

THE MASTER PLAN STUDY ON THE INTRODUCTION OF INTELLIGENT TRANSPORT SYSTEMS (ITS) IN BENGALURU AND MYSORE IN INDIA

Technical Advisory Group (TAG) Meeting
28 March 2014

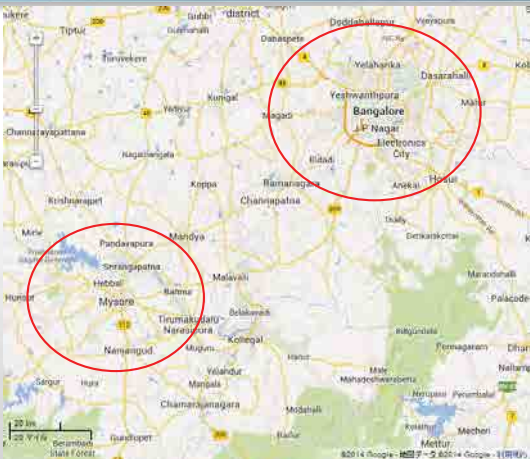
JICA Study Team

(Source: JICA Study Team)

Study Outline

Page 2 (Source: JICA Study Team)

Study Area



Page 3 (Source: JICA Study Team)

Expected Goals of Study

- Traffic congestion will be reduced by improving traffic flow on the road network including PRR realised by ITS
- Usage of public transport will grow through ITS enhancements
- Proper planning and implementation of road infrastructure development and traffic management will be realised by utilisation of quantitative data on traffic

Page 4 (Source: JICA Study Team)

Study Outputs and Major ITS Components for Consideration

Study Outputs

- 1) ITS Master Plan for Bengaluru Metropolitan Area
- 2) ITS Master Plan for Mysore
- 3) Basic Design Concept of Prioritised ITS Items for Bengaluru
- 4) Capacity Building

Major ITS Components for Consideration of Study

- ITS in the City for Traffic Management
- ITS for Peripheral Ring Road in Bengaluru
- Electronic Road Pricing
- Common Card

Page 5 (Source: JICA Study Team)

Overall Work Schedule and Milestones

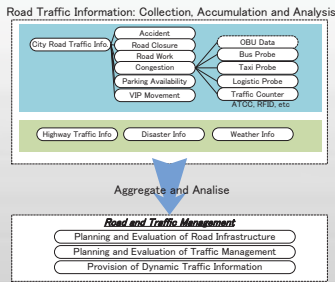
- Study Period: January 2014 – June 2015
- Three (3) Phases:
 - I. Mid July 2014: ITS Master Plan for Bengaluru Metropolitan Area
 - II. Mid October 2014: ITS Master Plan for Mysore
 - III. Mid December 2014: Basic Design Concept of Prioritised ITS Projects (services) for Bengaluru Metropolitan Area
- Study Tour
Japan and Singapore

Item	2014												2015									
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun				
1 ITS Master Plan for Bengaluru																						
2 ITS Master Plan for Mysore																						
3 Basic Design Concept of Prioritised ITS Menus for Bengaluru																						
4 Study Tour(Japan,Singapore)																						
Report Submission																						
Joint Coordinating Committee(JCC)																						

Page 6 (Source: JICA Study Team)

Policy 1: Effective Use of Road and Traffic Data for Appropriate Road Traffic Management

- Quantitative Comprehension of Traffic Conditions
- Aggregation and Utilisation of Data and Information Necessary for Road Traffic Management and Users



Policy 2: Traffic Control Using ITS

Major Points of Considerations of ERP

- Technical alternatives such as RFID / DSRC
- Utilisation of collected OD data for road and traffic management
- Area consideration for effective charging
- Organisational considerations including establishment of a new organisation for sustainable operation and management
- Effective utilisation of collected fees such as for operation and maintenance of ITS facilities
- Necessary legislation measures

Policy 3: Integration of ITS

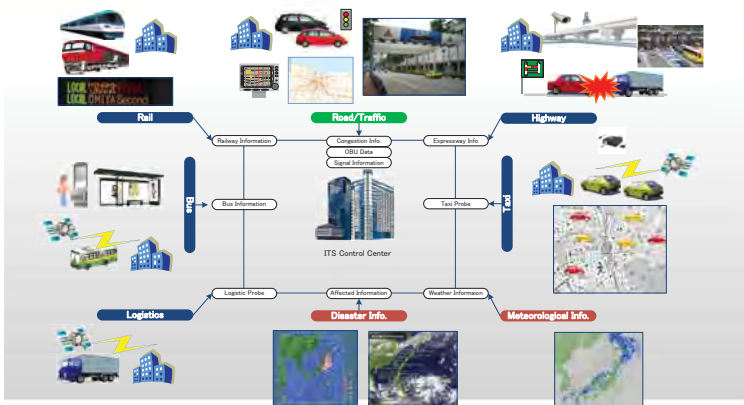
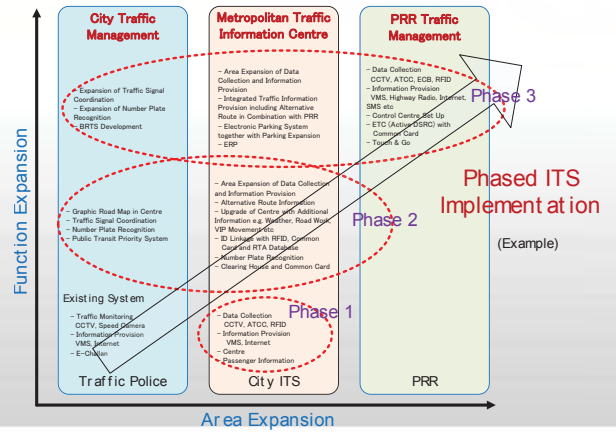
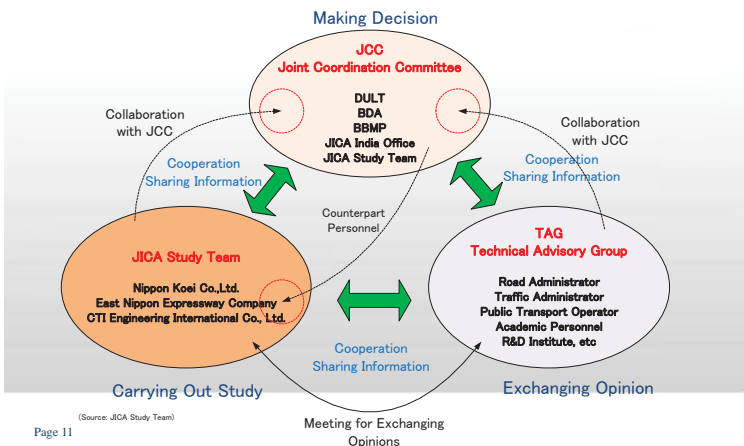


Image of Phased ITS Implementation



Collaboration with Joint Coordination Committee (JCC) and Technical Assistance Group (TAG)



Discussion Items

Bangalore ITS

Goals and Objectives

NO	GOAL	OBJECTIVE
1	Safety	<ul style="list-style-type: none"> To reduce traffic accidents To enhance communication and response in emergency To reduce damage during adverse condition
2	Environment / Energy	<ul style="list-style-type: none"> To reduce air pollution To reduce CO2 emissions To reduce energy consumption
3	Productivity	<ul style="list-style-type: none"> To increase economic output through efficient utilisation of transport facilities
4	Accessibility	<ul style="list-style-type: none"> To provide travel information To enhance intermodal connectivity To reduce travel time To reduce travel costs To give care to vulnerable people
5	Efficiency	<ul style="list-style-type: none"> To increase efficiency in road use To reduce cost of road management To enhance appropriate management of ITS data To provide transport related payment To support planning agency and administrator for efficient planning based on quantitative data

Page 13 (Source: JICA Study Team)


Existing and Future ITS of Bangalore

EXISTING SYSTEMS

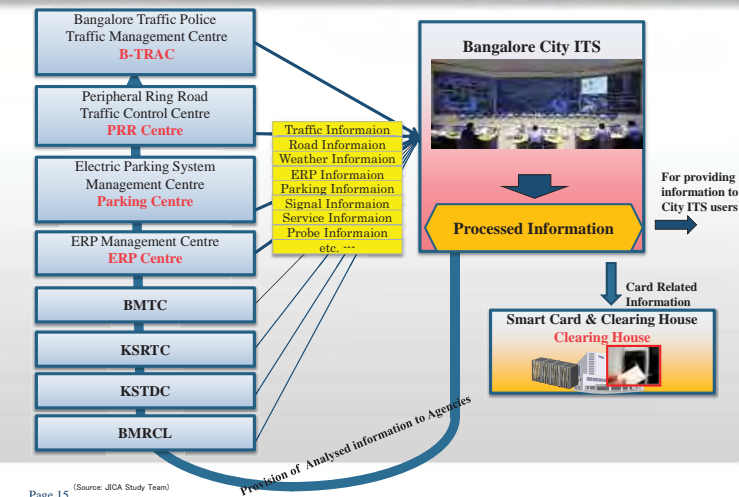
Bangalore Traffic Police Traffic Management Centre B-TRAC <ul style="list-style-type: none"> Upgrade the existing B-TRAC Enforcement of violation Operation & Maintenance of Signal Control
BMTC – Vehicle Tracking and Passenger Information System BMTC <ul style="list-style-type: none"> Probe Data from 4500 buses Provision of Bus Information to passengers
Probe Data from Taxi KSTDC
Probe Data from Bus KSRTC
Metro Rail Data BMRCL

Page 14 (Source: JICA Study Team)

PROPOSED ADDITIONAL SYSTEMS

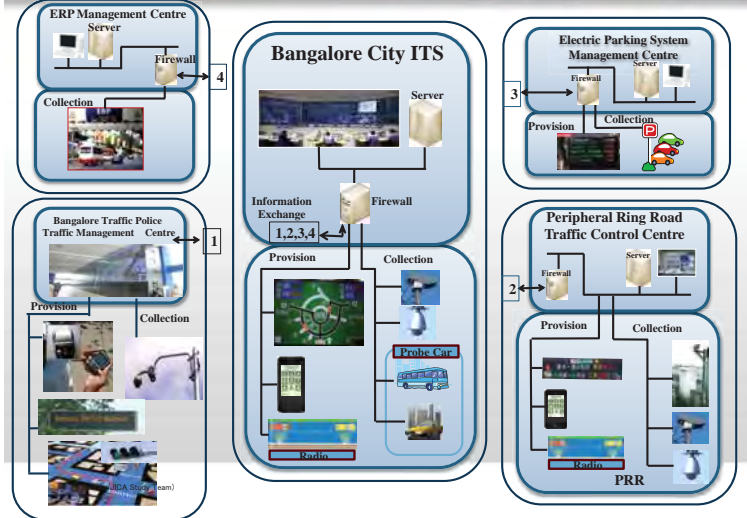
Bangalore City ITS  <ul style="list-style-type: none"> Data Collection Process & Analysis of real-time data Information Provision Data Storage Operation & Maintenance of City ITS 	Peripheral Ring Road (PRR) Traffic Control Centre <ul style="list-style-type: none"> Data Collection Information Provision Operation & Maintenance of HTMS & TMS on PRR
	Electric Parking System Management Centre <ul style="list-style-type: none"> EPS Management Operation & Maintenance of EPS
	ERP Management Centre <ul style="list-style-type: none"> ERP Management Operation & Maintenance of ERP
	Smart Card & Clearing House

Flow of Information and Data

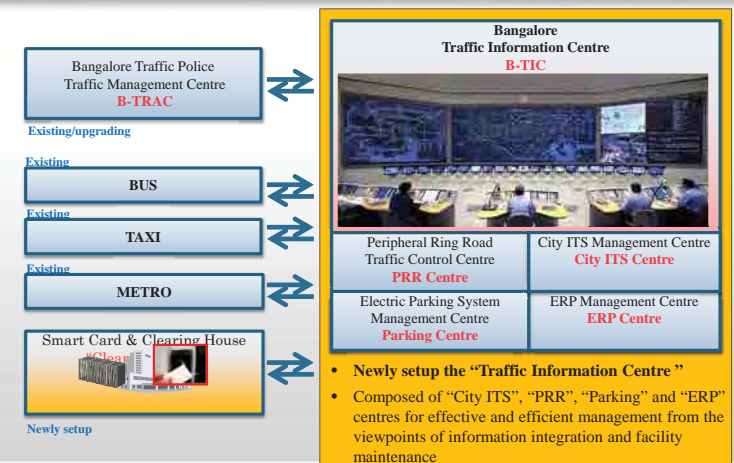


Page 15 (Source: JICA Study Team)

Outline of Information Flow

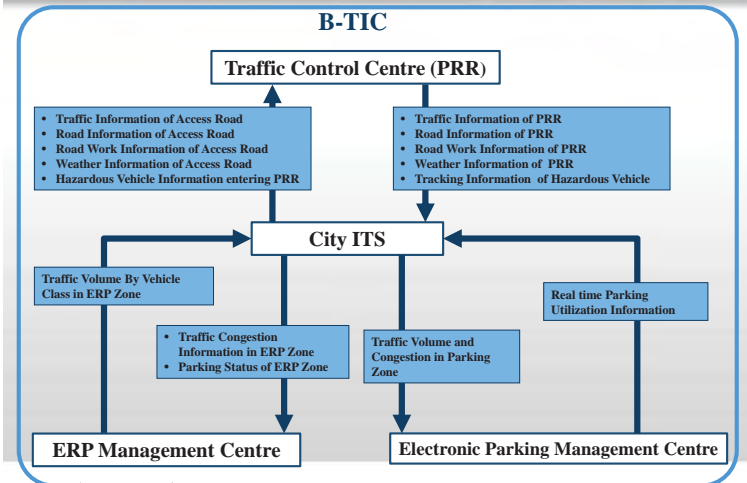


Organizational Structure of - B-TIC



(Source: JICA Study Team)

B-TIC



Page 18 (Source: JICA Study Team)

Establishment of B-TIC

Purposes of B-TIC

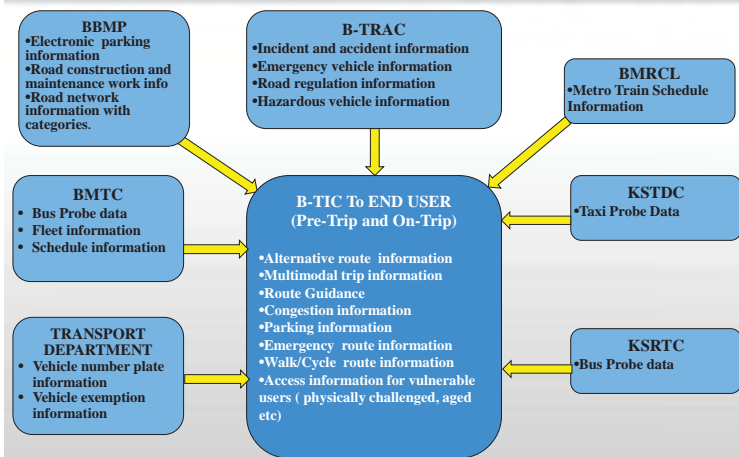
- To play as a central ITS coordination agency for Bangalore city
- To function as central agency for ITS planning, implementing evaluating
- To collect road/traffic data and provide to users and relevant agencies
- To carry out business with private sector by selling out generated data
- To play as a central engine for continuous ITS initiative

Establishment of B-TIC

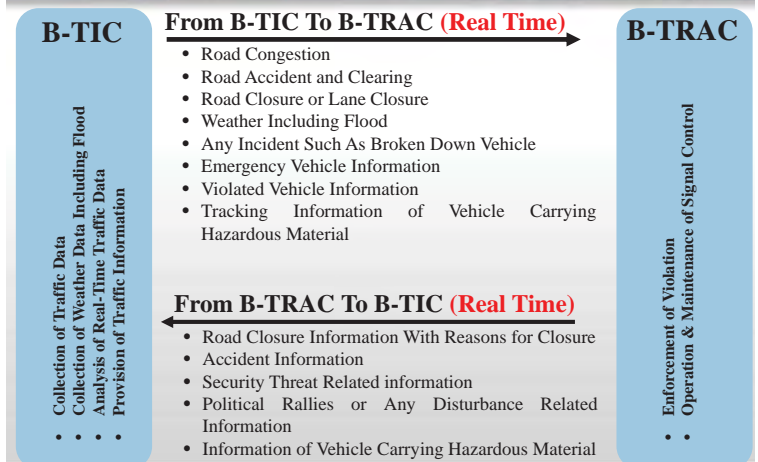
Functions

- **Basic Functions**
 - ✓ Collection of traffic data by road side sensors/probe cars
 - ✓ Collection of parking data
 - ✓ Collection of event and incident data
 - ✓ Provision of traffic information via VMS, SMS, Internet etc
 - ✓ ERP, other related facilities
 - ✓ Highway management by toll collection etc
- **Maintenance, Analysis, Evaluation, Planning**
 - ✓ Maintenance of ITS equipment
 - ✓ Analysis of dynamic real-time and off-line traffic data
 - ✓ Management of road inventory and drawings data

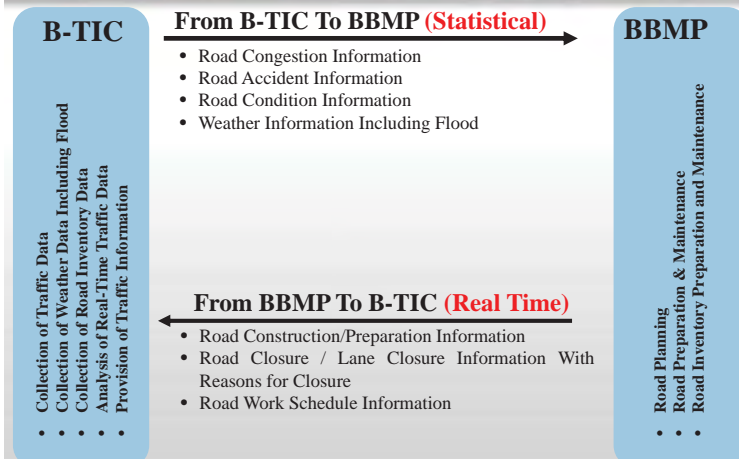
Information Flow to B-TIC



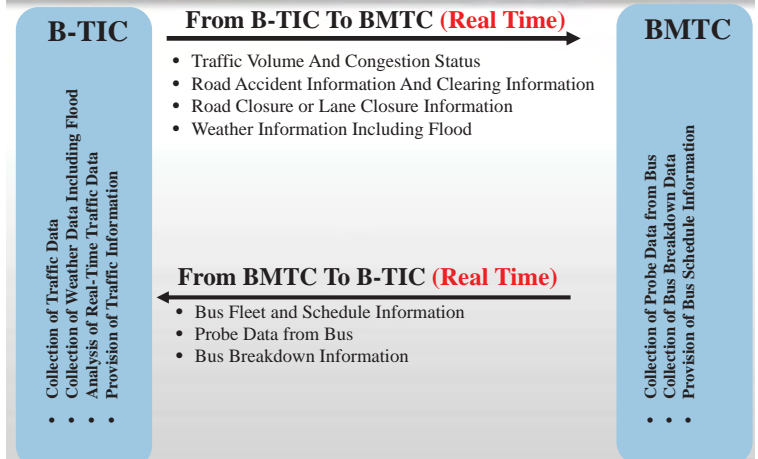
Roles & Information Exchange Between B-TIC And B-TRAC



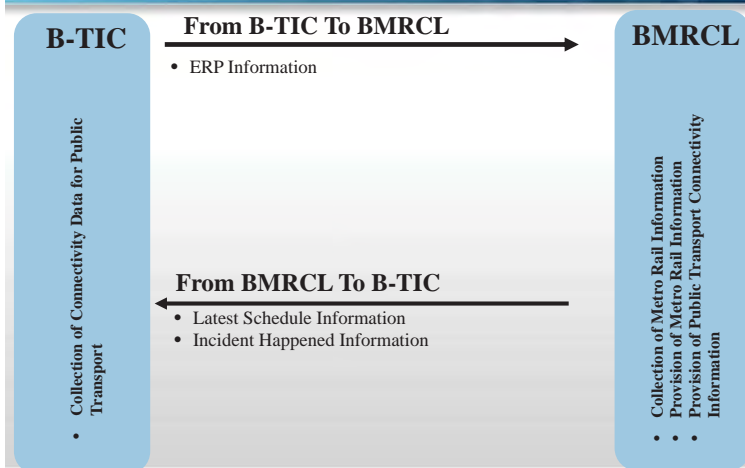
Roles & Information Exchange Between B-TIC And BBMP



Roles & Information Exchanged Between B-TIC And BMTC

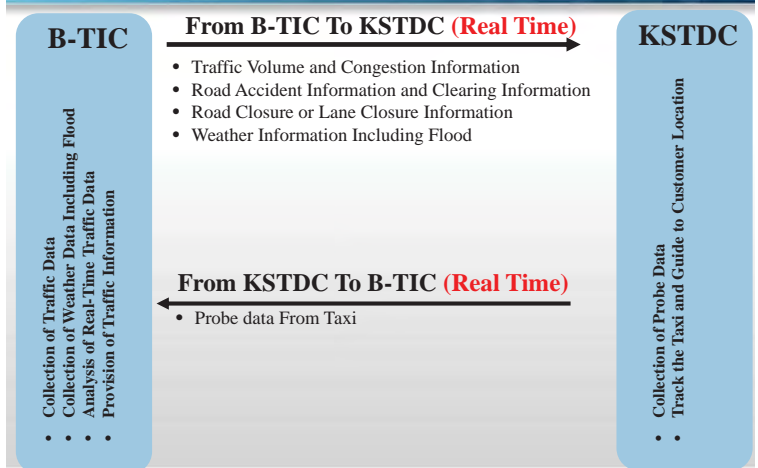


Roles & Information Exchange Between B-TIC And BMRCL



(Source: JICA Study Team)
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Roles & Information Exchange Between B-TIC And KSTDC



(Source: JICA Study Team)
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Exchange of Opinion with Agencies

Traffic Police

- How Police would like to modify the current way of Traffic Signal Control ?
- How Police would like to modify the current way of enforcement of traffic regulation and violation to improve efficiency and productivity ?
- How Traffic Police would like to improve the current type(s) of traffic information provision to road users?
- How Traffic Police would like to change the type of messages they provide currently on VMS?
- What kind of data the Traffic Police expect to be provided by other agencies?
- How the Traffic Police consider the traffic regulation during rainy season?
- How the Traffic Police feel that they are able to regulate traffic during incidents and Events in the City?
- What kind of more efficient Incident/Event management that Traffic Police are looking for?
- What is the view of Traffic Police regarding the Traffic Information exchange between various city agencies? These data include real time traffic images from CCTV, probe data, Incident data and Event data, Road closure, Road Repair work by BBMP etc.
- What is the expectation of Traffic Police from other agencies in regard to monitoring and controlling Freight movement ?

(Source: JICA Study Team)
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Exchange of Opinion with Agencies

BMTC

- What is the expectation of BMTC from B-TIC ?
- Did BMTC receive road closure and traffic diversion information from Traffic Police and BBMP currently ?
- Is real time Traffic Congestion information in anyway helpful to the BMTC ?
- What information is important for BMTC from Traffic Police and Road Administration agency for efficient operation and maintenance ?

(Source: JICA Study Team)
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Exchange of Opinion with Agencies

BDA / BBMP

- What is the expectation from B-TIC in terms of Road planning and maintenance perspective ?
- Did Road Inventory is available for complete city and how it is maintained?
- Is it important for the agencies to maintain Asset Information ?
- What BDA & BBMP would like to do differently for efficient management of freight movement in the city?

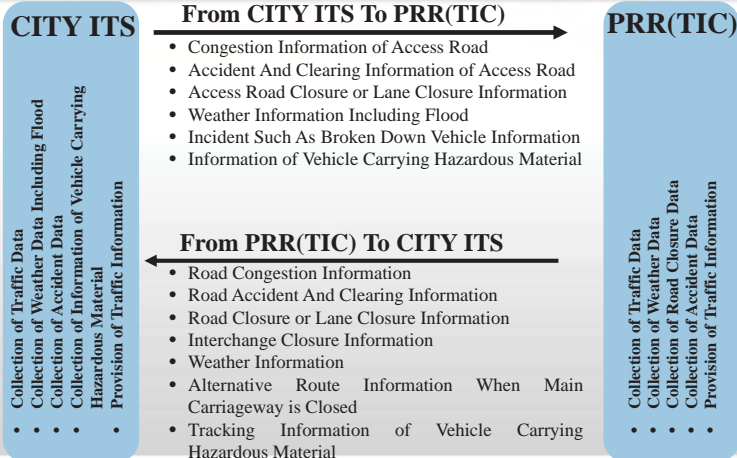
(Source: JICA Study Team)
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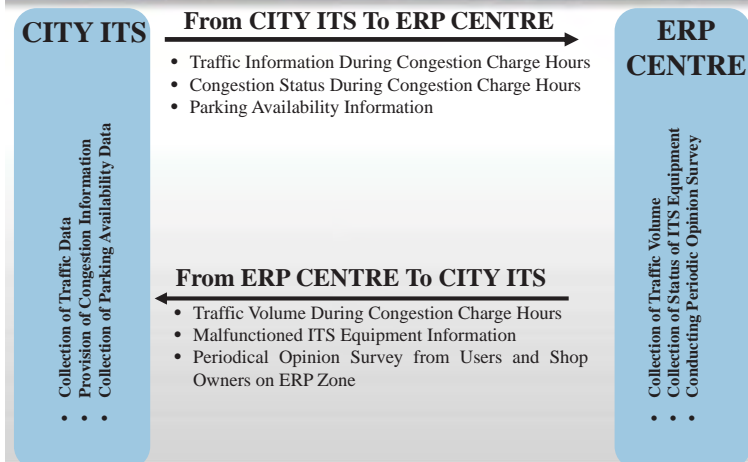
(Source: JICA Study Team)
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ADDITIONAL SLIDES

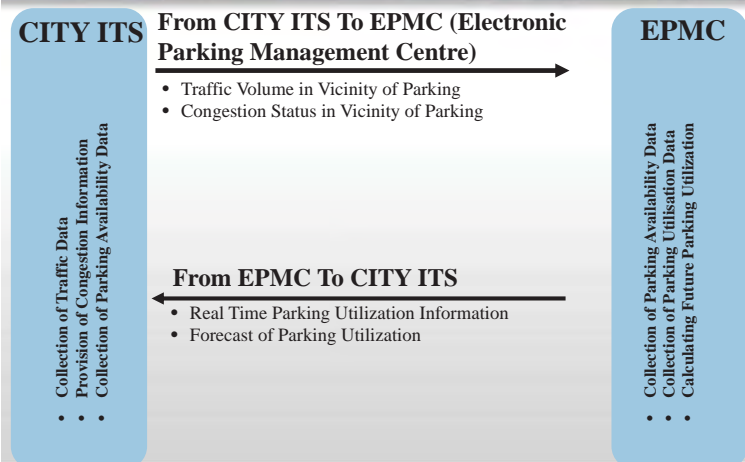
Roles & Information Exchange Between CITY ITS And PRR(TIC)



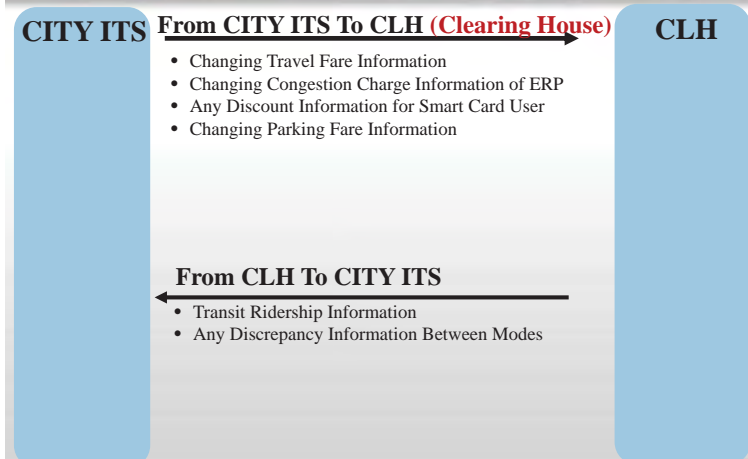
Roles & Information Exchange Between CITY ITS And ERP Centre



Roles & Information Exchange Between CITY ITS And EPMC



Roles & Information Exchange Between CITY ITS And CLH



Congestion Pricing in Singapore



Singapore (2012)

- Land area 714 sq km
- Population 5.31 mil
- Vehicles 969,000 (617,000 cars)
- **1 car per 10 persons (3 families)**
- Expressways 161 km
- Arterial roads 634 km
- Other roads 2580 km
- Traffic and pedestrian signals 2127 numbers
- Average speeds during peak period
E' way = 62 km/hr, Arterial Road = 28 km/hr
- **Modal split during peak period 63 : 37**
(public transport – bus , urban train and taxi)
- **Annual Accidents Fatal 169 (1.6 per 10,000 veh)**



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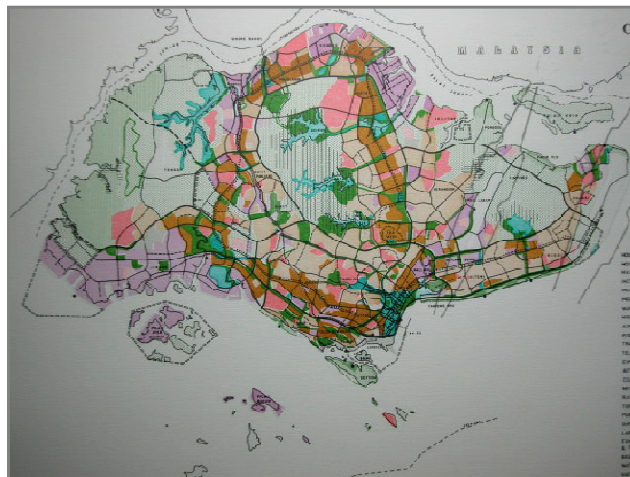
The Singapore Concept Plan (SCP) Project (1968 – 1972)

- Landuse Plan for 4 Million population (25 year projection)
- Transportation Plan
 - For road NETWORK
 - For mass TRANSIT SYSTEM (rail)
 - Vehicle Ownership AND **USAGE POLICY**

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The first Landuse-Transport Concept Plan (1971) – reviewed at 10 years intervals, but the basics remain the same



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SCP identified the

- Need to manage vehicle ownership growth in the long term
- Need to restrain vehicle (especially car) usage in the City (CBD) as early as 1972

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Transportation Strategy (1975) arising out of the Singapore Concept Plan- *still relevant*

- (a) Landuse - Transport Planning
- (b) Moderate road network
- (c) Traffic Management (including Intelligent Transport Systems)
- (d) Good public transport (metro and bus)
- (e) **Travel Demand Management**
 - Congestion (Road) Pricing
 - Vehicle ownership controls

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Road (congestion) pricing

Road pricing works on the principle that vehicles pay for the use of the road in proportion to the congestion they are causing.

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Road Pricing (First scheme in the world in 1975)

- Manual road pricing introduced on a cordon around the Central Business District (CBD)- vehicles needed to purchase and display area license to enter.
- Initially car pools were given free entry
- High administrative and enforcement manpower , inconvenient, limited in varying road pricing charges



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Manual Road Pricing went automatic 1998

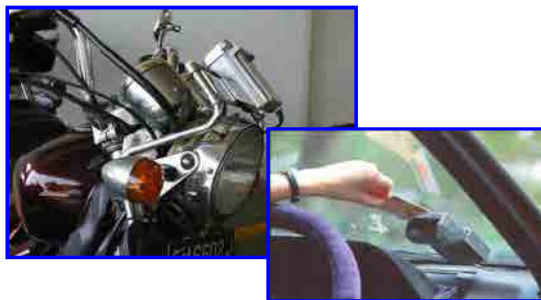


- Automated with the Electronic Road Pricing (ERP) system
- Fully replacing the manual scheme for the CBD
- Additional ERP control on some other important expressways /roads

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- **The ERP Gantry**
- Charging per entry
(when passing under
a gantry only)



- **Payment by
CashCard and
in-vehicle unit (IU)**

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IUs (Generation 1 and Generation 2) - powered by vehicle battery

- Different types for different categories of vehicles
- allow different road pricing charges for different categories



CashCards (contact cards (Gen1) and contactless cards (Gen 2))

- A smart card (integrated-chip card) marketed by a consortium of local banks(card issuer) for multiple uses



- Top-up with cash value at Automated Teller Machines (ATMs), petrol stations and convenience stores



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ERP Rate variations

- **Charging** is **per entry** or passing under a gantry. Once inside CBD, vehicles are free to move around or leave without further payment unless they pass another gantry
- **Rates** can be **changed at half-hourly intervals**, being highest during the rush hours and lower during other hours
- **Rates vary** from 50 cents at off-rush hours to \$5.00 at peak hours for cars
- There are some periods with **zero charges**

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Types of IUs/Charges

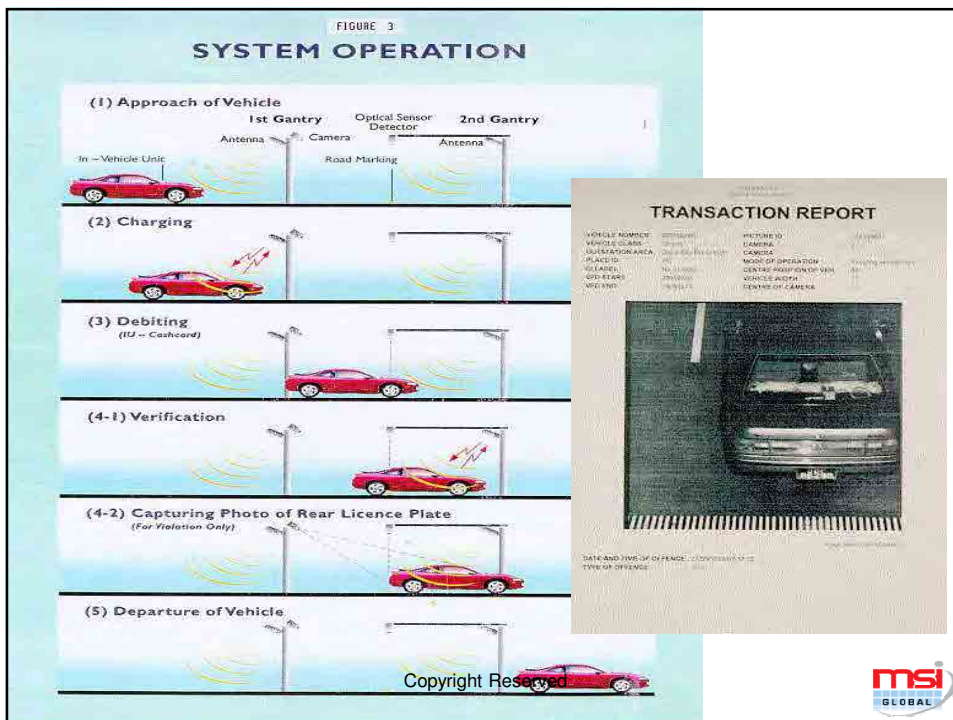
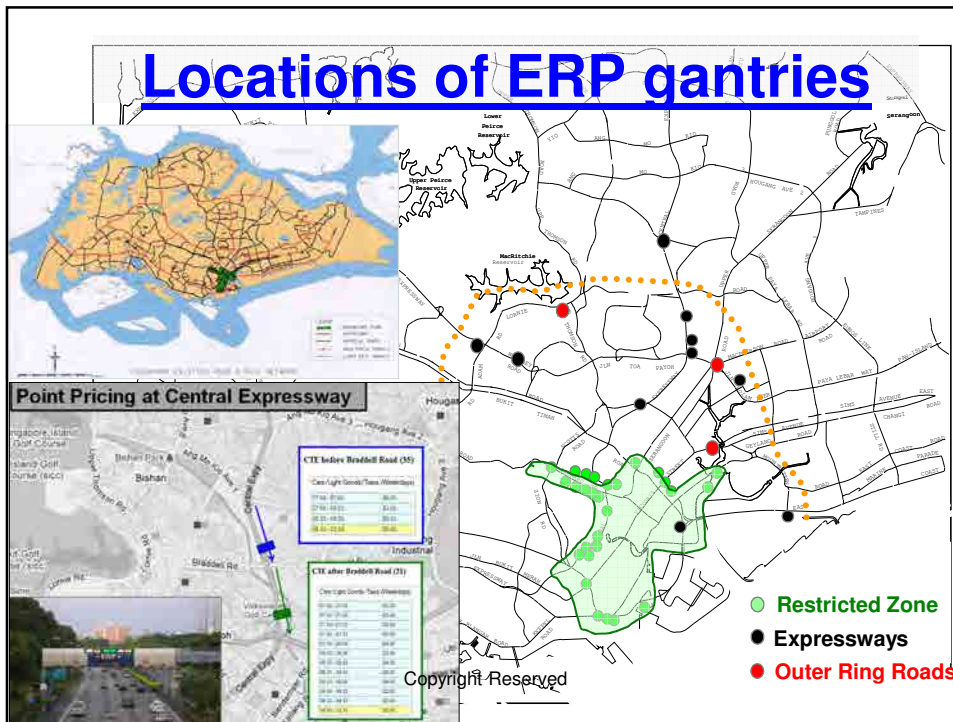
(e.g. If car is charged \$1 per entry, motorcycle pays \$0.50)

Vehicle Type	PCU(s)	Charge (S\$)	Charge (Rs)
Cars	1.0	1.00	48
Motorcycles	0.5	0.50	24
Lorries/Buses	1.5	1.50	72
Big Lorries/Buses	2.0	2.00	96
Ambulance, Fire Truck, Marked police car	No charge	No charge	No charge

Note: S\$1.00 equivalent to 48 Rs

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(Source: MSI Global)

Foreign vehicles (Malaysian and Thai)

- **Foreign vehicles can**
 - Fix an IU if they are regular users
 - Hire a temporary IU
 - Pay a flat charge of \$5 (240 Rs) per day for unlimited use of ERP priced roads (collected at the two checkpoints when they leave)
 - Do nothing if they do not intend to use ERP priced roads
- If they violate , they pay the fine at the two checkpoints when they leave

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Impact

- Violations & Errors

- Violations (~ 0.3% per day)
 - No IUs - Fine of S\$70 (3,360 Rs)
 - No CashCards or Insufficient cash value
in CashCard - Administrative Charge of S\$4 - \$10 (192 – 480Rs)
- Errors (~ 0.05% per day)
 - Motorists asked to have IUs and CashCards checked

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Administration

- 3 departments looked after congestion pricing scheme (1975 to 1995)
 - The Registry of Vehicles
 - Traffic Police
 - The Public Works Department (Roads)
- The Land Transport Authority has taken over all the roles (1995 onwards)

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Results of Road Pricing in Singapore

- a) No large scale congestion within the city and the controlled roads
 - b) Reduction of sharp peak traffic volumes
 - c) Some congestion on bypass roads
 - d) Increase in usage of public transport
- d) Price elasticity = - 0.12 to - 0.35 for car drivers
- 0.7 to -2.8 for motorcyclists

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Effects of ERP on driving behaviour

The choices are

- pay and enjoy good traffic conditions
- group trips for economy
- change the time of travel to pay less or nothing
- change the route to avoid paying
- change the mode of transport to pay less
- change destination
- abandon trip

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Lessons from Road Pricing (Singapore)

- ☞ has to be sold as part of a total package
- ☞ political support is essential
- ☞ a public dialogue is necessary
- ☞ need good alternatives for those affected
- ☞ public transport ridership will increase
- ☞ be prepared to make adjustments as necessary
- ☞ will solve congestion in the controlled area, but may transfer congestion
- ☞ Road pricing will only be accepted reluctantly

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Other Road Pricing Systems – London 2003

- Pricing Scheme
 - Fee is charged on vehicles travelling within the Congestion Charge Zone
 - £10 per day
 - Operating hours:
0700hrs to 1800hrs
(Monday to Friday)
- Payment can be done in advance or by midnight on the day of travel
- Automatic Number Plate Recognition (ANPR) system used



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Other Road Pricing Systems – Stockholm 2006

- Pricing Scheme
 - Cordon-based charging scheme. Charges apply per in and outbound trip
 - Capped at maximum amount of tax per vehicle per day of 60 SEK (7.34 EUR, 9.47 USD)
 - Operating hours:
0630hrs to 1830hrs
(Monday to Friday)
- Payment done in the 2nd month
- Automatic Number Plate Recognition (ANPR) system used



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Bangalore City

- Second fastest growing major metropolis in India
- Population Growth of 3% per year
- Vehicle Growth of 10% per year
- Travel Demand has increased by 6.7%
- High incidence of road accidents

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Bangalore's statistics

- Journey speeds is reduced by 45% of desired speed limit.
- Travel Time has increased by 69%.
- Total number of road fatalities have increased

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Current Situation in Bangalore

- 42% population uses Public Transport, but buses comprise only 2% of total vehicles
- Scarce road space, compounded by unauthorised parking
- High emission from vehicles



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Current Situation in Bangalore

- 10% vehicle growth per year
- Anticipated that by 2031, speeds may decrease to 10 km/hr
- Need for better Public Transport System



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Bangalore Congestion Pricing (Discussion)



Traffic Problems

- Traffic problems cannot be solved by merely building of roads
- No city has built its way out of congestion
- Engineering, operational, administrative solutions are needed to tackle problems
- Travel demand management is one such tool

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Demand Management measures for city (non- fiscal)

- Alternate day entry
(number plate rationing)
- Entry for high occupancy vehicles only
(car pools, public transport)
- Restrict number of car parks in the city



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Fiscal

- Higher car parking charge
- Road (congestion) pricing
- Toll roads (different from road pricing)



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Possible Strategy

- To charge vehicles at times and places when and where they cause congestion
(have some benchmark on reduction desired)
- To charge only during **peak hours**
- To charge only some **types of vehicles**
- To charge only **non-residents** of the controlled area
- To give **exemption** from charges to some vehicles
- To enforce (100% or less) – cost factor

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Possible Charging Methods

- At **Entry or Exit** on a cordon round the city
- Per **Pass or Passes** in case of individual roads
- Per **Distance Travelled** in a controlled area
- Per **Time spent** in a controlled area

There will be some **effect on other roads** in the vicinity where drivers who do not want to pay the charge

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Selection of Area or Roads to be charged

- Area experiencing traffic congestion
- Usually office and commercial areas
- Areas with large number of car parks
- Try to **avoid residential areas** as far as possible, although not entirely possible



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Determine Boundaries of Controlled Area

- Boundaries follow roads
- It will be difficult to exclude all residential areas
- Boundaries have to be adjusted so that vehicles are **not forced to enter** the controlled area unwittingly, in other words, there are escape routes



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Types of Vehicles to be Charged

- Usually motorized private vehicles
- Taxis and autos? Who pays?
- Motorcycles (2 wheelers) – too small, but large numbers can cause problem
- Should Public buses be exempted?
- High occupancy vehicles – car pools
- Level of exemption to be kept to minimum
- What about vehicles of residents within controlled area?

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Times of Operation

- Usually peak hours on weekdays
- Charges can vary by time of day
- No charges on public holidays and eve of public holidays

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Deciding on the Initial Charge

- Tie to something easily understandable as a base
 - Car park charge
 - Public transport charge
 - Petrol price
- Set the rate for cars first. Then use the passenger car equivalent other vehicle charge
- Better to start at a higher charge first
- Be prepared to adjust after monitoring

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Variation of Charges

- Charges can go up and down depending on traffic conditions
- Good to be flexible and review at 3 monthly intervals
- Have a basis for changing charges at regular intervals
- Basis could be traffic speeds after monitoring

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Type of System - Gadget in Vehicle

- Manual system easily tampered with
– not recommended
- Some sort of gadget inside the vehicle to communicate with an automatic system
- Is it transferable (rates are different)?
Or permanently mounted on the vehicle?
- Will it be compulsory to fix or optional?
If optional , what happens to occasional user?
- Will it be given free? If so, what is incentive to install?
- Set up a system making it easy for motorists to buy and repair all gadgets



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Type of System – Cameras

- Only use cameras which capture all vehicles entering or using the controlled area
- Payment made by internet, phone banking, etc
- Reconcile photos with payment and sieve out exceptions who are violators
- A large backend operation needed to process the system



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Enforcement of Violations

- 100% needed?
- Manual or camera or just computer records?
If camera, need standards for number plate sizes and letters
- Need a good database of owners' particulars and vehicle registration
- Otherwise, street enforcement selectively (not at passing point)

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Out of Town Motorists

- How to treat them?
- Publicity needed
- Possible Impact to Tourist Industry

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Legislation

- Needed to give Authority the power to charge and take enforcement action
- Distinguish between fraud and non-payment

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Costs

- Who will pay for infrastructure
 - private or public?
- Who will pay for operation and maintenance?
- Where will revenue go? Will additional revenue be used solely for transport purposes?
- Where will money from collection of fines go?
- Will other vehicle taxes be reduced as an inducement ?

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Administration

- Which Authority will be in charge?
(Usually one Authority is set up to operate, collect charges and enforce)
- Installation and Operation could be under different departments
- Who handles enforcement?
- Who will maintain?

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Alternatives

- What are the alternatives for those affected?
- Why this type of demand management?
- Can public transport handle diverted car drivers?
- How many vehicles use controlled areas as a bypass route?
- Are there many chauffeured cars?
- Is there a shortage of car parks?
- Are there some alternative routes for affected motorists?

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Public Relations

- Have a champion or focal point for the system
- Package strategies so that congestion pricing is only one part of it
- Involve community and interest groups
- Employ a public relations firm



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Monitoring

- Monitor closely by traffic counts, usage, revenue etc
- Be prepared to make changes
- Give out results to public frequently
- After that have a regular monitoring program

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Contingency

- Work out worst scenarios
- Civil disobedience
- Failure to pay fines
- Fraud

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Thank You!



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ITS for PRR

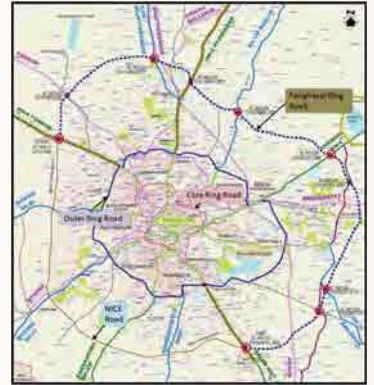
08 May, 2014

JICA ITS Master Plan Study Team

(Source: JICA Study Team)

Outline of Peripheral Ring Road

- Length: 65.5 km
- Design speed: 100 km/h
- Fully access controlled toll road.
- Interchange: 7
- ITS facilities proposed:
 - Toll Management System (TMS)
 - Highway Traffic Management System (HTMS)

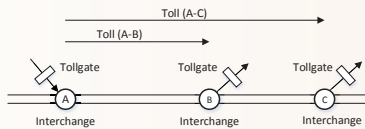


(Source: JICA Study Team)

P-01

Toll Management System

- Distance based toll system is adopted for PRR.
- Tollgate is required at both entry and exit points.
- Toll collection method:
 - Electronic Toll Collection (ETC): Non-stop toll collection
 - Touch and Go (T'nG): Driver touches reader/writer with smart card
 - Manual: By operator



(Source: JICA Study Team)

P-01

Toll Management System

- Smart card is used for all toll collection methods.
- Smart card for ETC and T'nG is same type and can be used interchangeably.
- Active DSRC for data communication between ETC roadside antenna and on-board unit.
- On-board unit will be 2-piece type.



(Source: JICA Study Team)

P-01

Merits of ETC

- Fast transaction processing and no waiting queue at tollgate.
- High throughput of transaction processing
 - 800 – 1200 vehicles/hour as compared with 200 – 300 vehicles/hour by manual method
- Less number of tollgates required resulting in less toll plaza area.
- Less back office operation and no cash handling.
 - Toll collection record is automatically produced
- No toll collector is required at toll lane.



(Source: JICA Study Team)

P-01

Merits of Touch and Go (T'nG)

- Fast transaction processing as compared with manual system.
- Less back office operation and no cash handling.
 - Toll collection record is automatically produced.
- No toll collector is required at toll lane.



(Source: JICA Study Team)

P-01

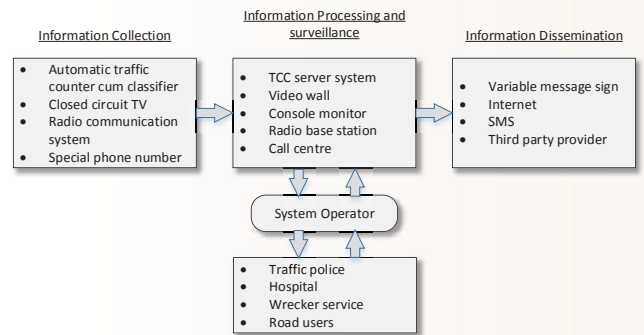
Highway Traffic Management System (HTMS)

- PRR is an access controlled road and entry and exit are possible at only limited points (interchange).
- PRR is an expressway with speed limited of 100 km/h.
- The facts above necessitate the proper management of traffic to ensure safe, efficient and comfortable trip.
- Drivers must be informed of traffic condition on PRR before they enter PRR.
- In case of incident (congestion, accident, road work, etc.), the incident information must be provided to drivers on the PRR as soon as possible for their safe and comfortable journey.

(Source: JICA Study Team)

P-01

Functions of HTMS



(Source: JICA Study Team)

P-01

Components of HTMS

- Automatic traffic counter cum classifier (ATCC) for traffic flow monitoring.
- Close circuit television (CCTV) camera for surveillance.
- Variable Message Sign (VMS) for information provision.
- Internet and SMS for information provision.
- Traffic Control Centre, where all information is collected, processed and disseminated.

(Source: JICA Study Team)

P-01

Components of HTMS



CCTV Camera



Image ATCC



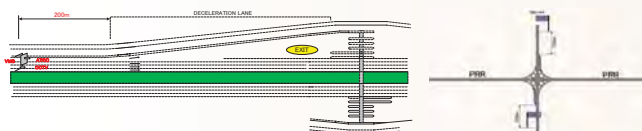
VMS

(Source: JICA Study Team)

P-01

Location of Field Equipment

Facility	Location	Quantity
Variable Message Sign	On PRR before off-ramp	12
	General road leading to on-ramp	14
CCTV Camera	Merging and diverting sections at interchange	12
ATCC	Each section between interchanges	12



(Source: JICA Study Team)

P-01



Traffic Signal System for Bengaluru

08 May, 2014

JICA ITS Study Team

(Source: JICA Study Team)

Existing Signal System



- Bangalore City Traffic Police embarked on a project entitled "**Bangalore Traffic Improvement Project-B-TRAC 2010**".
- It was 5-year programme with estimated cost of Rs. 350 crores. For the financial year 2007-08, 2008-09 and 2009-10, the Government has released Rs. 44 crores, 35 crores and 40 crores respectively.
- Currently there are 336 signals, 175 CCTV cameras and 20 variable message signs (VMS).

(Source: JICA Study Team)

Issues of Signal System



- No vehicle detectors that monitors traffic condition are installed in the existing system.
- Thus the existing system is not an area traffic control system, which dynamically adjusts signal timing based on the traffic condition monitored by vehicle detector.
- No traffic engineer is involved in the design and operation of signal system. No periodical review of signal timing parameters is made.
- B-TRAC plans to introduce actuation control or other sophisticated signal control, but it will be not realized in a foreseeable future.

(Source: JICA Study Team)

Issues of CCTV System



- CCTV camera system is suffering from low availability. 30 – 40% of cameras are not operating at a given time due to connectivity problem.
- The availability is simply too low, whatever the reason is, and improvement is not expected in the near future.
- Similar problem is expected to exist for traffic signal system.

(Source: JICA Study Team)

Proposal of New Signal System



- It is proposed to introduce an area traffic control system with all functionalities that standard ATC system has to Bengaluru as part of ITS project.
- The system will improve the efficiency of road traffic and large amount of benefits will be brought about.
- A component of project will be capacity building program that cooperates with Traffic Training and Road Safety Institutes at Tanisandra, Bengaluru proposed by Traffic Police

(Source: JICA Study Team)

THE MASTER PLAN STUDY ON THE INTRODUCTION OF INTELLIGENT TRANSPORT SYSTEM (ITS) IN BENGALURU AND MYSORE

- Current traffic situation and Issues -



JICA Study Team
Ryuichi OIKAWA

Traffic Survey

✓Traffic volume count survey;

- Locations; 9 point on major road (NH, SH, ORR)
- Date and Time period; 1 weekday in late March, 24 hours continuous survey
- Vehicle Classification; 6 type (2-Wheels, Auto, Car, Bus, LCV, Truck)
- Method; Manual counting

✓Travel speed survey;

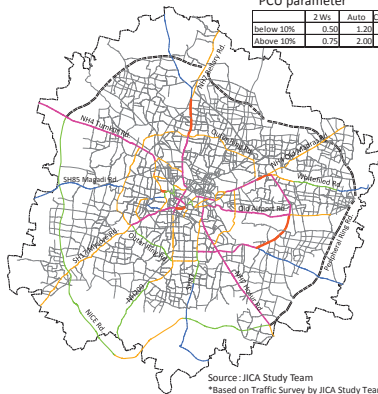
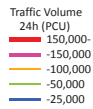
- Survey routes; 10 major radial road (NH, SH, etc) and ORR
- Survey date; 1 weekday in late March-April
- Time; Peak hour (Morning 9:00-11:00)
- Method; Floating car using the drive recorder

1. Traffic Volume

1-1. Daily Traffic Volume (PCU/24h)

PCU parameter		2 Ws	Auto	Fair/Jeep	Bus	LCV	Truck
below 10%		0.50	1.20	1.00	2.20	1.40	2.20
Above 10%		0.70	2.00	1.00	3.70	2.00	3.70

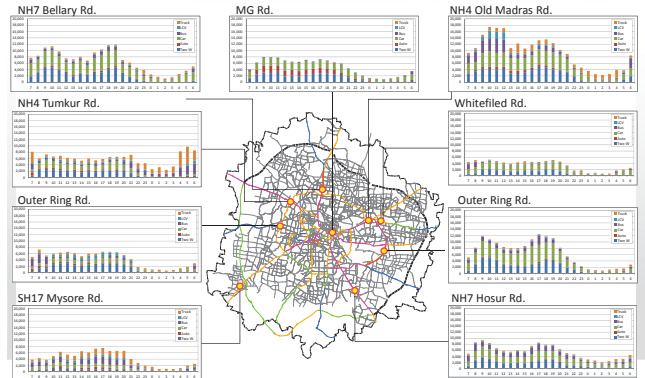
Source: IRC 106 (1990)



Source: JICA Study Team
*Based on Traffic Survey by JICA Study Team, and CTPT,CTTS, PTT-DPR

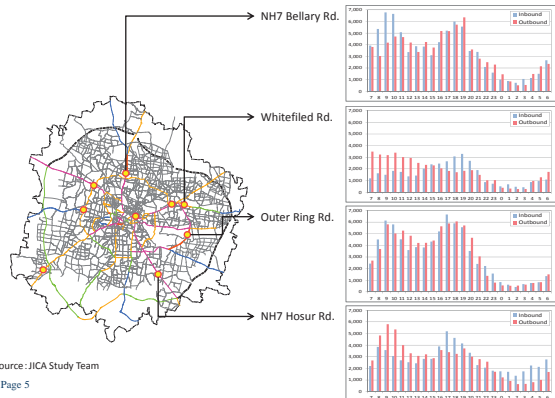
1. Traffic Volume

1-2. Daily Traffic Volume (PCU/24h) : Survey date (25-27, March 2014)



1. Traffic Volume

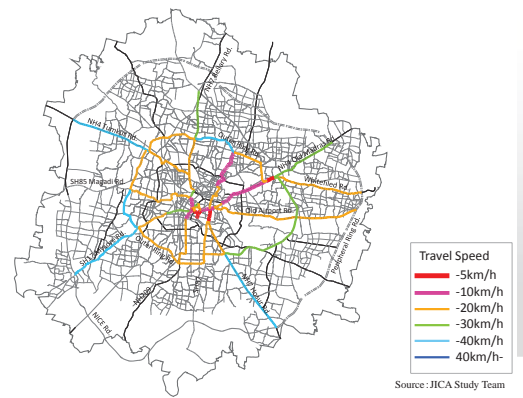
1-2. Daily Traffic Volume (PCU/24h) : Survey date (25-27, March 2014)



Source: JICA Study Team

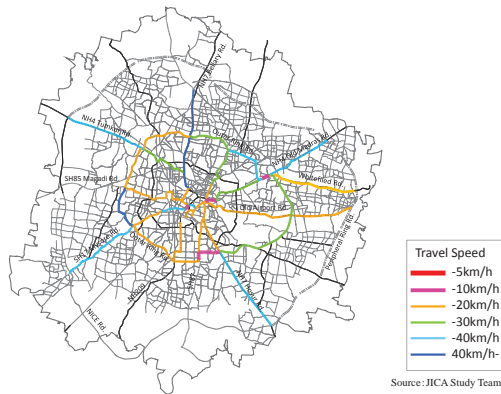
1. Travel Speed

1-2. Direction Inbound and CWR(ORR) -Morning Peak Hour 9:00-11:00-



1. Travel Speed

1-2. Direction Outbound and contra-CWR(ORR) -Morning Peak Hour 9:00-11:00-



Page 7
(Source: JICA Study Team)

2. Travel Speed and Major Bottleneck point

Data collection by GPS device and analysis of bottleneck points

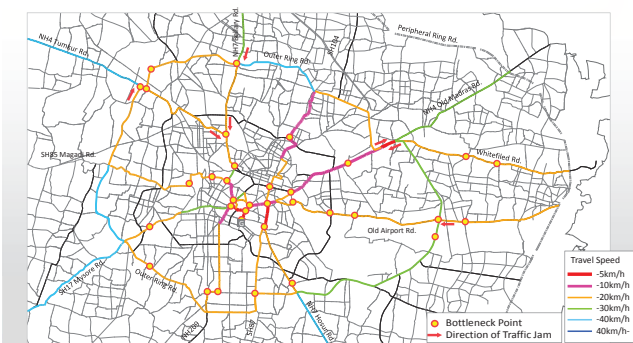
➤ Old Airport Road -Morning Peak Hour, Inbound-



Page 8
(Source: JICA Study Team)

2. Travel Speed and Major Bottleneck point

2-1. Direction Inbound and CWR(ORR) -Morning Peak Hour 9:00-11:00-



Page 9
(Source: JICA Study Team)

2. Travel Speed and Major Bottleneck point

2-2. Direction Outbound and contra-CWR(ORR) -Morning Peak Hour 9:00-11:00-



Page 10
(Source: JICA Study Team)

Identification of Current Traffic situation and Issues

3. Traffic Characteristic and key point of planning

Highlight Points;

- ✓ Traffic Volume;
 - High traffic volume (Over 100,000 pcu/day) within area of outer ring road and on major radial roads, such as NH-7 Bellary Rd., NH4-Thumkur Rd. to/from Peenya Industrial area, NH4-Old Madras Rd. to/from White Filed, NH7-Hosur Rd. to/from Electronic city.
 - 2 Peak hour; Morning peak (9:00-11:00), Evening peak (17:00-19:00).
- ✓ Travel speed and Main observed bottlenecks;
 - Average travel speed : 5km/h (city central)
10km/h (specific radial road),
20km/h (inside of ORR)
 - Bottlenecks at the intersection of the major road, mainly inside ORR

Key point of Planning;

- ✓ Reduction of traffic concentration to the city central
- ✓ Performance up of the major radial road
- ✓ Reduction of bottlenecks at major intersections

Page 11
(Source: JICA Study Team)

Common Card

1) Interoperability

It is the ability of different Transport agencies to coordinate and share information so that passengers can travel in a seamless fashion

2) Use of Common Card

- For travel on City Bus, Metro and Taxi
- For Payment of Toll, Congestion charge and Parking charge

3) What is Important for Seamless Travel

- Coordination of transfer points and schedule
- Simplified fare structures for seamless transfer from one mode to another
- Design of Transfer facilities
- Common interoperable fare media
- Convenient fare or payment media.

Common Card

Current Status in Bangalore

The City Transport Agencies BMRL (Metro) and BMTC (City Bus) have either started/starting the process of issuing Smart Card for the travellers. The Current situation of this procedure is as described below:

BMRL (Metro Train)

- Started issuing its own Smart card – MIFARE DESFire Type
- Metro Smart card is supplied by Samsung
- This card can be used only on Terminals that support MIFARE DESFire Type

BMTC (City Bus)

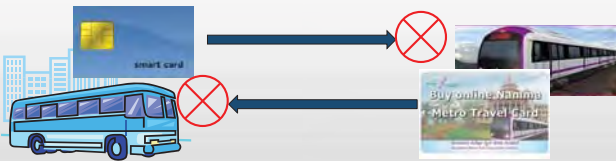
- Proposed to issue its own Smart card
- BMTC finalised the vendor AXIS Bank
- AXIS Bank chosen TRIMAX as its technical expert to supply Smart Card and System
- BMTC approached National Payment Corporation of India (NPCI) for Smart Card Technology
- NPCI proposed to develop Open Standard for Smart card

Common Card

Current Status in Bangalore

Currently Smart cards issued/proposed by METRO and City BUS are not Interoperable. That means:

- Smart card of METRO Train works for Metro Train only and not on City Bus
- Smart card of City Bus works on City Bus only and not on METRO Train



Common Card - Issues to be Addressed

For deployment of Interoperable Common Smart Card in Bangalore City, following issues need to be addressed :

- Acceptance of Technology by all the Stakeholders
- Business Model for the promotion of the Common card
- Established policy for Transaction Clearing and Settlement

Common Card - Issues to be Addressed

Technology

The City needs to adopt Smart Card Technology that –

- Supports common card for all transit modes
- Integrate existing smart card technologies with proposed national standards

Business Model

To encourage the usage of Common card, business promotion by stakeholders is required:

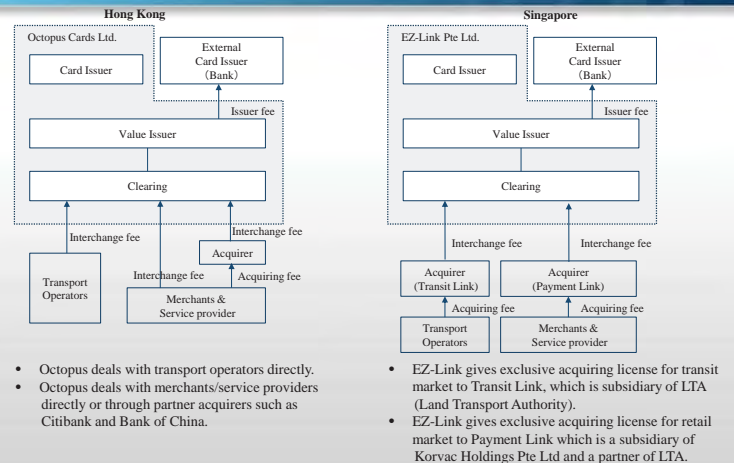
- Formulate Common Card Business unit with members from Stakeholders
- Device Promotion schemes such payback points, concession for common card usage, holiday packages etc

Transaction Clearing and Settlement

Transaction Clearing and Settlement is the critical part for implementation of Common Card

- Process and transaction procedures need to be elaborated and agreed by Stakeholders
- Memorandum of Understanding (MOU) need to be signed by all Stakeholders
- Trust and Transparency among Stakeholders

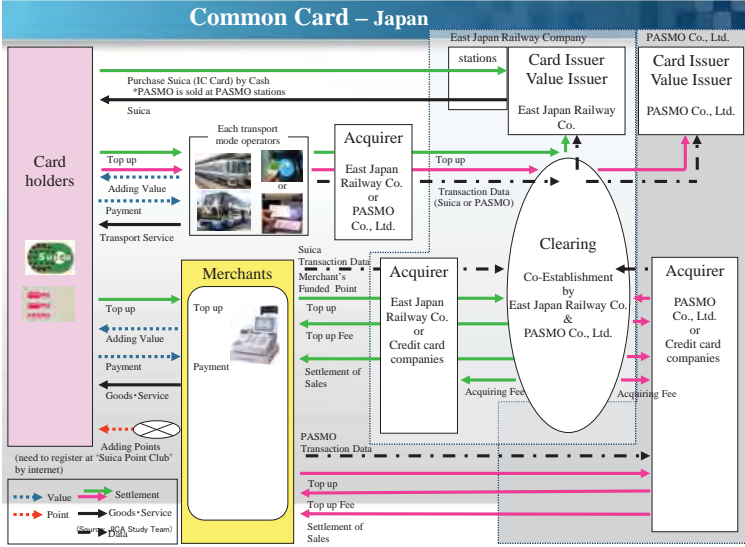
Common Card – Examples from World



- Octopus deals with transport operators directly.
- Octopus deals with merchants/service providers directly or through partner acquirers such as Citibank and Bank of China.

- EZ-Link gives exclusive acquiring license for transit market to Transit Link, which is subsidiary of LTA (Land Transport Authority).
- EZ-Link gives exclusive acquiring license for retail market to Payment Link which is a subsidiary of Korvac Holdings Pte Ltd and a partner of LTA.

Common Card – Japan



OPINION SURVEY FOR ITS MASTER PLAN FOR BENGALURU & MYSORE CITY

Investigators: **Dr. Prem Swaroup Reddy M**
Miss. Reashma P. S

(Source: JICA Study Team)

Contents

- Data Collection
 - Public Transport service user's Response
 - Bus
 - Metro
 - Private vehicles Response
 - Car
 - Bike
 - Commercial Vehicle Response
 - Emergency Vehicle Response
- Major Findings
- Conclusion

(Source: JICA Study Team)

Data Collection

Road User	Bangalore	Mysore
	Sample Set Target	Sample Set Target
Bus Users	150	50
Metro Users	150	-
Car Users	150	50
Two wheeler	150	50
Truck Drivers	150	50
Ambulance drivers	50	-
Total	800	200

(Source: JICA Study Team)

Bengaluru survey details

Road users	Sample set Target	Sample approached	Sample responded	Data analysis	Report
Metro users	150	300	150	√	√
Ambulance	50	100	50	√	√
Bus users	150	200	150	√	√
Two wheelers	150	200	150	√	√
Car users	150	300	150	√	√
Truck drivers	150	200	150	√	√

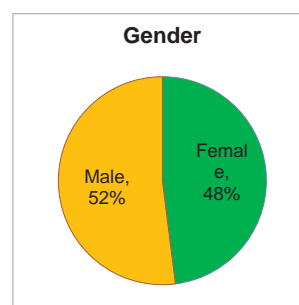
Public Transport Users – Bus

Bus : Location covered

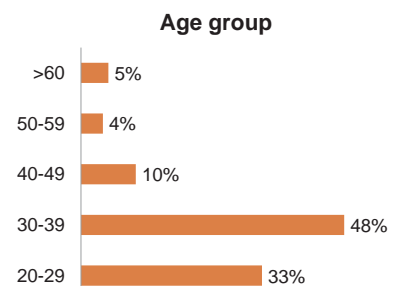
- Santhi Nagar Bus Terminal
- Hebbal Junction
- Sivaji Nagar
- Majestic Bus Terminal
- Corporation Circle
- BTM Layout Bus stop
- Yeshwanthpur
- Jaynagar (Fourth Block)
- Yelahanka Bus Terminal (old & new)
- KR Puram

(Source: JICA Study Team)

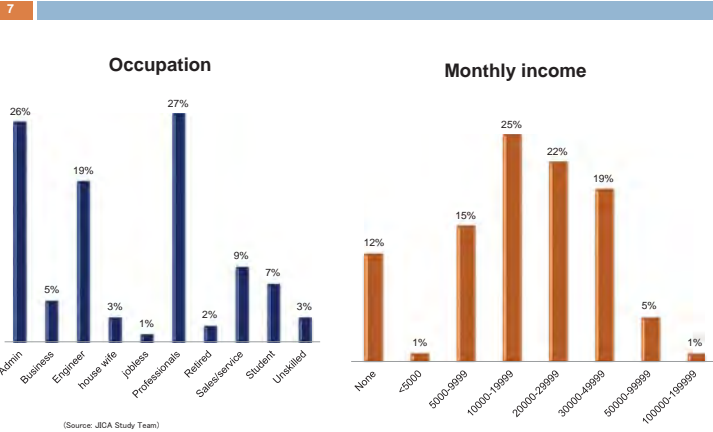
General profile (Bus Users)



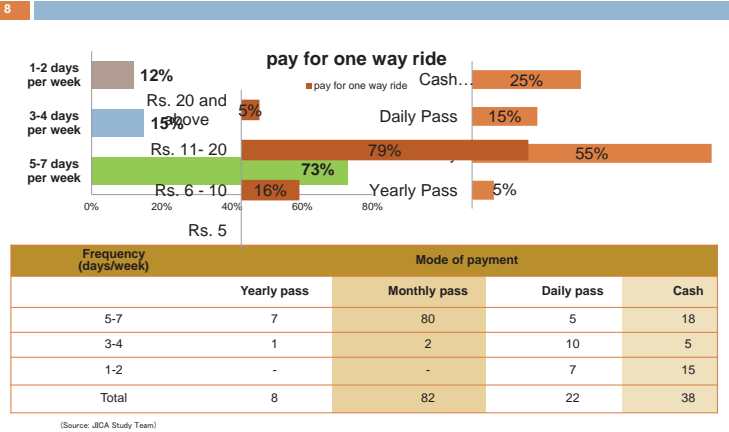
(Source: JICA Study Team)



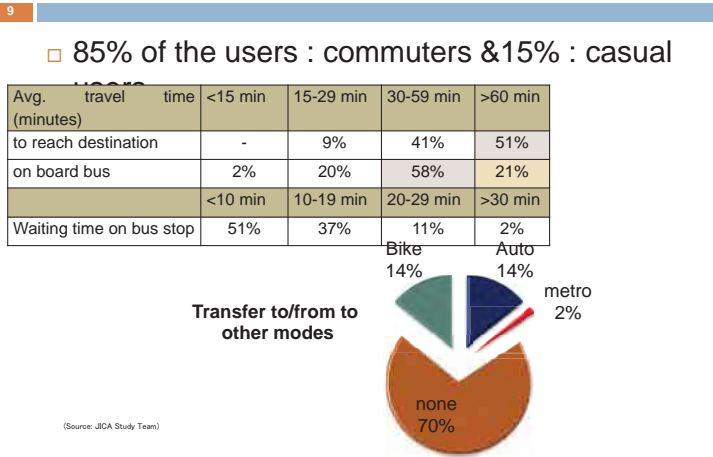
Job profile



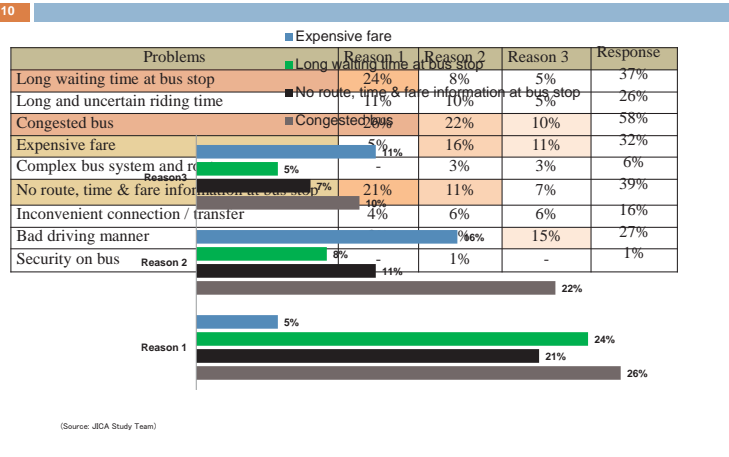
Trip Information



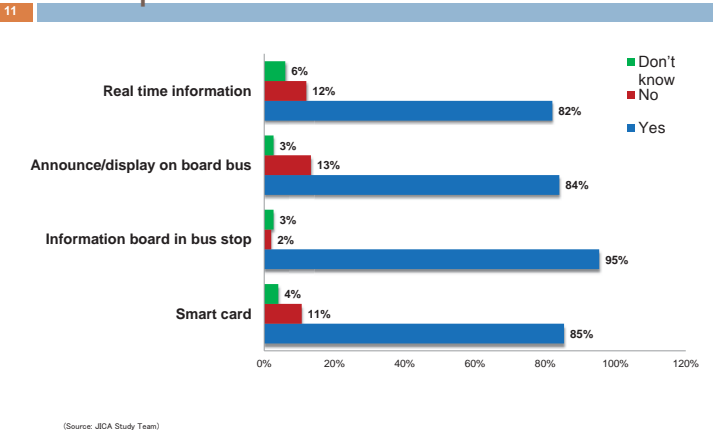
Trip Purpose and Travel Time



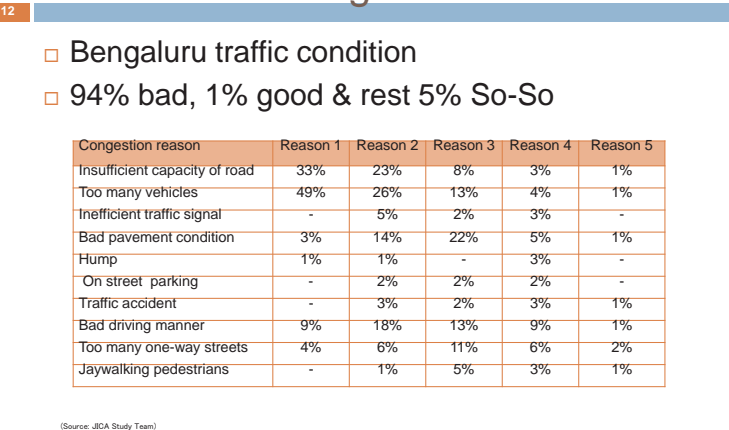
Passenger Problems



facilities needed to improve public transportation services

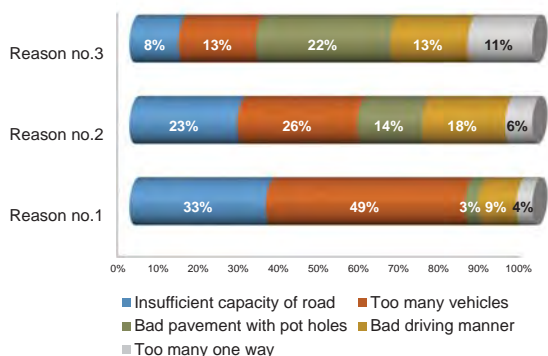


Traffic and Transportation Problems in Bengaluru



Reasons for congestion

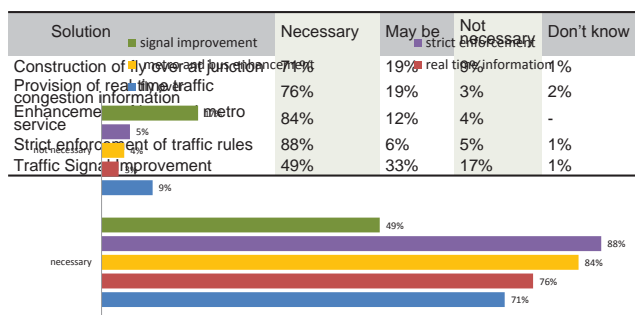
13



(Source: JICA Study Team)

Solution for the traffic and transportation problems

14

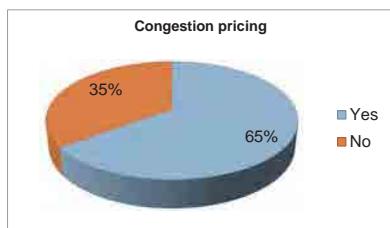


(Source: JICA Study Team)

Introduction of congestion charging

15

- Yes – for private vehicles



(Source: JICA Study Team)

Summary of bus users

16

- Problems
 - Congested bus,
 - Long waiting time at bus stop
 - Expensive fare, No route, time & fare information at bus stop
- Solutions
 - Smart Card
 - Information at bus stop and on board bus
 - Real time traffic information
- Bangalore problems
 - Insufficient road capacity
 - More no. of vehicles
- Solutions
 - Strict Enforcement of traffic rules
 - Enhancement of public transport service
- Not willing for congestion pricing

(Source: JICA Study Team)

Public Transport Users – Metro

17

Metro : Location covered

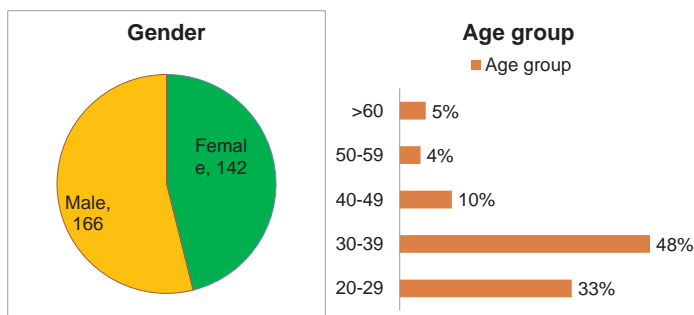
- MG Road station to Baiyappanahalli station
- Peenya Industry to Mantri Square Sampige Road
- Bayapanahalli
- Swami Vivekananda
- Indira nagar
- Halasuru
- Trinity
- M G Road
- Kempu nagar
- Peenya

(Ref: Running Metro Stations)

(Source: JICA Study Team)

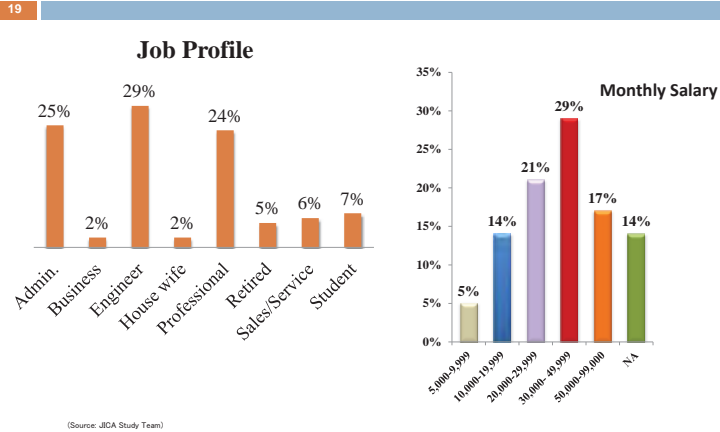
General profile

18

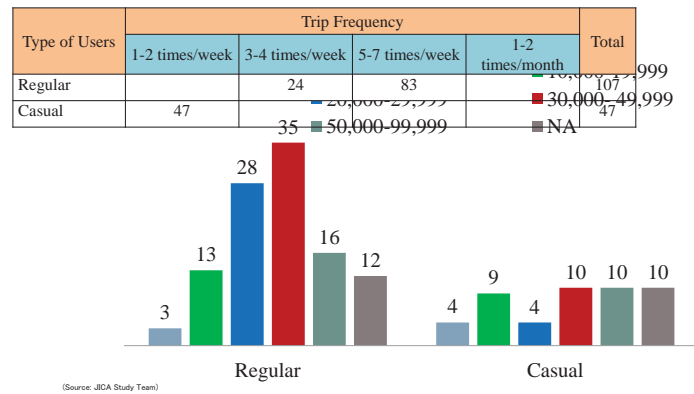


(Source: JICA Study Team)

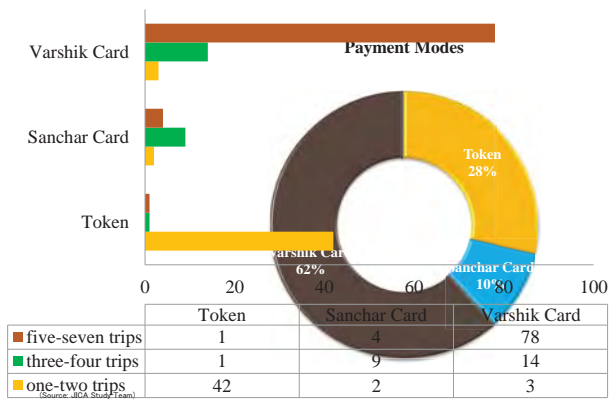
Job Profile and Income



Trip Frequency

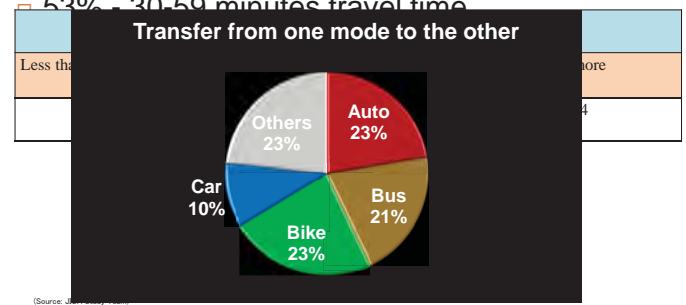


Mode of payment

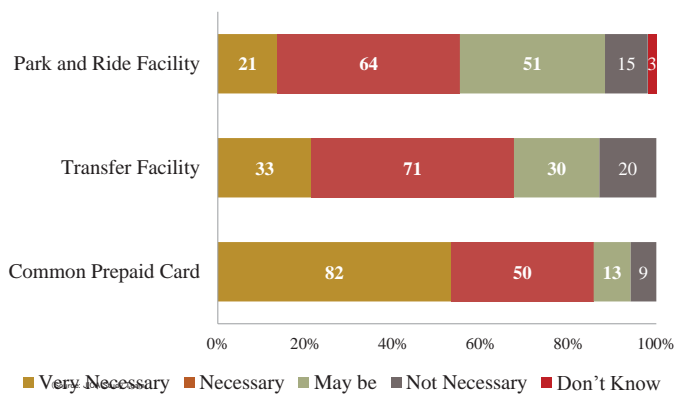


Trip Purpose

- 69% were commuters 31% were non-commuters
- 53% 30-59 minutes travel time



Improvement for Metro Service



Causes of Traffic congestion

Reasons	Reason 1	Reason 2	Reason 3	Reason 4	Reason 5	Reason 6	Total
Insufficient road capacity	60	35	17	4	8	3	127
more vehicles	49	36	22	14	8	1	130
inefficient traffic signal	3		1	2	3	6	15
bad pavement condition	7	24	28	20	9	1	89
humps on street	-	-	-	-	-	-	-
parking	-	-	1	1	1	2	5
bad driving manner	11	24	45	25	12	-	117
one way street	18	28	28	12	11	-	97
pedestrian crossing	3	6	7	1	1	2	20

(Source: JICA Study Team)

Solutions for Traffic and Transportation problems

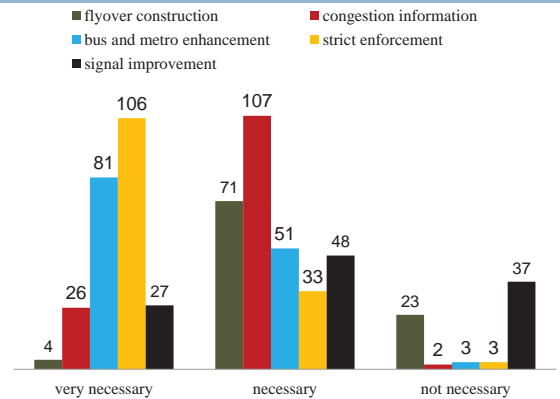
25

Solution	Very Necessary	Necessary	May be	Not Necessary	Don't Know
Construction of flyover at junction	3%	46%	36%	15%	-
Provision of real time traffic congestion information	17%	69%	12%	1%	-
Enhancement of bus and metro service	53%	33%	12%	2%	-
Strict enforcement of traffic rules	69%	21%	7%	2%	1%
Traffic signal improvement	18%	31%	27%	24%	1%

(Source: JICA Study Team)

Solution for Traffic and Transportation problems

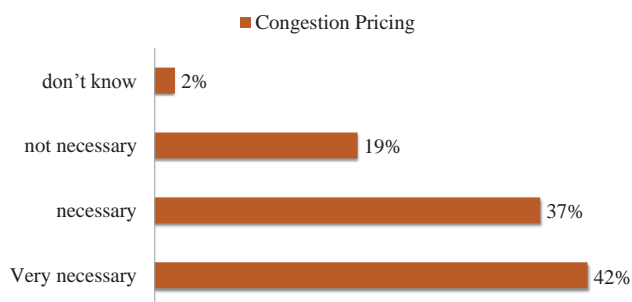
26



(Source: JICA Study Team)

Congestion Pricing

27



81% agreed for congestion pricing but only for private vehicles.

(Source: JICA Study Team)

Opinion survey Metro summary

28

- Improvements for metro services
 - Common prepaid card
 - Transfer Facility
- Bangalore problems
 - Insufficient road capacity
 - More no. of vehicles
 - Bad driving manner
- Solutions
 - Strict Enforcement of traffic rules
 - Enhancement of public transport service
 - Real time traffic information
- congestion pricing
 - Willing for congestion pricing (Private vehicles)

(Source: JICA Study Team)

Emergency Vehicle – Ambulance Survey Locations

29

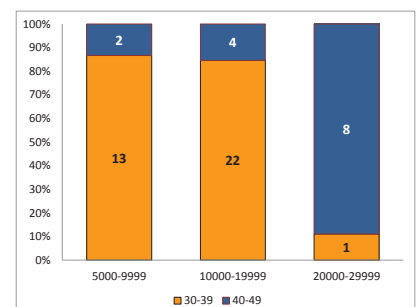
- st.John's
- Narayana Hrudhayalaya
- Jeydeva
- Nimans
- Manipal
- sanjeevini

(Source: JICA Study Team)

Ambulance Driver Profile

30

- 50 Ambulance Drivers
 - 28% were in the age group of 30-39
 - 72% were in the group of 40-49



(Source: JICA Study Team)

Trip Information

31

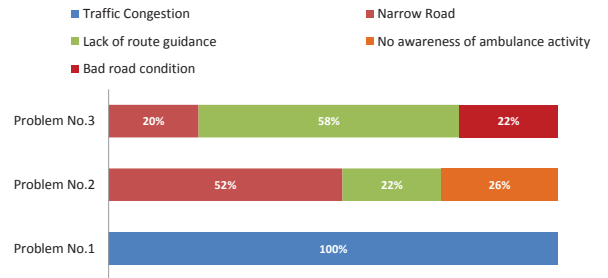
Frequency of emergency call (no. of times/day)	Response	Avg. Travel Time (minutes)		sources of information	
		Reach victim	Bring victim to hospital	Call from hospital	Call from citizens
1-2 calls	40%	40-45	40-50	Call from hospital	Call from citizens
3-4 calls	36%	40-45	40-50	Call from hospital	Call from citizens
5 calls	24%	20-25	20-25	108 facility	call from hospital

(Source: JICA Study Team)

Traffic Information & Problems

32

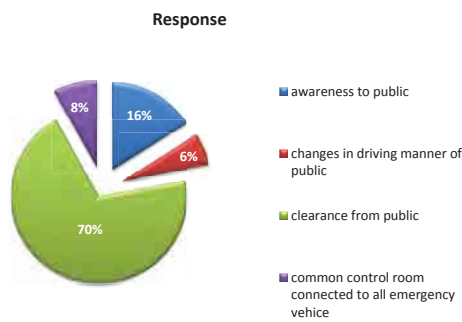
100% drivers agreed - not getting any traffic information before they start the trip



(Source: JICA Study Team)

Solutions from Driver's side

33



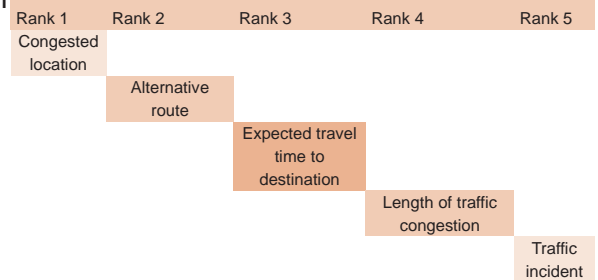
(Source: JICA Study Team)

ITS Solutions - Priority

34

100% dissatisfaction with current information system

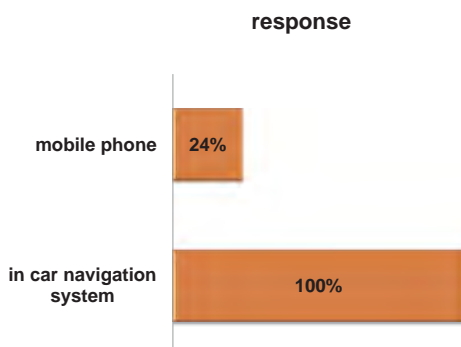
100% positive response for all ITS solutions



(Source: JICA Study Team)

Mode of receiving information

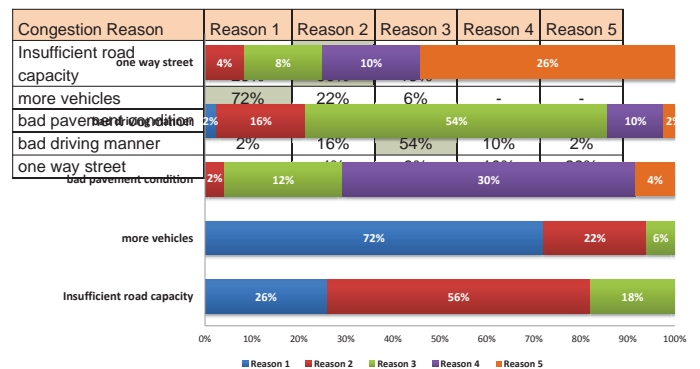
35



(Source: JICA Study Team)

Traffic and Transportation Problems in Bengaluru

36



(Source: JICA Study Team)

Solutions

37

Solution	Response	Answer
Construction of flyover at junction	100%	Very Necessary
Provision of traffic congestion information & alternative route	100%	Very Necessary
Strict enforcement of traffic rules	100%	Very Necessary
Provision of real time traffic congestion information	100%	Very Necessary
Enhancement of bus and metro service	100%	Necessary
Traffic signal improvement	100%	Necessary

100% agreed for congestion pricing, but for private vehicles only.

(Source: JICA Study Team)

Summary of Ambulance driver's response

38

- 100% dissatisfaction with current information system
- Improvements required
 - awareness to public
 - changes in driving manner of public
 - clearance from public
 - common control room connected to all emergency vehicle
- 100% positive response for all ITS solutions
 - Congested location
 - Alternative route
 - Expected travel time
- 100% agreed for congestion pricing, but for private vehicles only.

(Source: JICA Study Team)

Private Transport Two wheeler users

39

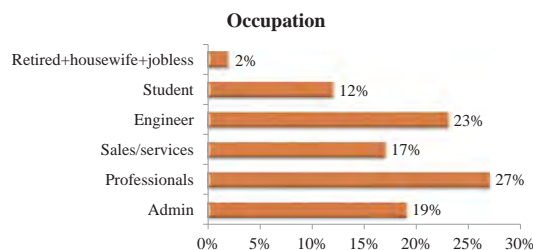
- Jayanagar
- Banashankari
- BTM
- Marathahalli
- Madiwala
- Forum mall
- Corporation
- Shanthinagar
- Shivaji nagar
- Hebbal
- Yelahanka
- M G road
- Garuda mall
- Mekri

(Source: JICA Study Team)

General Profile

40

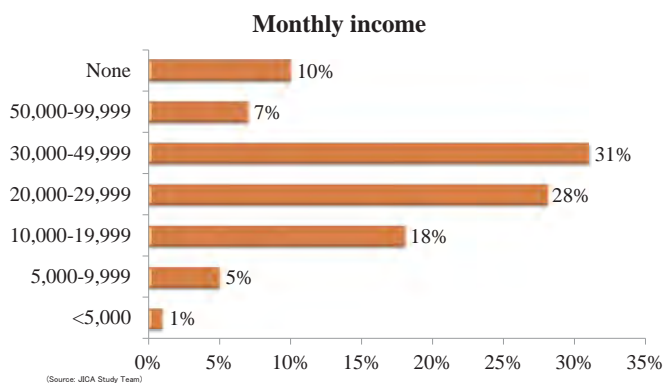
Age Group	15-20	20-29	30-39	40-49	50-59	>60	Total
Male	1%	19%	31%	11%	4%	-	66%
Female	-	16%	16%	1%	1%	-	34%



(Source: JICA Study Team)

Salary

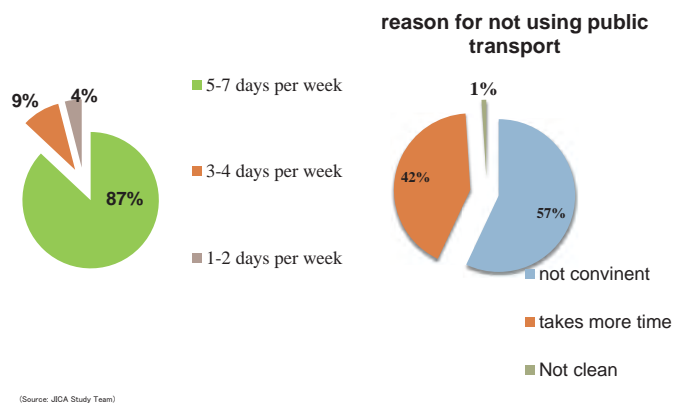
41



(Source: JICA Study Team)

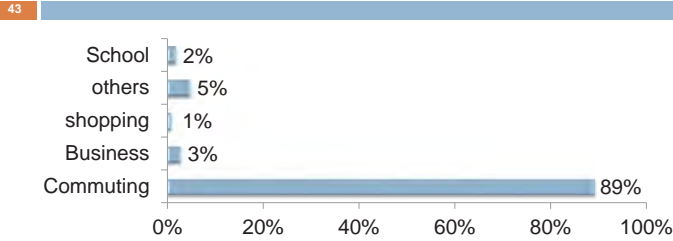
Travel Information

42



(Source: JICA Study Team)

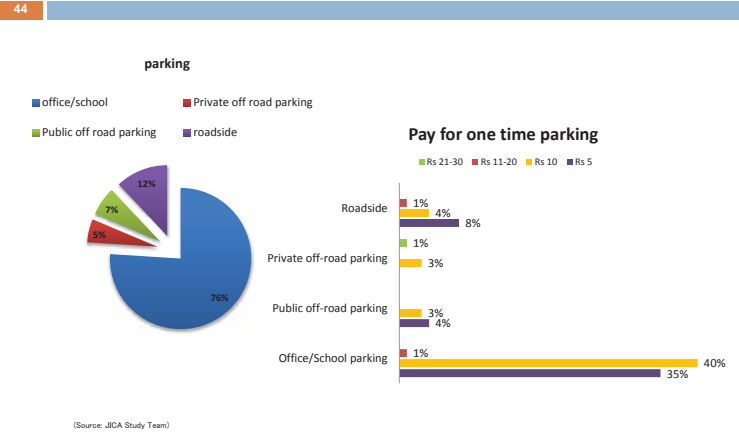
Trip Purpose



Trip Purpose	business	commuting	school	shopping	Others
five-seven	3	121	2	-	4
three-four		13	-	-	-
one-two	1	-	-	3	3

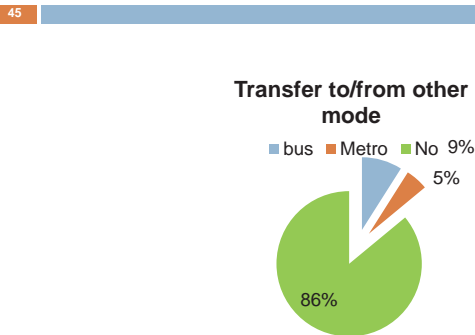
(Source: JICA Study Team)

Parking



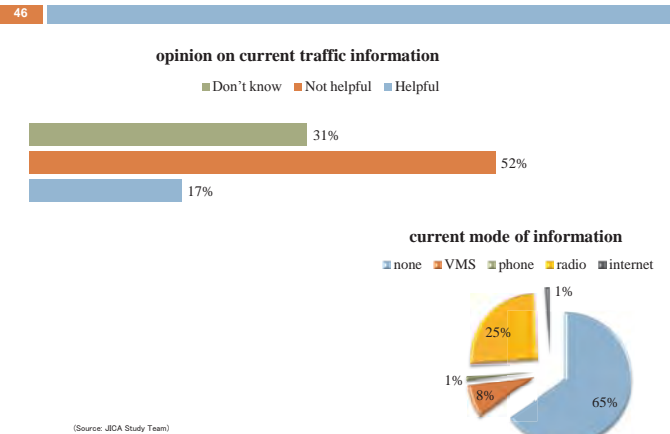
(Source: JICA Study Team)

Transfer to/from other mode



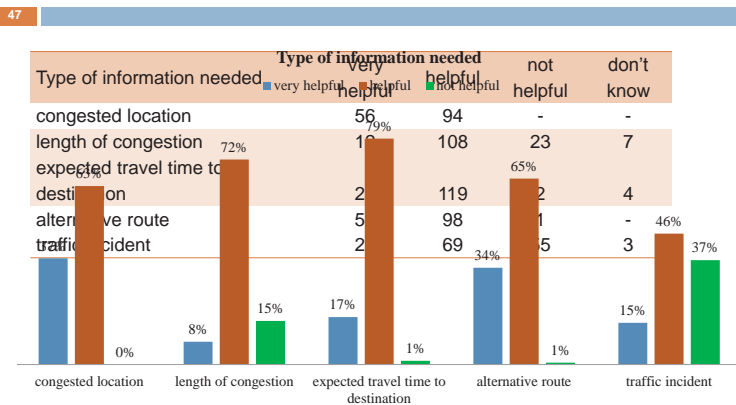
(Source: JICA Study Team)

Current Traffic Information



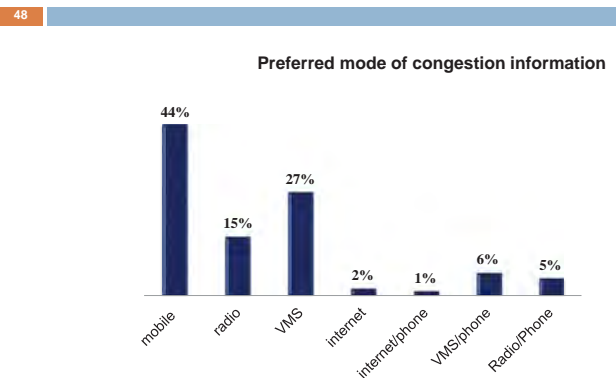
(Source: JICA Study Team)

Type of information needed



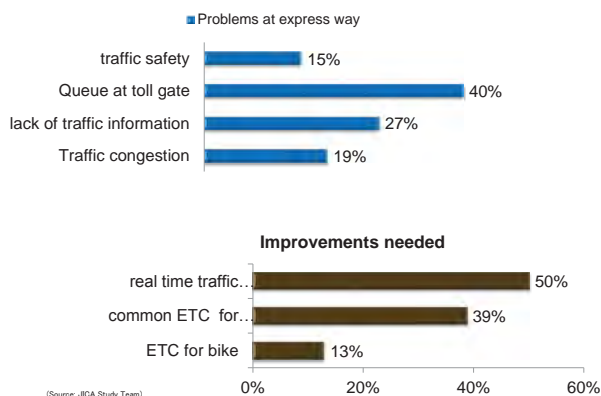
(Source: JICA Study Team)

mode of congestion information

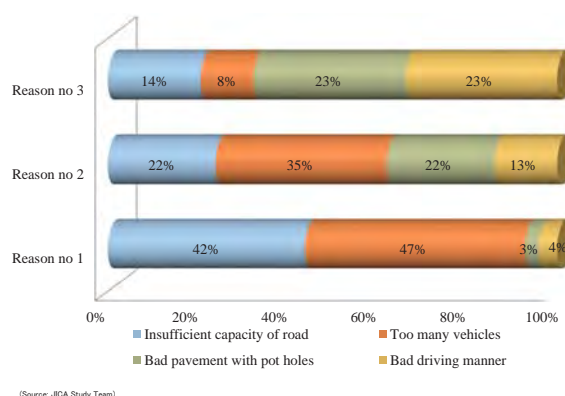


(Source: JICA Study Team)

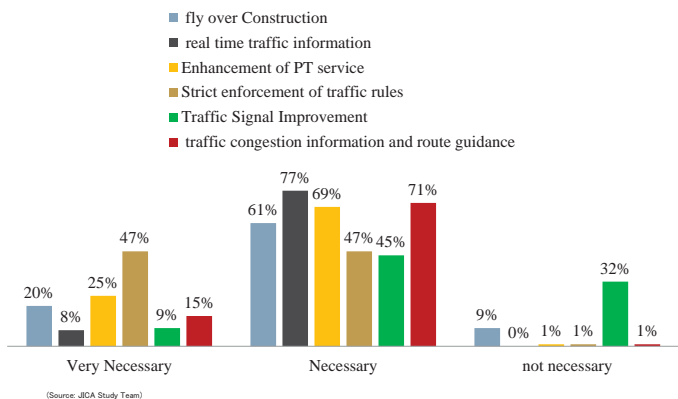
Expressway



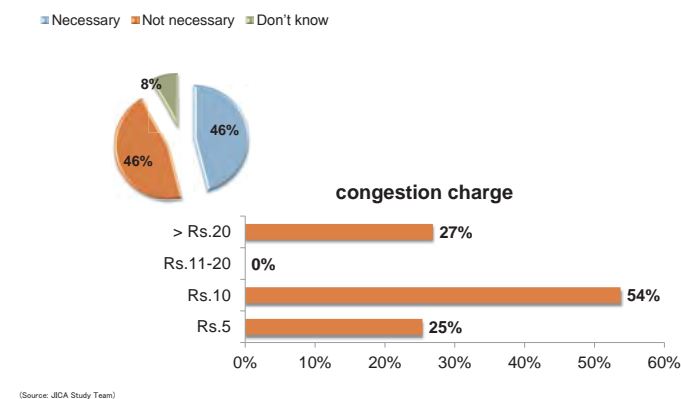
Bangalore Congestion Reasons



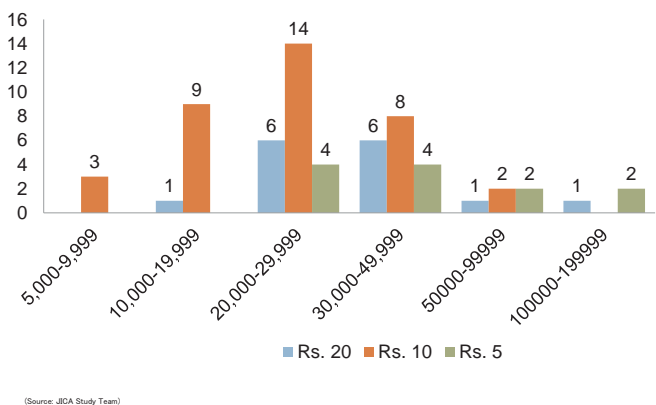
Solutions - priority



Congestion Pricing



Congestion Price – Monthly Salary



Summary of Two wheeler

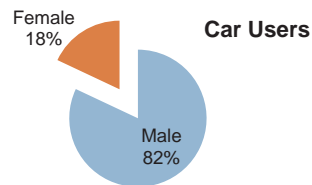
- Problems
 - Public transport – not convenient
 - Solutions
 - Expected travel time to destination
 - Length of congestion
 - Mobile phone and VMS
 - Bangalore problems
 - Insufficient road capacity
 - More no. of vehicles
 - Solutions
 - Strict Enforcement of traffic rules
 - Real time traffic information
 - Congestion and route guidance information
 - congestion pricing
 - 46% are willing
 - Rs. 5 - 10
- (Source: JICA Study Team)

Private Transport Car users

- Jayanagar
- Banashankari
- BTM
- Marathahalli
- Madiwala
- Forum mall
- Corporation
- Shanthinagar
- Shivaji nagar
- Hebbal
- Yelahanka
- M G road
- Garuda mall
- Mekri Circle

(Source: JICA Study Team)

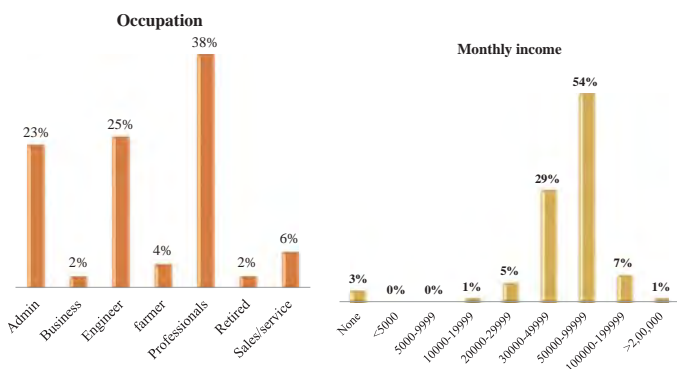
General profile



Age Group	20-29	30-39	40-49	50-59	>60	Total
Male	2%	35%	33%	10%	2%	82%
Female	1%	12%	4%	1%	1%	18%

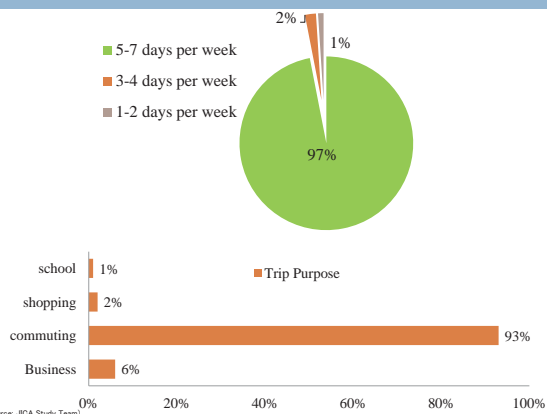
(Source: JICA Study Team)

Job Profile



(Source: JICA Study Team)

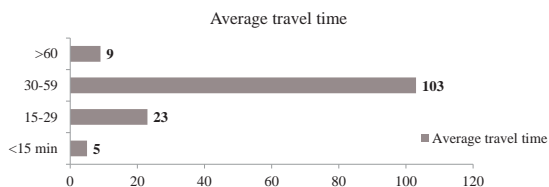
Travel Information



(Source: JICA Study Team)

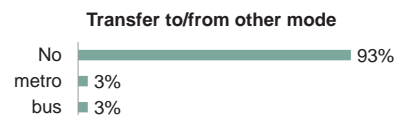
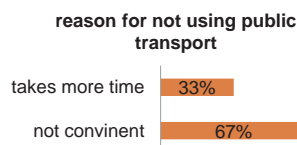
Trip Purpose and Travel time

Trip Purpose	business	commuting	school	shopping
five-seven	6	136	1	
three-four		2		1
one-two		2		2



(Source: JICA Study Team)

Why not public transport



(Source: JICA Study Team)

Parking facility

Parking Facility



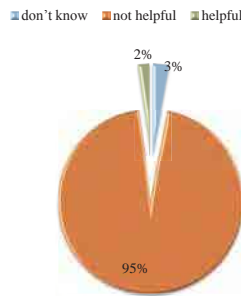
Pay and Park



(Source: JICA Study Team)

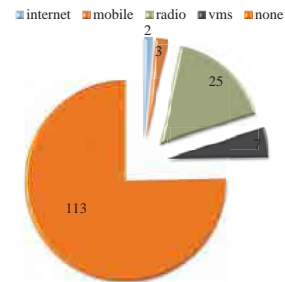
Current traffic information system

Current traffic information



(Source: JICA Study Team)

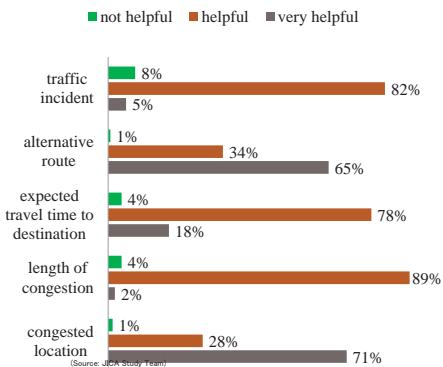
Current mode of congestion information



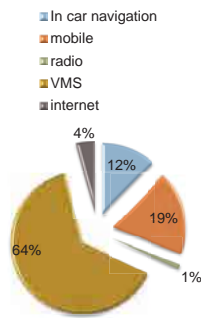
(Source: JICA Study Team)

Information needed

Type of information needed



Preferred mode of congestion information



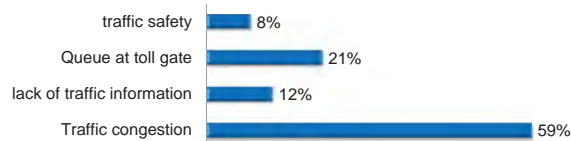
(Source: JICA Study Team)

Expressway

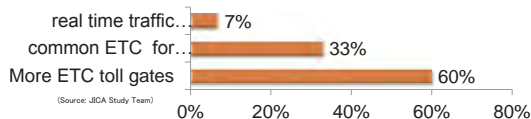
Expressway Use



Problems at express way



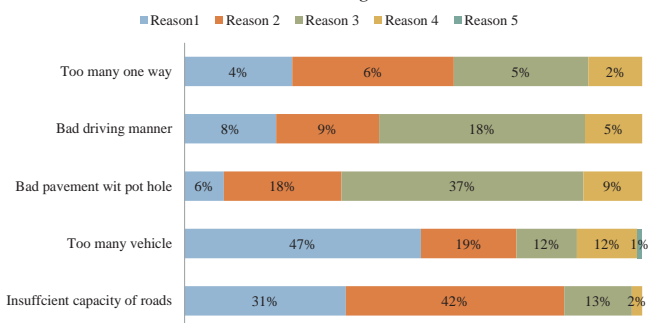
Improvements needed



(Source: JICA Study Team)

Bangalore Congestion Reasons

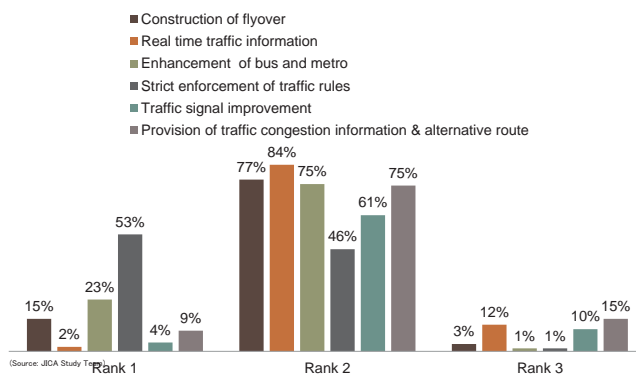
Reasons for congestion



(Source: JICA Study Team)

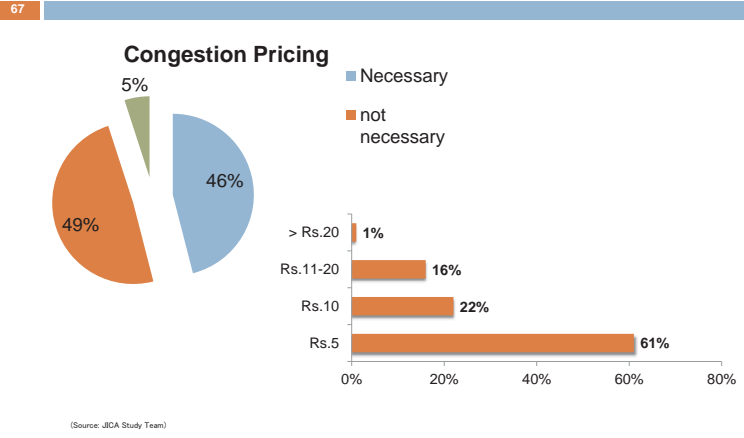
Solutions

Solutions

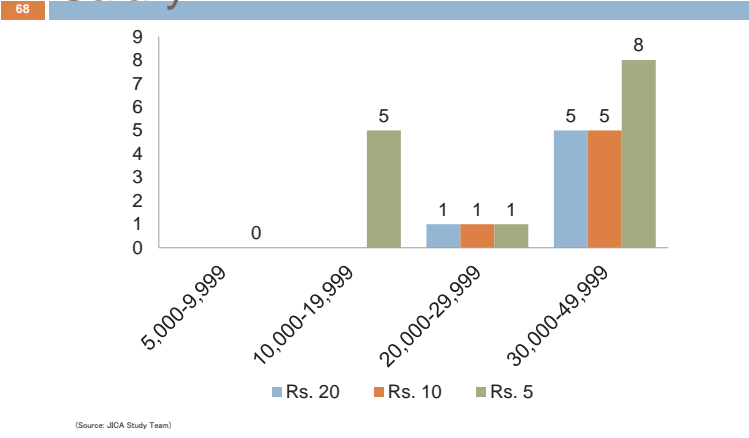


(Source: JICA Study Team)

Congestion Charging



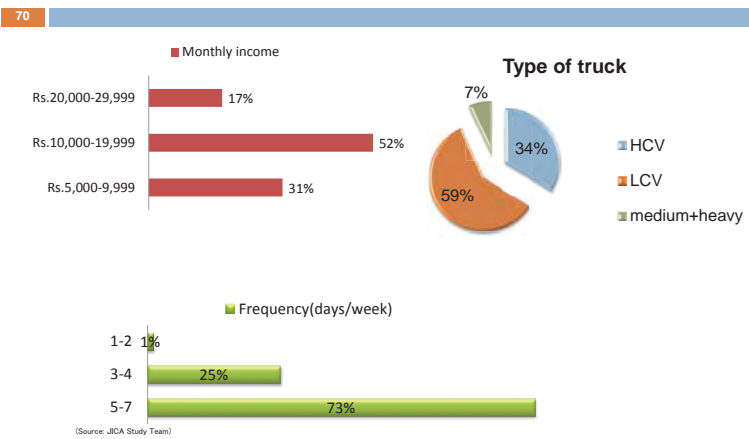
Congestion Price – Monthly Salary



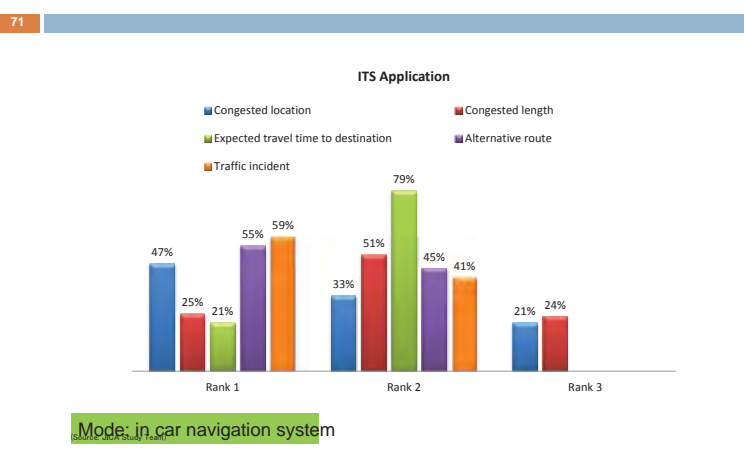
Summary

- 69
- Problems
 - Public transport not convenient
 - Bangalore Problems
 - Insufficient road capacity
 - More no. of vehicles
 - Improvements
 - Strict enforcement of traffic rules
 - Real time traffic information
 - Congestion Pricing
 - Mixed response (46% are willing)
- (Source: JICA Study Team)

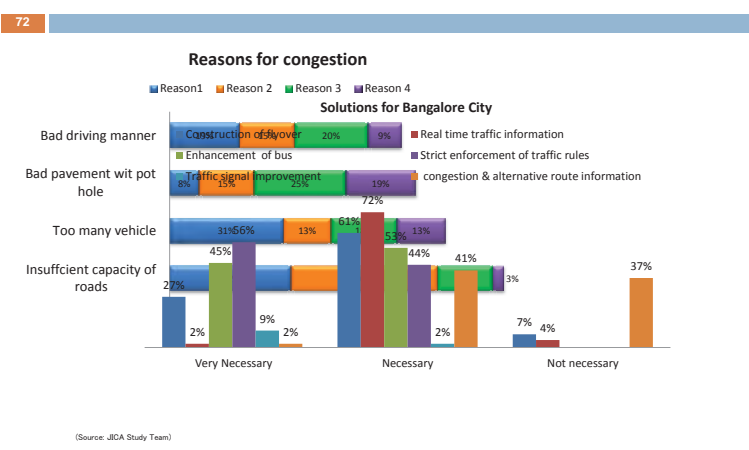
Commercial Vehicles



ITS Application



Truck drivers



Congestion pricing

73

- 99% disagreed
- 1% agreed

(Source: JICA Study Team)

Major Findings

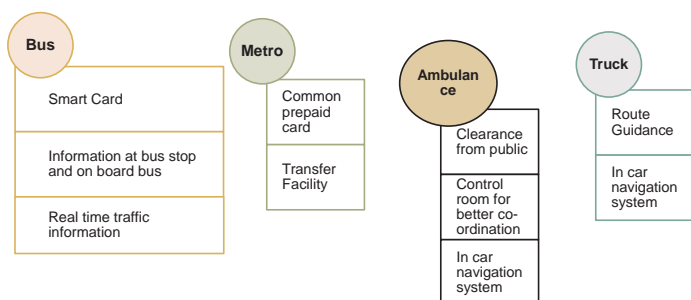
Traffic and Transportation Problems in Bengaluru

Mode	Problems	Solutions
Bus		
Metro	1. Insufficient road capacity 2. More number of vehicles 3. Bad driving manner	1. Strict enforcement 2. Enhancement of public transport system 3. Real time traffic information
Bike		
Car		
LCV/HCV		

(Source: JICA Study Team)

Enhancement of Transport Services

75



(Source: JICA Study Team)

Choice Over Congestion pricing

Mode	Yes	No	Don't know
Bus	100% (private vehicles)	-	-
Metro	79% (private vehicles)	19%	2%
Bike	46%	46%	8%
Car	46%	49%	5%
LCV/HCV	1%	99%	-

(Source: JICA Study Team)

THANK YOU!!

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Acknowledgements

JICA Team

DULT, Bangalore

BMRCL, BMTC, Traffic Police & other Stake



**THE MASTER PLAN STUDY
ON
THE INTRODUCTION OF
INTELLIGENT TRANSPORT SYSTEMS (ITS)
IN
BENGALURU AND MYSORE
IN
INDIA**

**Technical Advisory Group (TAG) Meeting
30 July 2014**

JICA Study Team

(Source: JICA Study Team)

- Table of Contents -

1. Activities Carried Out by JICA Study Team
2. Goals and Objectives
3. Overall Diagram
4. Bengaluru Traffic Information Centre (B-TIC)
5. ITS for PRR
6. Traffic Signal
7. Common Card

Page 2

(Source: JICA Study Team)

1. Activities Carried Out by JICA Study Team

- Meetings with Stakeholders
- Information Collected through Interviews
- TAG Meetings - Opinion of Stakeholders Shared
 - 28th March 2014: Study objectives, study outcome and initial observations
 - 23rd April 2014: Discussion for introduction of ERP
 - 8th May 2014: Identified issues, required measures, discussion on ITS components for Bengaluru
- Supplementary Traffic Survey Conducted by Study Team
- Traffic Opinion Survey Conducted

Page 3

(Source: JICA Study Team)

2. Goals and Objectives

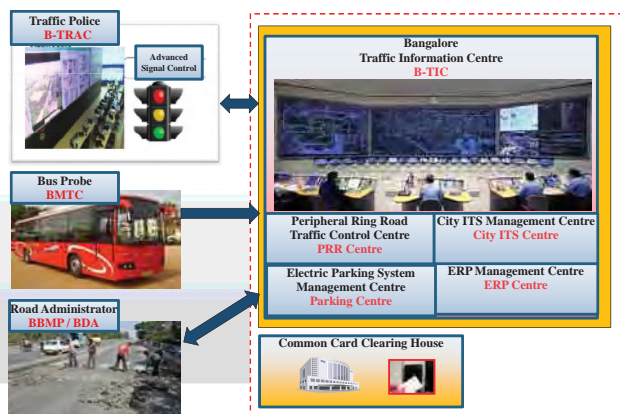
Goals and Objectives for Bengaluru ITS

NO	GOAL	OBJECTIVE
1	Safety	<ul style="list-style-type: none"> ▪ To reduce traffic accidents ▪ To enhance communication and response in emergency ▪ To reduce damage during adverse condition
2	Environment / Energy	<ul style="list-style-type: none"> ▪ To reduce air pollution ▪ To reduce CO2 emissions ▪ To reduce energy consumption
3	Productivity	<ul style="list-style-type: none"> ▪ To increase economic output through efficient utilisation of transport facilities.
4	Accessibility	<ul style="list-style-type: none"> ▪ To provide travel information ▪ To enhance intermodal connectivity ▪ To reduce travel time ▪ To reduce travel costs ▪ To give care to vulnerable people
5	Efficiency	<ul style="list-style-type: none"> ▪ To increase efficiency in road use ▪ To reduce cost of road management ▪ To enhance appropriate management of ITS data ▪ To provide transport related payment ▪ To support planning agency and administrator for efficient planning based on quantitative data

Page 4

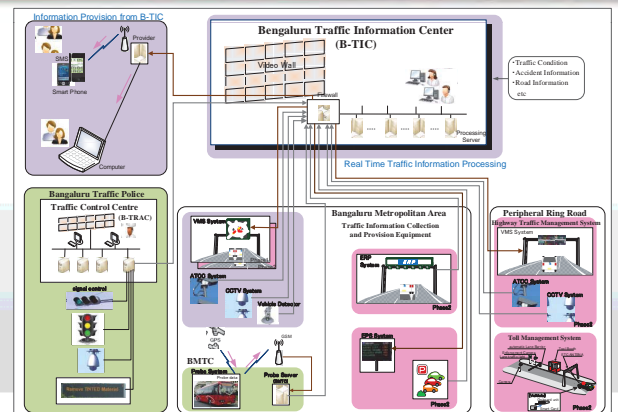
(Source: JICA Study Team)

3. Overall Diagram (1/2)



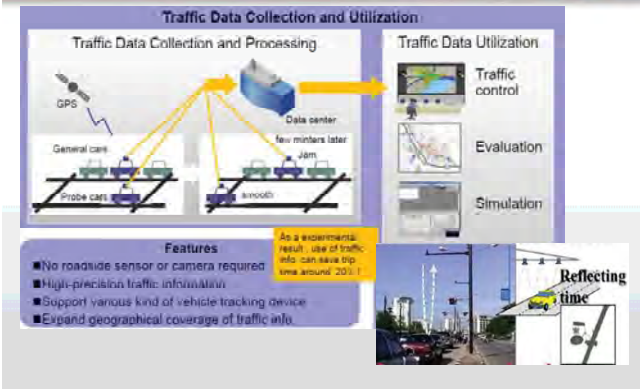
(Source: JICA Study Team)

3. Overall Diagram (2/2)



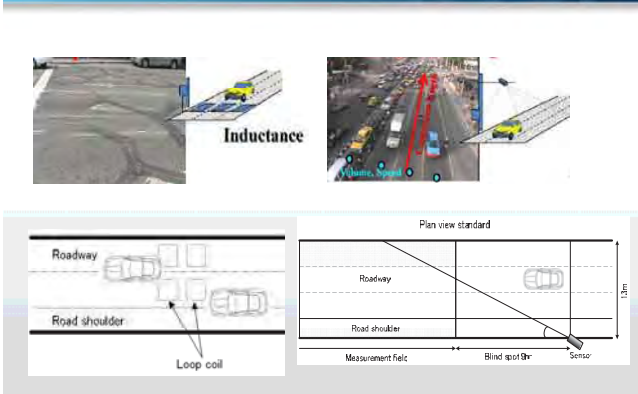
(Source: JICA Study Team)

4. B-TIC: Data Collection by Probe and Detector (1/6)



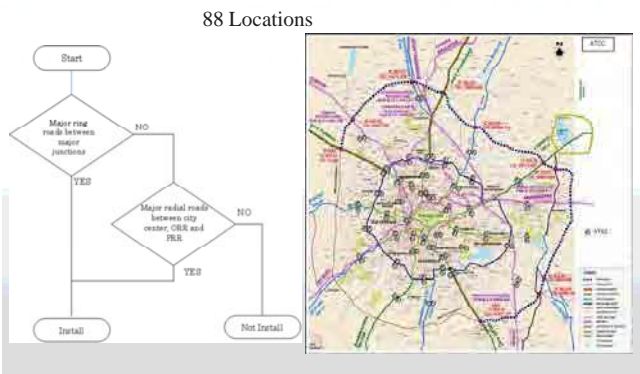
Page 7
(Source: JICA Study Team)

4. B-TIC: Data Collection by ATCC (2/6)



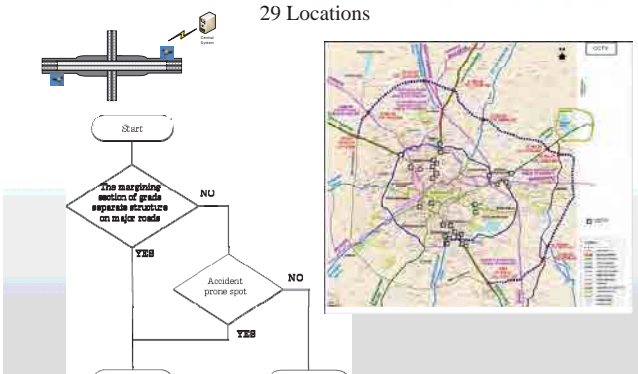
Page 8
(Source: JICA Study Team)

4. B-TIC : Data Collection by ATCC (3/6)



Page 9
(Source: JICA Study Team)

4. B-TIC : Monitoring by CCTV (4/6)



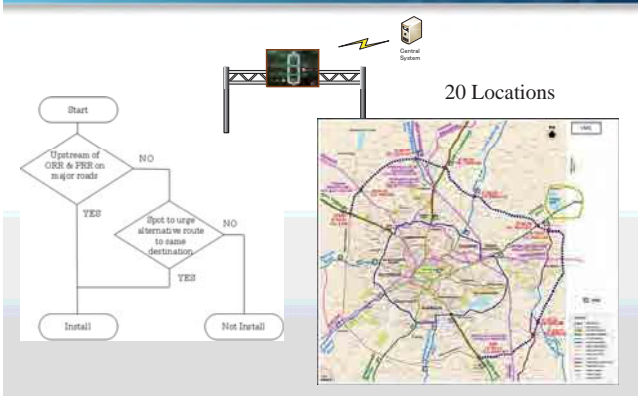
Page 10
(Source: JICA Study Team)

4. B-TIC: Information Provision by VMS (5/6)

Type	Image	Function
VMS(Text & Symbol)		To inform the road, traffic and weather conditions by using text information and symbol mark.
Travel Time Display		To provide travel time information from VMS location to major destinations.
Graphic Information Signboard (Multi-colore, multi-display)		To inform congested sections to make drivers select most suitable traveling route by using graphic information. In addition, information of various incident and/or time to destination can display.

Page 11
(Source: JICA Study Team)

4. B-TIC: Information Provision by VMS (6/6)



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(Source: JICA Study Team)

5. ITS for Peripheral Ring Road (PRR) (1/9)

- Two ITS Components will be introduced:
 - Toll Management System (TMS)
 - Highway Traffic Management System (HTMS)



5. ITS for PRR: Toll Management System (TMS) (2/9)

- PRR is a toll road and distance based toll is collected.
- Tollgate is setup at every interchange (both entry and exit)
- Three collection methods (ETC, touch & go, manual) will be adopted.

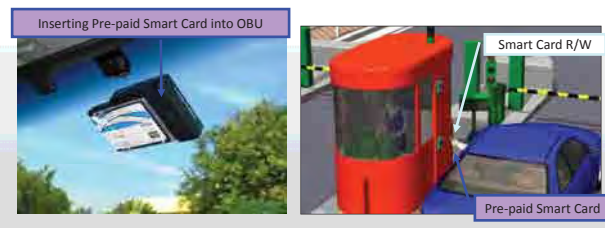


5. ITS for PRR: Toll Management System (TMS) (3/9)

- Electronic toll collection
 - Non-stop operation using wireless communication between vehicle (on-board unit) and roadside antenna
- Touch & Go
 - Use prepaid contactless smart card
 - Driver touches the reader/writer with prepaid card
- Manual toll collection
 - Toll paid in cash

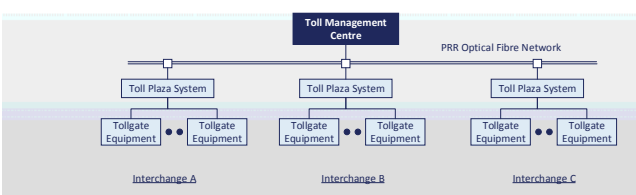
5. ITS for PRR: Use of common prepaid smart card (4/9)

- Same smart card is used for both ETC and Touch & Go.
- Smart card can be compatible with BMRTC and BMTC cards.

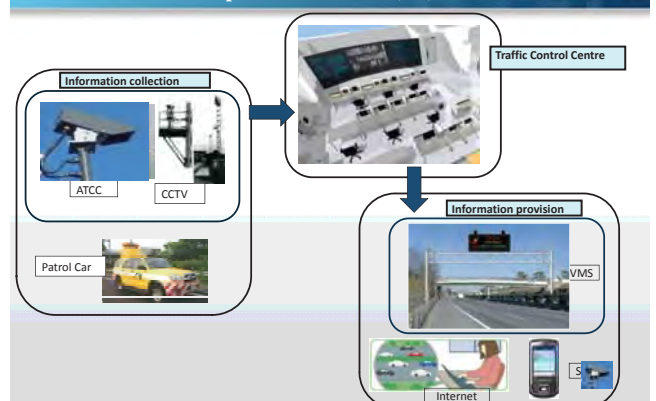


5. ITS for PRR: TMS System Configuration (5/9)

- TMS is an isolated and independent system for PRR.
- System has three levels (tollgate, toll plaza and traffic management centre) of equipment.
- Optical fibre network provided by HTMS will be used for data communication.



5. ITS for PRR: Components of HTMS (6/9)



5. ITS for PRR: Variable Message Sign (VMS) (7/9)

Variable message sign

- Provides road users with various information such as traffic condition, accident, construction work and travel time information.

Installed at every IC on main line and connecting general road



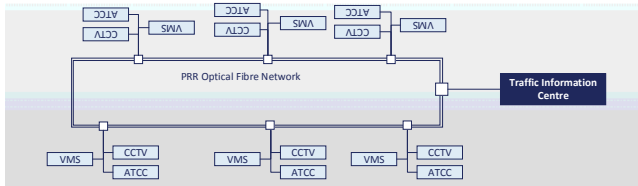
ABCD IC — RXYZ IC
ACCIDENT
DRIVE CAREFULLY

5. ITS for PRR: HTMS Facility Layout (8/9)



5. ITS for PRR: HTMS System Configuration (9/9)

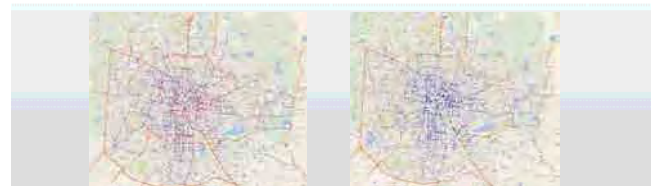
- HTMS is a part of Traffic Information Centre
- Roadside equipment will be directly connected with Traffic Information Centre
- Monitoring of system is possible at each interchange



6. Traffic Signal System (1/4)

Traffic Police implemented B-TRAC since 2010.

- Traffic Management Centre
- 336 traffic signals
- 176 CCTV cameras
- 20 Variable message signs



Signal Location

CCTV Location

6. Traffic Signal : Limitation of Current Signal System (2/4)

Current system has the following limitations:

- Vehicle detector is not used and signal timing is adjusted by time of day.
- Communication line is not reliable. As a result, many signals and CCTV cameras are not connected with the Centre.

6. Traffic Signal : Upgrading of Signal System (3/4)

Improvement will be made to the system and traffic responsive / adaptive control will be introduced.

Phase	Centre System	Roadside Equipment	Coverage Area
1	<ul style="list-style-type: none"> Detector data processing function Signal control based on traffic condition 	<ul style="list-style-type: none"> Installation of vehicle detector 	<ul style="list-style-type: none"> Core area (approx. 100 signals)
2	No change but coverage area will be expanded.	Same as above	Intermediate area (approx. 150 signals)
3	No change but coverage area will be expanded.	Same as above	Outer area (approx. 150 signals)

6. Traffic Signal : Pilot Signal Project (4/4)

- A pilot signal project is planned to demonstrate new signal control technology.
- Autonomous signals that are not connected to centre but coordinate each other and adjust signal timing by themselves will be introduced.
- Candidate location: Yelahanka New Town and ()



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(Source: JICA Study Team)

7. Common Card: Benefits of Common Card (1/11)

The advantages of using smart card

- Higher Security
 - Safe independent data storage on one single card
 - Protection against duplicating or disrupting to information stored on the chip
- Higher Durability
 - Long life span of up to 10,000 read/writes before failure
- Faster Transaction
- Higher memory to handle a large volume of transaction



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(Source: JICA Study Team)

7. Common Card: Benefits of Common Card (2/11)

The reason why **common** smart card is convenient to use

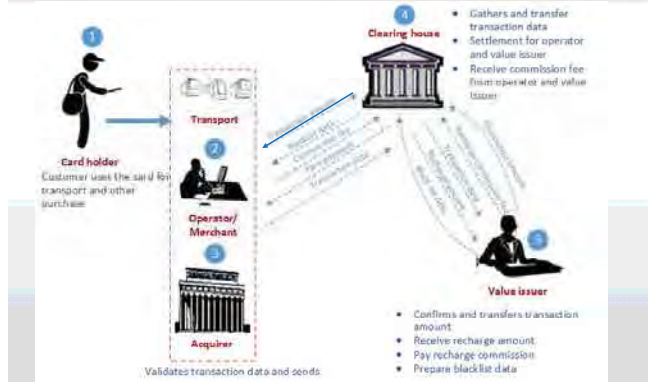
- Fast payment processing at entry/exit gate of transportation modes
- Sufficient memory for saving inter-modal travel records
- Flexible payment such as discounts
- Possible to change from zoning or fixed fare collection to distance-based fare collection
- Avoiding queue waits for tickets



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(Source: JICA Study Team)

7. Common Card: Roles of Participants (3/11)



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(Source: JICA Study Team)

7. Common Card: Current Status of Card Usage (4/11)

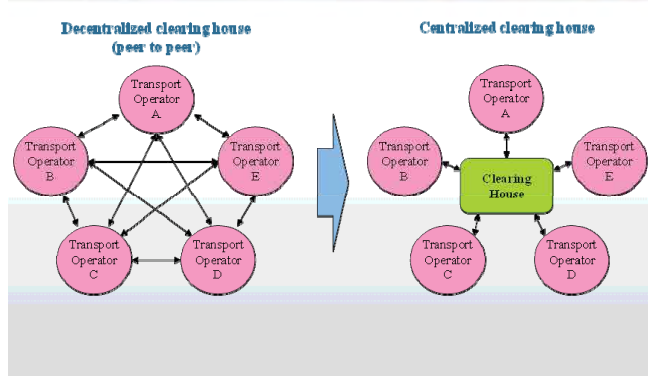
Function	Metro Rail (BMRCL)	City Bus (BMTCL)
Ticket Product	<ul style="list-style-type: none"> • Single Journey Ticket • Monthly Pass 	<ul style="list-style-type: none"> • Single Journey Ticket • Daily Pass • Monthly Pass
Smart Card Type	<ul style="list-style-type: none"> • Mifare DESFire • ISO 14443 Type A • Memory Size is 4 Kb 	<ul style="list-style-type: none"> • NPCI based standard framework which expected to be released by end of July 2014
Smart Card Format	Proprietary	NPCI standard
Vendor	Samsung	Axis Bank



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(Source: JICA Study Team)

7. Common Card: The Importance of Clearinghouse (5/11)



Page 30

(Source: JICA Study Team)

7. Common Card: The Importance of Clearinghouse (6/11)

	Peer to Peer Settlement Method	Centralised Settlement Method by Clearing House
Advantage	<ul style="list-style-type: none"> Simple system if the numbers of the operators are limited 	<ul style="list-style-type: none"> The data flow and settlement procedures are much simpler than the case of peer to peer settlement in the case of multiple participants Additional investment for new comer is smaller than developing his own settlement system.
Disadvantage	<ul style="list-style-type: none"> Scalability is complex 	<ul style="list-style-type: none"> New organization set up is required System is relatively complex

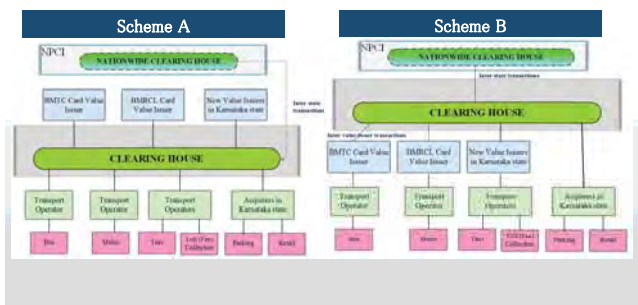
7. Common Card: Management Committee(7/11)

Roles of Management Committee

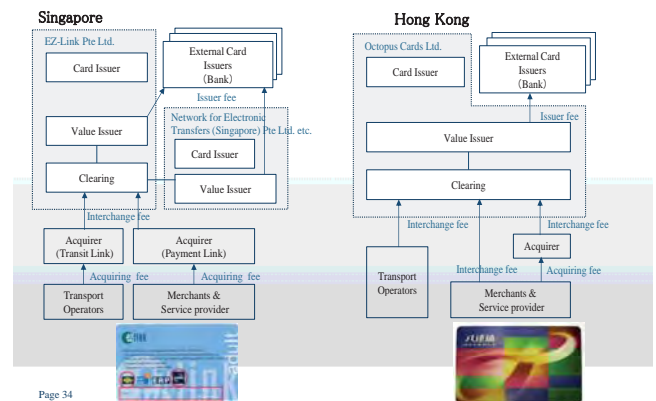
- To formulate business rules and regulations under which the interoperability is assured,
- To determine specification and security policy in line with the framework of NPCI,
- To prepare a rolling out schedule for establishing the clearing house,
- To make operation and maintenance plan of clearing house,
- To define data format for transaction,
- To determine interoperable tariff for transfer amongst different transport operators such as metro, bus, parking, toll road, etc.,
- To determine judgement of acceptance of new comers such as value issuers, card issuers, acquires, transport operators, retailers, etc. to join

7. Common Card: Business model of Clearing House (8/11)

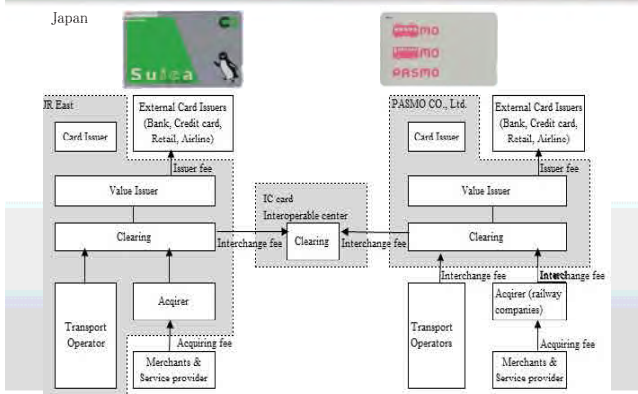
Comparison of 2 different business models



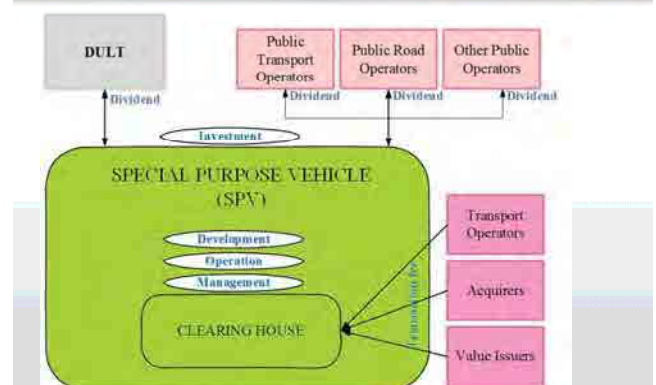
7. Common Card: Review of World Practice (9/11)



7. Common Card: Review of World Practice (10/11)



7. Common Card: Proposal for Clearinghouse in Bengaluru (11/11)



ITS Master Plan for Hyderabad and Bengaluru Metropolitan Cities

December 2014
JICA Study Team

(Source: JICA Study Team)

Table of Contents

1. Introduction to JICA
2. Target Cities
3. National Level: Current Condition and Issues
4. ITS Master Plan formulation
5. Proposed ITS Master Plan for Hyderabad
6. Proposed ITS Master Plan for Bengaluru
7. Conclusion

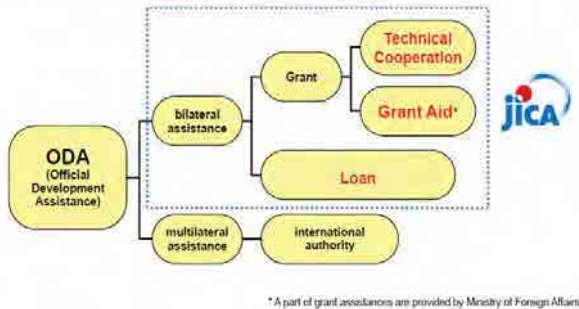
(Source: JICA Study Team)
Page 2

1. What is JICA? (1/3)

Japan's Official Development Assistance (ODA)

What is "JICA"?

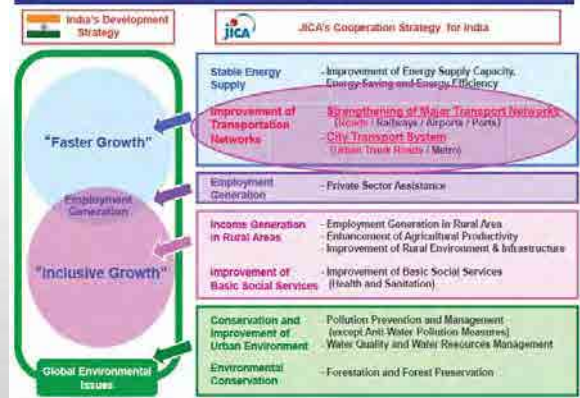
- ✓ the World's Largest Bilateral Development Agency
- ✓ India is the largest partner for JICA



(Source: Seminar on Highway Development and Intelligent Transport Systems (ITS) in Chennai, India, JICA, 2014)
Page 3

1. What is JICA? (2/3)

JICA's Cooperation Strategy for INDIA



(Source: Seminar on Highway Development and Intelligent Transport Systems (ITS) in Chennai, India, JICA, 2014)
Page 4

1. What is JICA? (3/3)

JICA's Cooperation in Transport & Urban Infra Sector



(Source: Seminar on Highway Development and Intelligent Transport Systems (ITS) in Chennai, India, JICA, 2014)
Page 5

2. Target Cities

- New Delhi
- Ahmedabad
- Hyderabad
- Bangalore
- Mysore
- Chennai
- Indore
- Mumbai
- Pune



(Source: JICA Study Team)
Page 6

3. National Level: Current Condition and Issues

Major Identified Issues: National Level

1. Regional Issues

- 1-1 Establishment of transportation system which enables to address excessive concentration of urban population

2. Transportation Issues

- 2-1 Road capacities are saturated in core areas of mega cities
- 2-2 Insufficient spaces for parking with increasing number of vehicles
- 2-3 Insufficient public transport network and connectivity amongst different transport mode
- 2-4 Heterogeneous traffic and large proportion of 2 and 3 wheelers
- 2-5 Improper road alignment and intersection structures
- 2-6 Absence of road infrastructures for pedestrian

3. National Level: Current Condition and Issues

Major Identified Issues: National Level

3. ITS Related Issues

- 3-1 Absence of clear vision of national ITS policy, National ITS Master Plan
- 3-2 Absence of National ITS Architecture
- 3-3 Some ITS related systems are being implemented, but they are not integrated.
- 3-4 Absence of basic road and traffic data/information, thus proper road and traffic management is difficult
- 3-5 Enforcement systems are in place in some cities, but tracking of violated vehicles is difficult
- 3-6 The proper measures to reduce the accidents are difficult due to absence of accident analysis
- 3-7 Absence of proper management of ITS facilities

3. National Level: Current Condition and Issues

Major Identified Issues: National Level

4. Institutional Issues

- 4-1 Some ITS facilities are being prepared, but they are not well coordinated for planning and implementing
- 4-2 Absence of sufficient institutional structure for initiating ITS at both national and state level

4. Master Plan formulation

1. Objective and Scope of Study
2. Study Area
3. Study Methodology
4. Issues
5. Required Measures
6. Proposed ITS components

4.1 Study Objectives and Major Outputs

To Assist State Government / City Authorities to Improve and Modernize Transportation System by;

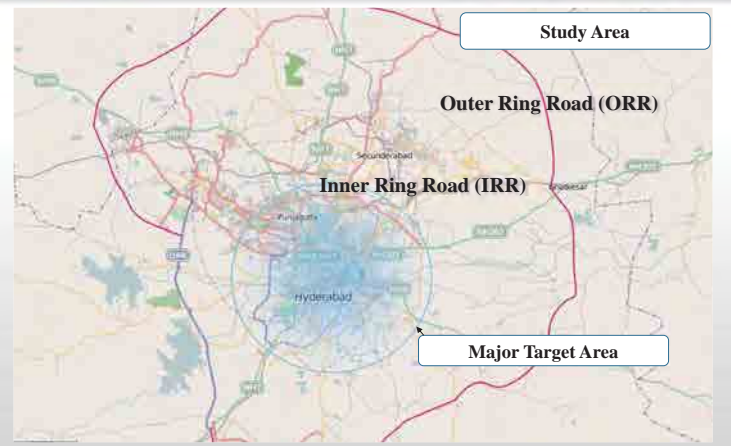
1) Formulation of ITS Master Plan

2) Basic Design of Pilot Project

3) Organization Set Up for Individual ITS Menus

4) Capacity Building

4.2 Study Area (Hyderabad)

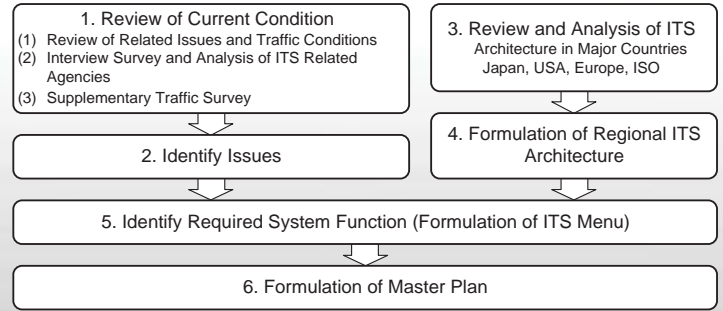


4.2 Study Area (Bangalore)



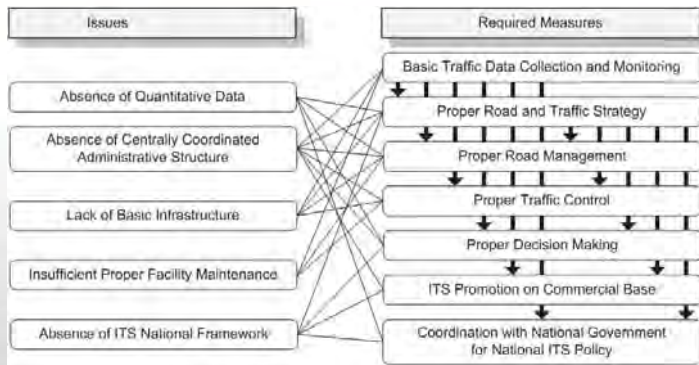
4.3 Study Methodology

Methodology for ITS Master Plan Formulation



4.4 Issues and Required Measures

Establishment of ITS Centre



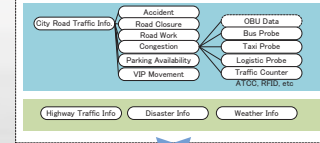
ITS Centre will be established to tackle the issues and realise the measures above

4.5 Study Policy (1/2)

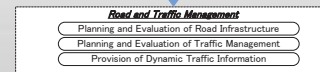
Policy 1: Effective Use of Road and Traffic Data for Appropriate Road Traffic Management

- Quantitative Comprehension of Traffic Conditions
- Aggregation and Utilisation of Data and Information Necessary for Road Traffic Management and Users

Road Traffic Information: Collection, Accumulation and Analysis

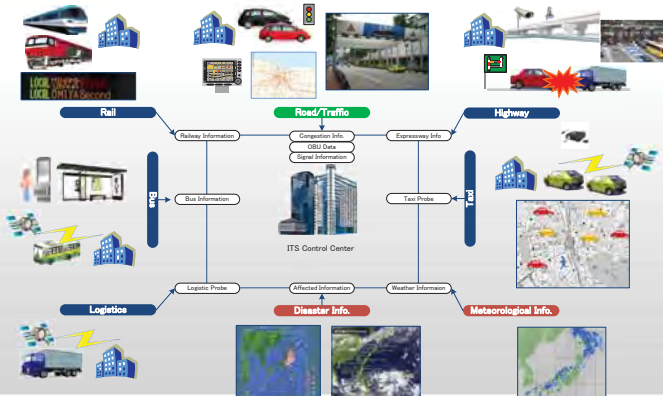


Aggregate and Analyse



4.5 Study Policy (2/2)

Policy 2: Integration of ITS



4.6 Proposed ITS Components for Hyderabad

Major ITS Components for Consideration of Study

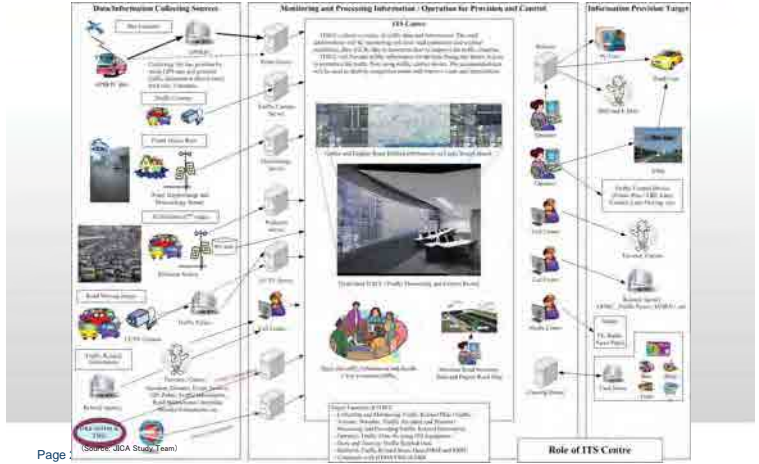
- ITS in the City (City ITS Centre)
- ITS for Outer Ring Road
- Highway Traffic Management System
- Toll Management System
- Vehicle Tracking System on Buses

5. Proposed ITS for Bengaluru

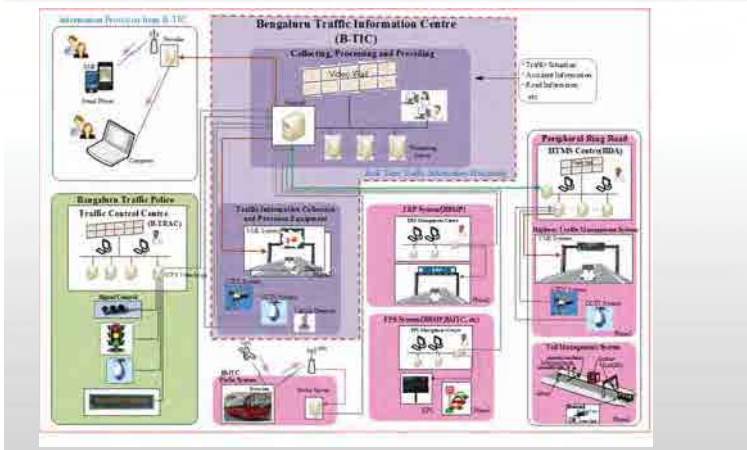
1. Bangalore Traffic Information Centre
2. ITS for PRR: Highway Traffic Management System
3. ITS for PRR: Toll Management System
4. Signal Control System
5. Electronic Road Pricing System
6. Common Mobility Card

6. Details of Proposed ITS Components

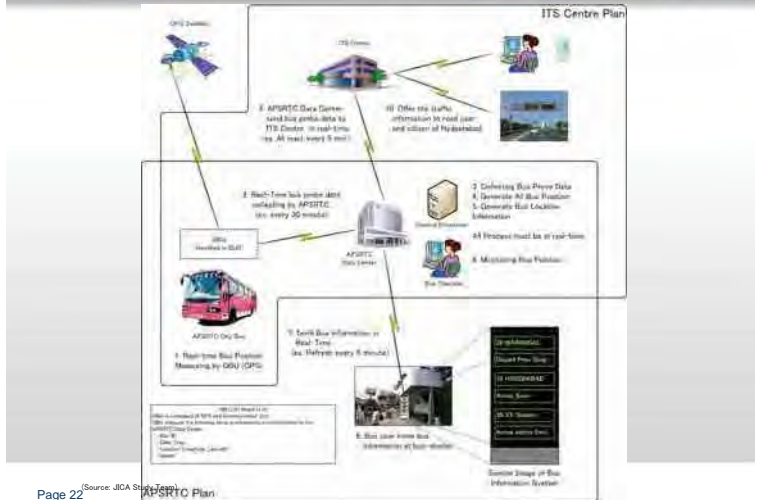
1. Information Collection and Dissemination (Hyderabad City ITS centre)



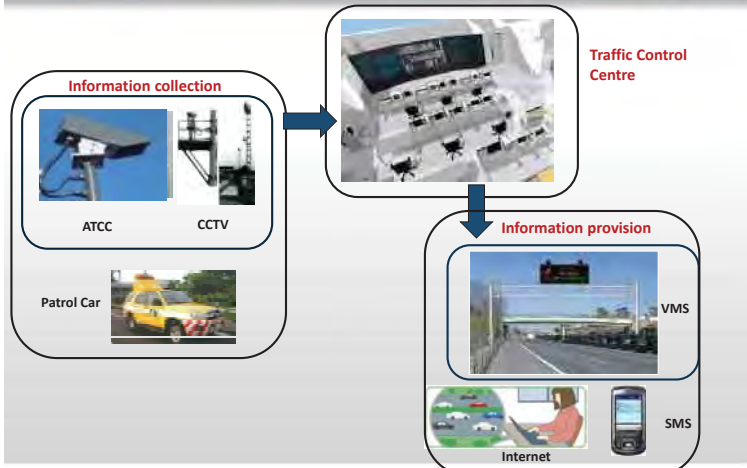
Bangalore Traffic Information Centre



Vehicle Tracking System on Buses



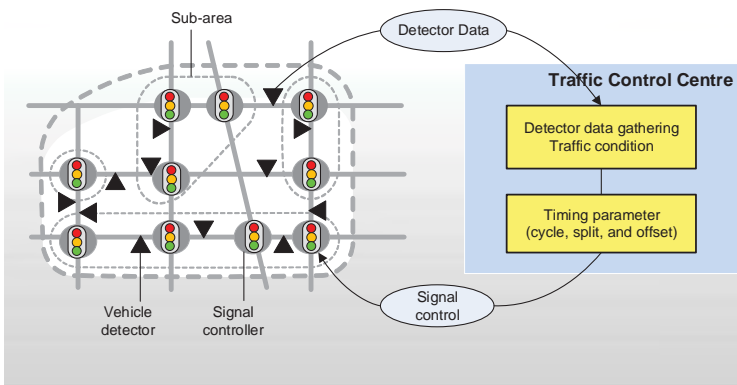
ITS for PRR: Highway Traffic Management System



ITS for PRR: Toll Management System



Signal Control System



Common Mobility Card and Clearing House



7. Conclusion

- ✓ Firm Commitment of local Govt. for Implementing ITS Envisaged by Master Plan
- ✓ Development and Improvement of Transport Infrastructure Together with ITS
- ✓ Incorporating ITS Master Plan into Transport Plan in respected cities
- ✓ Adopting New Technologies
- ✓ Revising ITS Master Plan
- ✓ Continuous Promotion of ITS and Harmonising with ITS National Policy
- ✓ Capacity development
- ✓ Establishment of Strong Central Body
- ✓ Strengthening Drivers'/Pedestrians' Education and Enforcement of Traffic Rules and Regulations
- ✓ Standardising Motor Vehicle Number Plate and Improvement of Vehicle Registration

THE MASTER PLAN STUDY ON ITS IN BENGALURU AND MYSORE

December 2014

JICA Study Team

Regional Traffic/Transport Issues

1. Rapid growth of urban population and vehicles
2. High proportion of motorcycle and heterogeneous traffic composition, heavy traffic volume, chronic traffic congestion.
3. Many one way roads which cause complexity for road users
4. Insufficient connectivity between different transport mode
5. Large proportion of road transport mode usage
6. Many level-crossing of railway
7. Lack of public transport information
8. Improper location of bus stops
9. High number of road traffic accidents



(Source: JICA Study Team)

Road Infrastructure/Facilities & Traffic Manners Issues

1. Lack of road infrastructure to accommodate the traffic demand
2. Improper design of junctions/intersections
3. No sufficient maintenance of road and systems
4. Absence of data base for planning/traffic such as road inventory
5. Insufficient coordination for traffic management
6. Lack of engineering experience
7. Absence of standard No. plate and vehicle database
8. Lack of facilities for vulnerable
9. Lack of traffic discipline



(Source: JICA Study Team)



Please Look at reference document

Goals and Objectives of ITS

No.	Goal	Objectives
1	Safety	<ul style="list-style-type: none"> To reduce risk in transportation To reduce traffic accidents To enhance communication and response in emergency To reduce damage in disaster
2	Environment / Energy	<ul style="list-style-type: none"> To reduce air pollution To reduce CO₂ emissions To reduce energy consumption
3	Productivity	<ul style="list-style-type: none"> To increase national or regional economic output through efficient utilisation of transport facilities
4	Accessibility	<ul style="list-style-type: none"> To increase efficiency in reaching destination To provide travel information To enhance intermodal connectivity To reduce travel time To reduce travel costs To give care to disabled people
5	Efficiency	<ul style="list-style-type: none"> To invest efficiently in traffic related infrastructure To increase efficiency in road use To reduce cost of road management To enhance appropriate management of ITS data To provide transport related payment

(Source: JICA Study Team)

Example of ITS Solution -1

Possible measures by Maximum Utilization of existing infrastructure

- Guiding violated parking vehicle to parking lot



Parking Availability Information



- Utilization of road infrastructure with flexibly



Reversible Lane

(Source: JICA Study Team)

Example of ITS Solution -2

Traffic Image Processing System

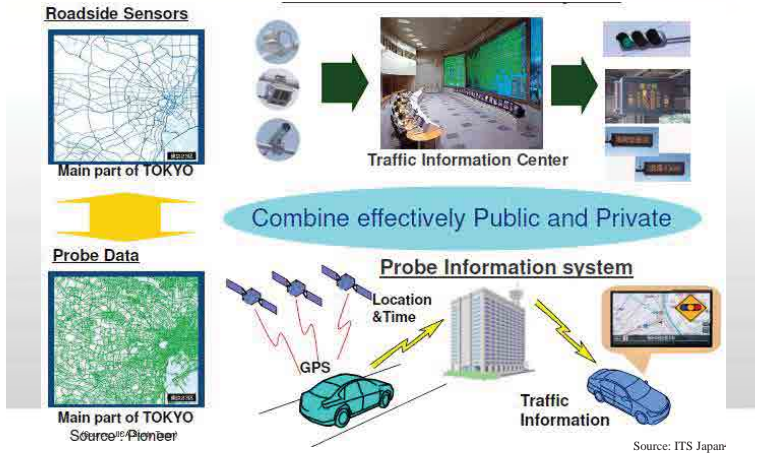


(Source: JICA Study Team)

Source: HITACHI

Example of ITS Solution -3

Promote the Chance to Select Alternative Route



Source: ITS Japan

Example of ITS Solution -4

Area Control by Signal Coordination

Systematical Signal Control

For safety and smooth flow, traffic signals are systematically controlled by measuring and predicting traffic flow.



Source: ITS Japan

Example of ITS Solution -5

Provide More User Friendly Information

Displaying Time to Destination and Alternative



Highway Radio



Information Terminal at Rest Area



Collection probe data through smart phone



(Source: JICA Study Team)

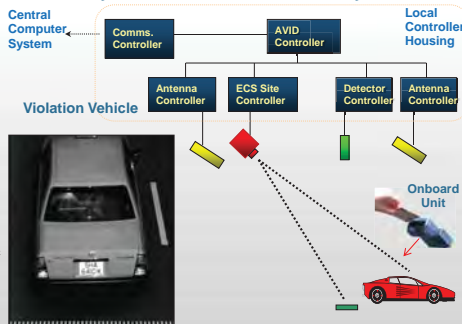
Page 10

Example of ITS Solution -6

Enhance the Modal Shift

Electronic Road Pricing System

A System Architecture of the ERP System



Travel Demand Management

- Better management of traffic demand / city congestion
- Drivers pay for the use of congested roads
- Fully automatic deduction of a fee from vehicle's onboard unit/RFID
- Charging fee(s) could vary with time of day (peak/non-peak hour)

(Source: JICA Study Team)

Source: Mitsubishi Heavy Industry

Example of ITS Solution -7

Comfortable Modal Shift

Various Way to Use single Smart Card



(Source: JICA Study Team)

Example of ITS Solution -8

Advantage of ETC



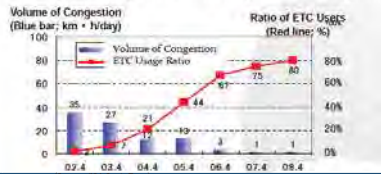
31% of congestion is due to inadequate capacity at toll plazas.



Fig. Causes of congestion on expressways



Trends in ETC usage rates and congestion at tollgates

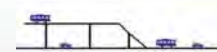


Source: MLIT (Ministry of Land Infrastructure & Transport, Govt. of Japan, 2009)

Example of ITS Solution -9

BRT Guideway Bus (Dual mode BRT)

When bus is running on elevated level, bus will lead by guide rail installed left side crash barrier without handling.



Example of ITS Solution -10

Promote the Mobility Sharing



Mainly for tourist



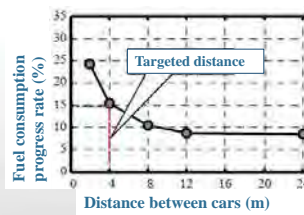
Autolib (EV Sharing)

Multi-Mobility Sharing

Example of ITS Solution -11

Vehicle Platooning

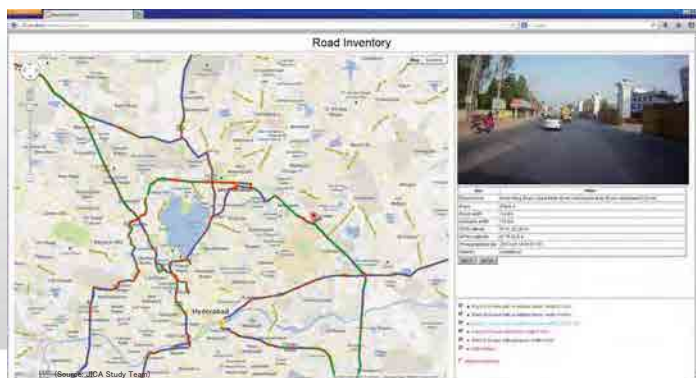
Platooning Vehicles reduce the fuel consumption by reduction of air resistance



Example of ITS Solution -12

Road Inventory

No basic data for road cannot make adequate planning and maintenance of road.



Example of ITS Solution -13

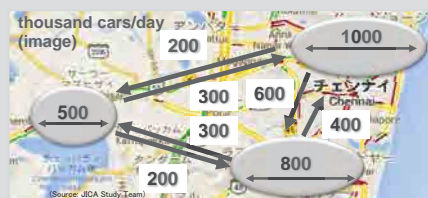
City Transport Planning

Person trip data collection by smart phone



Collect person trip data easier and cheaper by Hitachi's smart phone user's transportation mode automatic classification technology.

Collect actual OD data for make an efficient city transportation plan.



OD analysis / City transportation planning

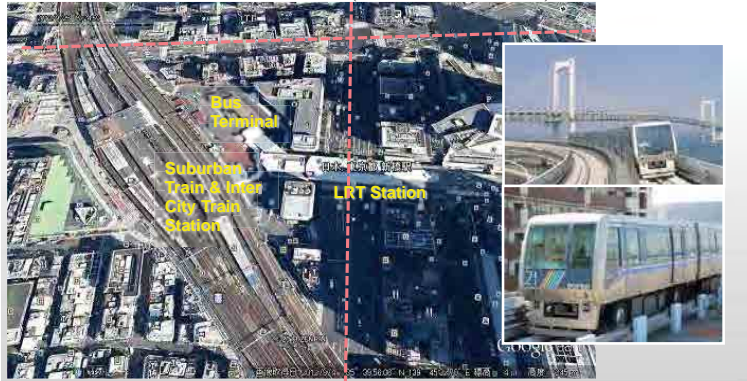


- Expressway
- Bus, BRT
- Metro, LRT, Monorail

Example of Inter-modal Connectivity

Comfortable Modal Shift

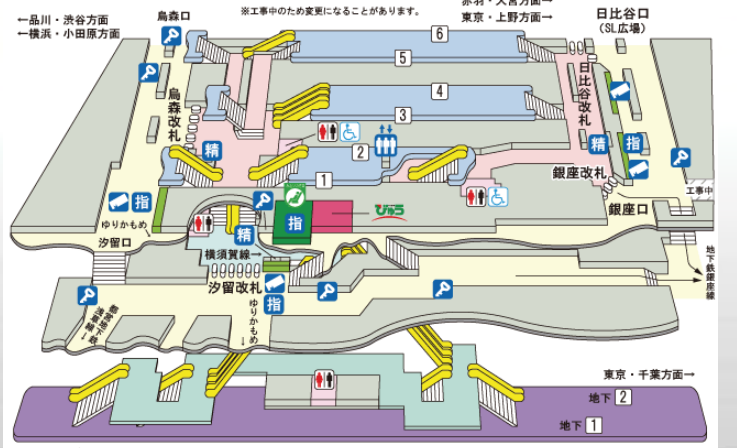
Various Modes are Within Walkable (ex: Shinbashi Station)



Connecting 2 Underground Metro Lines

(Source: JICA Study Team)

Example of Inter-modal Connectivity



(Source: JICA Study Team)

©KOTSUSHIMBUNSHA

Example of ITS Solution -

<https://www.youtube.com/watch?v=k-aMerrKPgl>

(Source: JICA Study Team)

Thank You for Your Attention

Page 22 (Source: JICA Study Team)