

SESSION IV

Financing Urban Transport Infrastructure in Mega-cities

Towards Sustainable Urban Mobility

Dr Pawan Maini
Senior Industry Specialist

Why is Urban Transportation Financing Challenging?

- Multiple government agencies involved
- Variety of direct and indirect fees
- Farebox revenues typically insufficient for project cost
- No clear mechanism for private sector participation
- Appropriate risk allocation between private and public sector



What do these Challenges Result in?

- Insufficient funds for both capital and O&M expenses
- Inadequate provision of services – both for private and public transport
- No clear mechanism for improvements
- Hesitancy from private sector to get involved



International
Finance Corporation
World Bank Group

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Why Private Sector Participation?

- Not necessary to increase public expenditures for infrastructure
- Incentive for private firm for good construction quality
- Cost-based user fees easier to justify for private infrastructure
- Positive distributional impacts (those who benefit, pay)
- Market mechanisms guide project selection



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Generating Funds for Urban Transportation

- Property Development
- Advertising
- Services
 - At stations
 - On public transport
- Transferrable development rights
- Allied transportation services
- Entry toll
- Toll roads
- Leveraging lending



Success at Implementation

- Think
- Plan
- List and manage risks
- Detailed scheduling



IFC Experience

- Bangkok Skytrain
- IAMS/DTM Bus Operator
- Guatemala BRT
- Marcopolo Buses
- Istanbul Metro



Bangkok Skytrain

- \$ 1.5 billion - 23 km elevated train
- Concession won by Tanayong Corporation (real estate developer)
 - Siemens (railway technology)
 - Ital-Thai (contractor)
- Completed in 1999 after significant delays
 - Initial schedule of 42 months unachievable
 - Utilities relocation in downtown - longer
 - Depot location change - environmental concerns
 - Automatic fare collection system
 - Asian financial crisis (1997-98)
- IFC - \$ 100 million equity - key role in project financing





Issues Faced & Lessons Learned

Cost Overrun	• Provide for adequate cost overruns • Ensure promoter guarantee for cost overruns • Even in US, 36% of all projects face cost overruns
Opening ridership 200,000 against forecast of 570,000	• Thorough traffic demand modeling required • Extremely challenging for greenfield projects; few reach expectation
Project Design	• Proper emphasis to enviro/public concerns (Depot relocation -central public park) • Impossible schedule • Insufficient data (utilities)

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Guatemala - Municipality of Guatemala City

Risk-sharing agreement for single credit exposure

- Financed critical urban transport infrastructure that reduced travel times and congestion in one of the largest cities in Central America.
- Improved lives of 180,000 daily users, many of whom in poorest segments and depending on public transportation to reach their employment.
- Introduced a new source of commercial funding that does not rely on sovereign guarantee, for municipalities in Central America.
- Enhanced municipal financial management practices and diversified funding sources through WBG technical assistance.
- Created an entry point for a leading Guatemalan bank to participate in the municipal financing business.

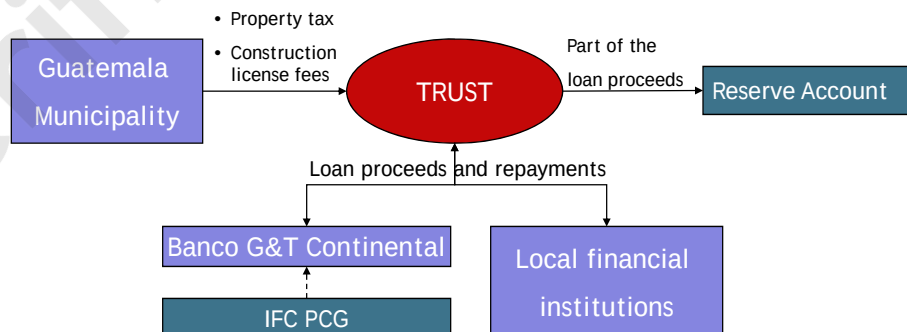
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Guatemala BRT - Financial Structure

- **10-year syndicated loan** for Q279 million (US\$36.7 million) secured by a mechanism that aggregated property taxes and construction licenses in a separate trust account to service specific Municipality of Guatemala City debt.
- A **local currency loan** from Banco G&T Continental for Q72 million (US\$9.5 million)
- **Risk-sharing agreement** for single credit exposure for 70 percent of the total bank exposure of Q72 million (US\$9.5 million).

Guarantees - Risk-sharing on a loan + trust arrangement

- Risk sharing facility for 70% of the exposure to a local Bank to finance a municipal urban transport infrastructure project.



10 Principles for transport in urban Life

Shreya Gadepalli

INSTITUTE FOR TRANSPORT AND DEVELOPMENT POLICY

The Mother Principle
India is a DEMOCRACY

Constitution of India

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

- ✓ **JUSTICE, social, economic and political;**
- ✓ **LIBERTY** of thought, expression, belief, faith and worship;
- ✓ **EQUALITY** of status and of opportunity; and to promote among them all
- ✓ **FRATERNITY** assuring the dignity of the individual and the unity and integrity of the Nation;

BIRDS = FLY

FISH = SWIM

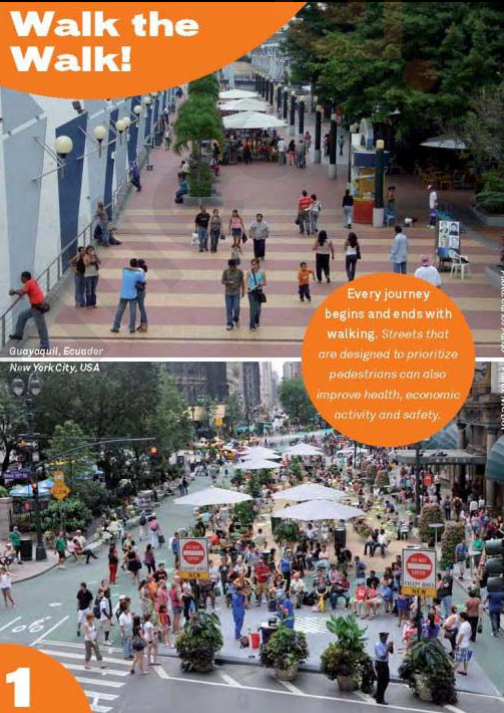
MAN = ?



MAN
WAS BORN
SO HE COULD
WALK!

WOMEN TOO!

Walk the Walk!



Guayaquil, Ecuador
New York City, USA

Every journey
begins and ends with
walking. Streets that
are designed to prioritize
pedestrians can also
improve health, economic
activity and safety.

1

Walk the walk!

Walking is the most universal
form of transport. Great cities
start with great pedestrian
environments.

There is much more to walking -than walking!



A mode of transport - but with a potential for much more –
and the 'much more' is by far the more interesting part!

You can walk -and walk - and walk....



-but you could just as well "walk`n-talk"



-or you can "stop-n-talk"



-or you can "stop-n-watch"



and watch-n-watch"



-or "watch-n-learn"



You can
"play-n-laugh"



-or "sit-on-top"



-or you can "walk-n-dance"



-or you can "stop-n-snooze"



-and whenever you
feel like
you can even address
your fellow citizens!

Beyond survival needs, there are
HAPPINESS NEEDS.

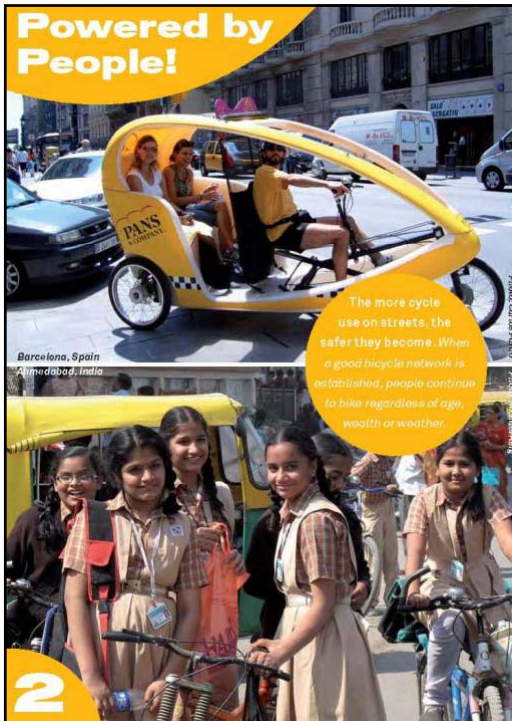
We are pedestrians. We need to walk,
and be outdoors, not in order to
survive, but to be happy.

In terms of infrastructure what makes an
advanced city are not highways or subways
but great footpaths.









2

Powered by people!

Bicycles and other means of people-powered transport, like rickshaws are great for short trips. Building bike lanes and slowing down traffic are key to making it safe.



Or has it really???





Why do Danes cycle?

1%

state that it is
because of the
environment

6%

state that it is
because it is cheap

19%

state that it is
because of the
exercise

61%

state that it is
because it is
convenient, fast
and easy

Copenhagen Bicycle
Account 2006





RAMPS FOR BICYCLES



3

Get on the bus!

Mass transit can move millions of people quickly and comfortably using a fraction of the fuel and street space required by automobiles.

Cars are wonderful but they don't function well if we all decide to use them simultaneously at peak hours



The only solution is public transport, not just for those with lower incomes, but for everybody.

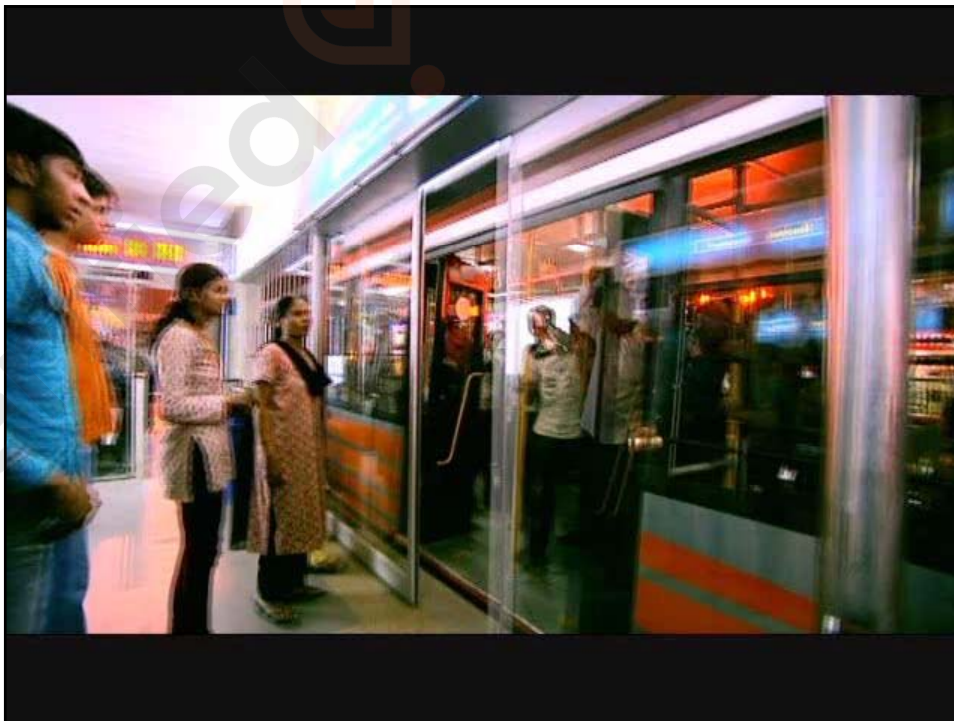


What is Bus Rapid Transit (BRT)?



Bus Rapid Transit is *high-quality, customer-orientated transit* that delivers *fast, comfortable and low-cost urban mobility*.

It is not business as usual.

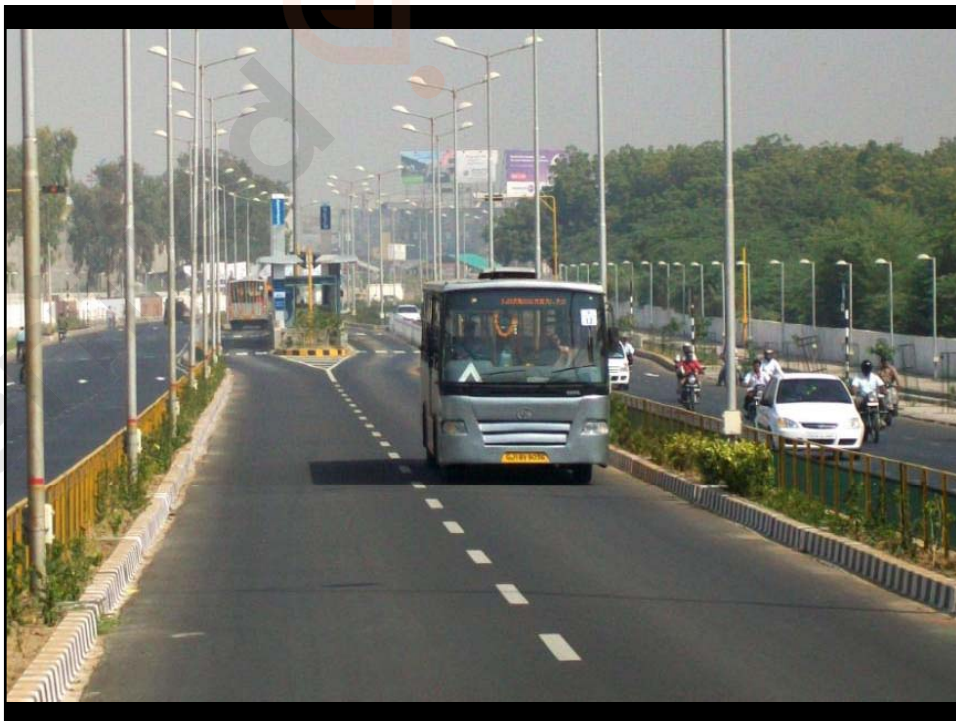


“Think rail, use
buses!”



Bus Rapid Transit can give the same quality of service as Metro to a large number of citizens across the city at relatively low cost.

Our cities should have a few hundred kilometers of MRT in the form of BRT by itself or in addition to Metro









But BRT is only possible on wide roads?



Not really. There are many examples of BRT on narrow streets.

Traffic jams without public transport are relatively useless;

So is public transport without traffic jams or some other form of automobile use restriction.



4

Cruise control

By managing private car use, cities can minimize problems while creating space for pedestrians, mass and non-motorized transit.

Quality public transport is necessary
but not sufficient.

Private vehicle use must be
restricted.





Parking
is not a constitutional right
in any country



The biggest threat
to green spaces and parks in our cities
is parking



DUMBO, Brooklyn

Before: Community leaders requested more open space for a burgeoning residential and commercial district.
 After: DOT reclaimed road space to create a new public plaza.



BEFORE



AFTER



PARKING - MYTH vs REALITY

MYTH

On-street parking is a public right!
Government should provide it.

REALITY

- ✓ Parking is private need of private individuals that should be dealt with in the private realm.
- ✓ Vehicles are parked for 96% of the time. They often occupy 50% of street space. It's a wasteful use of streets and public space.

PARKING - MYTH vs REALITY

MYTH

Multi-storey parking will solve the problem

REALITY

- ✓ Unless parking on streets is restricted, multi-storey parking doesn't work.
- ✓ Parking fee should pay for the cost of creating multi-storey parking.

PARKING - MYTH vs REALITY

MYTH

The solution to parking problem is more parking

REALITY

- ✓ More parking means more vehicles are attracted to use the road resulting in more congestion and poor mobility for all.

PARKING - MYTH vs REALITY

MYTH

Builders should provide necessary free parking

REALITY

- ✓ Parking space in building complex has a cost. Builders charge it one way or the other.
- ✓ Those households that do not want parking should have the opportunity to save money

One multi-storey
car parking space

=

One Low Income
Home

Who should get priority???

WHAT WILL HAPPEN WHEN YOU ARE
OFFERED LAND FOR FREE???

Parking has a cost

Rs 5000-15000 per month
per car parking

Rs 20-60 per hour!

Average space required per car in off-street multi storey parking is 250 sq ft.
Average occupancy of 80% during working hours on working days.
All costs are from Chennai city

Deliver the Goods!

Servicing the city in the cleanest and safest manner. Sustainable cities will be cleaner, quieter, and safer by creating eco-zones, slow speed zones, and regulating the times and places where goods can be delivered.

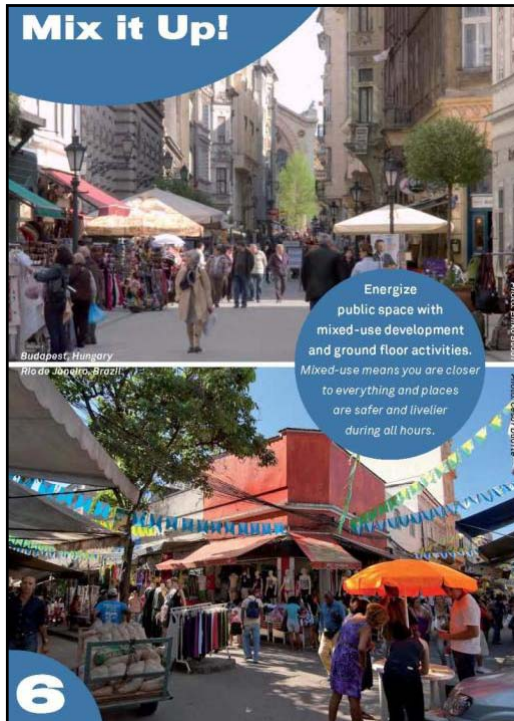
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Deliver the Goods!

Cities need to create incentives to use cleaner, smaller, quieter, slower and safer delivery vehicles.

Photo: La Petite Reine

An average delivery van weighs more than one metric ton, and delivers less than 100 kg of goods within a total distance of only 15 km. Cargocycles weigh only 100 kg, have a load capacity of 180 kg, and an autonomy of 30 km, making them much more efficient.

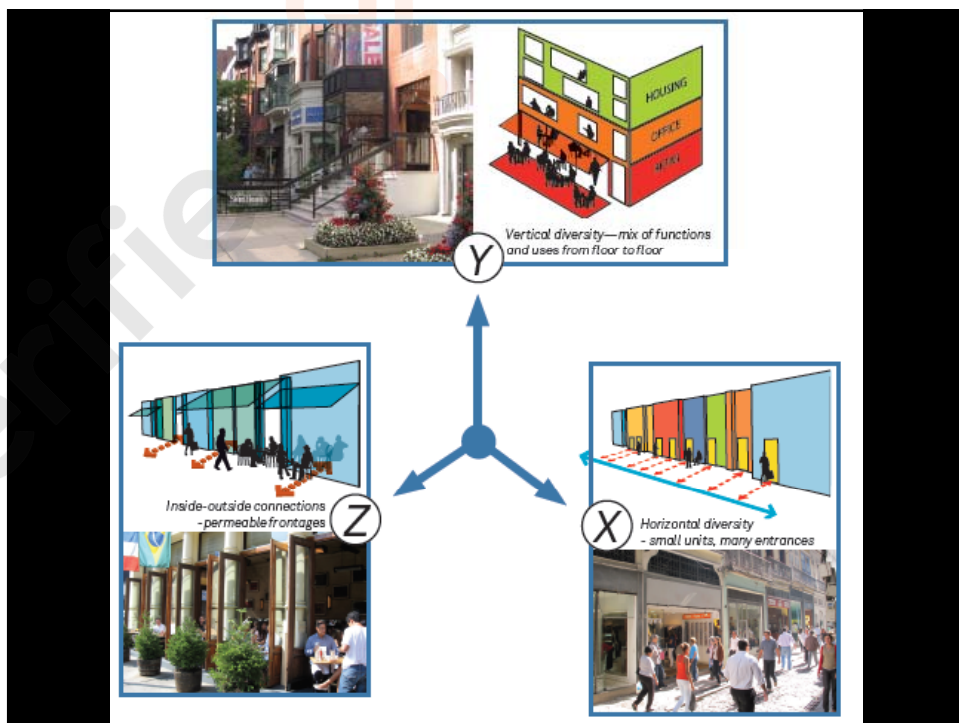


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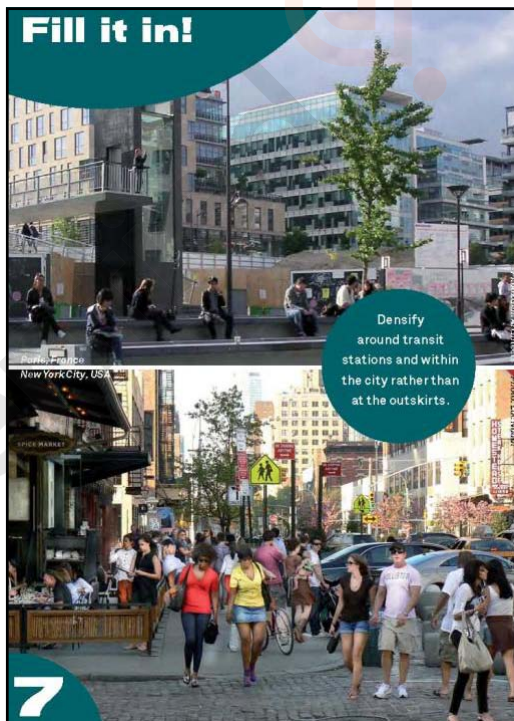
Mix it up!

Lively cities stack retail on the ground floor, with residences and offices above, so the streets are vibrant day and night.





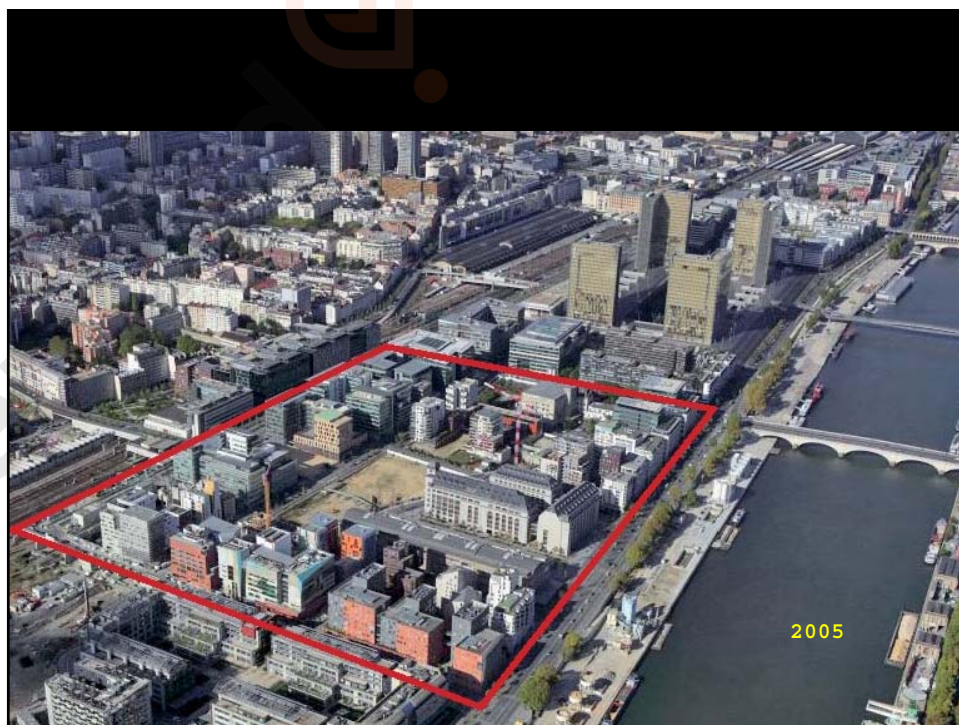
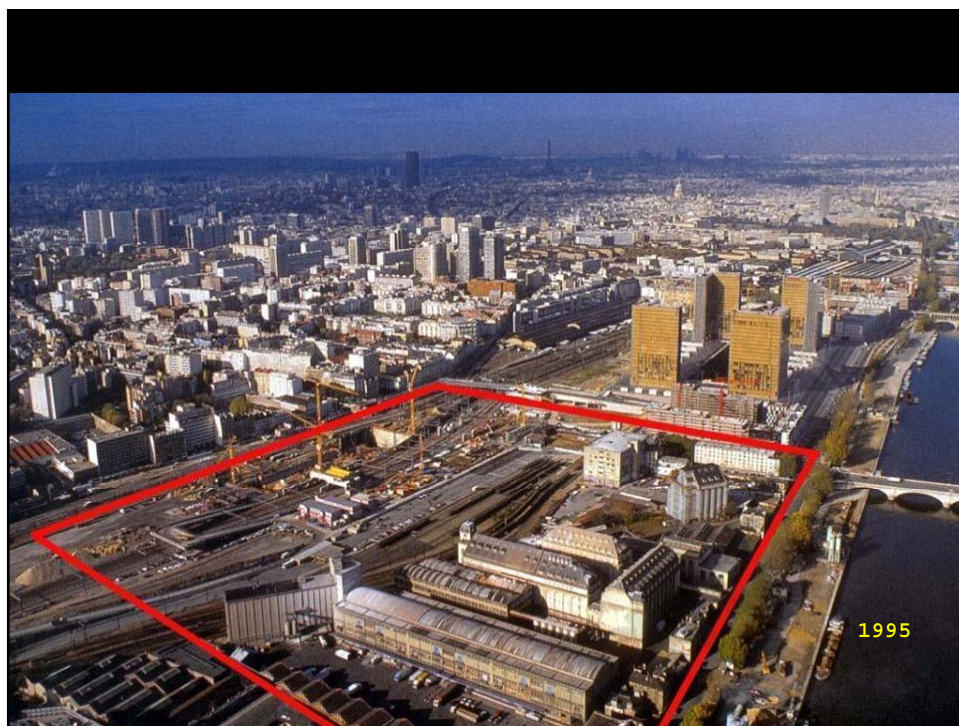




7

Fill it in!

Building on vacant lots and brown-fields prevents urban sprawl and makes urban neighbourhoods more vibrant.





8

Get real!

A community's history, natural environment and ethnic traditions all contribute meaningfully to what makes a place unique. Finding these elements and enhancing them is critical to distinguishing one place from another.

Get Real!

Distinguish by preserving and enhancing the natural, cultural, social, and historical assets of the place. In a globalized world, identity and cultural heritage becomes a competitive advantage.

Seoul, South Korea
Rio de Janeiro, Brazil

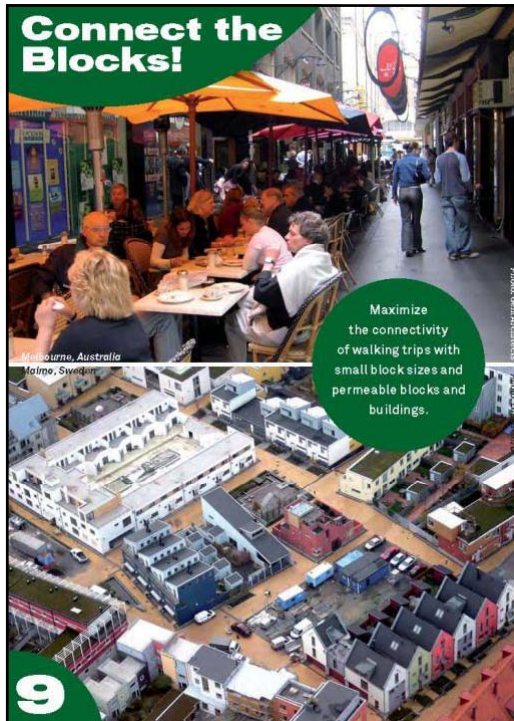
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Photo: Anuj Malhotra

Local markets reduce need for transport, while creating local jobs and a social forum. Ahmedabad, India.

Architectural heritage under restoration, Historic Center, Mexico City, Mexico.

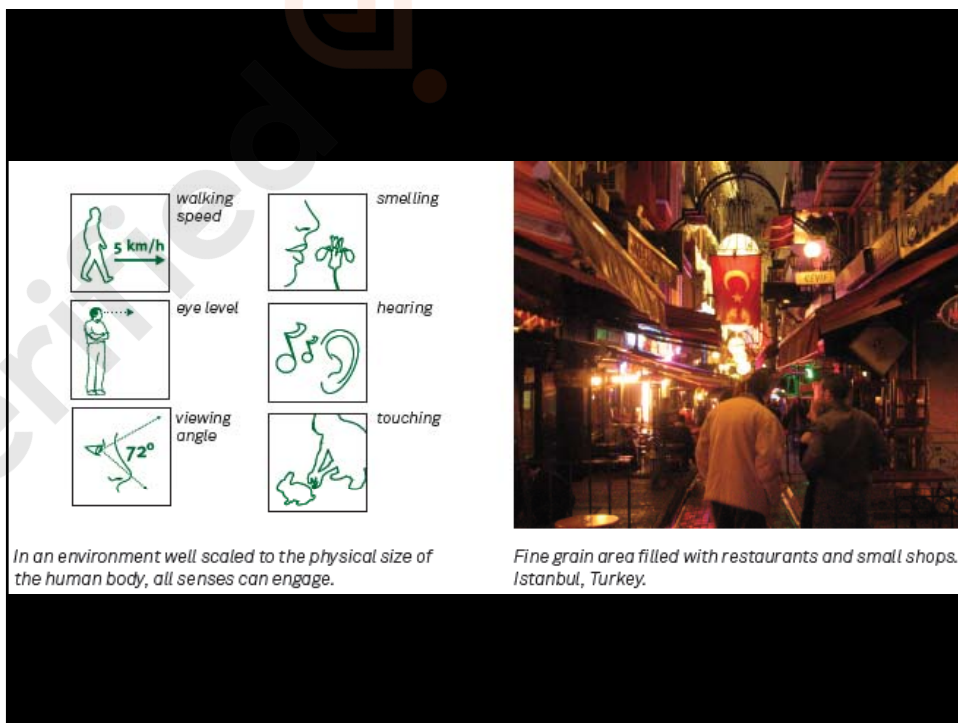


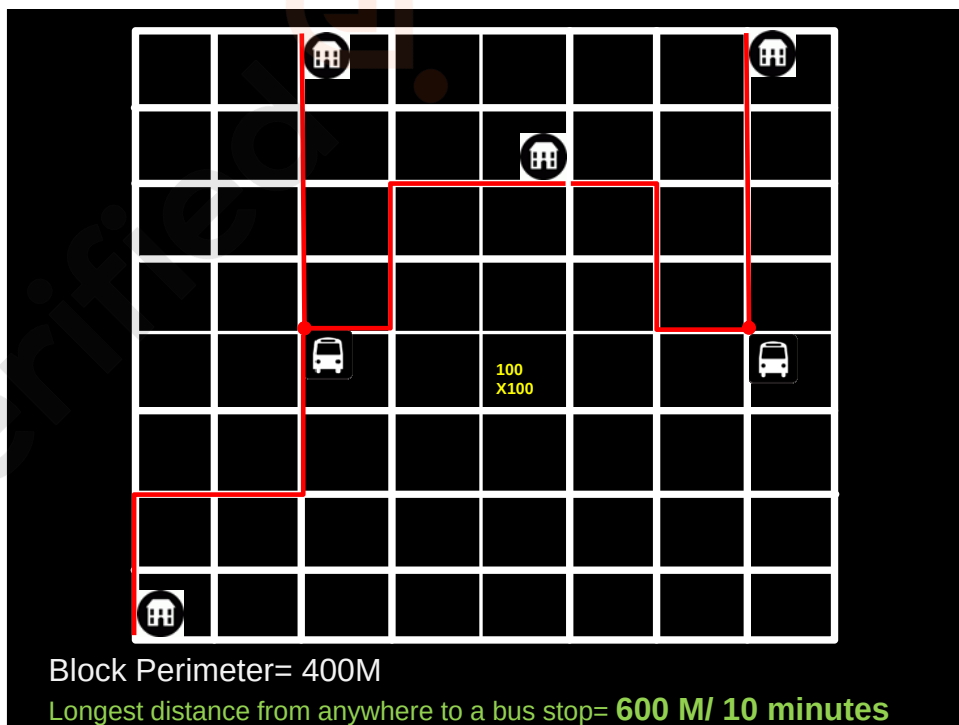


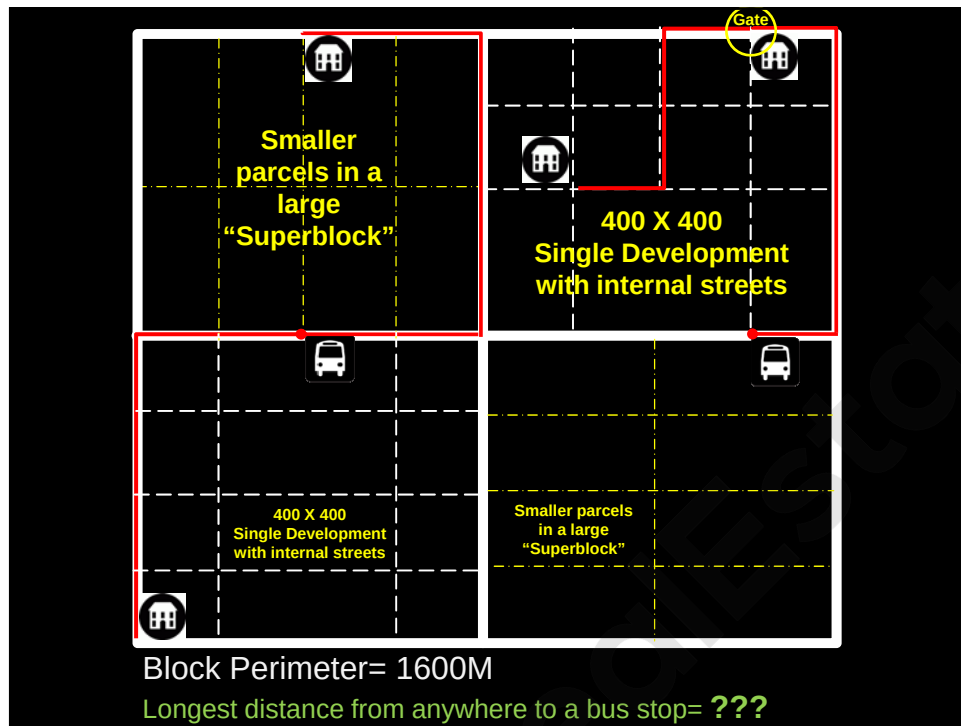
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Connect the Blocks!

The more connected the blocks, the shorter the distance between destinations, making walking and biking more appealing.







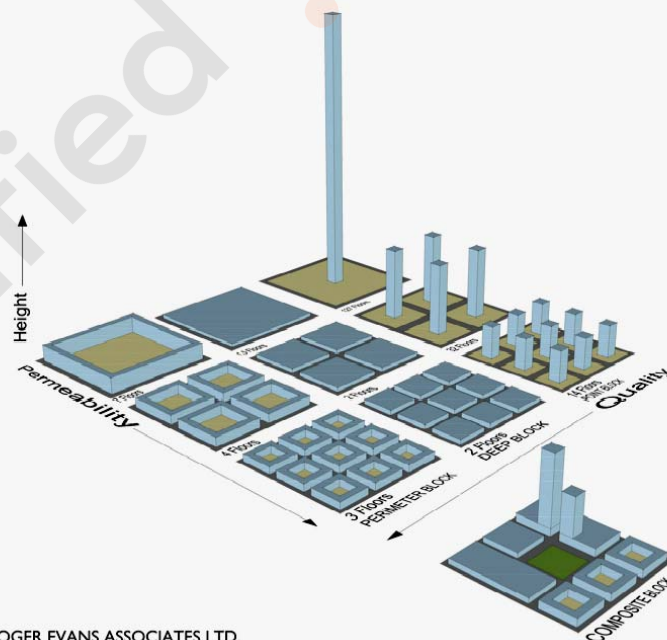




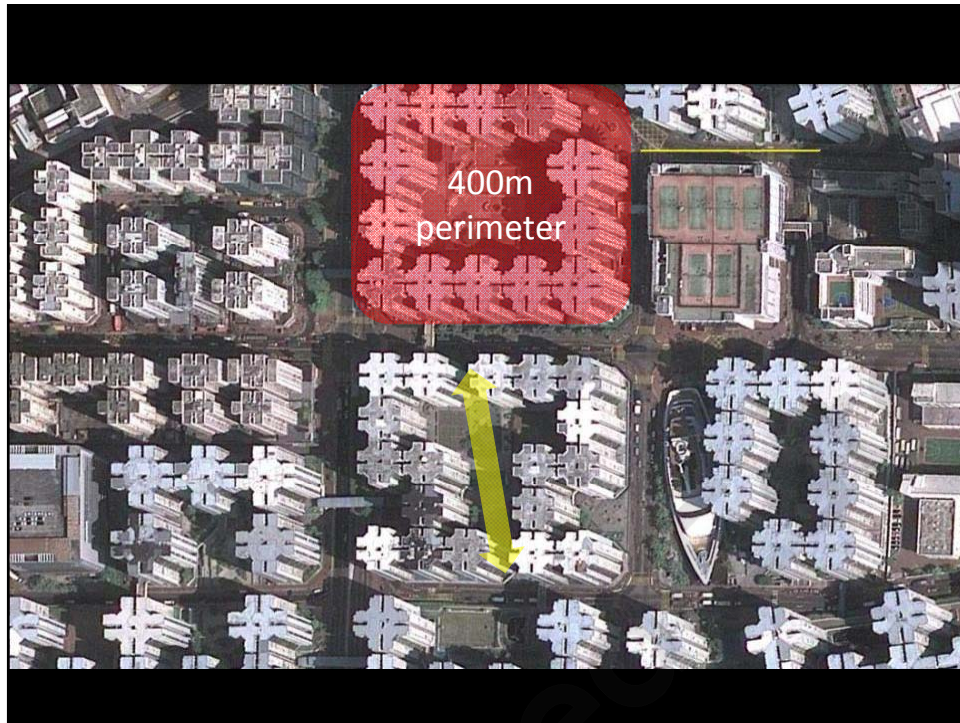
Density is necessary for efficient use of urban infrastructure.

Low density reduces opportunities, increases cost of services, stifles economy.

10 ways of delivering 3 hectares of land to achieve the **SAME** density



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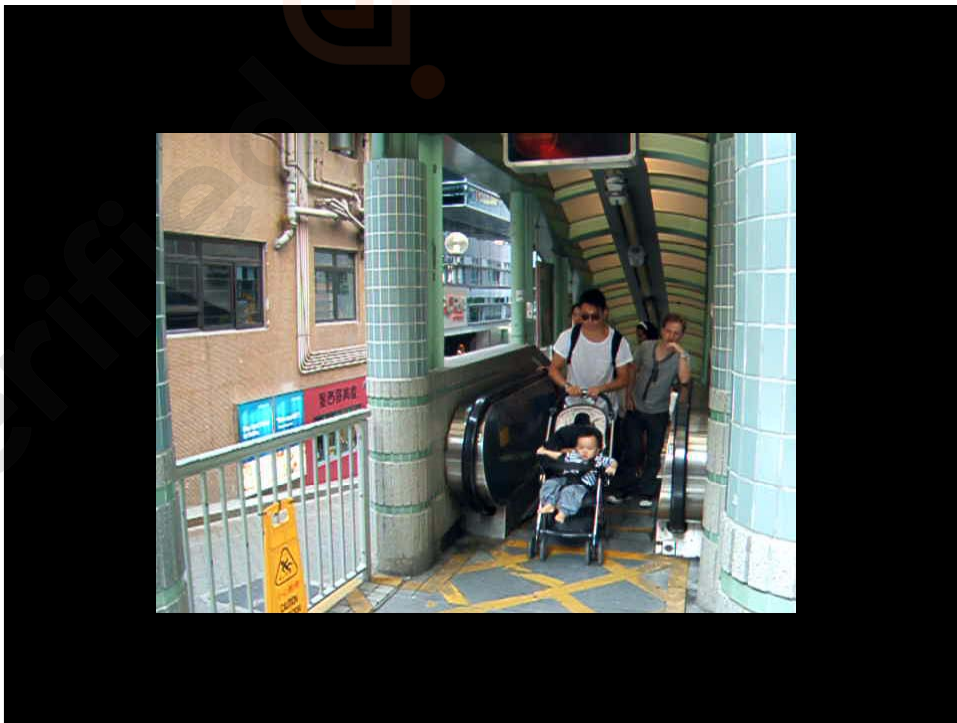


Pedestrian cut through encourage walking



Buildings do not end at the ground. Any new building must IMPROVE public pedestrian space quality around it.

Especially the big ones.



A self sustained township
within a city is a fantasy.

Over time, they make life difficult for
people and value starts degrading.



10

Make it last!

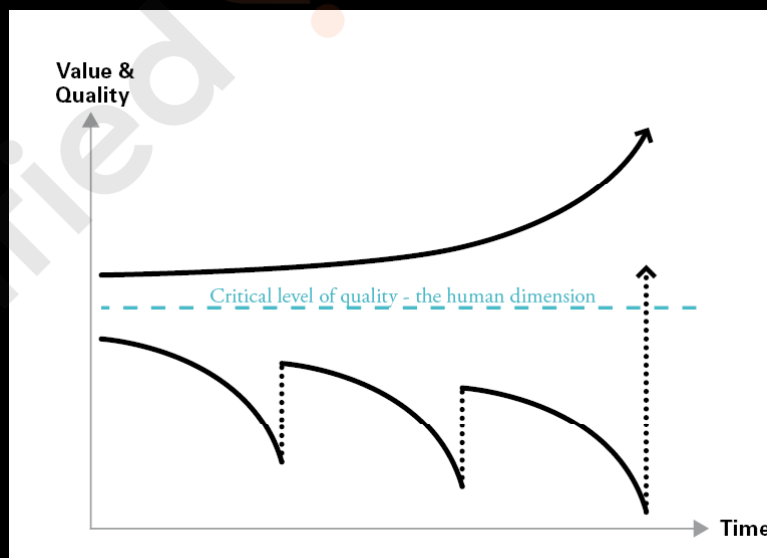
Streets and public spaces, if built with quality materials and are well-designed, well-maintained, and well-managed, can last for decades

Make it Last!

Build for the long term. Sustainable cities bridge generations. They are memorable, malleable, built from quality materials and well maintained.

New York, USA
Lyon, France

10



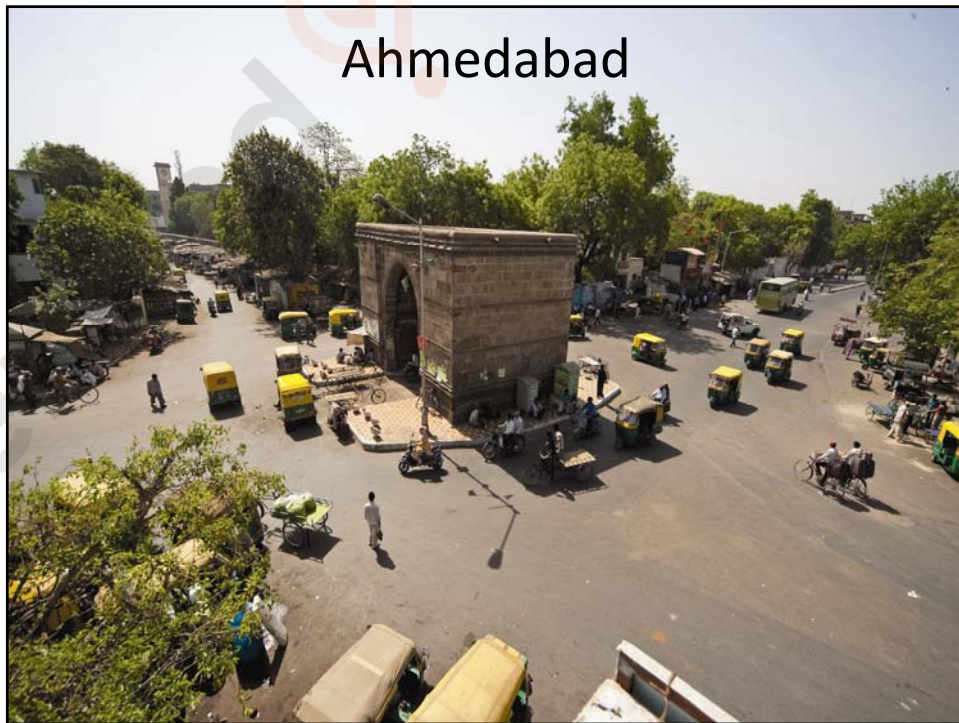


WE CANNOT DESIGN AN URBAN
TRANSPORT SYSTEM UNLESS WE KNOW
WHAT KIND OF A CITY WE WANT.
THE VISION OF OUR CITY



Brand New Towns???





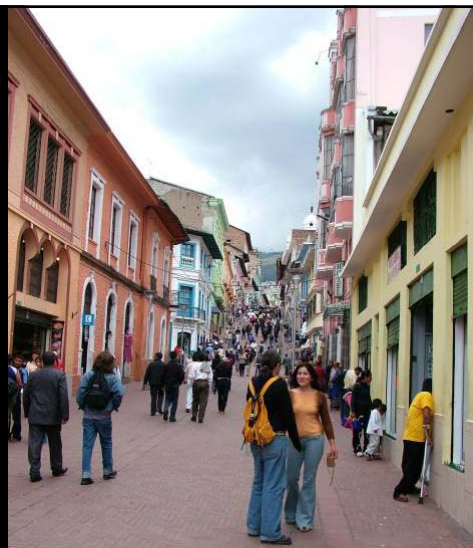
Ahmedabad



Ar. Bimal Patel visualization for Our Cities Ourselves



Life - Spaces - Buildings -and in this order, Please



Think BIG

- but always remember to make people places small

When we stop being experts and start acting using common sense, we will have better cities.

Modern, desirable, sustainable walking cities require

- Mixed uses – in all forms
- Active, people-oriented design
- Small blocks & human scale streets
- High density & good public transit access



ITDP

Institute for Transportation
& Development Policy

Institute for Transportation and Development Policy

*is an international not-for-profit organization
that is a leader in promoting environmentally sustainable
and socially equitable transportation worldwide.*

www.itdp.org

www.ourcitiesourselves.org

[www.twitter.com/#!/itdpindia](https://twitter.com/#!/itdpindia)

ITDP key program areas are

Public transit:

Investing in modern, attractive public transit systems, specifically bus rapid transit, to provide a higher quality of life in cities

Non-Motorized Transport:

Making streets safer and more convenient for cyclists and pedestrians, improving the quality of affordable non-motorized vehicles, and promoting bike use

Travel Demand Management:

Reducing air pollution, congestion, and CO2 emissions by reducing private car use through parking regulations, access management, and road user charging

Urban Accessibility:

Reinforcing urban centers by encouraging pedestrian-oriented real estate development, urban design, and public space management

Sustainable Transportation Investment:

Ensuring necessary funding is available for sustainable transport projects.

IMPORTANCE OF TRAFFIC ENGINEERING IN URBAN MOBILITY



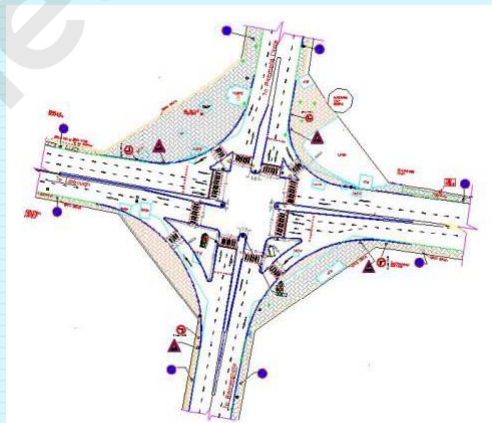
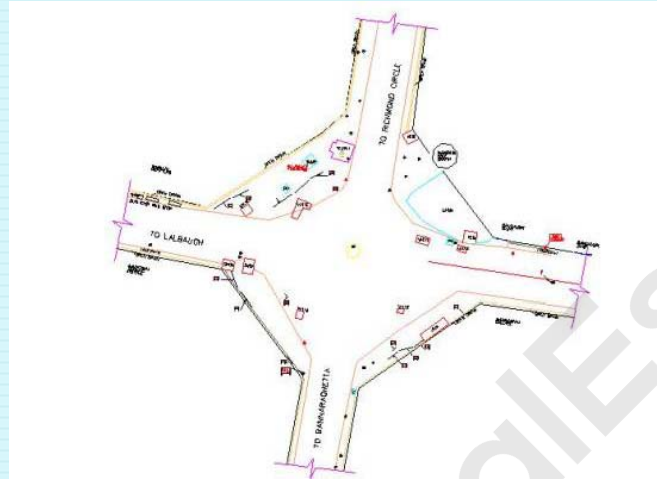
Vinoba Sunder Singh - Senior Vice President
Urban Mass Transit Company Limited





Components that make up a city street

- ☐ The physical elements of the pavement
- ☐ The user
- ☐ The traffic Police
- ☐ The control elements
- ☐ Signage
- ☐ Road markings
- ☐ Footpaths
- ☐ Street furniture





One Signboard too many



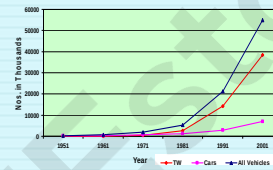
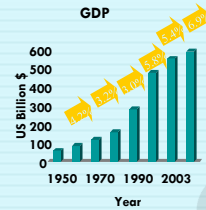
Hide and Seek



The Urban Scenario



- GDP increased 4 fold in the period 1985 to 2005
- Has 10 of 30 fastest growing cities in the world
- 700 million will urbanise by 2020
- 140 million rural will enter to urban by 2020
- 100 million people will enter labour force by 2020
- Number of Metro Cities with Pop > 1 Mill - 51 by 2021
- Growth of Vehicles at double digits



All this leads to a huge demand for Traffic

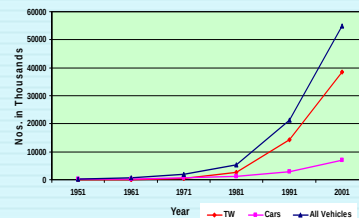


Urban Transport Scenario



Car ownership is still very low when compared to Developed countries - 10 times lower

Speed Trend - No network development (in KMPH)					
Category	City Population (In Millions)	2007	2011	2021	2031
1	<0.5	26	22	15	8
2	0.5-1.0	22	18	13	9
3	1.0-2.0	18	13	10	7
4	2.0-5.0	22	18	12	9
5	>5.0	17	12	9	6



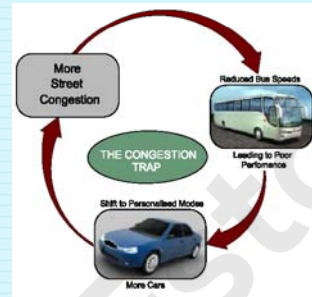
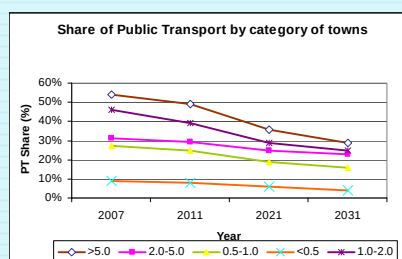
- Road Network speeds will be at walking speeds!!
- Cities will experience economic decay

Source: Study on traffic and transportation policies and strategies in urban areas – Ministry of Urban Development

Share of Public Transport



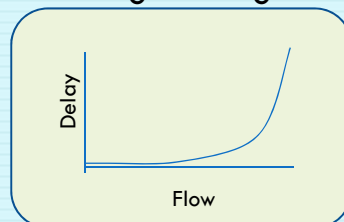
Share of PT is fast declining and has dropped by about 10% per decade - and will continue to decline in the future



Talking Traffic



- How many junctions are working at optimal conditions?
- Is the traffic policeman equipped to do traffic engineering
- How many traffic engineers are there in the city
- Can all traffic engineering works be outsourced



Traffic Management



- Junction Improvements
- One way streets
- Tidal flow operations
- Parking
- NMT
- Goods Vehicles Management
- IPT Management



ITS



- Level 1 : Traffic Policeman
- Level 2 : Traffic Signal
- Level 3 : Video Camera's
- Level 4 : Controller control from OCC
- Level 5 : Traffic Feeds to OCC
- Level 6 : Software optimisation

Traffic Engineering and Mobility



- ❑ Optimise our Resources
- ❑ Improved Bus Operations
- ❑ Safety
- ❑ Convenience for Walking
- ❑ An overall pleasing look
- ❑ Lesser air and noise pollution



- ❑ Lets get our Traffic Engineering in order
- ❑ Lets get the institutions that are responsible for traffic engineering setup/strengthened.
- ❑ Lets invest in ITS and optimise our resources
- ❑ Lets live better – live safer

□ Thank You

TRAVEL DEMAND MANAGEMENT IN URBAN TRANSPORTATION



Dr. Sanjay Gupta
SPA, Delhi
Seminar Chennai

25th Feb 2011 CMDA



NEED FOR TRAVEL DEMAND MANAGEMENT

- ⊙ Growth in population, number of vehicles and travelers, freight, and development has affected travel demand and reshaped travel patterns.
- ⊙ The inability to add new infrastructure in time has led to the need for planners to pay more attention to managing demands.
- ⊙ Demand-oriented approaches are needed to address the transportation issues created by growth and the variability in demand for use of the systems.
- ⊙ **TDM** is the use of policies, programs, services and products to influence whether, why, when, where and how people travel.



CONCEPT OF TRAVEL DEMAND MANAGEMENT

Travel Demand Management (TDM) is the implementation of programmes of measures which seek to change travel demand patterns by:

- ⊙ **Trip reduction**
- ⊙ **Reduction in vehicle use**
- ⊙ **Increase in vehicle occupancy**
- ⊙ **Increased travel by alternative modes**
- ⊙ **Trip retiming**
- ⊙ **Offering alternative destinations**
- ⊙ **Reduction in trip length**



CONTRIBUTION OF TDM

- ⊙ **Greater community well-being through improved public health and road safety**
- ⊙ **Increased use of public transport, cycling, and walking modes of travel**
- ⊙ **Reduced transport-related greenhouse emissions and non-renewable energy use**
- ⊙ **Community connectedness**
- ⊙ **Improved access to key destinations via the transport network**
- ⊙ **Reduced expenditure by private and commercial vehicle owners on fuel and vehicle maintenance**
- ⊙ **Improved cost-effectiveness, capacity and efficiency of the transport network.**



CATEGORIES OF TDM STRATEGIES

⊙ **Parking Management**

- Parking cash-out programs
- Priority parking for carpools, vanpools, and short-term parkers

❖ **Land Use Management**

- Mixed-use development
- Increased densities in transit corridors
- Infill and brown field development



CATEGORIES OF TDM STRATEGIES

❖ **Improved Transportation Options**

- Biking and walking
- Transit

❖ **Incentives to Use Alternative Modes and Reduce Driving**

- Telework and flexible work schedules
- Road and parking pricing
- Road space allocation (bike lanes, transit-only lanes)
- Carpool incentives



IMPACT OF SELECTED TDM STRATEGIES

Strategy	Modal Share Impact
Congestion pricing	London: 37% vehicle speed increase, 30% decrease in peak period delays; 50% decrease in bus delay. ¹ 14-30% increase in transit ridership (London, Stuttgart, Singapore) ²
High capacity transit	20-72% of new riders shifted mode from auto ³
Parking management (includes pricing and availability strategies)	40-50% reduction in parking demand under peak period and long-term parking pricing increases; SOV mode share 16%- 25% lower when employees paid for parking ⁴
Transportation-efficient development	15-24% SOV reduction ⁵



PARKING MANAGEMENT



- ⊙ Strategies that encourage more efficient use of existing parking facilities, reduce parking demand and shift travel to other modes resulting in enhanced community liveability, access to retail businesses and neighbourhood vitality.
- ⊙ Effective Parking Management Practices
 - Variable Market Rate On-Street Pricing
 - Unbundling Parking Costs
 - Parking Tax
 - Parking Cash-Out
 - Electronic Parking Guidance Systems
 - Park-and-Ride



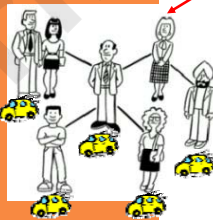
TRANSIT USE AND CARPOOLING

Proven strategies include:

- ⊙ Put more transit service
- ⊙ Build compact communities with sufficient density to support high-frequency transit service.
- ⊙ Get low cost or free transit passes
- ⊙ Improve and distribute transit and carpool rider information
- ⊙ Build park-and-rides and HOV lanes
- ⊙ Support car-sharing



TRADITIONAL CAR POOL



Origin

Location: XX Society
Time: 8:00 AM



Destination

Location: YY Limited
Time: 6:00 PM

Morning

Evening

Morning

Evening



LAND USE MANAGEMENT



New dense housing development in downtown Vancouver increases walk trips.

Vancouver, Canada

Increased housing capacity in the downtown area "living-first strategy".

From 1991 to 2002, the number of residents living downtown increased by 62%, to 76,000, but car trips into downtown remained essentially constant.



TRANSIT ORIENTED DEVELOPMENT

Transit-oriented development (TOD) creates mixed-use, higher density communities that encourage people to live, work and shop near transit services and decrease their dependence on





CHARACTERISTICS OF TOD

- ⦿ Compact, higher density land development
- ⦿ Mixed uses
- ⦿ Good pedestrian environment
- ⦿ Public amenities
- ⦿ Parking management
- ⦿ Good transit service
- ⦿ Strong connectivity between transit and development



high density along the transportation corridors
putting people where the services are



BIKE PATHS AND PEDESTRIAN FACILITIES



EMPLOYER-BASED TDM STRATEGIES

- ⦿ **Financial Incentives** – makes non-SOV options relatively cheaper for the employee to use.
- ⦿ **Facilities and Services** –services to make non-SOV commute options more appealing
- ⦿ **Flexible Scheduling** –employees to reduce their number of weekly commute trips and shift work trips to nonpeak hour times of day.
- ⦿ **User Information** – The employer provides information on available alternatives to driving alone,



IMPACT OF SELECTED EMPLOYER-BASED TDM STRATEGIES

Strategy	Details	Employee Vehicle Trip Reduction Impact
Parking Charges ¹	Previously Free Parking	20-30%
Information Alone ²	Information on Available SOV-Alternatives	1.4%
Services Alone ³	Ridematching, Shuttles, Guaranteed Ride Home	8.50%
Monetary Incentives Alone ⁴	Subsidies for carpool, vanpool, transit	8-18%
Services + Monetary Incentives ⁵	Example: Transit vouchers and Guaranteed Ride Home	24.50%
Cash Out ⁶	Cash benefit offered in lieu of accepting free parking	17%



CONGESTION PRICING



The "C" symbol indicates the Congestion Pricing Area in London.

- ⊙ Techniques that use variable charges to provide disincentives to drive vehicles in certain areas or on particular roadways during periods of peak congestion.
- ⊙ Examples include:
 - Variably priced lanes
 - Variable tolls on entire roadways
 - Cordon charges
 - Area-wide charges
 - Variably priced ramps



CONGESTION PRICING CASE STUDY: LONDON

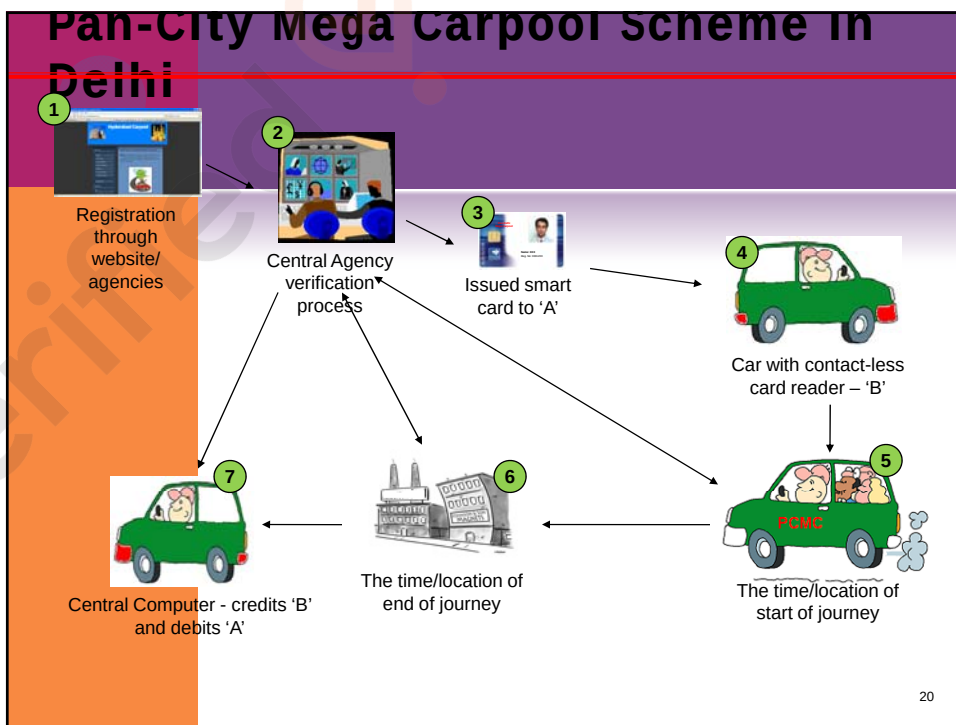
- ⊙ Since 2003, London has charged a congestion fee to most motorists entering or leaving its central area between 7 AM and 6:30 PM weekdays; residents receive a 90% discount, and motorcycles, taxis and some other vehicles are exempted.
- ⊙ In 2004/2005, the program generated £190 million in total revenues (£118 million in fees and £72 million in fines), of which £97 million was invested in improvements to public transportation.
- ⊙ Within three years, average car speeds within the zone had increased 37%, and peak period delays had decreased 30%.



Map showing London's expanding congestion zone.



Cameras capture license plates of cars entering the zone.





CAR POOLING - RESEARCH EXPERIENCES IN DELHI

- Propensity to car pool is positively correlated with journey length and time.
- 30 to 50 yrs age group are more inclined towards car pool.
- Males are more inclined than Females for car pooling
- Estimated Economic and Environmental Benefits due to car pooling in Delhi estimated Rs 28.5 lakh/day (1991).



ACTIVITY RESCHEDULING – RESEARCH EXPERIENCES IN DELHI WHOLESALE MARKETS

Market	Commodity	Establishment No.	Direct employment in the establishment *
M1	Food grains	1100	9240
M2	Spices/Dry Fruits	2180	10940
M3	Hardware, Paper	4636	12980
M4	Textiles	4385	9428
M5	Electricals, Electronics, Pharma	4418	9277
M6	Miscellaneous	-	-

* In addition indirect employment @ 3 – 9 persons/direct employee.



ACTIVITY RESCHEDULING – RESEARCH EXPERIENCES IN DELHI WHOLESALE MARKETS

.....

- **Characteristics:**
 - Total Vehicles in the study area – 3.60.000
 - Destined Trips – 2,48,085
 - Shared Destined trips
 - Textile = 34.2%
 - Hardware =20.4%
- **Impact**
 - Percentage reduction in the travel demand
 - Varies between (electrical)to 24.3% (textile)
 - Percentage reduction in vehicle km varies between 3% to 50%



IMPACT ASSESSMENT OF ACTIVITY RESCHEDULING

Market	Reduction ('000)			% age Reduction		
	Trips	Vehicle km	Vehicle Hr	Trips	Vehicle km	Vehicle hrs
M1	40	54	597	16.2	16.8	13.9
M2	24	31	551	9.5	9.7	12.8
M3	51	24	1931	20.4	7.5	45.1
M4	85	163	586	34.2	51.2	13.7
M5	16	8	66	6.2	2.6	1.6
M6	33	38	548	13.1	12.2	12.9



SUMMING UP

- Develop a TDM strategy and action plan.
- Integrate TDM into land use and transportation plans
- Support TDM through the development approval process.
- Build TDM into infrastructure plans

Agenda for Action

- Undertake pilot studies on TDM to check their effectiveness
- Develop planning tools and guidelines for TDM implementation
- Develop real time traveler information system on priority
- Encourage stakeholder participation, public awareness on TDM

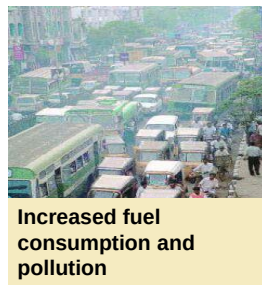
ITS for Sustainable Urban Mobility

Dr. R. Sivanandan

Professor
Transportation Engg. Division
Dept. of Civil Engineering
IIT Madras, Chennai

Towards Sustainable Urban Mobility (Seminar)
February 25, 2011, Chennai

Today's Traffic Problems in Urban India

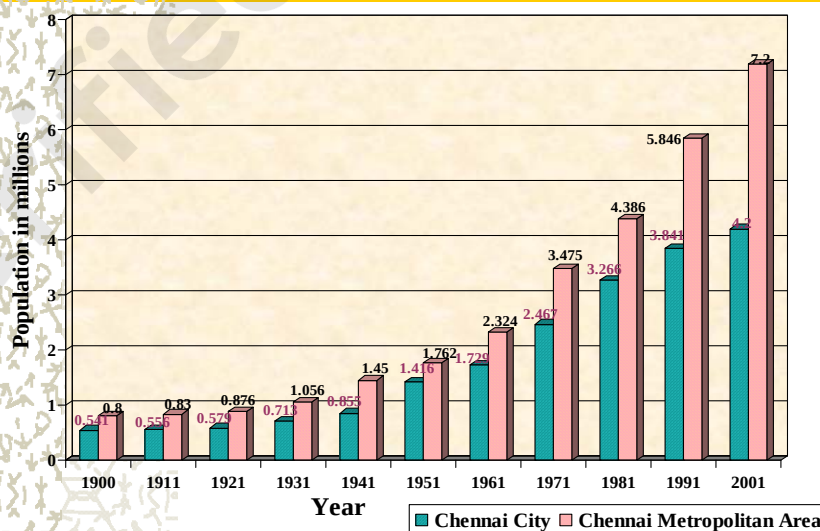


Causes of Urban Traffic Problems

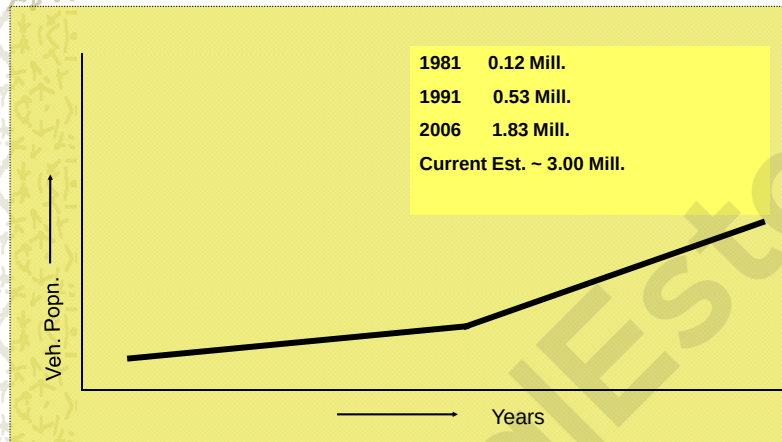
(Chennai as a Case Study)

- ✱ Population growth
- ✱ Increase in per capita trip rate
- ✱ Modal shift (towards personal vehicles)
- ✱ Steep rise in vehicular population
- ✱ Less than commensurate growth in road network
- ✱ Inadequacy of public transport
- ✱ Others ...

Growth of Population (Chennai)



Steep Growth in Vehicle Popn. (Chennai)



Growth in Per Capita Trip Rate (Chennai Metropolitan Area)

Year/Study	Per Capita Mechanised Vehicular Trip	Per Capita Total Trips
1971-MATSU	0.39	0.866
1984-Kirloskar Study	0.70	1.146
1992-HHI Survey	0.73	1.282
2011-Projected	0.93	1.500

MATSU- Madras Area Transportation Study Unit (MATSU, 1974)

Kirloskar Study - Transportation Study by Kirloskar Consultants Ltd.

(Kirloskar Consultants, 1986)

HHI Survey-Household Interview Survey (PTCS, 1993)

Changing Trend in Modal Split (Chennai)

Mode	% of Total Trips Shared by Various Modes		
	1970 ^a	1984 ^b	1992 ^c
Bus	41.50	45.53	37.90
Train	11.50	9.03	4.10
Car, Van, Jeep	3.20	1.45	1.50
Two Wheelers	1.70	3.24	7.00
Bicycle	21.30	10.70	14.20
Walk	20.70	28.07	29.50
Others	0.10	1.98	1.00
IPT (Auto Rickshaw, Cycle rickshaw)	NA	NA	4.80

% of Total Trips by Modes	
2007 ^d	
Public Transport	31
Car	10
Two Wheelers	20
Bicycle	9
Walk	22
Auto	8

Sources: a. MATSU, 1974
b. Kirloskar Consultants, 1986
c. PTCS, 1993

d. Wilbur Smith Assoc. for MoUD

What can be done?

- ✦ Travel Demand Management
- ✦ Transportation System Management (TSM) Measures
- ✦ Building New Infrastructure
- ✦ Advanced Technology Applications (ITS)

Advanced Technology Applications

- ✦ Intelligent Transportation Systems (ITS)
- ✦ ITS are applications of advanced technologies to transportation systems to:
 - enhance their efficiency
 - promote safety

Potential Applications for Urban Areas

- ✦ Advanced Traffic Management System (ATMS)
- ✦ Advanced Traveller Information Systems (ATIS)
- ✦ Advanced Public Transportation Systems (APTS)

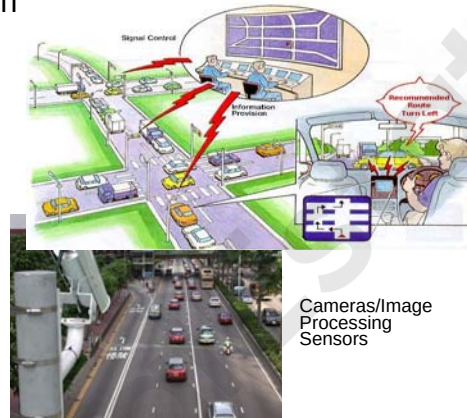
(Based on ITS America's Classification)

Advanced Traffic Management Systems (ATMS)

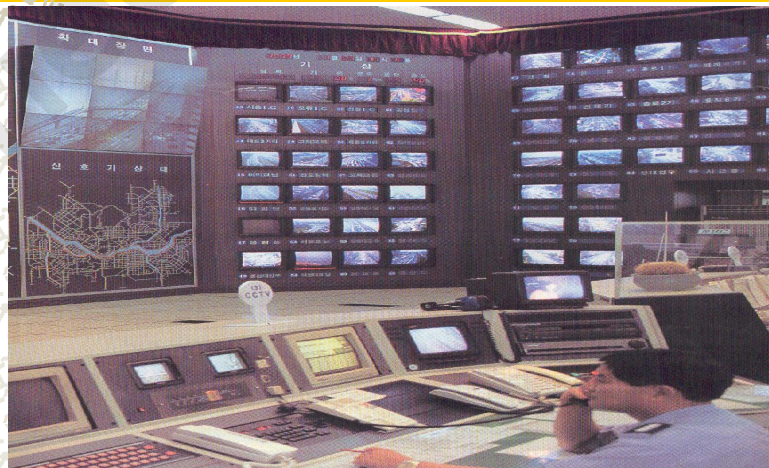
- ✦ To monitor, control and manage traffic and to ultimately predict and prevent congestion

Elements

- ✦ Surveillance
 - Sensors (Examples)
 - Loop Detectors
 - Infrared Sensors
 - CCTVs
 - Image Processing Sensors
- ✦ Traffic Control
 - Area-wide, Adaptive
- ✦ Advisory
 - VMS, In-vehicle Displays, etc.



TRAFFIC CONTROL CENTRE



Source: ITS World, Sep./Oct. 98

Advanced Traveller Information Systems (ATIS)

- ✦ Provide up-to-the-minute information on road and weather conditions, detours, construction zones, bus schedules and parking
- ✦ Available before trip and en route
- ✦ Examples
 - Pre-trip Travel Information
 - In-vehicle Dynamic Navigation
 - Driver Advisory
- ✦ Media
 - VMS
 - In-vehicle
 - Others



Source: Rockwell / ITS International, Sep. 96

Advanced Public Transportation Systems (APTS)

- ✦ Improvements to mass transit to make it more efficient and attractive to users
- ✦ Examples
 - Real-time Passenger Information
 - Fleet Management
 - “Smart” Cards
- ✦ Superior transit service with APTS technologies

ITS Application Issues and Challenges

★ ATMS Issues

- Functional Requirements
- Data Needs
- Specifications for Components
- Architecture
- Traffic Data Collection technologies
 - Assessment and Identification of Appropriate Technologies in the Context of:
 - Heterogeneous Traffic
 - Indisciplined Flow
 - Performance Evaluation



ITS Application Issues and Challenges (contd.)

★ ATIS Issues

- User Needs
- Functional requirements
- Specifications of Components
- Data Needs and Collection
- Integration with ATMS Components
- Architecture
- Others
 - Role of ICT in Information Dissemination
 - Driver Compliance

★ APTS Issues

- Bus Transit Information System
 - User Perception
 - Location Technologies
 - Information Displays
- Cost Effectiveness



ITS Application Issues and Challenges (contd.)

✧ Modelling Traffic Flow for ITS

- Implications of Technology
- Information Availability
- Driver Behaviour/Compliance
- Heterogeneity

✧ Network Issues

- Alternate Routes
- Area-wide Vs. Corridor
- Adaptive Actions
- Capacity Restrictions
- Absence of Urban Expressways
- Optimisation

ITS Application Issues and Challenges (Contd.)

✧ Field Implementation

- Technology Issues
- Connectivity for Real-time Needs
- Security/Vandalism

✧ Reliability of Systems

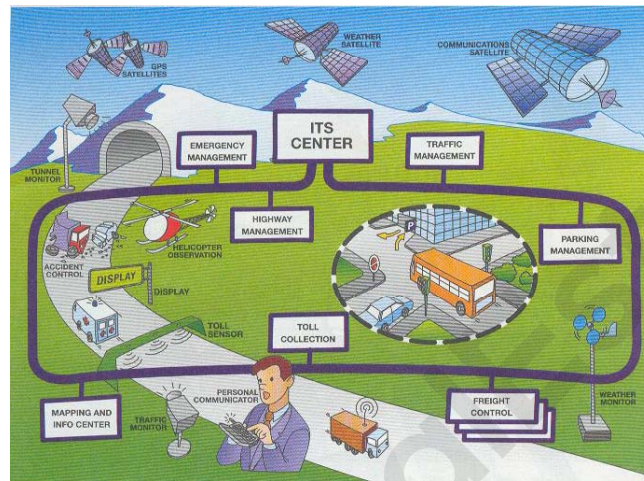
- Credibility Issues

✧ Agency Roles

- Identification of Roles and Responsibilities
- Inter-agency Coordination

✧ Funding Issues

A Full Fledged ITS Scenario - Complexities in Deployment



Source: Traffic Technology International '99

Summary

- ✦ Potential for ITS Applications
 - ATMS, ATIS and APTS in Urban Situations
- ✦ Understanding User Needs
- ✦ Selective Adoption/Adaptation
- ✦ Use of Appropriate Technologies
- ✦ Deployment in Incremental Fashion
 - Pilot Studies
 - Sub-area/Corridor Applications
- ✦ Benefits to be Convincing to User Agencies
- ✦ Inter-agency Cooperation and Coordination Essential
- ✦ Research Needs in Several Aspects – Role of Academic Institutions



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