

# Revenue Maximization from PEDL trips using Network analysis and Geospatial mapping



PEDL – by Zoomcar

# Agenda

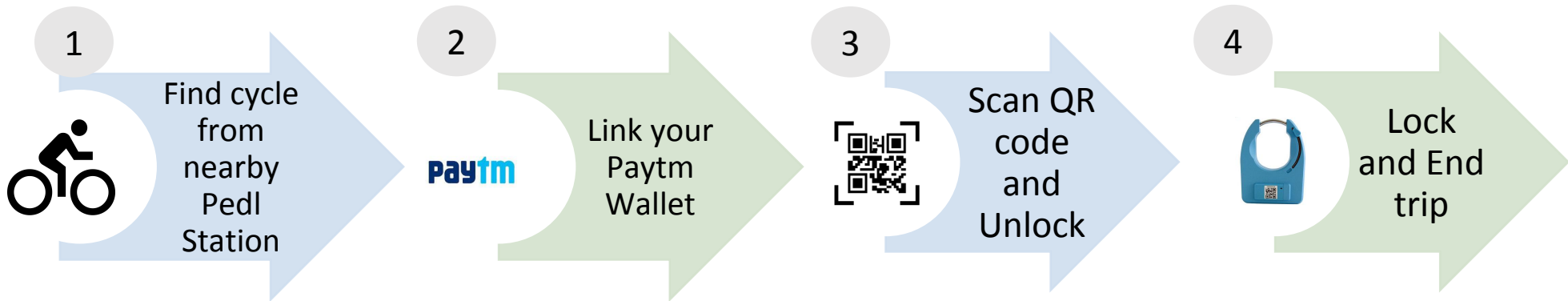
1. Understanding Pedl
2. Journey till Now
3. Challenges faced
4. Fleet optimization to maximize “Trips per cycle” through network analysis
5. Geospatial mapping of trips and searches to identify new expansion opportunities
6. Use cases for other businesses
7. Q&A



## What is PEDL?

**PEDL** is a smart, affordable and environment friendly cycle sharing service for short trips around your city

## How PEDL works?



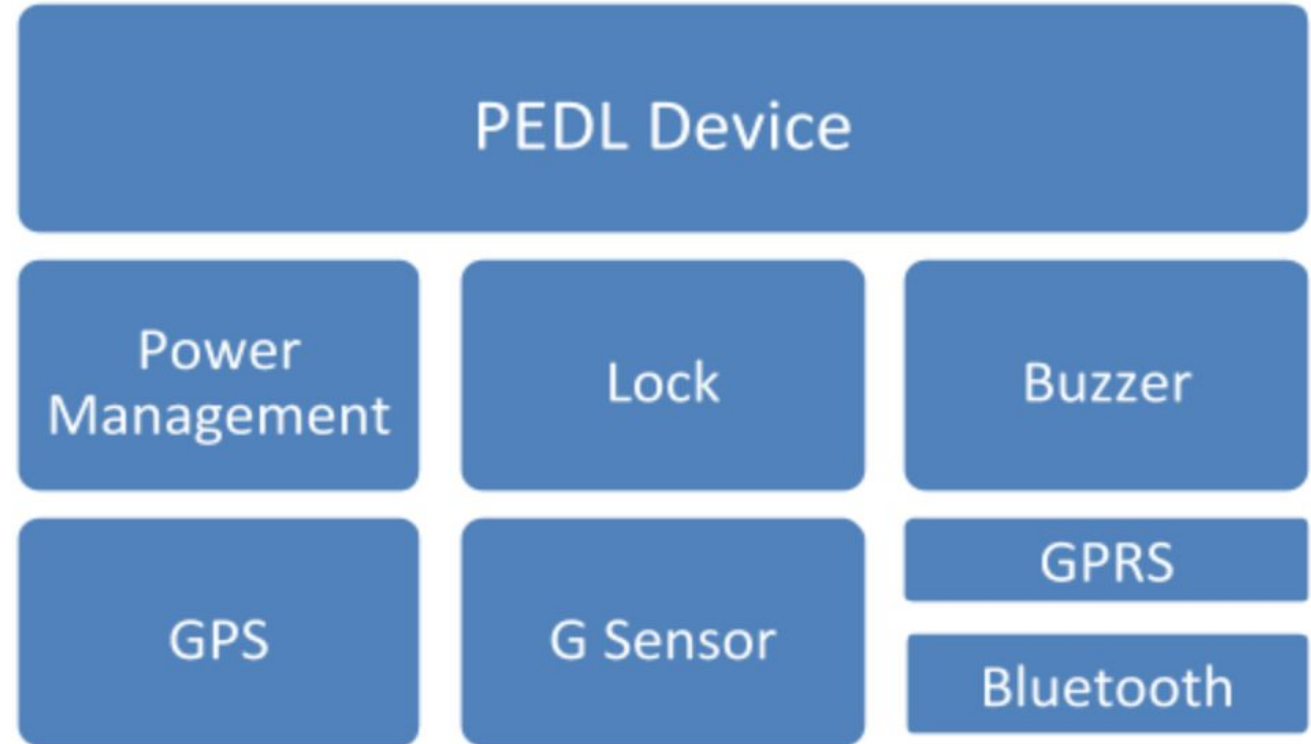
Note: Trip can only be ended at a valid station

# IOT device features and data collection process

PEDL lock is compact IOT device



Basket has a solar panel that powers IOT lock



# IOT device features and data collection process

PEDL lock is compact IOT device



Basket has a solar panel that powers IOT lock



We get cycle GPS data, battery status, lock/unlock status and signal strength from the lock

# PEDLing our way to Expansion

- MVP conceptualized
- Launched with 30 cycles in HSR layout, Bengaluru
- Manual Operations
- 15 station network in HSR

30



Nov  
2017

- Expanded in Agra and Jaipur with 100 cycles each
- Had to withdraw due to high Vandalism cases
- Launched in close circuits like IIT Chennai, IIT Bombay and IISC

3000



April  
2018 -  
Present

1000



Jan 2017

- IOT implemented in cycles
- Device captured battery status, lock status, GPS tracking, theft protection
- All fleet removed
- Expanded in Pune and Kolkata as they were smart cities

Jan 2018

- Presence in 15 cities across india. New cities like Ranchi, Raipur, Varanasi etc
- Maximum density in Bangalore, Kolkata and pune

12000+



# Challenges along the Way

- Cycles were operated manually
- Personal info was manually collected including photo id and phone number
- Customer would take the cycle for a particular location but end up at other station. Coordination was menace

30 

Nov  
2017

- High cases of Vandalism in North smaller cities like Jaipur and Agra. Had to Withdraw eventually
- Tried tech parks, military establishments, commercial areas etc
- Metros were tried but parking was an issue so opened station within 100m to connect last mile

4000 

April  
2018 -  
Present

3000 

Jan 2017

- When IOT was implemented there were issues that GPS accuracy from cycles were not good, leading to customers not able to end the trip
- Using Parking space was a challenge. Tied up with local shops

Jan 2018

 10000+

- Load balancing of cycles to maintain high station utilization
- New site identification
- Network Mapping



## Addressing the Core Issue

Apart from the operational issues such as Repair & Maintenance, IOT device issues etc the core problem is:

**“ How to increase number of trips per cycle hence maximizing Utility and revenue”**

### Challenges:

1. Allocation of cycles at stations was heuristic based
2. The trips per cycle was lower than expected
3. Rebalancing of cycles was done once a week in lack of a scientific optimization method
4. Identification of new sites for expansion was completely intuition based



# Approach to solve the core Issue

**How to Increase no of trips per cycle**

**Optimizing current network of stations within an area cluster**

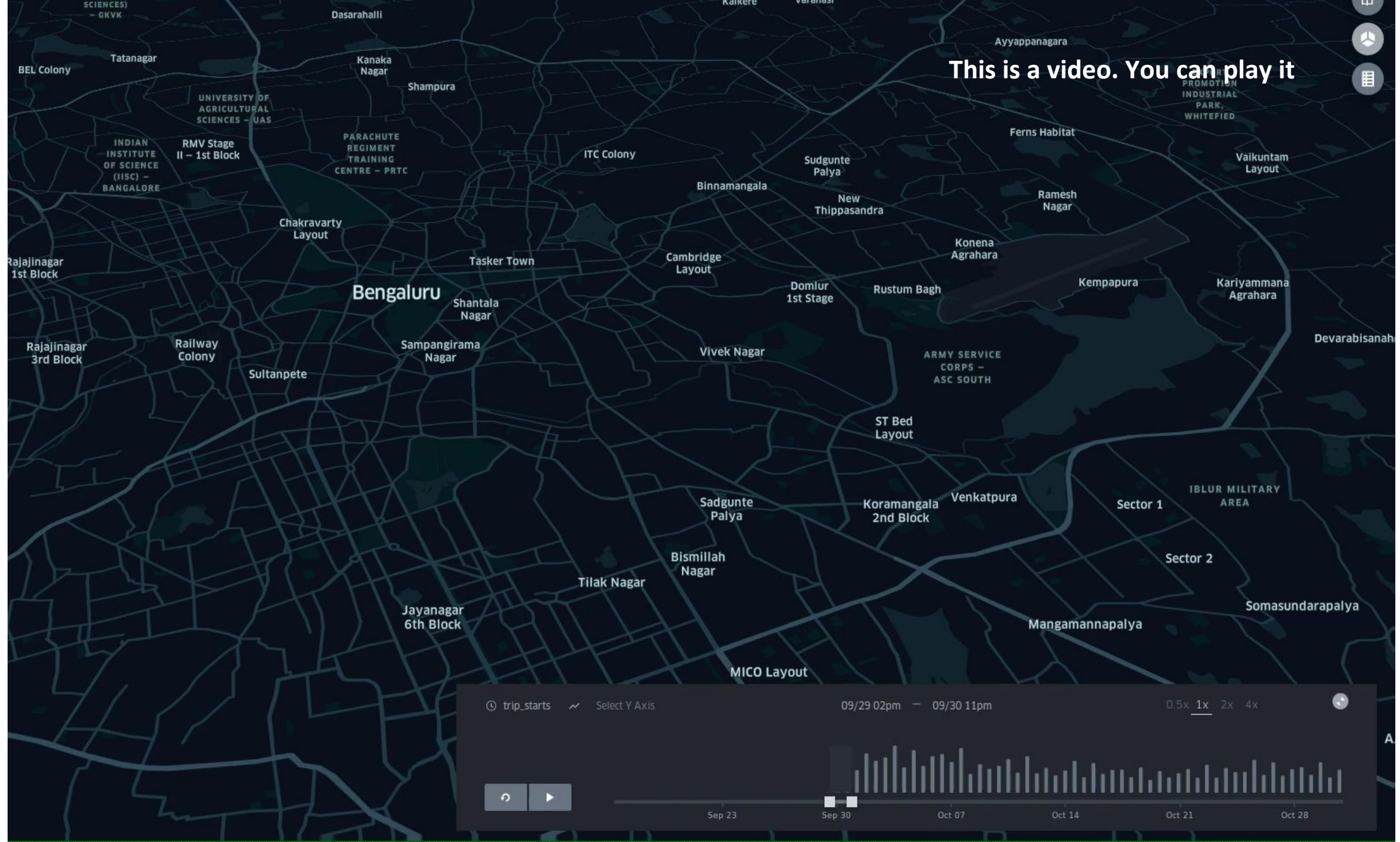
1. Cycle rebalancing to optimize for no of trips per cycle
2. Identifying dead stations, areas
3. Identifying frequented routes with no stations
4. Identifying areas where people abandon cycles due to lack of stations
5. Launched subscription package to increase frequency of trips

**Expanding in new areas with high expected demand**

1. Identify areas with high volume of empty searches
2. Identifying connecting neighborhoods

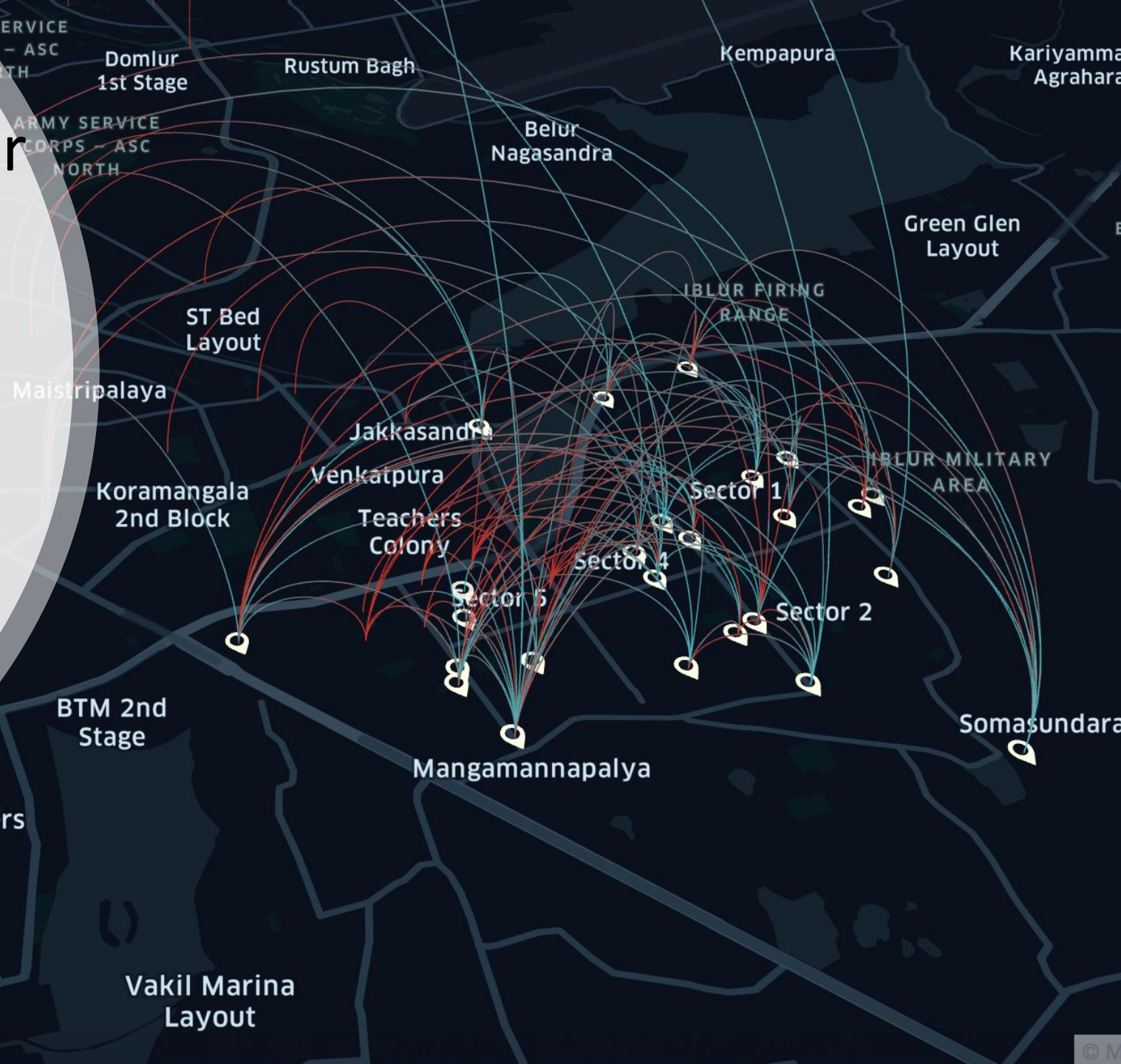
# Understanding PEDL network

This is a video. You can play it



# Decoding PEDL Network for Fleet optimization

- Creating network chains using rate of trips and transition probabilities
- Fitting a polynomial optimizer to maximize trips per cycle
- Creating daily cycle redistribution plan for fleet



# Objective

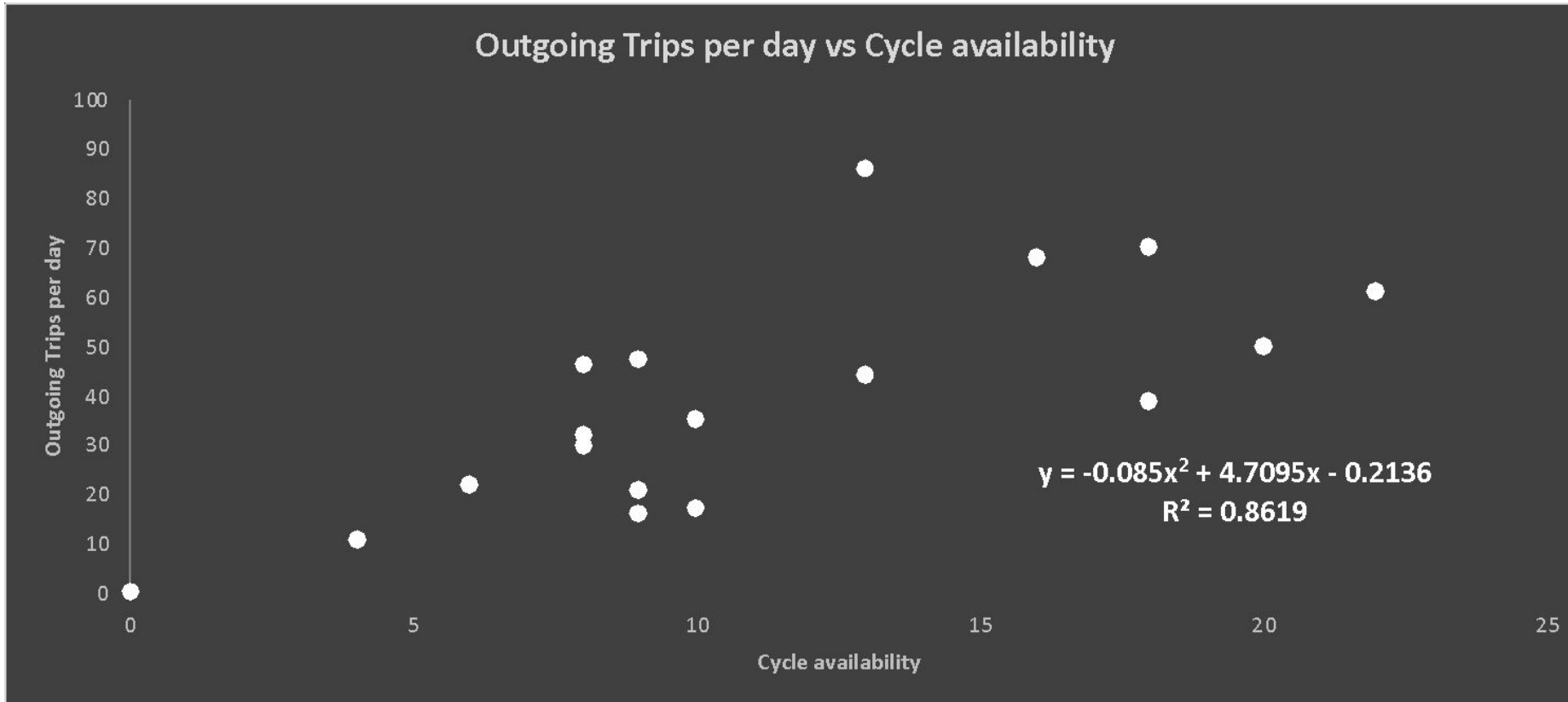
- To identify the number of cycles that should be present at the start of the day at each station in order to maximize Trips per cycle and thus Revenue

## *Concepts:*

1. *Rate of outgoing trips from a station*
2. *Transitions probability from A to B*



# Rate of Trips from a Station (ROT)



ROT

This is expected number of trips per day from a Station, given cycle availability at day start

For every station a polynomial function was derived that best explains the rate of trips per cycle availability at that station

Objective function  
(Total trips)

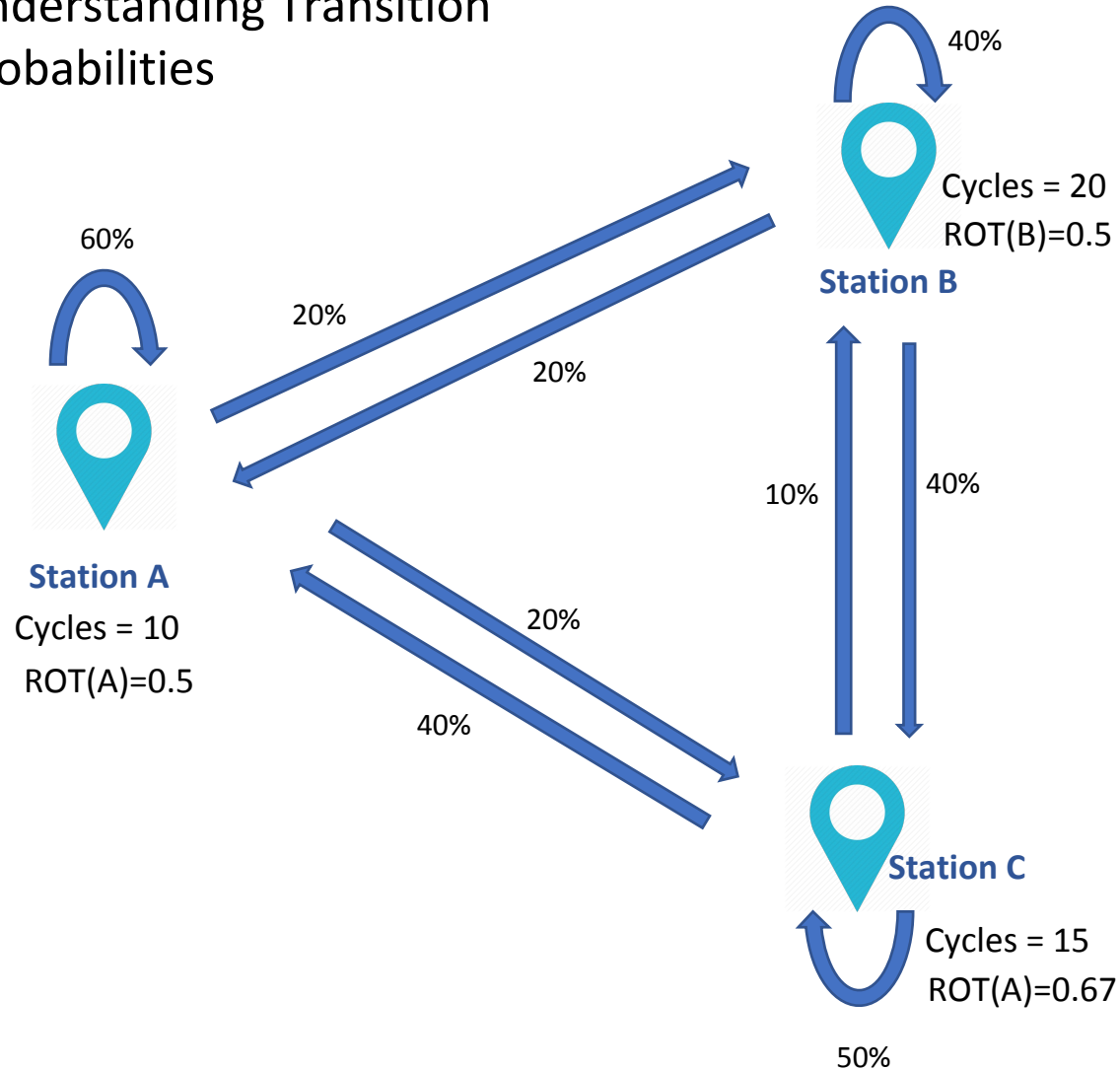
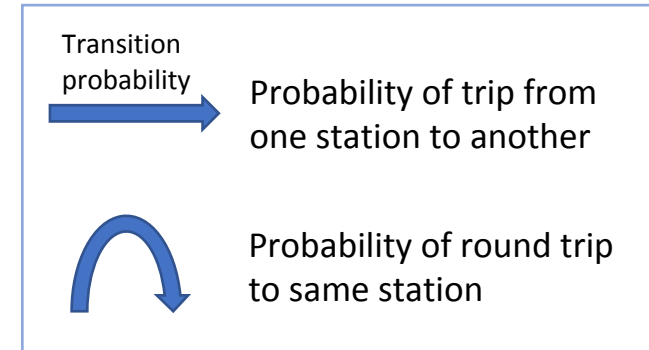
$$f(x) = \sum_{i=1}^n (C_i * ROT_i)$$

where

$C_i$  = cycles at station  $i$  at the start of day  
 $ROT_i$  = Expected outgoing trips for station  $i$  in a day given cycles  $C_i$

# Network Chains

## Understanding Transition Probabilities



$$Cycles_A (at\ day\ end) = Cycles_A (day\ start) + Incoming(A) - Outgoing(A)$$

$$Incoming(A) = Cycles_B(start) * ROT(B) * 20\% + Cycles_C(start) * ROT(C) * 40\%$$

$$Outgoing(A) = Cycles_A(start) * ROT(A) * (1 - prob\ of\ round\ trip)$$

$$Cycles_A(day\ end) = 10 \text{ \#cycle availability} + 20 * 0.5 * 0.2 + 15 * 0.67 * 0.4 \text{ \#Incoming} - 10 * 0.5 * 0.4 \text{ \#outgoing} = 14 \text{ cycles}$$

# Constraints

1

Cycles at start of day  
at any station  
should be  $\geq 0$

2

The cycles at the  
end of the day at  
any station should  
be  $\geq 0$

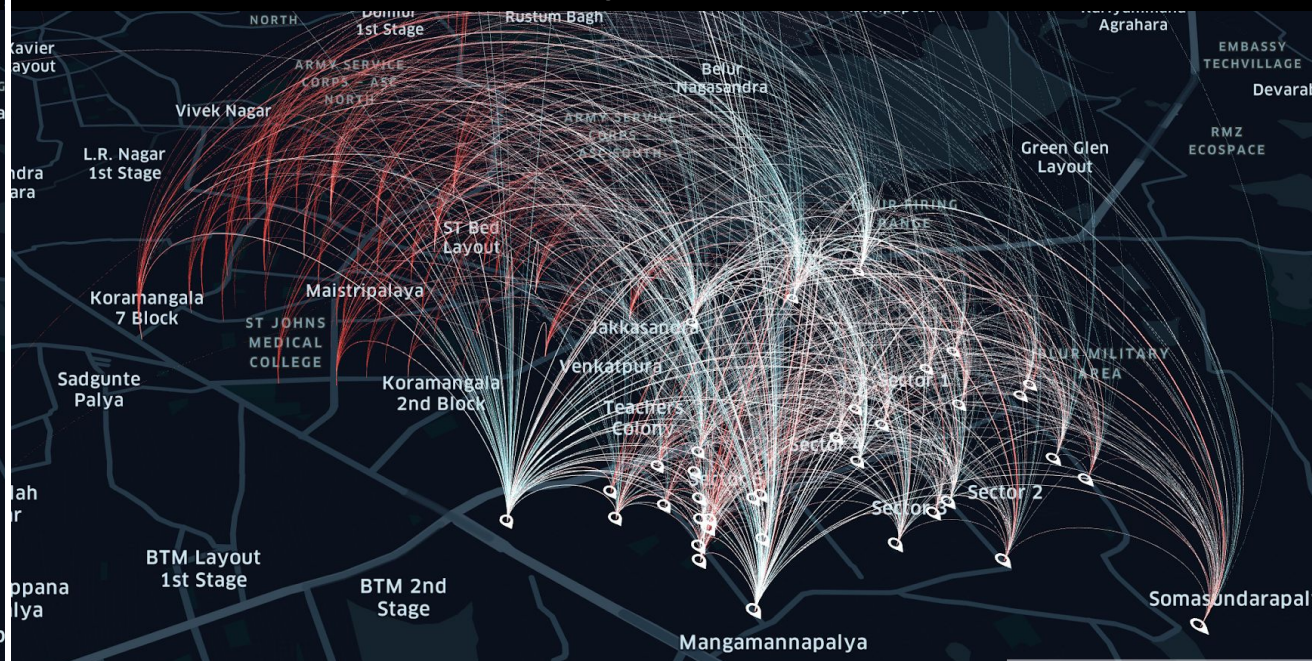
3

Sum of cycles at all  
stations should be  
equal to total cycles

# Before Optimization



# After Optimization



Landmark	Before Opt. (cycles)	After Opt. (cycles)
Agara lake	18	20
Arrow electronic India pvt Ltd	17	14
Salarpuria Serenity	15	20
Twin Park	10	5
Outer Ring Road - Agara Park	9	15
Aston Service Apartment	8	10
Petoo	8	0
4th Main Park	7	0
Hsr juice and chats	7	10
Vasudev Adiga's	7	11
Manar Elegance	6	3
Jai Plaza Symphony	6	10
NH Hospital	6	4
Moghul's Awadhi Restaurant	6	5
HSR Club Road	5	15
<b>No of trips per cycle</b>	<b>2</b>	<b>2.5</b>
<b>Total Trips per day</b>	<b>284</b>	<b>355</b>

**Total Cycles in HSR: 150**  
**Uplift in Trips per cycle: 20%**  
**Uplift in revenue\*: 15%**

\*Uplift in Revenue per cycle is lower than uplift in trips per cycle due to extra cost of rebalancing fleet daily



The background features several sets of concentric, curved lines in shades of gray, some solid and some dashed, creating a sense of motion or a circular path. A blue speech bubble shape is positioned on the left side, containing the main title.

## Finding new sites for expansion

- Identify Frequented routes with no stations
- Areas with no station and high cycle abandonment
- Identifying areas with high empty searches

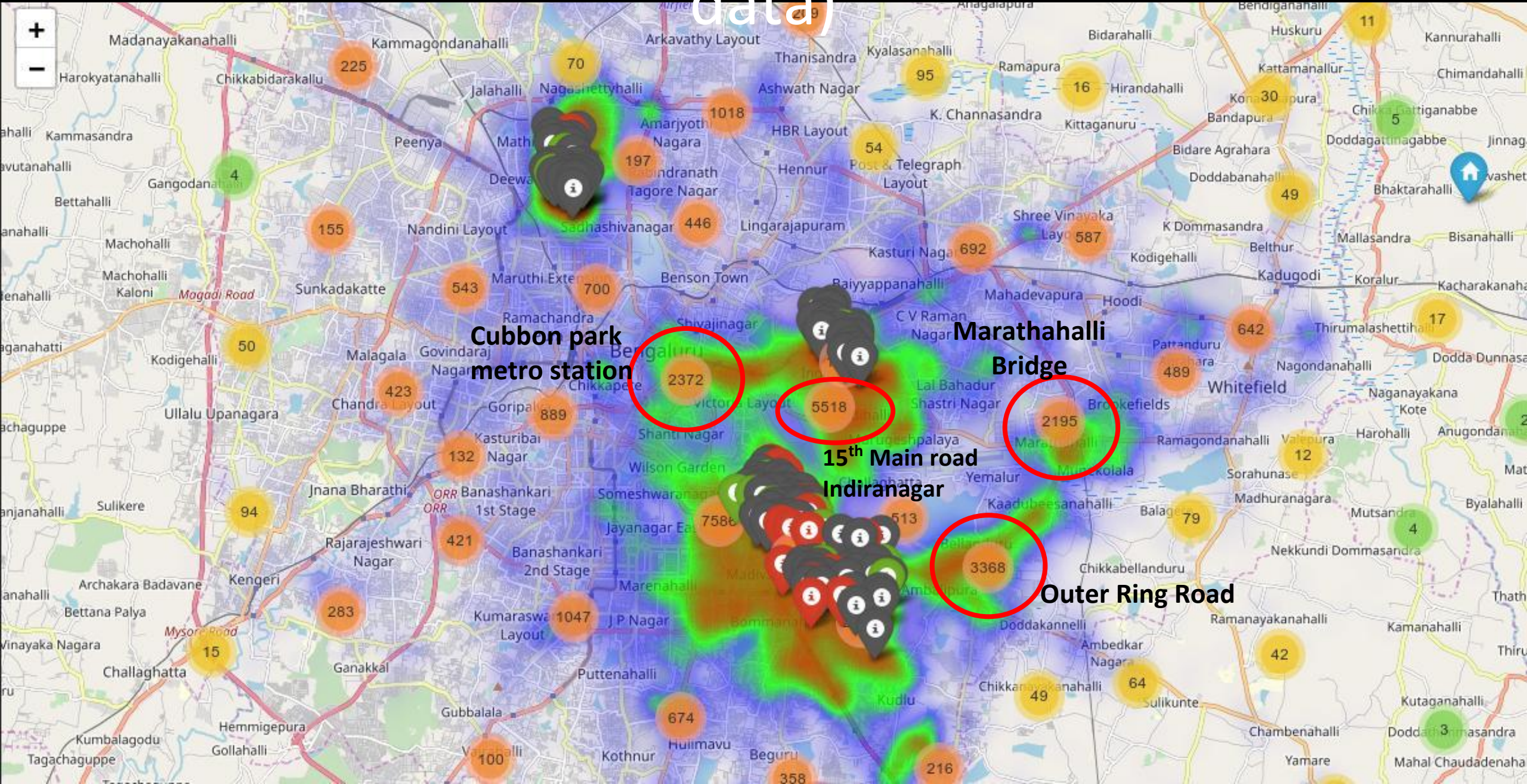
# Frequented routes Heat Map (HSR, Bengaluru)



# Identifying Cycle abandonment areas



# Identifying new sites for expansion (user search data)



# Tools and Techniques used for demand mapping

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## Plotting tools

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Kepler.gl

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Folium

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Mapbox

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## Techniques

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Heat Maps

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Network analysis and Operational  
research

## ← PEDL Subscription Plans

### Choose the plan

best suited to you, cancel anytime



#### PEDL Perks

₹149 ₹49

Unlimited free rides for a total of 1 hour daily

Validity 30 days

#### PEDL Perks Plus

₹349 ₹199

Unlimited free rides for a total of 2 hours daily

Validity 30 days



- Free Zoomcar Voucher worth Rs. 1,000
- Discount worth Rs. 10,000 for first month subscription of ZAP subscribe

## Recent initiatives to increase revenue per cycle

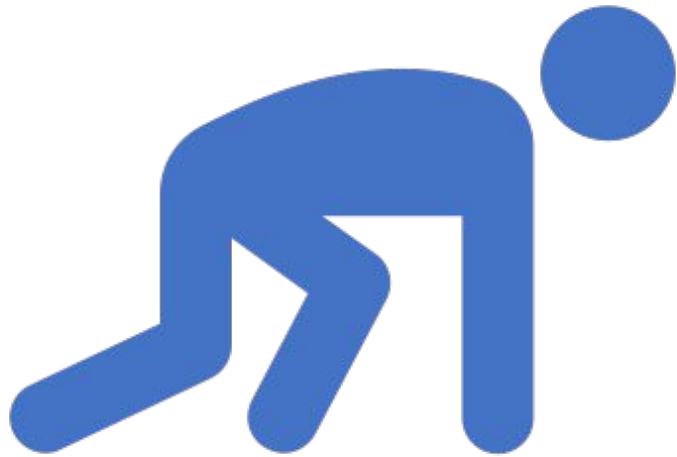
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- We also introduced PEDL subscription at 49 and 199rs. per month with unlimited rides to further increase trips per cycle
  - *Area with more subscribers are given priority in cycle allocation*
- We have plans to incentivize users to drop cycles at particular stations in order to maintain optimal availability of cycles at all station at all times and reduce rebalancing costs

# Implementation was never a cake walk

## Learnings

- **Start with smaller experiments** (we started with 15 stations in HSR layout)
- **Keep measuring and flashing results** (we tracked the results everyday and flashed uplift reports)
- **Build maps to highlight actions and not just describe data**
- **Don't underestimate the power of making it look good** (it's as much of an art as science)



# How can other businesses use this?



- Identifying areas to expand operations using app search data (food delivery, groceries, medicine, ecommerce etc.)
- Recruitment or allocation of fleet personals by areas to optimize order delivery time
- Decentralizing warehouses/ pick up stations across city to minimize time to delivery
- Tracking of Fraud during delivery





## Team Behind Scenes



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