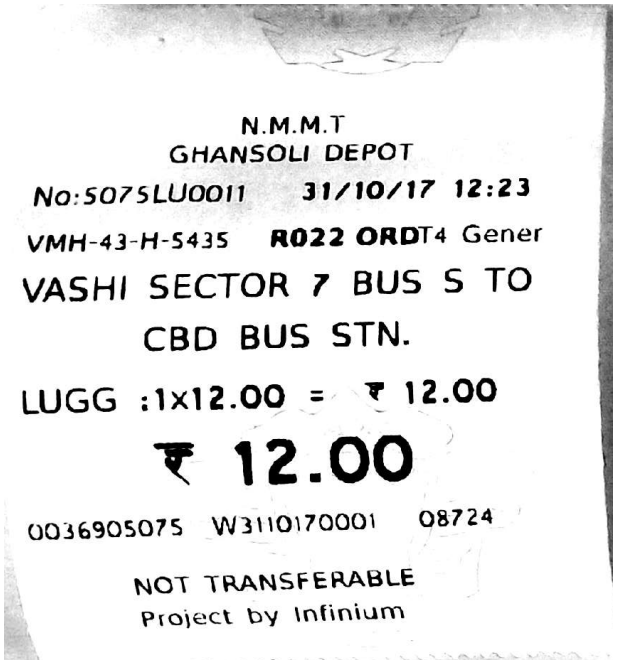
Mobile App


12:30
Route Details
Ahmedabad - Rajkot
Bus No : GJ 03 1475
Type : Express
Running
Km
123
Distance
Hr
3:20
Time
Rs
123
Fare
Geeta Mandir - Ahmedabad
Paldi
Arrive at: 3:15 PM
Nehrunagar
Arrive at: 3:15 PM
Iscon
Arrive at: 3:15 PM
Sarkhej
Arrive at: 3:15 PM
Surendranagar
Arrive at: 3:15 PM
Limdi
Arrive at: 3:15 PM
Chotila
Arrive at: 3:15 PM
Greenland Chokdi
Arrive at: 3:15 PM
Rajkot
Arrive at: 3:15 PM
Station
Map
Favorite
Schedule


Route Details
Ahmedabad - Rajkot
Bus No : GJ 03 1475
Type : Express
Km
123
Distance
Hr
3:20
Time
Sardar Patel Stadium, Navrangpura
Ahmedabad
Map data © 2016 Google
Station
Map
Favorite
Schedule

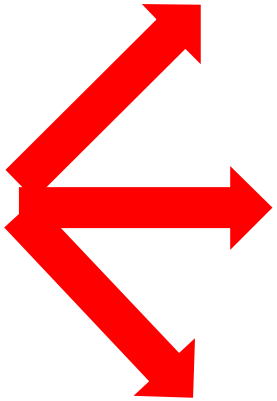

12:30
Routes
Ahmedabad
Select the starting Point
Rajkot
Select the Destination Point
Nehrunagar Bus Stand
Central Bus Stand
Volvo
10:00 AM
Date of Journey
25 Friday , February 2016
Search Bus

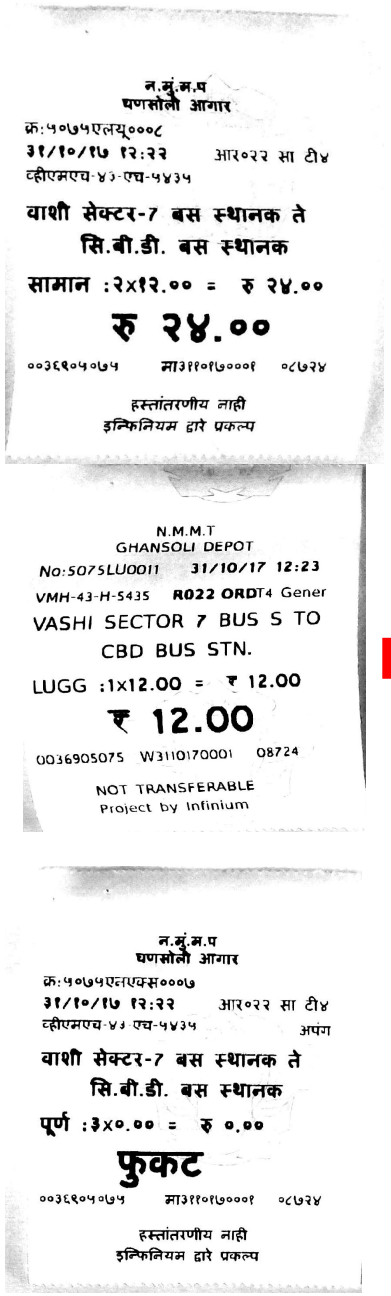

12:30
Routes Available
Feb 21 Mon
Feb 22 Tue
Feb 23 wed
Feb 24 Thu
Feb 25 Fri
Feb 26 Sat
Feb 27 Sun
Feb 28 Mon
Feb 29 Tue
Feb 30 Wed
Ahmedabad - Rajkot
Bus No : GJ 03 1475
Type : Express
Arrival Time : 11.05 pm
Fare : 250 rs
Running
Ahmedabad - Rajkot
Bus No : GJ 03 1475
Type : Express
Arrival Time : 11.05 pm
Fare : 250 rs
Scheduled



In-bus ticketing with ETM


A007
0027488
नवी मुंबई महानगरपालिका
परिवहन उपक्रम
१.००
रूपये
बालक
सामान
खास
नियमानुसार दिलेले तिकिट * अहस्तांतरणीय




न.मुं.म.प
घणसोली आगार
क्र:५०७५एलयू०००८
३१/१०/१७ १२:२२ आर०२२ सा टी४
व्हीएमएच-४३-एच-५४३५
वाशी सेक्टर-7 बस स्थानक ते
सि.बी.डी. बस स्थानक
सामान :२x१२.०० = रु २४.००
रु २४.००
००३६९०५०७५ मा३११०१७०००१ ०८७२४
हस्तांतरणीय नाही
इन्फिनियम द्वारे प्रकल्प
N.M.M.T
GHANSOLI DEPOT
No:5075LU0011 31/10/17 12:23
VMH-43-H-5435 R022 ORDT4 Gener
VASHI SECTOR 7 BUS S TO
CBD BUS STN.
LUGG :1x12.00 = ₹ 12.00
₹ 12.00
0036905075 W3110170001 08724
NOT TRANSFERABLE
Project by Infinium
न.मुं.म.प
घणसोली आगार
क्र:५०७५एनएक्स०००७
३१/१०/१७ १२:२२ आर०२२ सा टी४
व्हीएमएच-४३ एच-५४३५ अपग
वाशी सेक्टर-7 बस स्थानक ते
सि.बी.डी. बस स्थानक
पूर्ण :३x०.०० = रु ०.००
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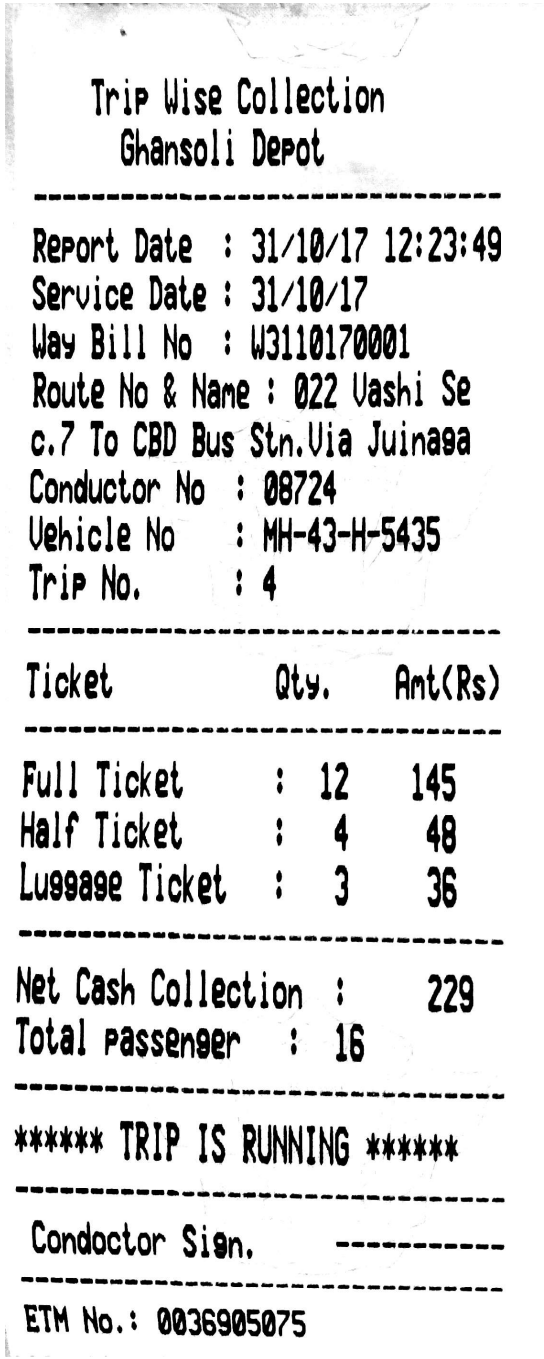
००३६९०५०७५ मा३११०१७०००१ ०८७२४
हस्तांतरणीय नाही
इन्फिनियम द्वारे प्रकल्प


10000707
sitilink
SURAT SITILINK LIMITED

Fare Collection Report from ETM



Trip Wise Collection
Ghansoli Depot

Report Date : 31/10/17 12:23:49
Service Date : 31/10/17
Way Bill No : W3110170001
Route No & Name : 022 Vashi Se
c.7 To CBD Bus Stn.Via Juinaga
Conductor No : 08724
Vehicle No : MH-43-H-5435
Trip No. : 4

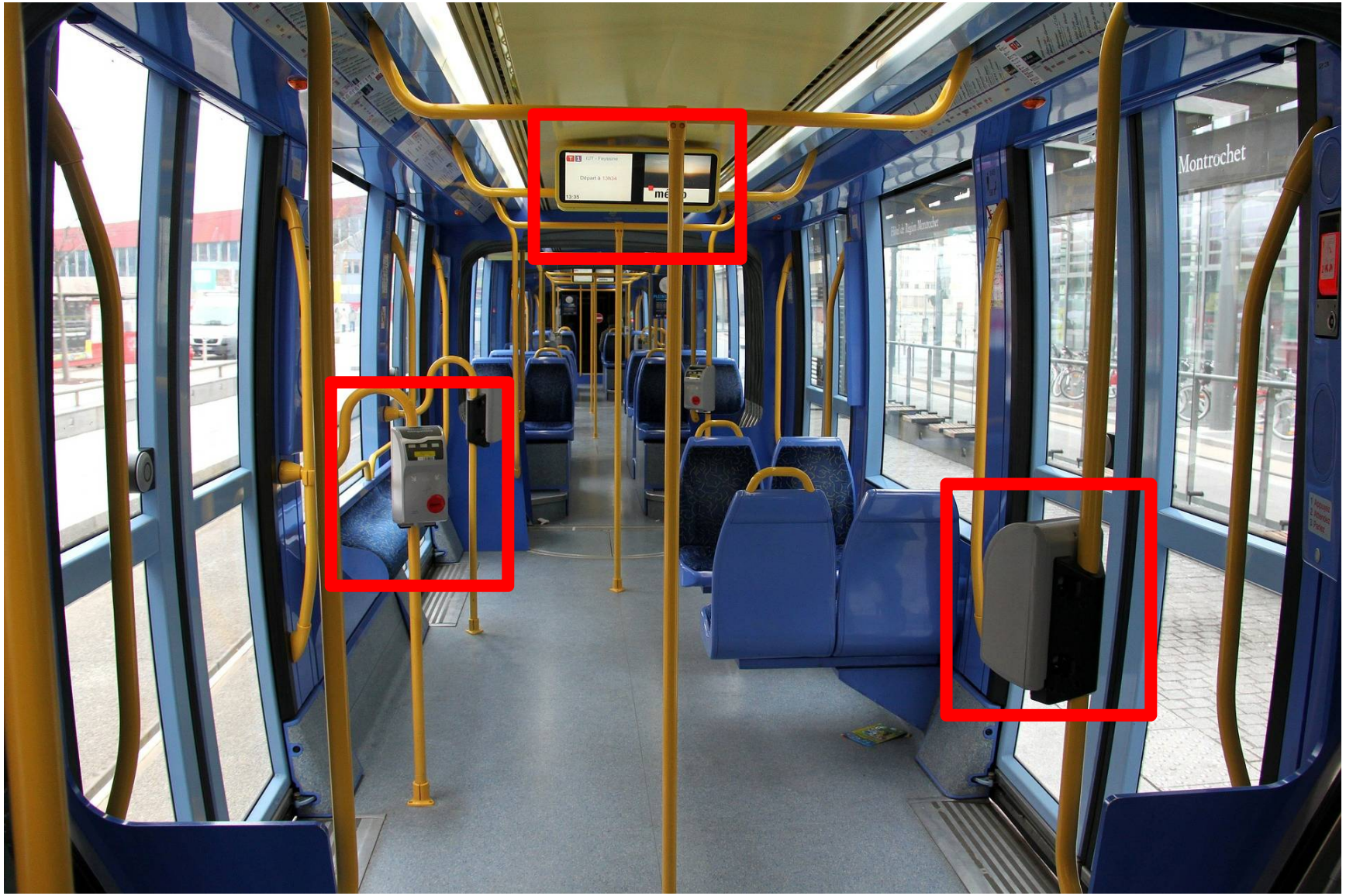
Ticket	Qty.	Amt(Rs)
Full Ticket	12	145
Half Ticket	4	48
Luggage Ticket	3	36

Net Cash Collection : 229
Total passenger : 16

****** TRIP IS RUNNING ******

Condoctor Sign. ----------

ETM No.: 0036905075

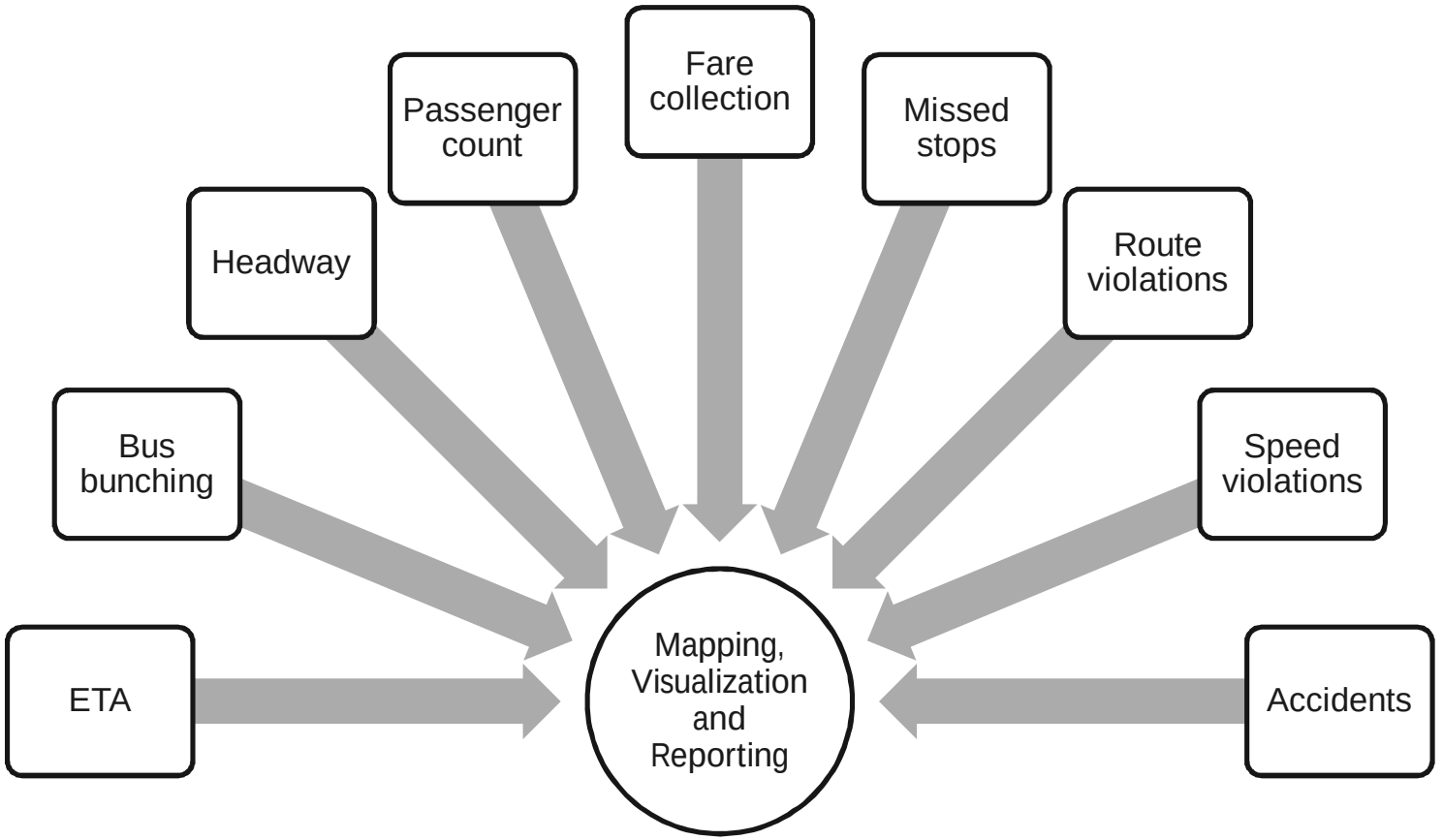


In-bus components

Fare Collection

- The BRT Standard recommends off-board fare collection
  - Barrier-controlled,
  - Proof-of-payment
- Both approaches can significantly reduce delays but barrier controlled systems are slightly preferred
  - Minimizes fare evasion, as every passenger must have his/her ticket scanned in order to enter the system versus proof-of-payment, which requires random checks;
  - The data collected by barrier-controlled systems upon boarding, and sometimes upon alighting, can be useful in future system planning.

ITS – What does it tell you?



Potential Benefits

- Complete visibility of
  - Asset performance
  - Revenue generation
  - Schedule performance – cancelled trips, lost revenue, etc.
- Safety – better monitoring and response to incidents
- Dispute resolution, contractor payments
- Commuter convenience

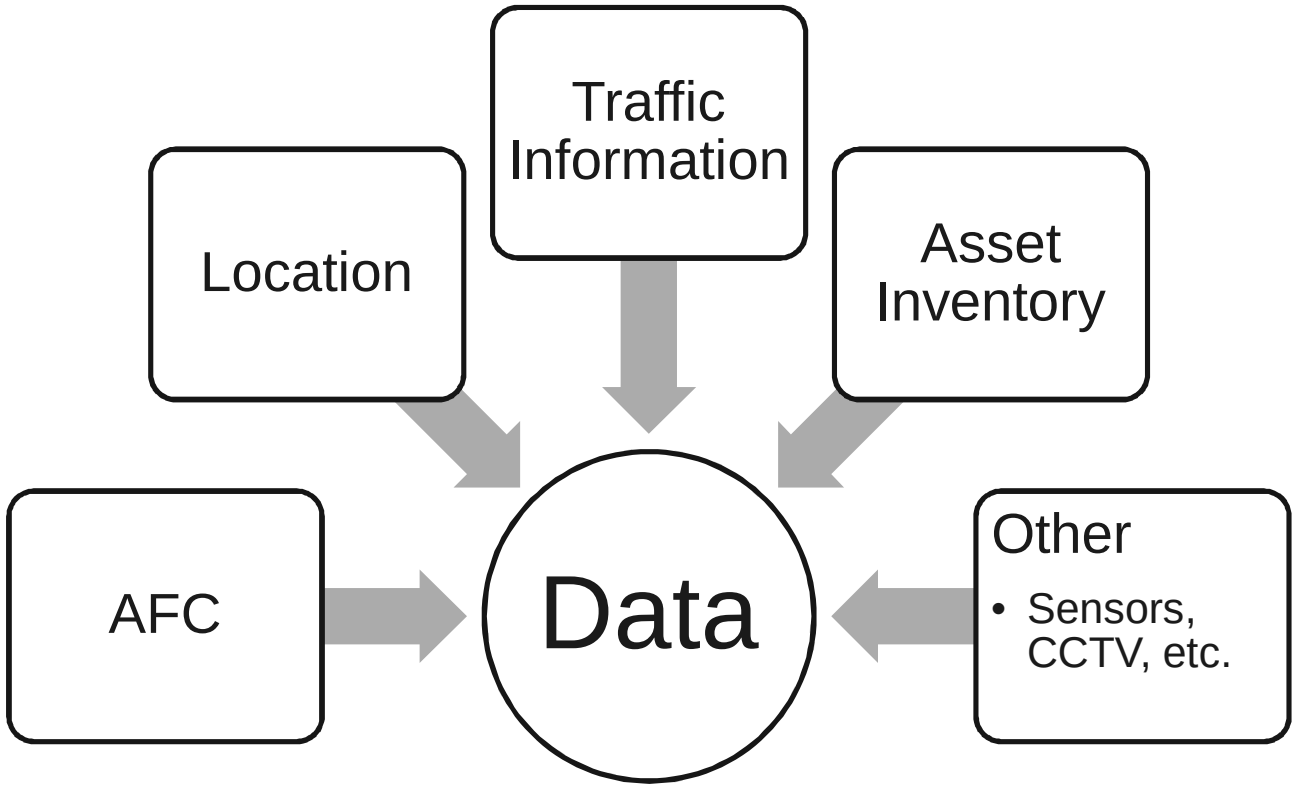
The low hanging fruit...

- Mobile based functionality
  - Journey planning
  - Where's my bus?
  - Directions to / from bus station
- Open loop payments – electronic ticketing, smart cards, mobile, NFC, EMV, etc.
- Multi-modal travel, ticketing and scheduling

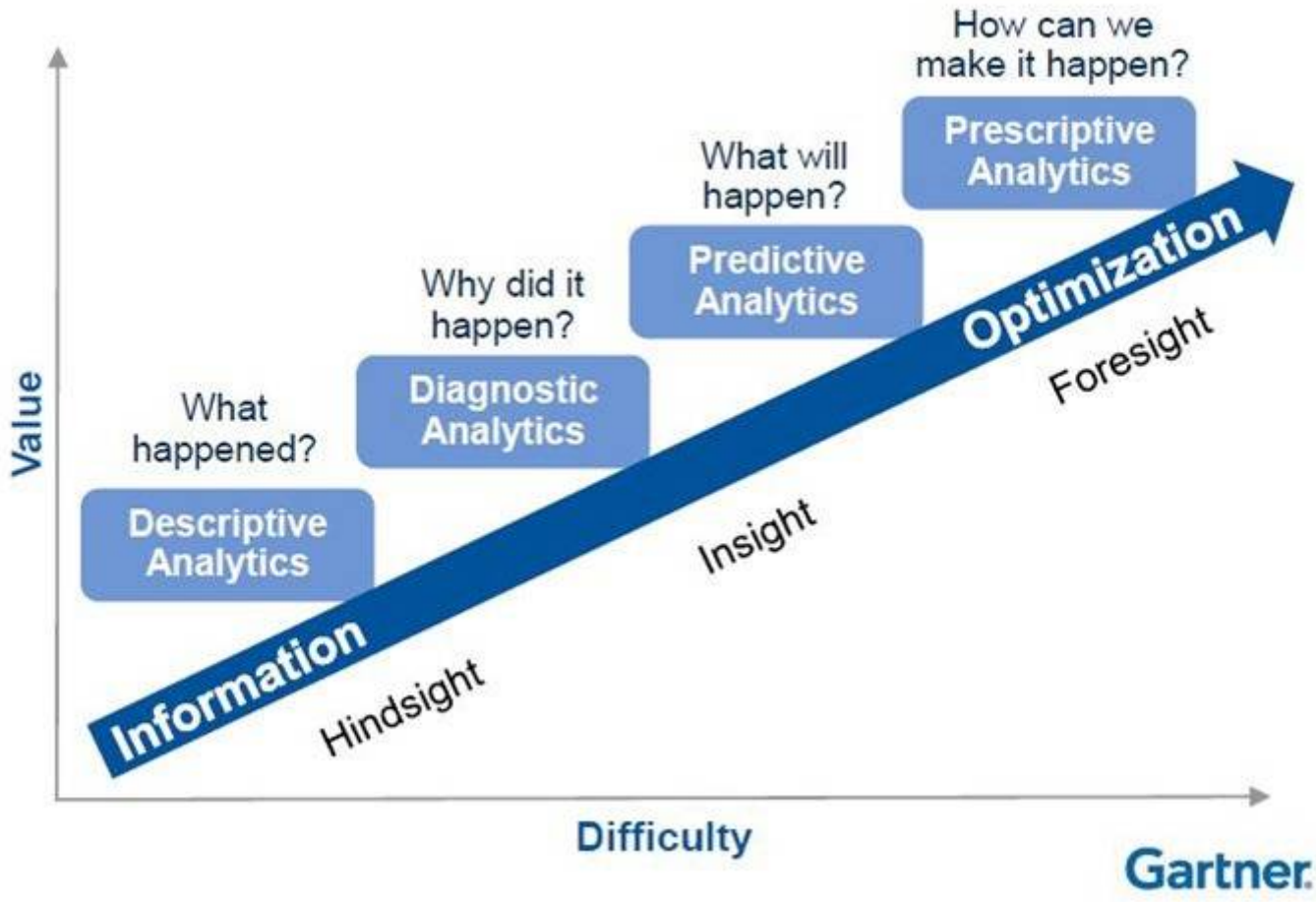
Modern transit systems generate a lot of data – some of it in "real time."

Can we make better use of the data?

Where does the data come from?

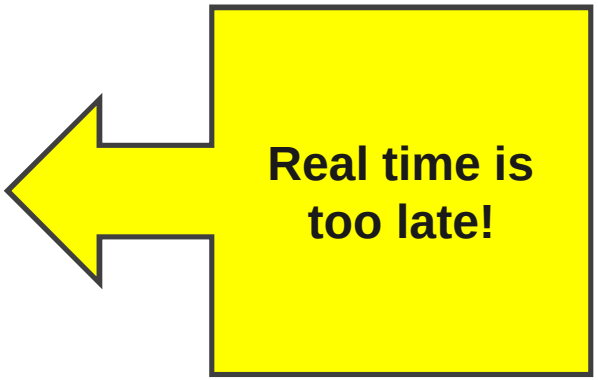


Where are we currently?



Analytics Maturity Model

- Descriptive
  - What was the passenger load today? (Hindsight)
  - What is the passenger load right now? (Real time)

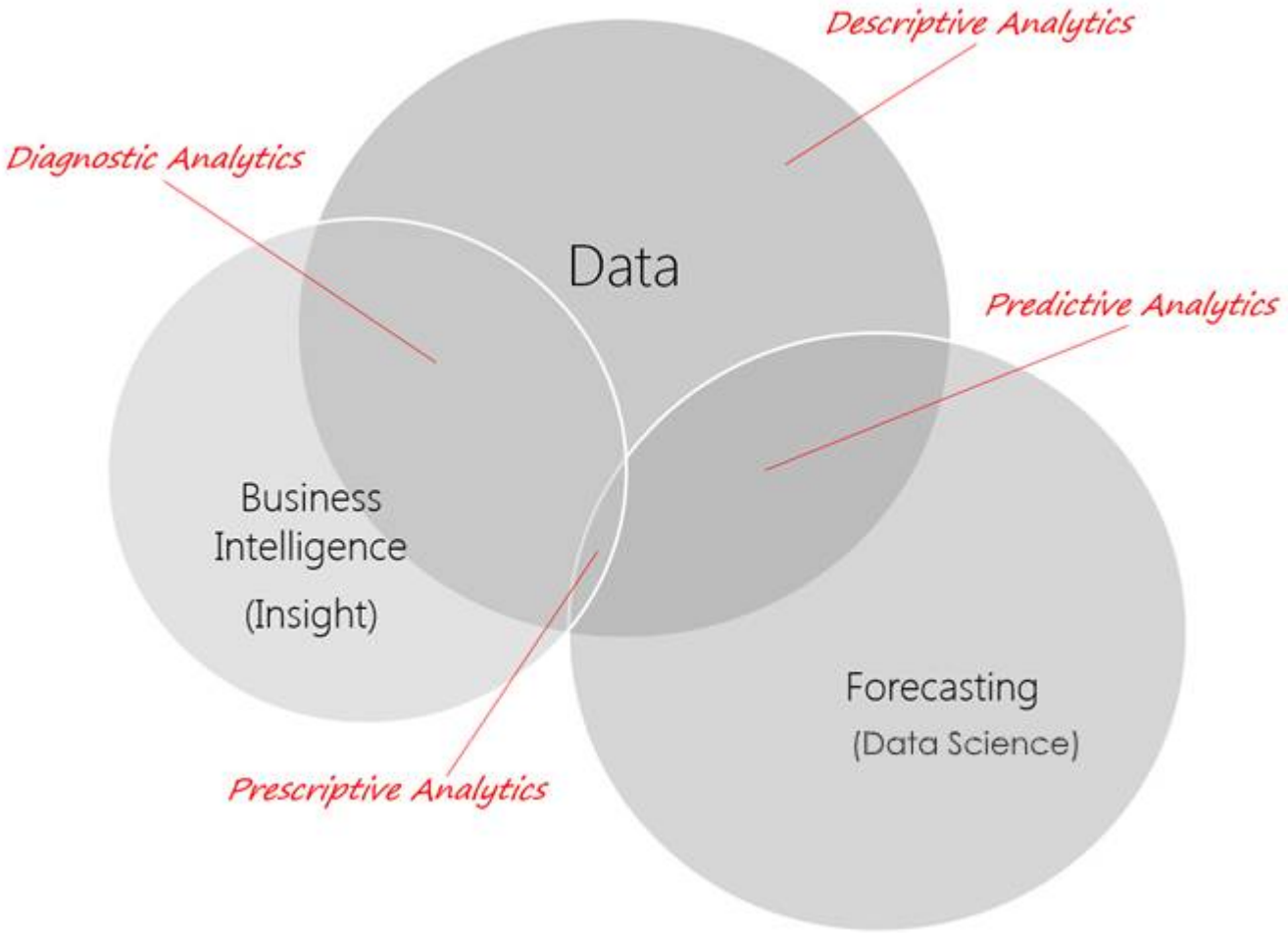


- Diagnostic
  - Why was a particular bus / route more congested today?

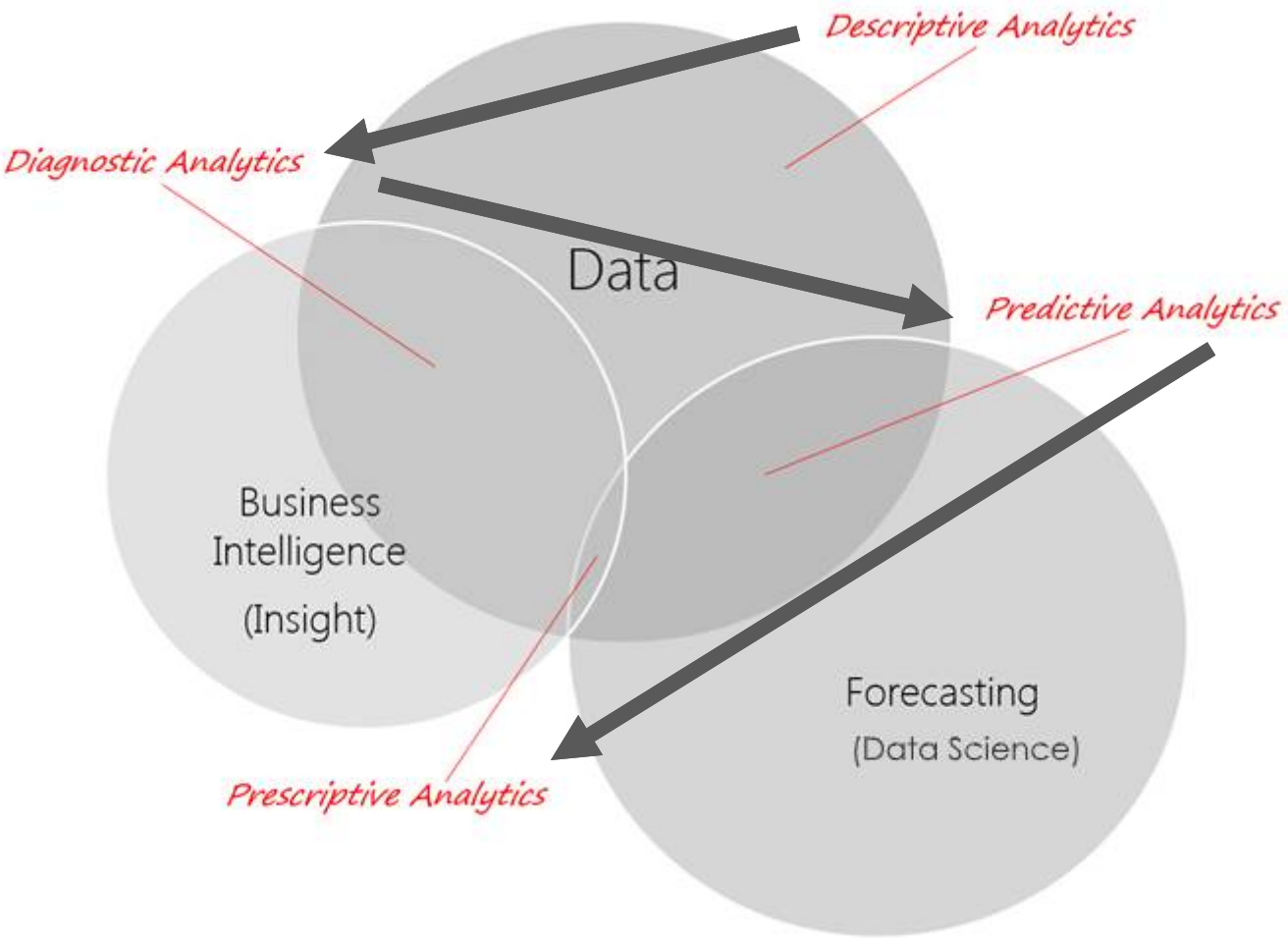
Analytics Maturity Model

- Predictive
  - What will be the passenger load tomorrow (or on a certain day)?
  - How will demand for public transit grow over the next 10 years?
- Prescriptive
  - If the passenger load is at a certain level on a certain day (according to the predictive model), what should I do?
    - What should the optimal schedule be?
    - How many buses will be required?
    - What should the duty rosters be like?

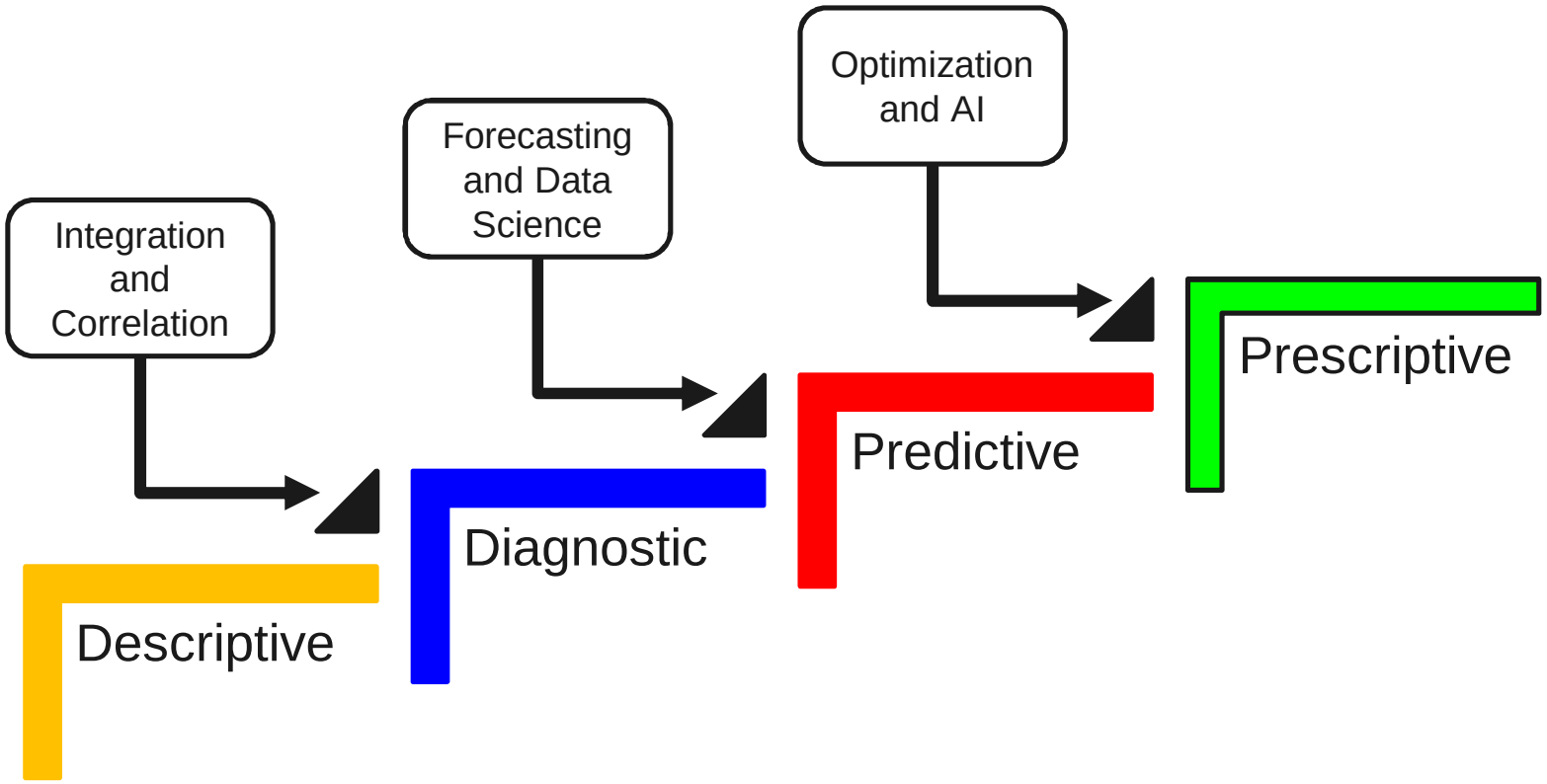
Approach


Descriptive Analytics
Diagnostic Analytics
Data
Predictive Analytics
Business
Intelligence
(Insight)
Forecasting
(Data Science)
Prescriptive Analytics

Approach


Descriptive Analytics
Diagnostic Analytics
Data
Predictive Analytics
Business
Intelligence
(Insight)
Forecasting
(Data Science)
Prescriptive Analytics

How do we get there?



What’s possible?

Better Planning and Demand Modelling

- Precise understanding of the customer demand on different routes.
- Map customer journeys across multiple modes of transportation – trains, buses, private modes of transportation etc.
- Use this data to improve planning on the future routes resulting in increased ridership.
- Plan parking along bus corridors / routes

Better Planning and Demand Modelling

- Naïve approach
  - Estimate ridership data
  - Extrapolate
- Approach #1
  - Collect ridership data from AFC system
  - Extrapolate considering patterns
    - Day of week
    - Time of day

Better Planning and Demand Modelling

- Do other factors influence the demand for public transit?
  - Day of week
  - Time of day
  - Price of fuel
  - Fare
  - Availability of alternative modes of transport
  - Cost of other transport alternatives
  - Population
  - Demographics – employment status, income levels, etc.
  - Other
- Build a model
- Improve accuracy – advanced data science models

Predictive Maintenance

- Currently, we can monitor vehicle parameters (descriptive / diagnostic) through sensors on buses (CAN / OBD integration)
- Data from the sensors can be analyzed to predict upcoming faults at the individual component levels such as brakes, engines, etc.
- Authorities can schedule maintenance (prescriptive) of the equipment precisely at the right time – not too early (which is unnecessary and expensive) or not too late (which is expensive and disruptive to the service).

Prescriptive

- Capacity Planning
- Optimize the scheduling of buses and crew based on demand and desired service levels.
- Network and route design
- Dynamic dispatch
- What if?
  - What should I (planner and commuter) do if a particular segment of road is closed due weather or an incident or for maintenance?
    - Dynamic re-routing
  - How many passengers will be affected?
    - Capacity estimation

Optimum Response

- Recommend optimum response in case of likely occurrence of unplanned service incidents have the high economic impact / cost to a transit agency like
  - Late-arriving bus
  - A traffic accident
  - Vehicle breakdown
  - Signal outages / blocked corridor
- What-if?
  - Examine the impact of a major commercial development, such as the building of a new stadium to take account of the relationships between transit usage and other relevant factors such as demographics, geospatial data

Road Condition Monitoring

- Sensors on the bus provide data that may be helpful to monitor road conditions
  - Jerks, vibration, etc.
- Build a model to predict road conditions based on sensor data
- Extend to automatically create an alert for bad road condition and dispatch repair crew (we already know the location from GPS)
- Re-route if required
- Improvement in vehicle health – lower maintenance cost

Off-peak Pricing

- Israel has introduced a 13-mile fast lane on Highway 1 between Tel Aviv and Ben Gurion Airport.
  - The lane uses a toll system that calculates fees based on traffic at the time of travel.
  - The system counts the cars on the road
  - Also evaluate the space between cars to measure congestion.
  - If traffic density is high, tolls are high; if there are few cars on the road, charges are cheap.
  - This not only keeps toll revenues flowing but also reduces congestion by “steering” demand.
- Can we do something similar in public transit?
  - Influence demand using congestion pricing

Off-peak pricing at Hong Kong Mass Transit Railway

- Introduced a discount in September 2014 to encourage users to travel before the peak.
- Data were reviewed to reveal travel patterns and congestion.
- Then, changes to users' departure times were studied to evaluate the promotion's effects.
- The incentive was found to have affected morning travel, particularly at the beginning of the peak hour period and among users with commuter-like behaviour.
- Aggregate and group-specific elasticities were developed to inform future promotions and the results were also used to suggest other potential incentive designs.

EXIT THE GATE BETWEEN 7:15 AND 8:15 A.M. TO EARN A 25% FARE DISCOUNT

MTR continues to bring you the Early Bird Discount. Become an early riser to avoid the crowds and save more! There's no better way to start the day!

Available Monday to Friday (except public holidays), from 7:15 and 8:15 a.m., passengers using an Adult Octopus can enjoy a 25% fare discount when exiting any of the designated core urban stations.

Promotion period: **1 June 2017 to 31 May 2018**

Can we not do the same for bus transit?

Issues and Challenges

- Awareness and acceptance
- Garbage in, garbage out
  - Need for good data
  - What do we mean by “good” data
    - Relevant, complete, accurate, current, economical
- Integration
  - Enablers – open data, GTFS, standard APIs, etc.
- Cost benefit analysis
  - If we add facilities, will people use them?
  - Are people willing to pay for them?
- There are many stakeholders. How do we share the benefits?
- Privacy concerns and data protection
- Disciplined operations
- Skills

Data is here to stay.

Make the data work for you.

Thank you.