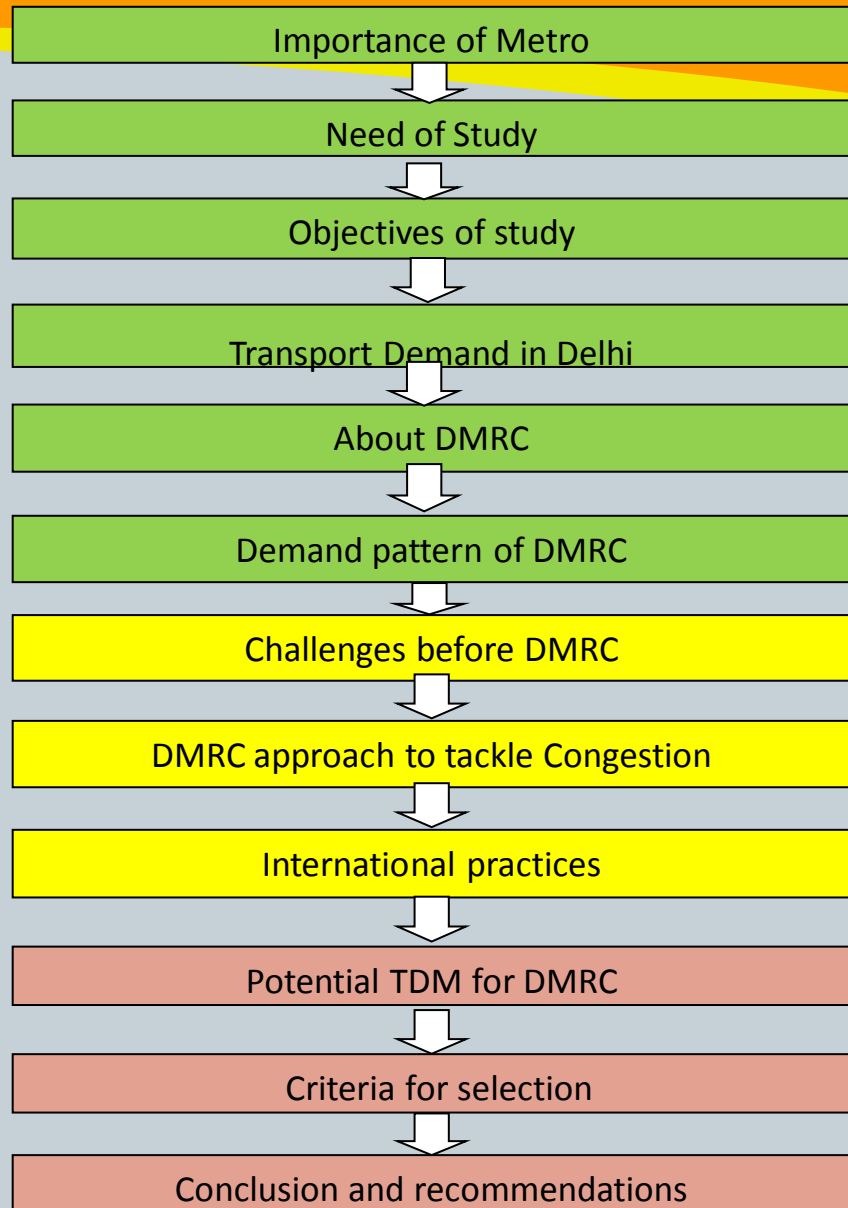# TRANSPORT DEMAND MANAGEMENT TOOLS FOR METRO RAIL SYSTEM-
STRATEGY TO EASE CONGESTION IN DMRC

Amit Kumar Jain
Priya Agrawal

INDIAN RAILWAYS

9th Urban Mobility India 2016

Flow Chart of the work

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Introduction

- Importance of Metro rail in urban mobility
  - Fast pace of Urbanisation:Urban population growing @3% per annum
  - High PHPDT >20,000
  - Only 2 m of central median required for elevated
- Modal Share- Target 80% PT
- Promotion of Sustainable mobility
  - Low carbon Mobility
  - Energy efficient
  - Electric based so no pollution in the city

Need of the study

- High Level of congestion in metro rail system in peak hours

- Capacity Utilisation in peak hours is already 100%

- Captive customer oriented growth
  - Bus users shifting to metro
  - private vehicle users are not attracted towards metro rail system.
  - Modal share in terms of use of PT has not changed significantly

- Congestion in Railway premises need to be managed

Objectives of the Study

- To assess the role of metro in sustainable mobility in a city

- To identify the congestion related impacts on ridership

- To review international best practices in Metro rail system demand management

- To assess degree of congestion in the busiest line of Delhi Metro- Yellow line

- To propose TDM tools applicable for case corridor (yellow line) of DMRC and assess the potential benefits

Travel Demand in Delhi

- Population: 18 million

- Population Density: 9,500 persons/sq.km

- Vehicular population ~ 9 million

- Public transport

comprises of :

✓ Bus – 45 lacs pax per day

✓ Metro – 28 lacs per day

Model Share (Yr 2007 data)

- Car
- 2 wheeler
- Auto
- Public Transport

19%

22%

52%

7%
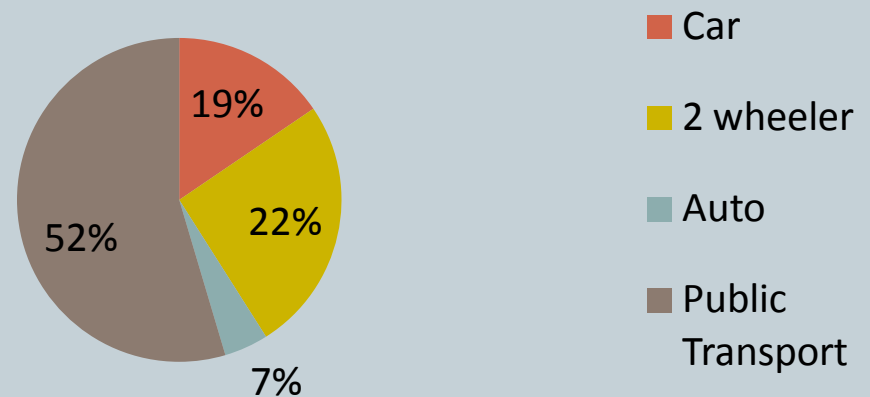
In 1999: For each bus in Delhi, there were 62 two-wheelers. 24 cars, 3 auto-rickshaws.

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Traffic Demand Forecast

Mode	2007		2021	
	Trips	Modal share	Trips	Modal share
car	2902120	19.3	5974706	23.4
Two wheeler	3250755	21.7	5601484	21.9
Auto	1028622	6.9	1295978	5.1
Bus	7276892	48.5	9289047	36.4
Metro	552745	3.7	3380769	13.2
Total	15011134	100.0	25541984	100.0

Source: Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network for NCT of Delhi, RITES & DIMTS

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Delhi Metro Rail Corporation (DMRC)

- Set up as a JV of Govt. of India & Govt. of Delhi on 3 May 1995 with E. Sreedharan as the managing director

- Responsible for Planning, operation and management of Metro services in Delhi.

Phase	Start date	End date	Cost (Rs crore)	Length (km)
Phase I	Sept 1996	March 2006	10,571	65
Phase II		Feb 2011	18,783	119.65
Phase III	Under Construction		41,079	160.5
Phase IV	Under Planning		55,208	103.9

OPERATION HIGHLIGHTS of DMRC

- Network Length: **190** Km (Excluding AEL), 22
- Stations: **154 stations**
- Average Ridership: **2.73 million (Oct'16)**
- Maximum Ridership: **3.37 million (17th Aug'16)**
- Avg train trips per day: **2911**
- Total number of train cars: **1398**

- Minimum Headway : **2'13"**
- Train running with a punctuality **99.9%**
- Service Reliability – **99.9%**
- Passenger Safety - No passenger injury in train accident .
- Step free access at all stations

OPERATIONAL HIGHLIGHT

Line Name	Length (Kms)	Stations	PHPDT	Average daily ridership
(Line 1) Dilshad Garden-Rithala	25	21	24056	3,56,007
(Line 2) Samaypur Badli-Huda City Center	49	37	54075	9,71,055
(Line 3 &4) Noida City Center-Dwarka Sector 21 & Yamuna Bank-Vaishali	59	51	45098	10,18,147
(Line 5) Kirti Nagar-Inderlok-Mundka	18	16	11830	1,03,845
(Line 6) ITO – Escorts Mujesar	35	28	21564	2,74,216
Total	186	153		27,35,742
AEL	21	6		45,000

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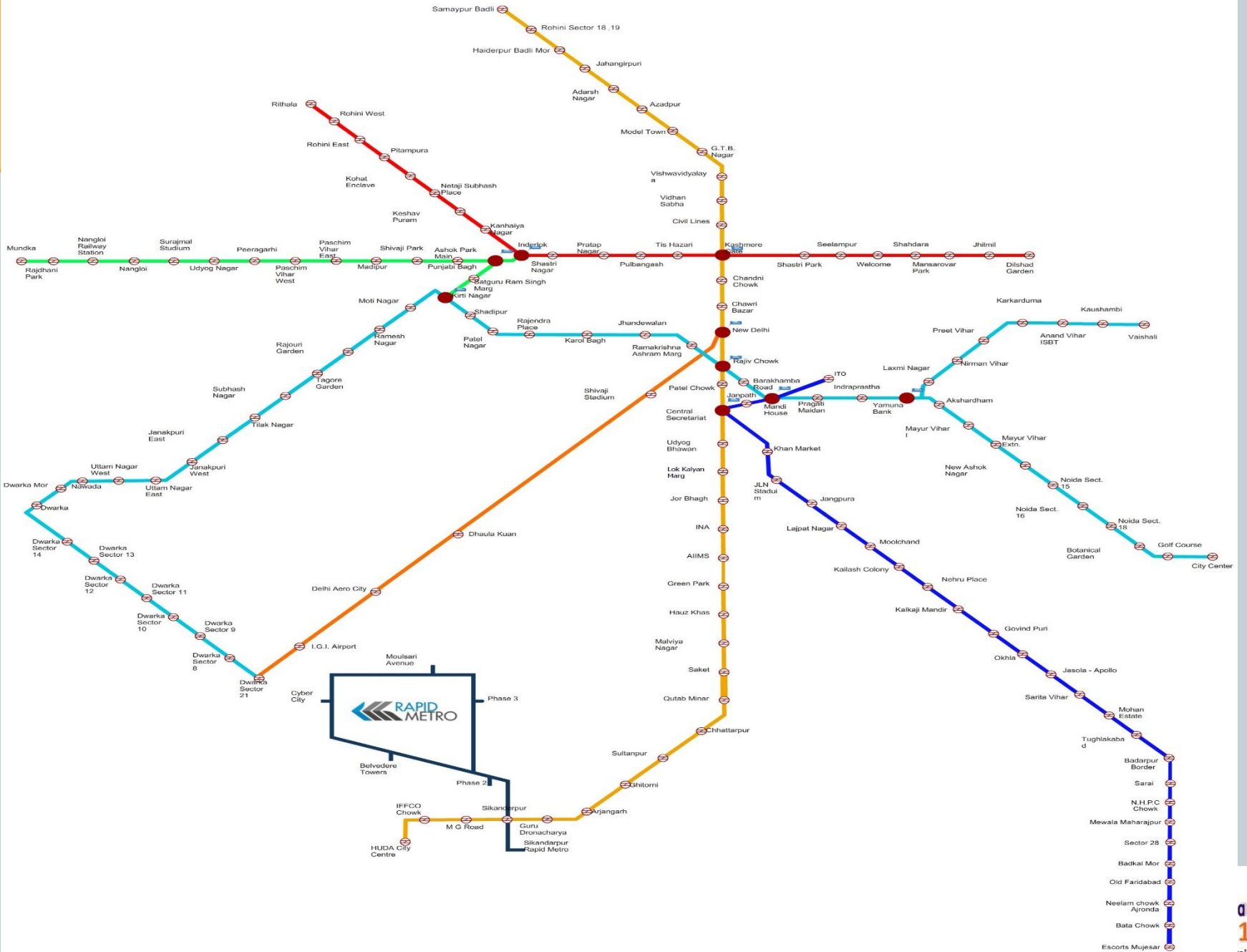
DMRC: Demand Patterns

At some interchange stations such as: Rajiv Chowk, Kashmere Gate & Central Secretariat, queues are too long

Average Ridership & Network Length

Network Length   Ridership

Evening rush at Rajiv Chowk Metro station
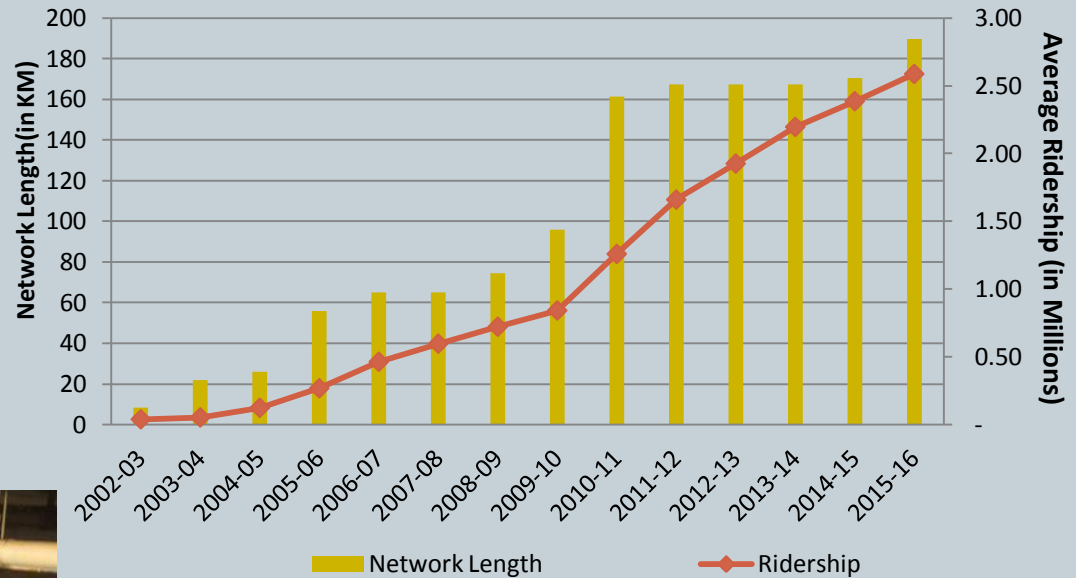
Besides high passenger demand, Delhi Metro shows lot of *Temporal and Spatial Variations* in travel demand
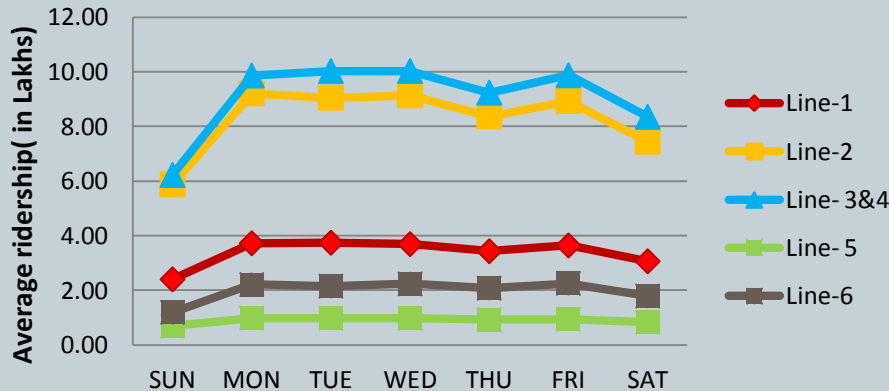
Temporal Demand Variation
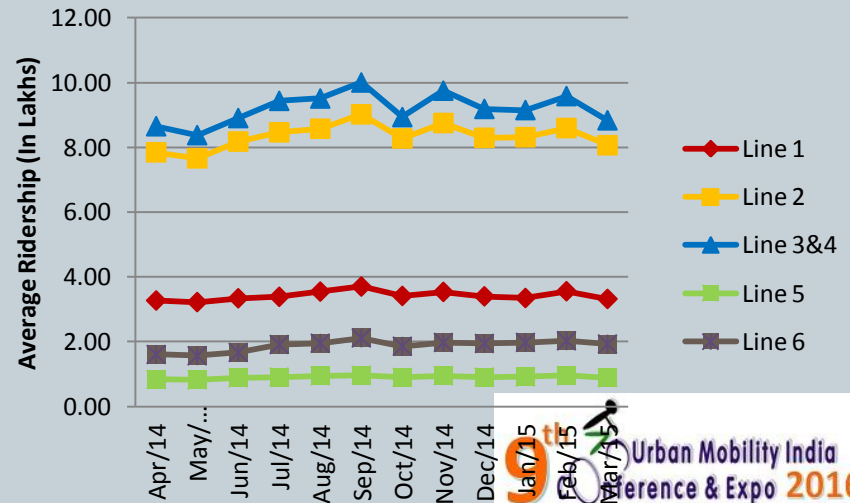
Variation across time of the day (Yellow line)
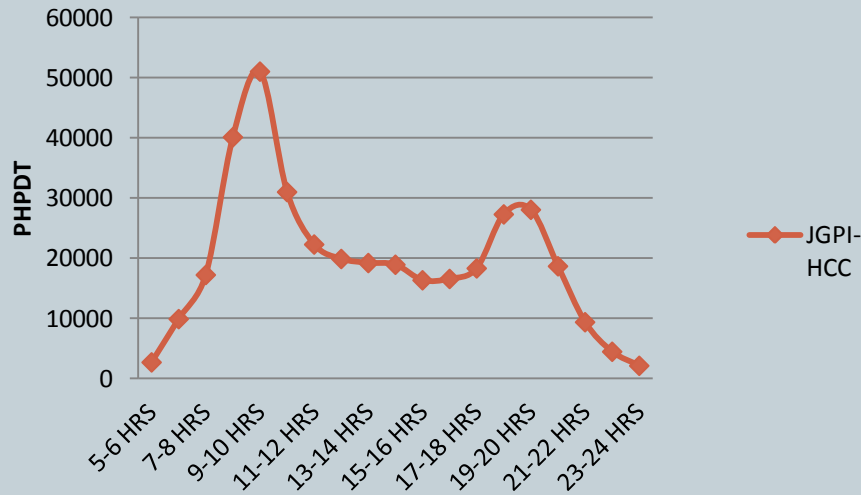
Variation across time of the day (Blue line)
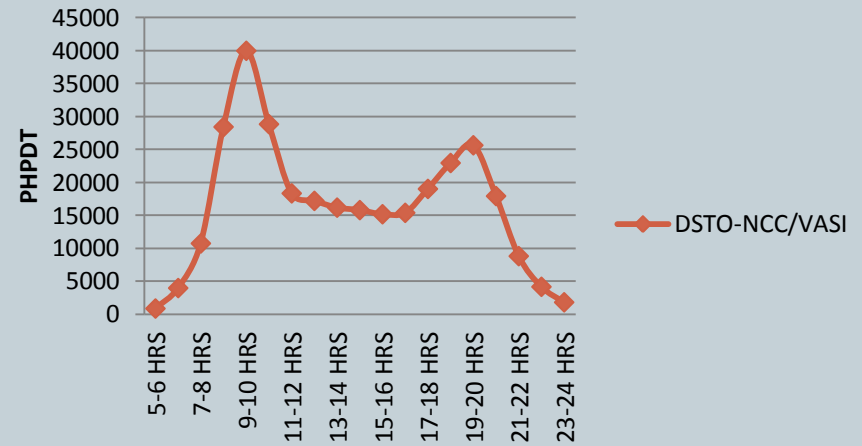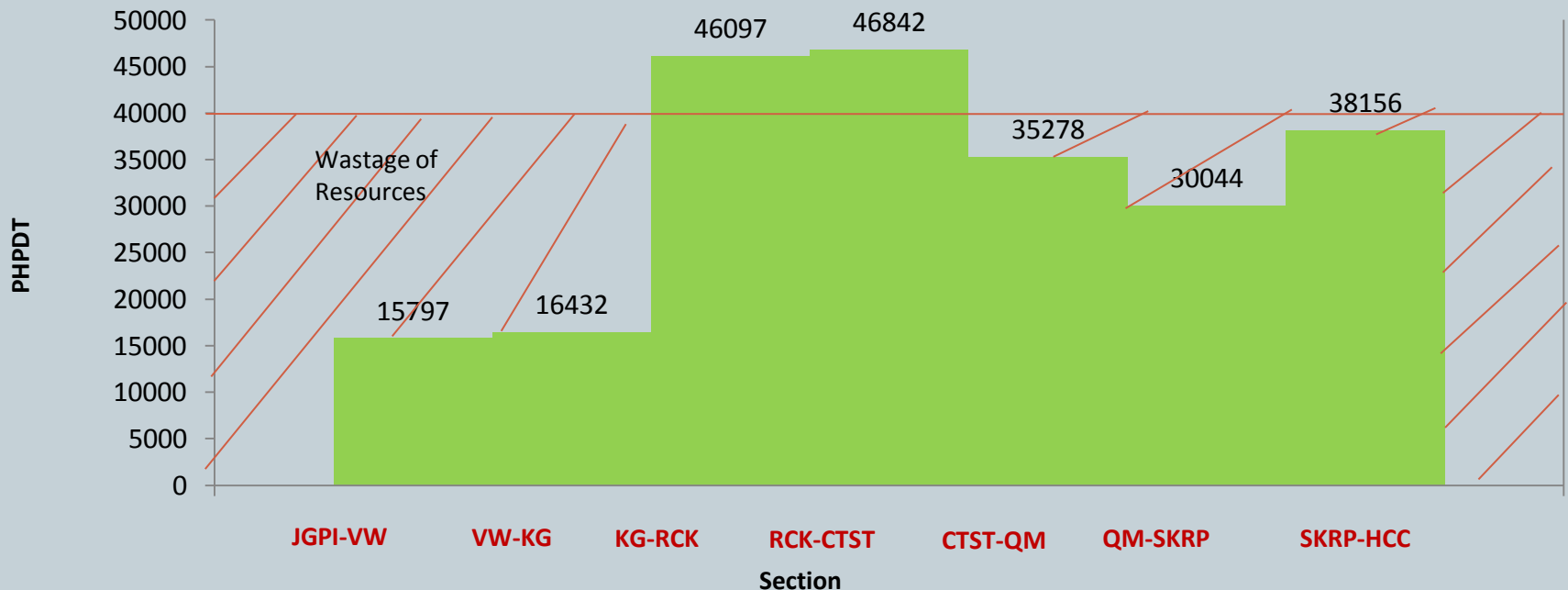

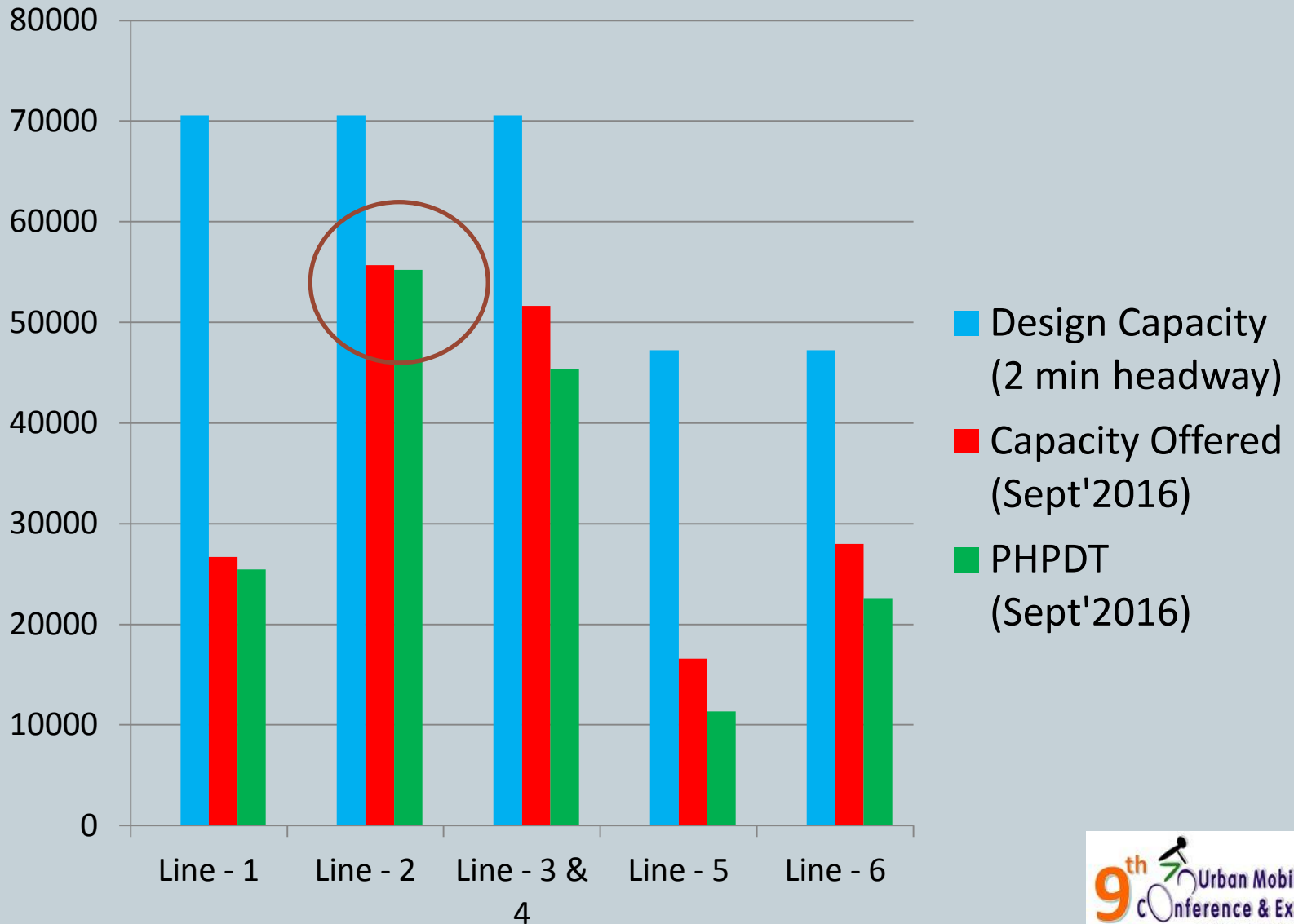*Weekly average Ridership*

Monthly Average Ridership

Spatial Demand Variation

- The travel demand varies geographically: Higher demand near the CBD area and lower demand towards the city outskirts

Spatial variation of demand along yellow line of DMRC network

Challenges before DMRC

- Meeting the demand

- easing congestion

- Attract customers to remain financially viable

- Optimum utilisation of capacity

DMRC approach to tackle congestion

- Increase in number of trains per hour : DMRC runs 27 trains per hour in yellow line

- Converting 4 car trains to 6 car trains and 6 car trains to 8 car trains in busy lines

- Use of a combination of front and rear cross overs at terminal stations to reduce rake turn around time

- Use of Automatic Train Operations (ATO) to improve efficiency and reliability of the operations.

The problem of Congestion still remains….

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DMRC approach to tackle congestion

- Auto Turn back (ATB) of trains at terminals to minimise turn back time.

- Intermediate reversal of trains (rather than end stations) to improve the train availability in the high demand sections.

- Introduction of additional trains from sidings, terminals during the peak hour in peak direction traffic.

- Real time demand monitoring and introduction of trains as per demand.

The problem of Congestion still remains….

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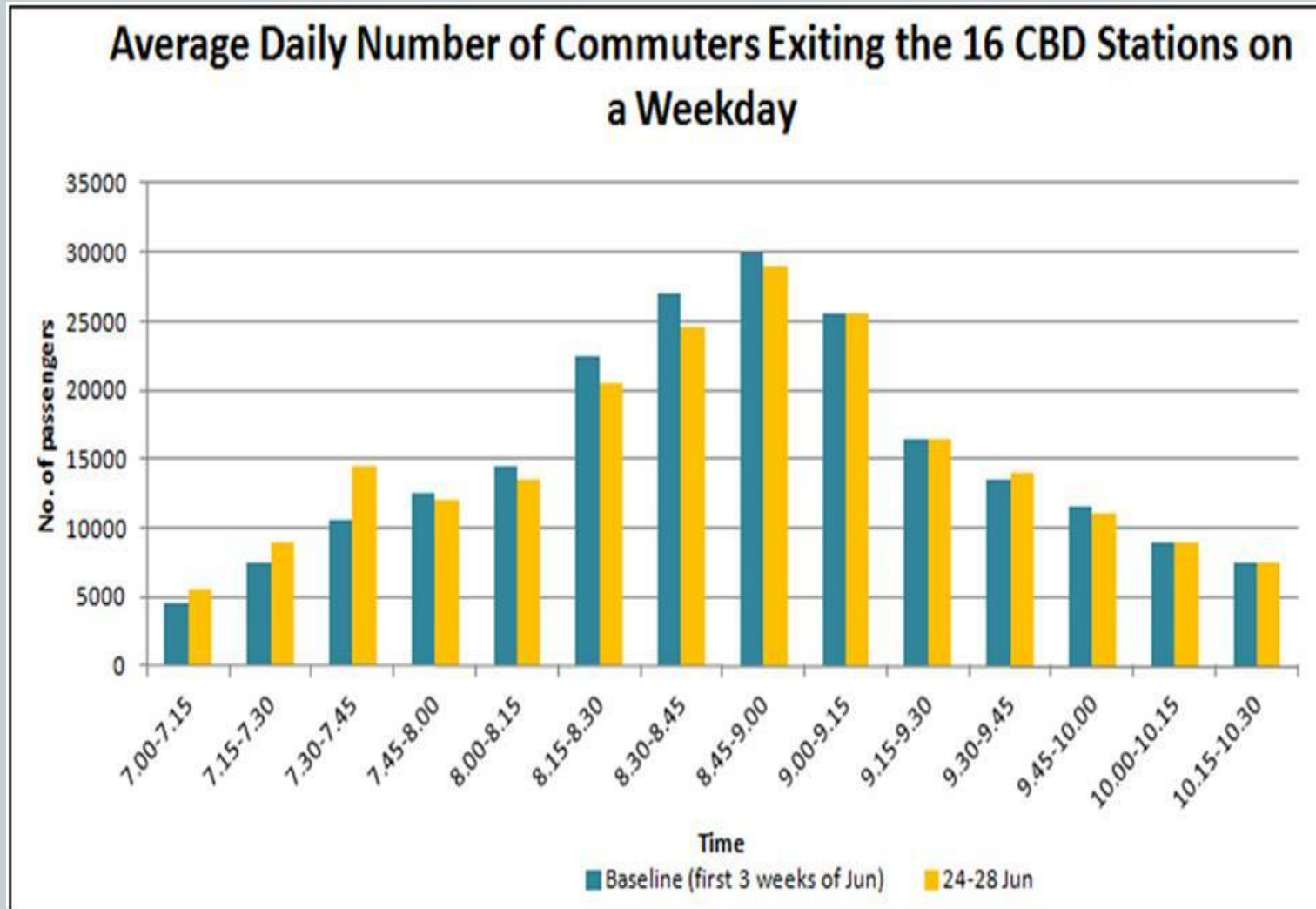# International Practices for Demand Management

- London Underground , New York Metro, Washington Uses differential pricing

- Singapore Metro:
  - *Free Pre-Peak Travel scheme* : Incentivizing passengers (free travel) to end their journey before 7.45am on weekdays
  - *INSINC Programme*: Passengers earn 1 point every 1 km travelled on the train all day Monday through Friday, 3 points per km in off peak hours
  - *Travel Smart*: Promoting employers to change work commute patterns of employees.

- Tokyo Metro: Sell three types of Coupon Tickets to meet passengers' needs

- Beijing metro: Passenger flow restrictions during the morning rush hour. Some stations build queuing lines outside the stations

London UG- Differential Fares

From-To	Peak hour fares* (Oyster card) in £	Off peak hour fares (Oyster card) in £
Within zone 1	2.40	2.40
Zone 1 & 2	2.90	2.40
Zone 1&3	3.30	2.80
Zone 1 &4	3.90	2.80
Zone 1&5	4.70	2.10
Zone 1&6	5.10	3. 10

Best Practices- Singapore Metro free travel before 7:45 AM

Average Daily Number of Commuters Exiting the 16 CBD Stations on a Weekday

Y-axis: No. of passengers (0 to 35000)

X-axis (Time): 7.00-7.15, 7.15-7.30, 7.30-7.45, 7.45-8.00, 8.00-8.15, 8.15-8.30, 8.30-8.45, 8.45-9.00, 9.00-9.15, 9.15-9.30, 9.30-9.45, 9.45-10.00, 10.00-10.15, 10.15-10.30

Legend: ■ Baseline (first 3 weeks of Jun) ■ 24-28 Jun

Beijing Metro- Entry Restriction in peak hours

Demand Management Tools

- **Differential pricing :** Higher fares during peak hours & lower fares for nonpeak hours.

- **Parking Policies:** Higher parking rates for peak hours: encourage commuters to start early and travel in non peak

- **Mix land use:** Multiple economic and social activities in a region to avoid long distance travel. Development of multiple CBDs

- **Integrated Fares:** Integrated fares for multiple modes of transport to promote hassle free travel assuming demand is optimally distributed among different modes of transport. E.g Switzeland, Paris

Demand Management Tools

- **Staggered office/school timings:** Staggering the timings of the offices in three slots of 8:30-17:00, 9:00-17:30 and 10:00 to 18:30, can help in smoothening the peak travel demand

- **Work from Home:** Employers to encourage work from home. E.g. Hong Kong, Singapore

- **Encouraging non peak hour travel by offering special incentives** to senior citizens and differentially abled persons. E.g. INSINC in Singapore

- **Bicycling :** Promote use of bicycles for smaller distances, first and last mile connectivity

Criteria to select Demand Management tool

- Level of Service (LOS) improvement
  - Inside train: LOS D
  - In circulating area: LOC C
  - In walkway: LOS C
  - At Platform : LOS D
- PHPDT within Limit (< Capacity @ 6 pax/sqm)

Way Forward

- **Proposed Demand Management tools for DMRC**

- **Evaluation of Demand Management tools on above criteria**

- **Limitations**

Proposed TDM for Metro systems

- Differential Fares
- Incentives to travel in Off peak hours eg INSINC scheme of Singapore
- Integration with other modes
  - Physical
  - Fare
- Network Design- Multiple interchange points
- Promote non congested routes in case of multiple routes
- Parking Policies
- Time Tabling – Supply more than demand in off peak hours to attract leisure travellers/SrCitizens etc in off peak hours

THANK YOU