

# Social Inclusion through Play

A New Methodology for Public Transport Planning in the Indian Context



27<sup>th</sup> August 2019

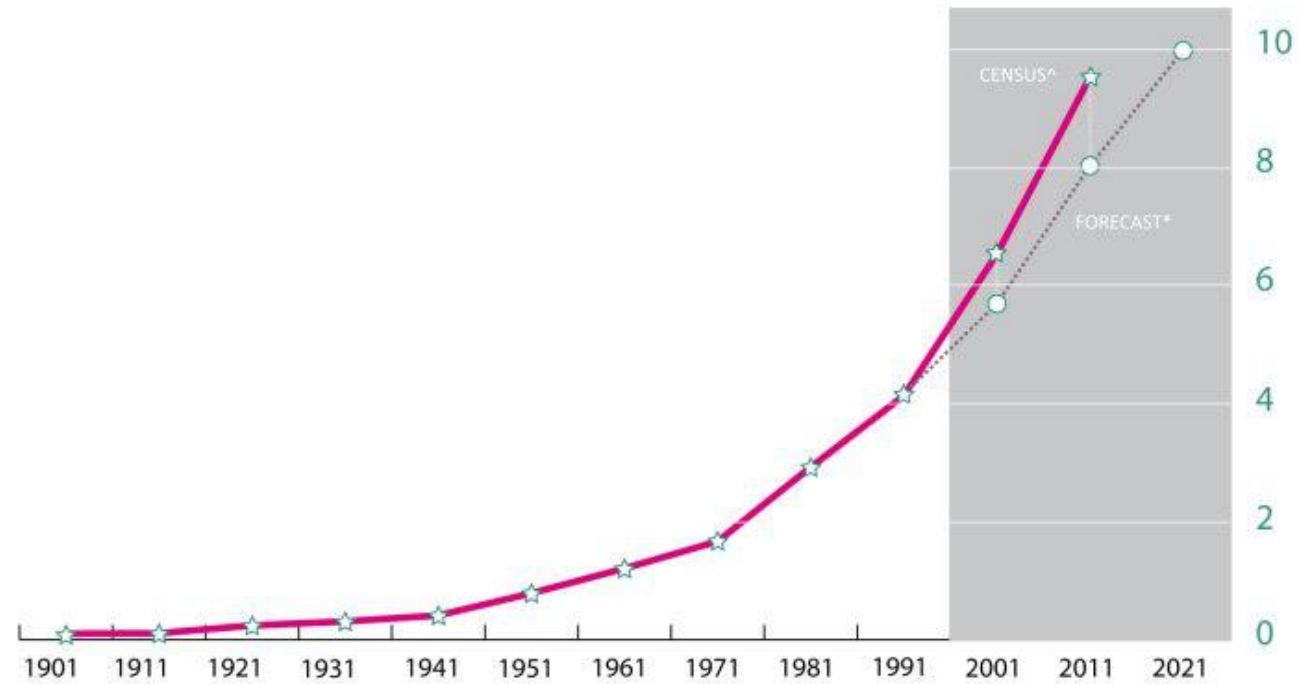
Threadbo, Singapore

# Bangalore's Population growth

## Bangalore's Exploding Population

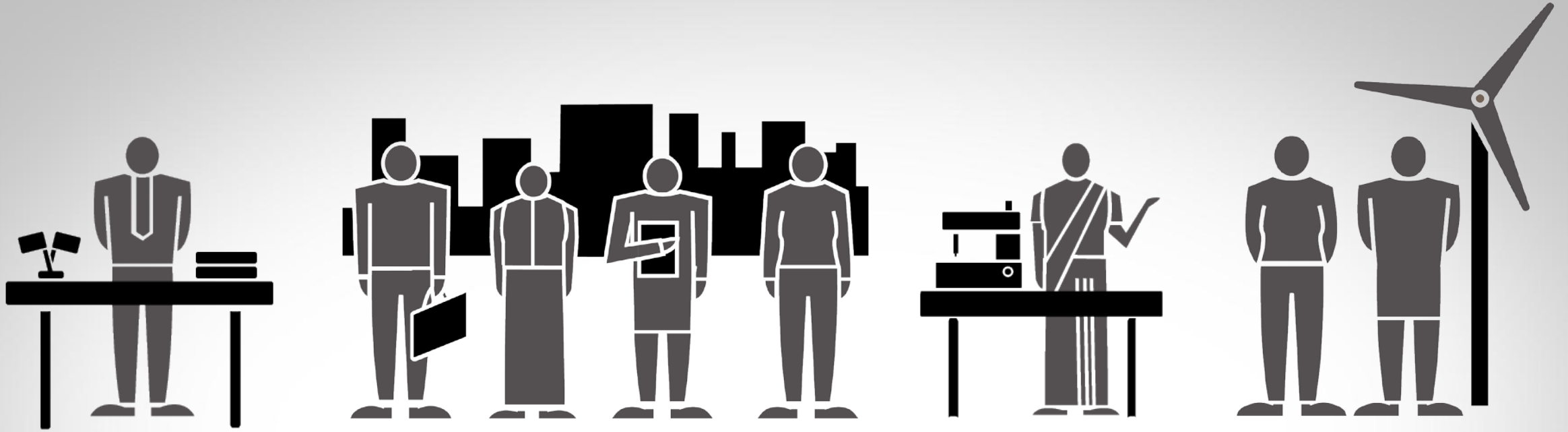
Population Growth by Decade

Millions of People



Source: Forecast\*: BDA Draft Master Plans 2015 (Scenario Indicators)

Census\*: Directorate of Census Operations - Karnataka, Census 2011 (Provisional Population Totals)



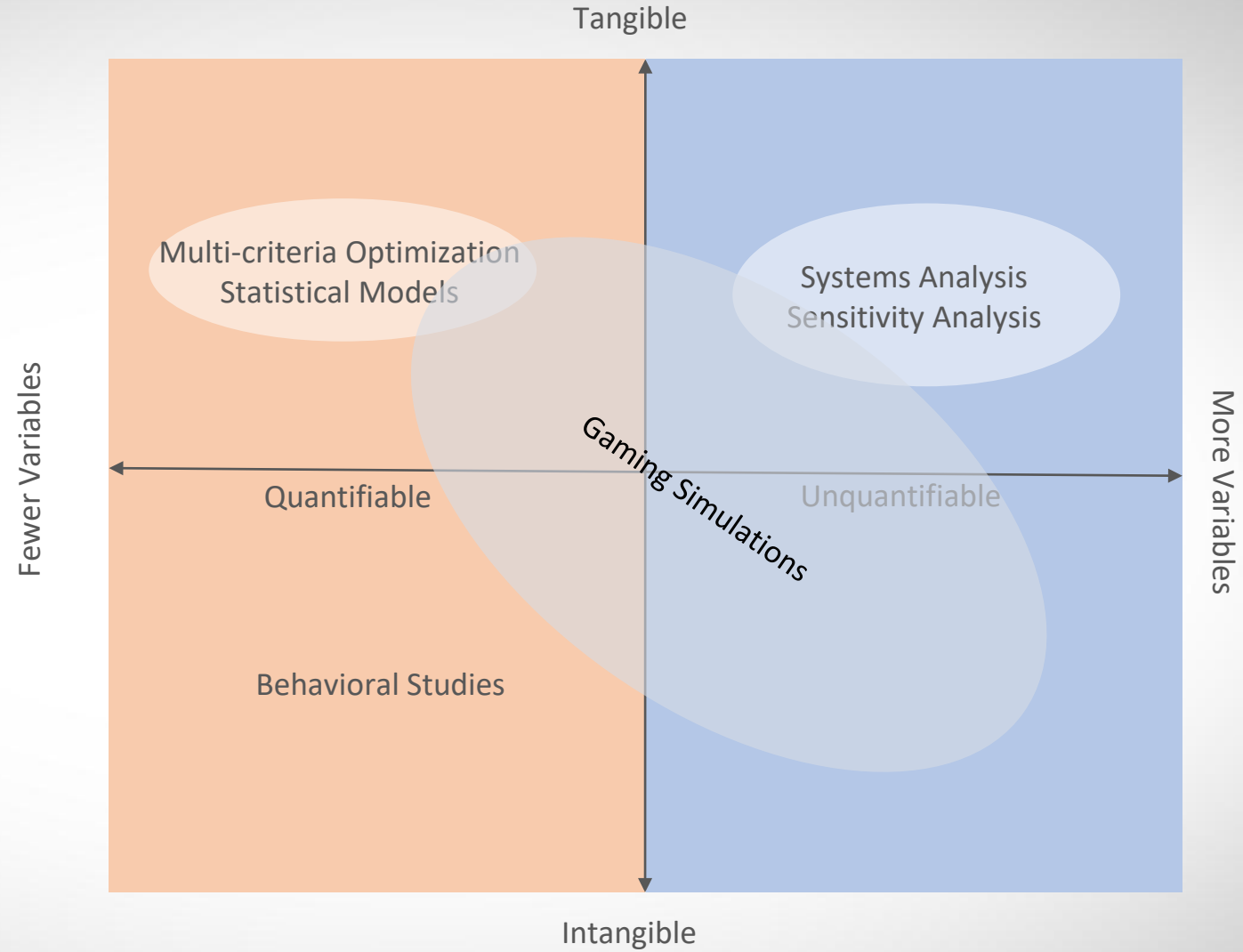
We need policies that are **relevant** to the lives of people.

We need **rapid** policymaking.

We need policies **responsive** to changing social, political,  
and environmental situation.



# How - Modelling approaches?




Shubik, Martin. Games for society, business, and war. Elsevier, 1975.




# simulation models


Legend




Time of travel




Fuel cost




Cost of ticket




Waiting time




Distance




Route




Level of comfort




Reason for travel




Preference




Time of the day



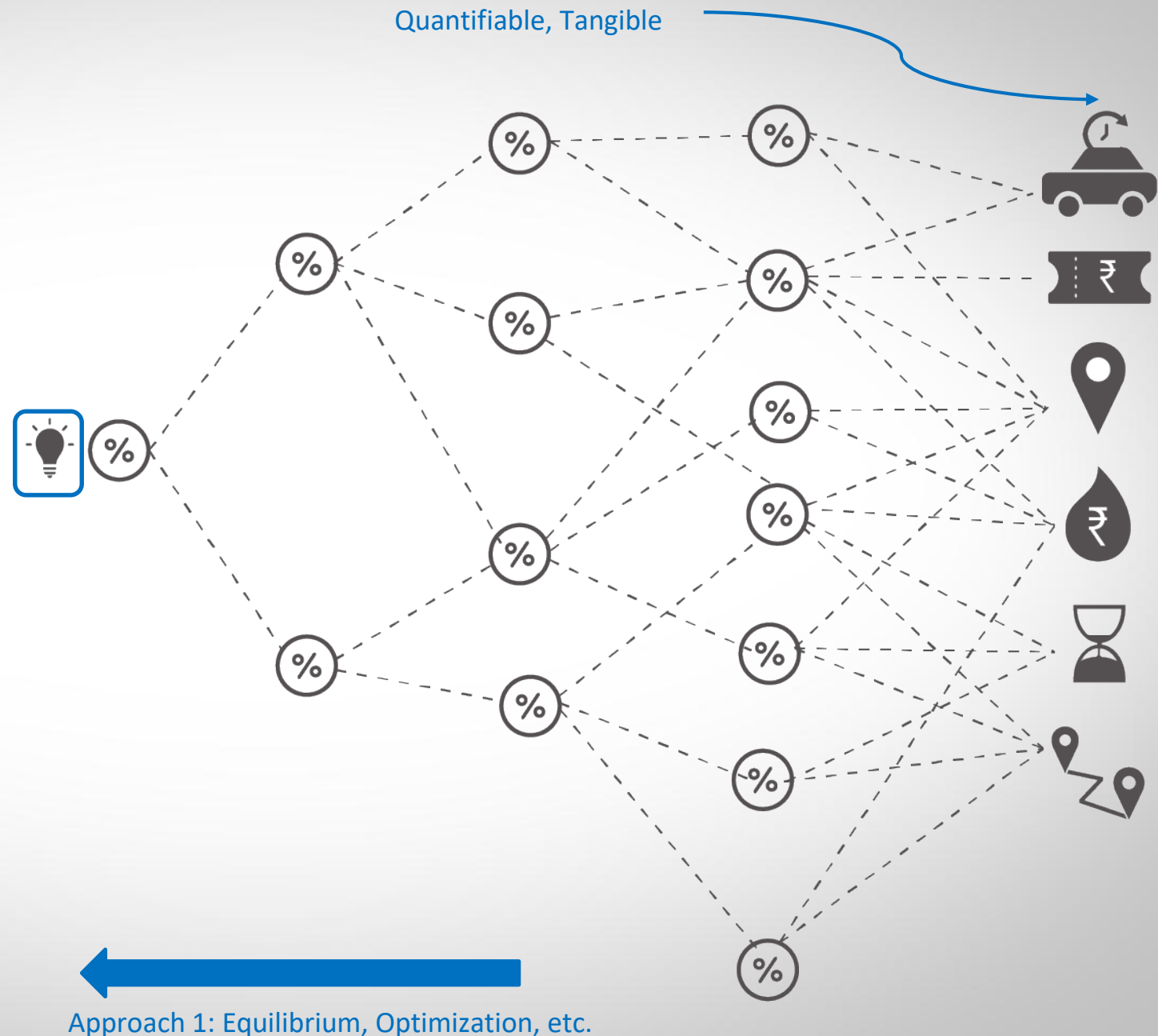
Scenario generation



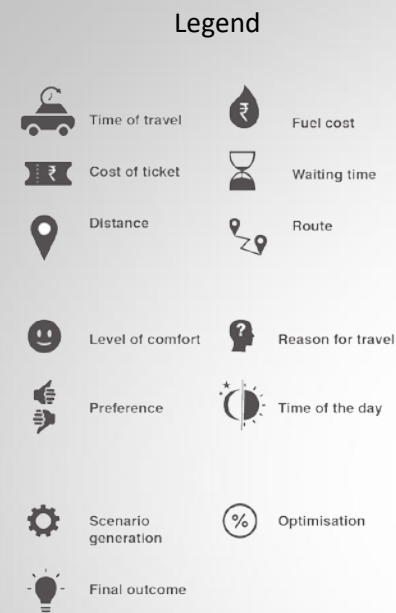
Optimisation



Final outcome

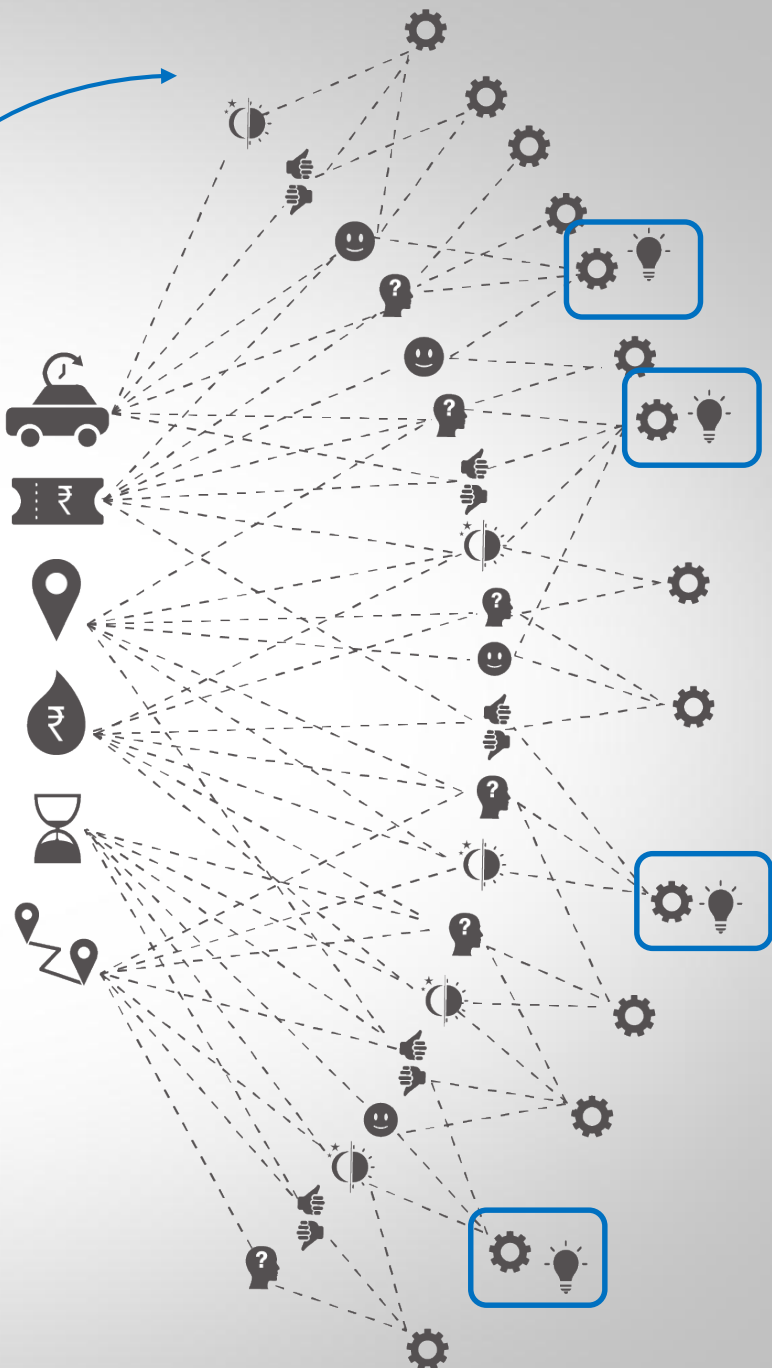


# simulation models



Unquantifiable, Intangible

Quantifiable, Tangible



Approach 2: Generative, Adaptive, etc.



How do we plan for Affordable,  
Accessible and Available Public Transport  
Service?



# Transport Trilemma

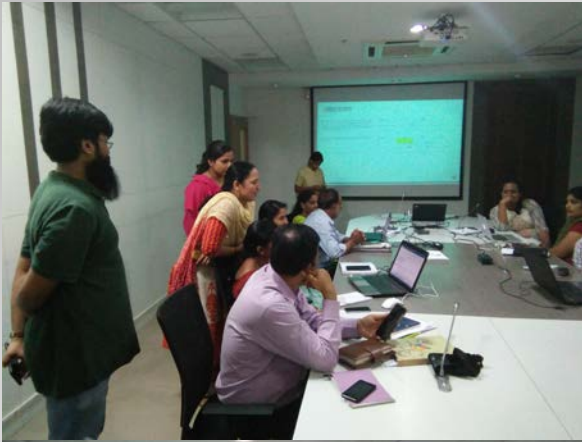
Game



# Game Elements

Game elements	Description
Objectives in the Game	<ol style="list-style-type: none"><li>1. Create plans to achieve set targets for annual ridership and gross revenue for PT Operator for the period 2018-2020.</li><li>2. Prevent insolvency</li></ol>
Role	PT Operator (Buses)
Resources	Revenue, buses, routes, information
Boundaries	Public bus transportation restricted to City Area for the period 2018-2020
Outcome	Annual Transport Plans





## Game sessions

Bus  
Operator  
r

Commute  
er  
Forum





# Transport TRILEMMA

Plan Information Routes **Targets** Fares Graphs Public ▾

### Transport Trilemma Target

Change year to put your assumptions for the highlighted cells for corresponding indicators. You can compare with review period data while putting your assumption for forecast period.

Variable	2018	2019	2020
AVG RIDERSHIP/DAY			
GROSS REVENUE			

### Achieved

Players can see their achieved gross revenue and passenger capacity for year in forecast period.

Variable	2018	2019	2020
AVG RIDERSHIP/DAY	856	856	856
GROSS REVENUE	856	856	856

Submit Plan



# Assumptions for Ridership Planning

- Decadal growth of previous years are used to decide future targets
  - Load factor
  - Annual revenue
  - Population Growth Rate
- Ridership and revenue have a priority over addition of new routes
- Increase in buses would lead to increase in ridership
- Increase in ridership would lead to increase in revenue



# Challenges and Requirements

- Lack of data on passes
- Wanted Bus Operator to be exempt from the payment of various taxes like MV tax, road tax etc.
- Government funding and loan waivers for Bus Operator
- Difficulty in scheduling due to dynamic traffic conditions in various traffic zones in the city.



# Observations from the game session

- Factored the impact of Metro on ridership, revenue, inflation and other parameters in their estimations
- Not interested in changing the fare structure across any service
- Less attention on operational parameters such as:
  - rate of bus breakdowns
  - rate of bus accidents
  - fuel efficiency etc.
- Realised that data needs to be segregated and more granular across different services for precise planning
- Observed schedules vary from set schedules (Form-4) by the Bus Operator leading to disparities in frequency, journey times and other parameters resulting in delays, bus-bunching and other problems.



# Insights

- Bus Operator interested in knowing what kind of data is required and how can it be used for route rationalisation and to meet ridership demand on specific routes.
- New strategies are needed to tackle schedules affected by bus bunching.
- Form-4 process needs to be restructured to make it more responsive to changing traffic conditions.
- Not used to taking decisions at high level. Have been working towards a set target.
- Players were indifferent to messages from an IT system.
  - Preferred to clarify and discuss with people rather than reading information on the screen



# Game sessions and observations

Game Session	Summary
Bus Operator	More focus on meeting targets than how these targets are met. Net number of buses on road was increased with increased fares across services year-on-year while little or no significance was attached to the number of routes or schedules of buses.
Commuter Forum	More focus on how the targets are met. Was more interested in increasing the number of routes and schedules of buses to enhance commuter accessibility
University	Was more interested in experimenting and trying out new strategies over achieving targets. Most targets weren't achieved but new strategies were explored to achieve them
Planning Group	A systematic methodology was followed to arrive at respective targets. All estimations were based on detailed analysis of information provided in addition to which, certain external parameters were also used for coming up with different strategies.



# Overview of plans from all game session for the first year

Plans	Target status	Plan target-1 Annual ridership (lakhs)	Plan target-2 Annual revenue (lakhs)	Accessibility (Number of routes, Number of schedules)	Affordability (Net Fare changes)	O&M Efficiency (Fleet, breakdowns, accidents)
Plan-Operator	Achieved	51.4	195,531	2502,6223	+6%	6783,7.6,1.0
Plan-Commuter Forum	Achieved	55	150,000	2532, 6515	-185%	7383,2.3,0.2
Plan-University	Achieved	50	200,000	2508, 6331	+50%	6603,10.4,0.8
Plan-Planning Group	Achieved	49	65,000	2509, 6361	-95%	7533,16.3,3.6

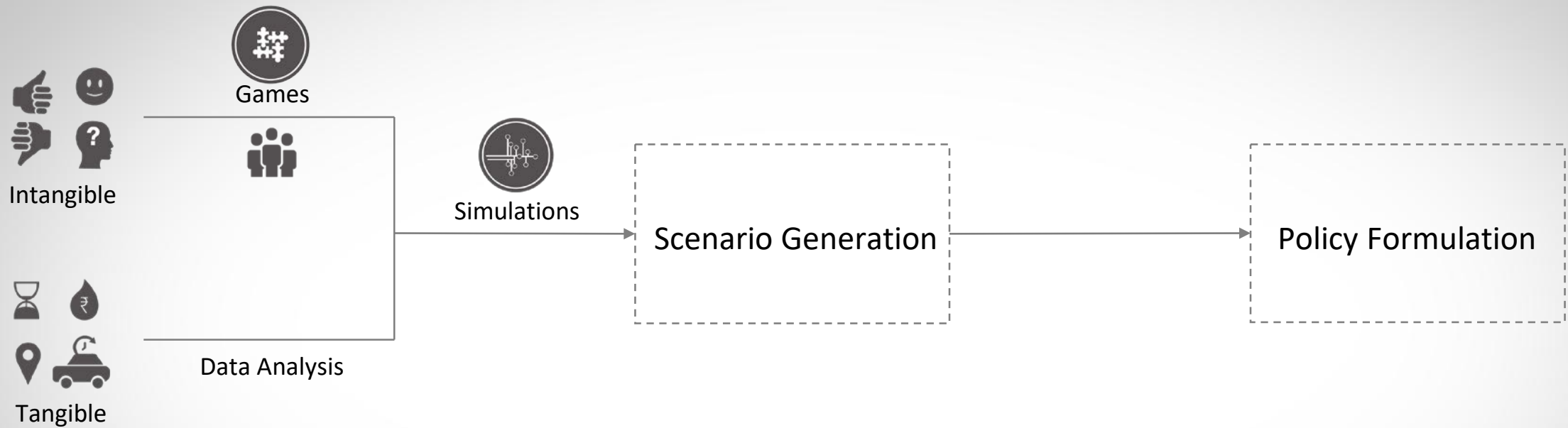


# Fallout of Current Transport Planning

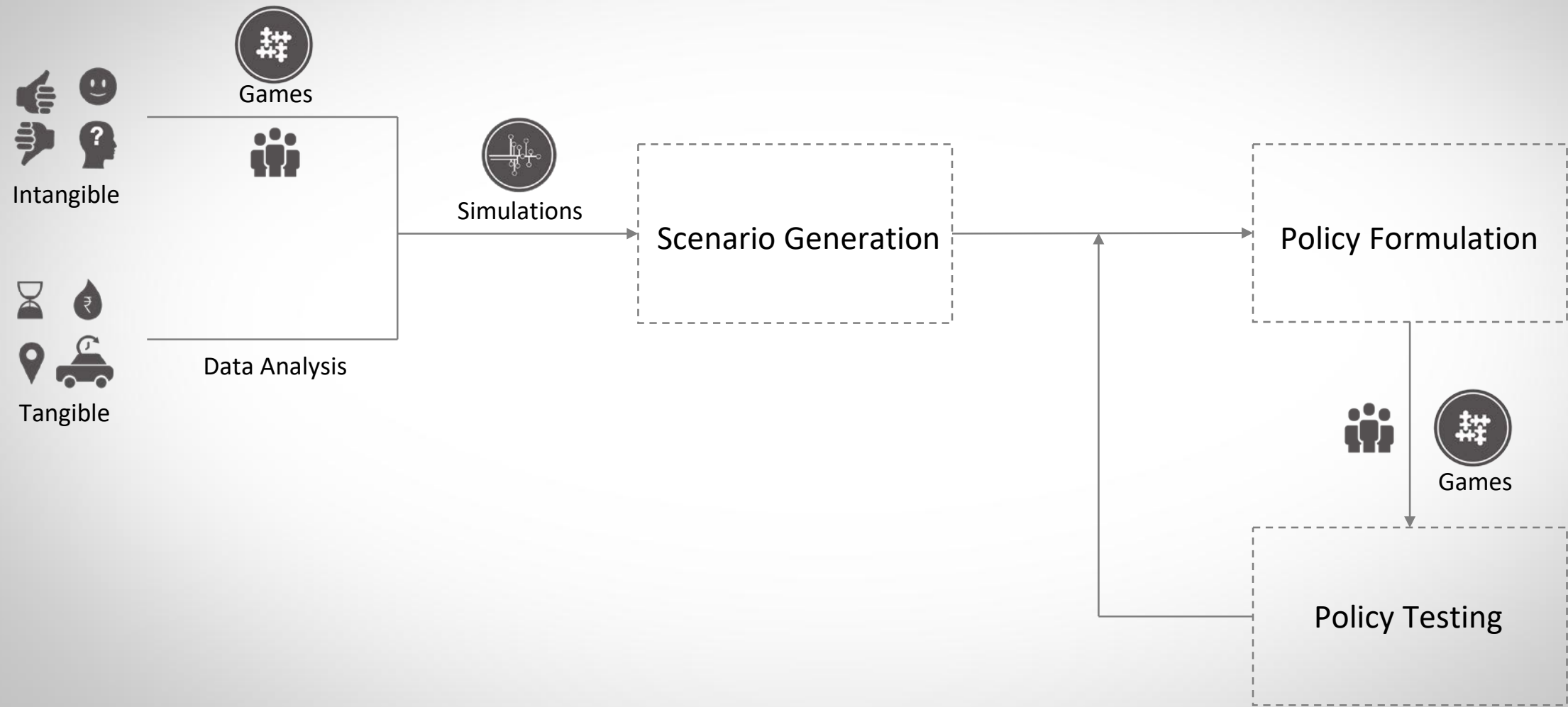
- Garment workers:
  - Bus fares are far too expensive for them to afford for daily commutes and consumes close to approximately 1/3rd of their monthly income (Hindu, 2012).
- CBA fails to capture several qualitative aspects of planning in its assessment for effectively evaluating trade-offs.
  - Outputs are too concise which fail to enable dialogue-building processes with stakeholders concerning public transportation



# Tools for policy formulation



# Tools for policy formulation

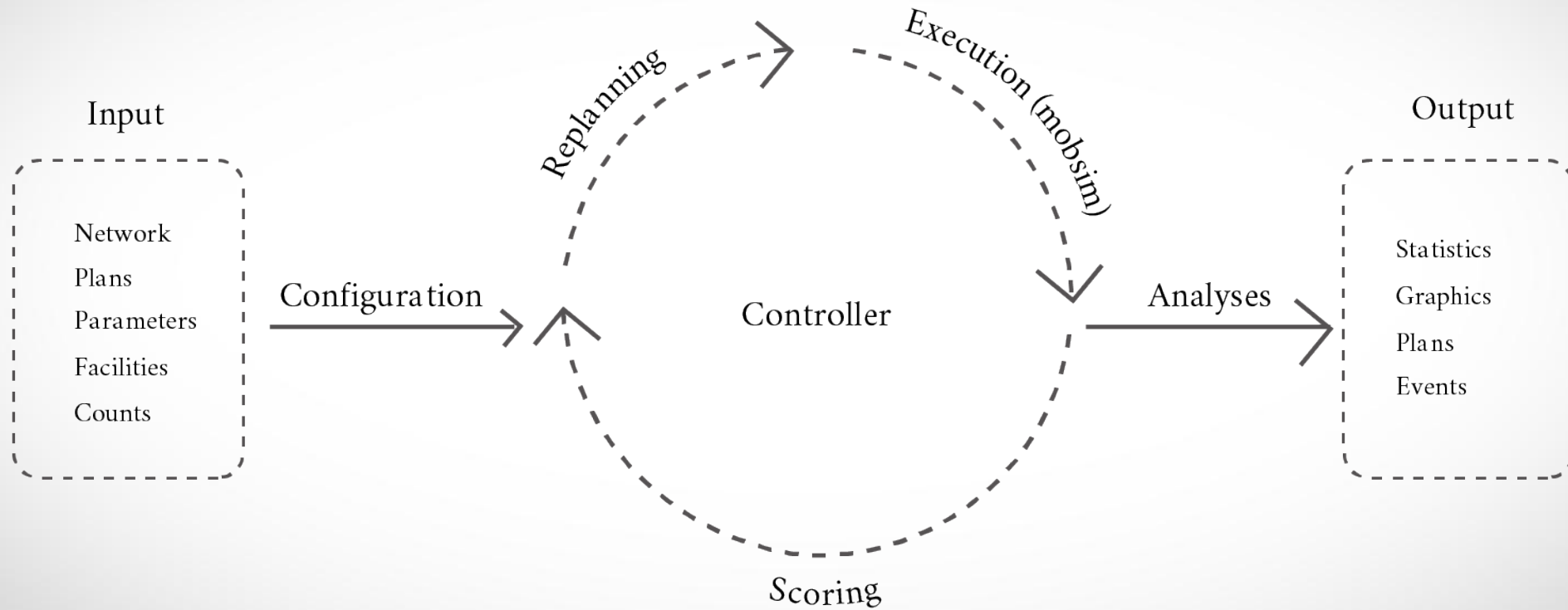


# Simulations

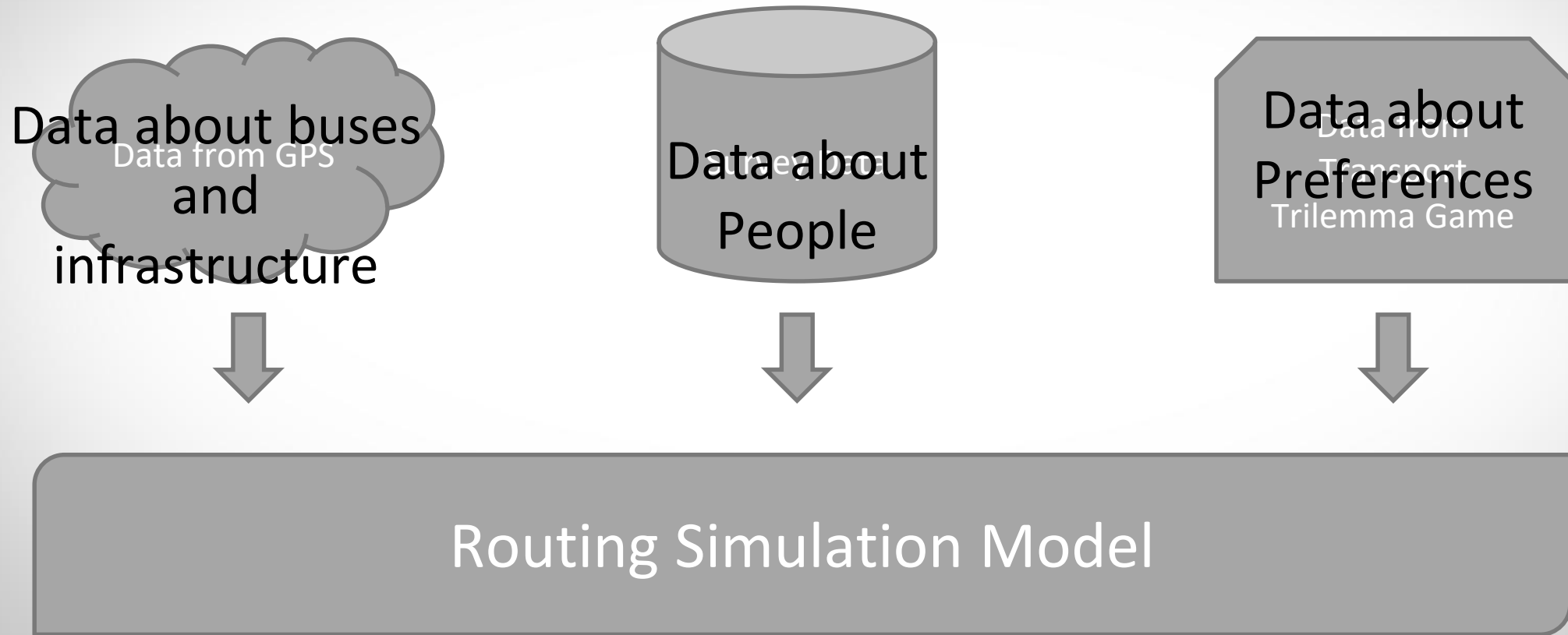
MATSIM, Form - 4



# Using matsim for the Indian context

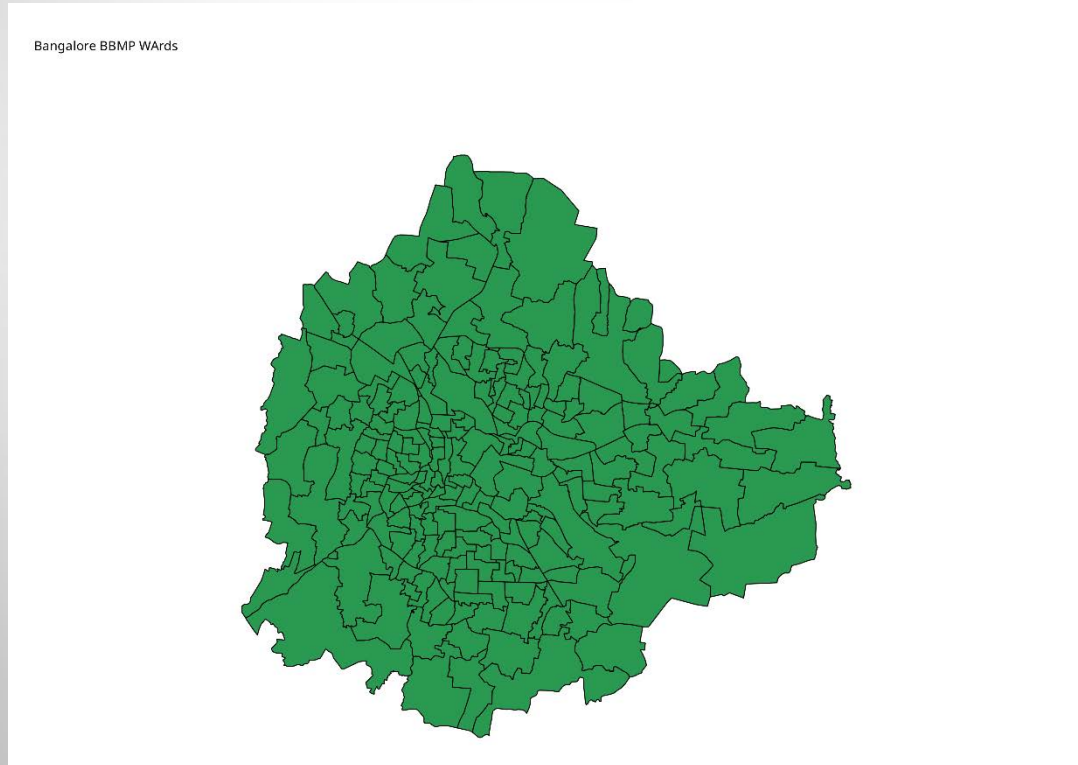


# Simulation for Routing

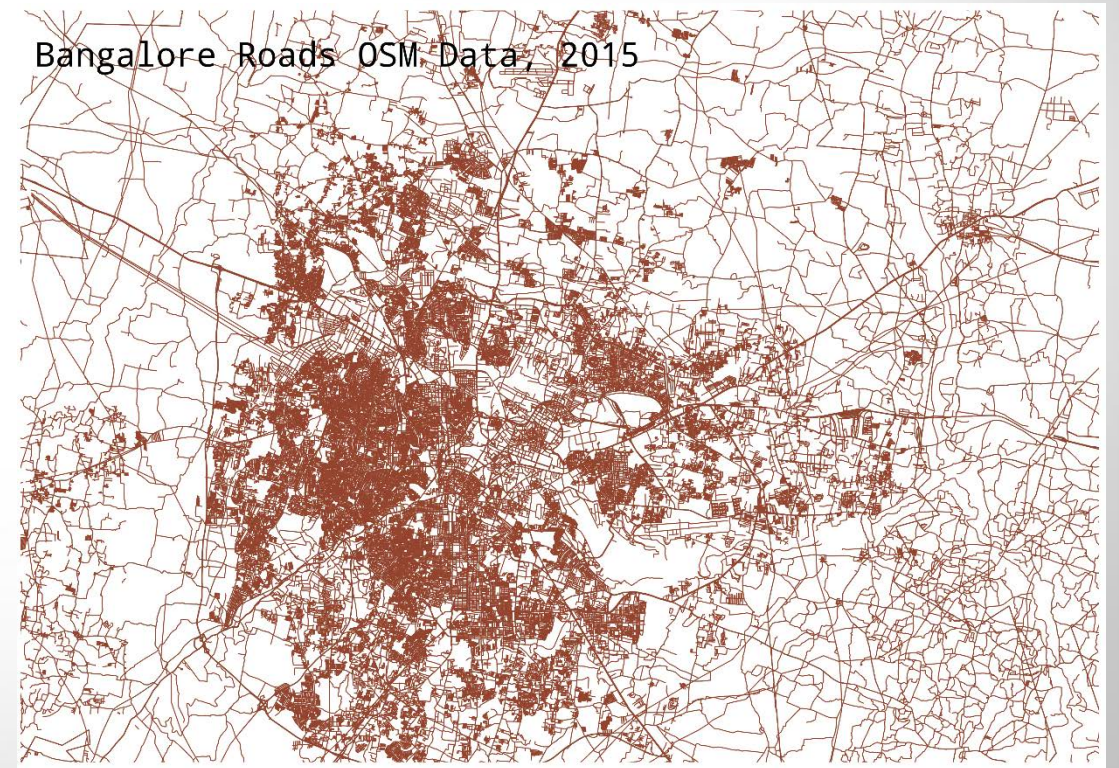


# Bangalore Geography

Bangalore Wards (BBMP Data 2015)

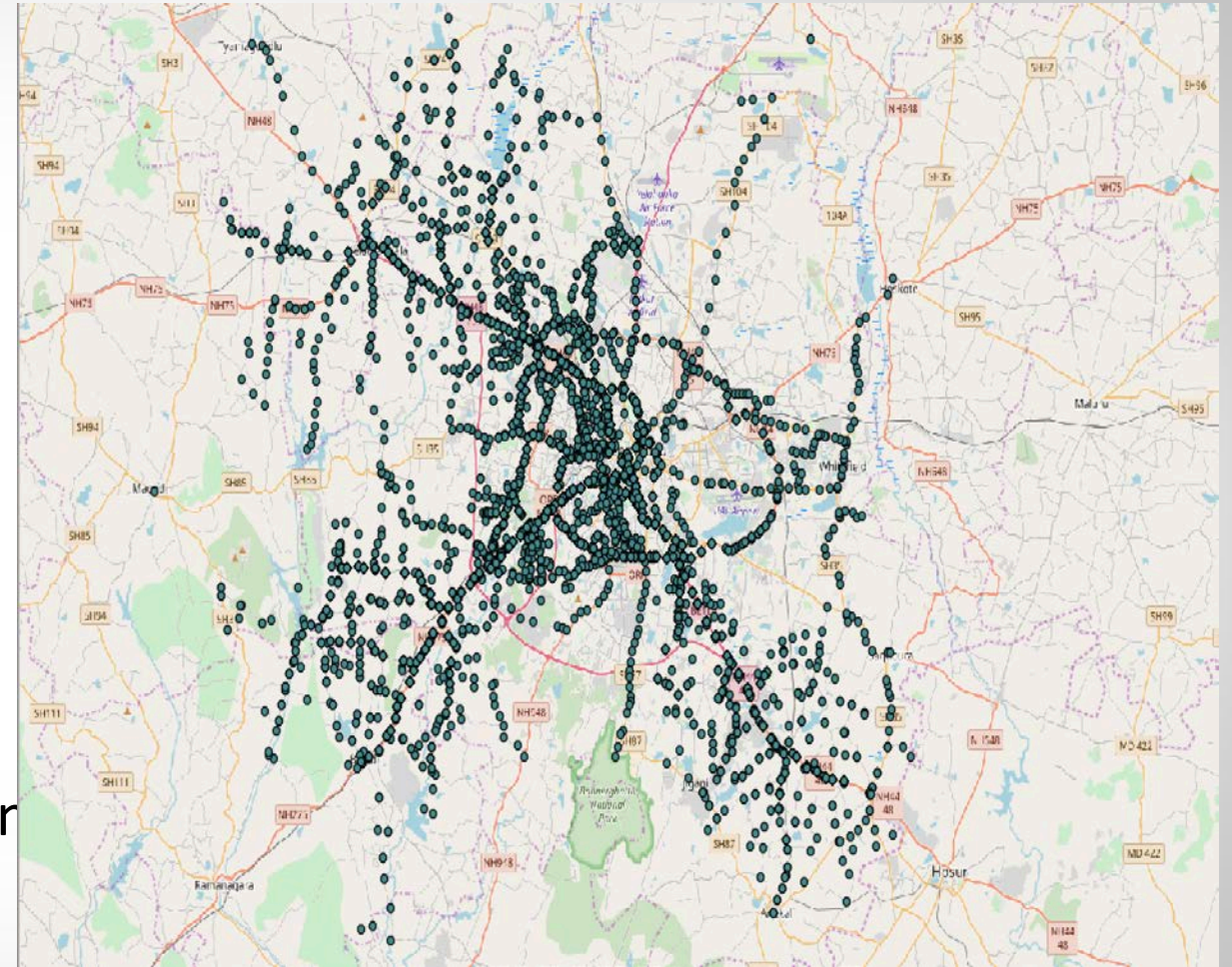


Bangalore Road Network (OSM, 2015)



# Scheduling Simulation

- Garment factory areas
  - Bommanahalli
  - Nayandahalli
  - Peenya 1<sup>st</sup> Stage
  - Peenya 2<sup>nd</sup> Stage
  - Peenya 3<sup>rd</sup> Stage
  - Peenya 4<sup>th</sup> Stage
- 454 Routes
- ~16,000 stops
- Plot routes for different origin destination



# Working with Route Data

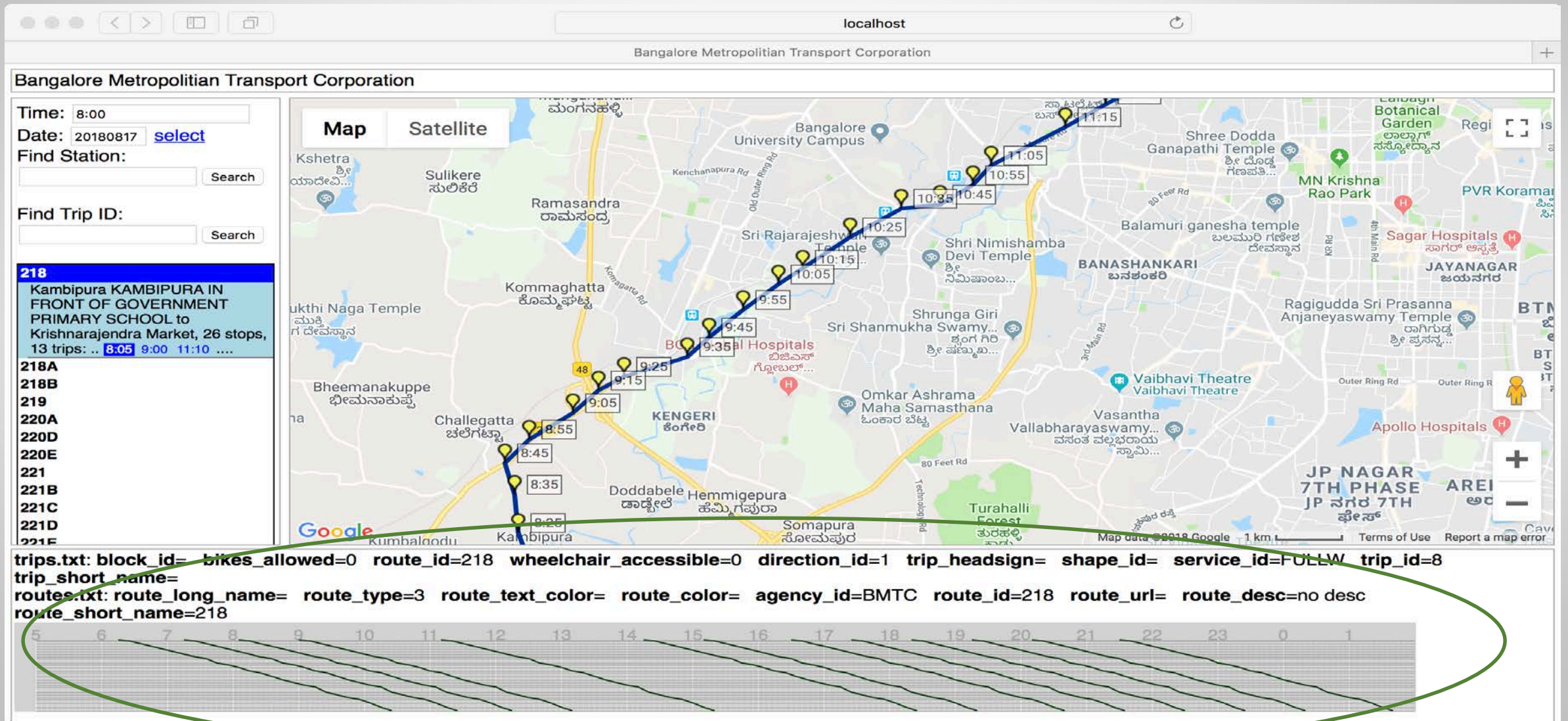
Sample route data for a BMTC route

route_no	distance	origin	destination	departure_from_origin	arrival_at_origin	departure_from_destination	arrival_at_destination
218	18.8 KM	Kambipura	Krishnarajendra Market	07:15, 09:00, 14:15, 16:30, 18:20, 20:10	07:05, 08:55, 12:00, 16:00, 18:15, 20:05, 22:20	06:15, 08:05, 11:10, 15:10, 17:25, 19:15, 21:30	08:00, 09:50, 15:05, 17:20, 19:10, 21:00

- Origin, Destination as bus-stops
- Estimating travel times at different times of day on all legs
- Conversion to GTFS (General Transit Feed Service).



# Visualising the GTFS data

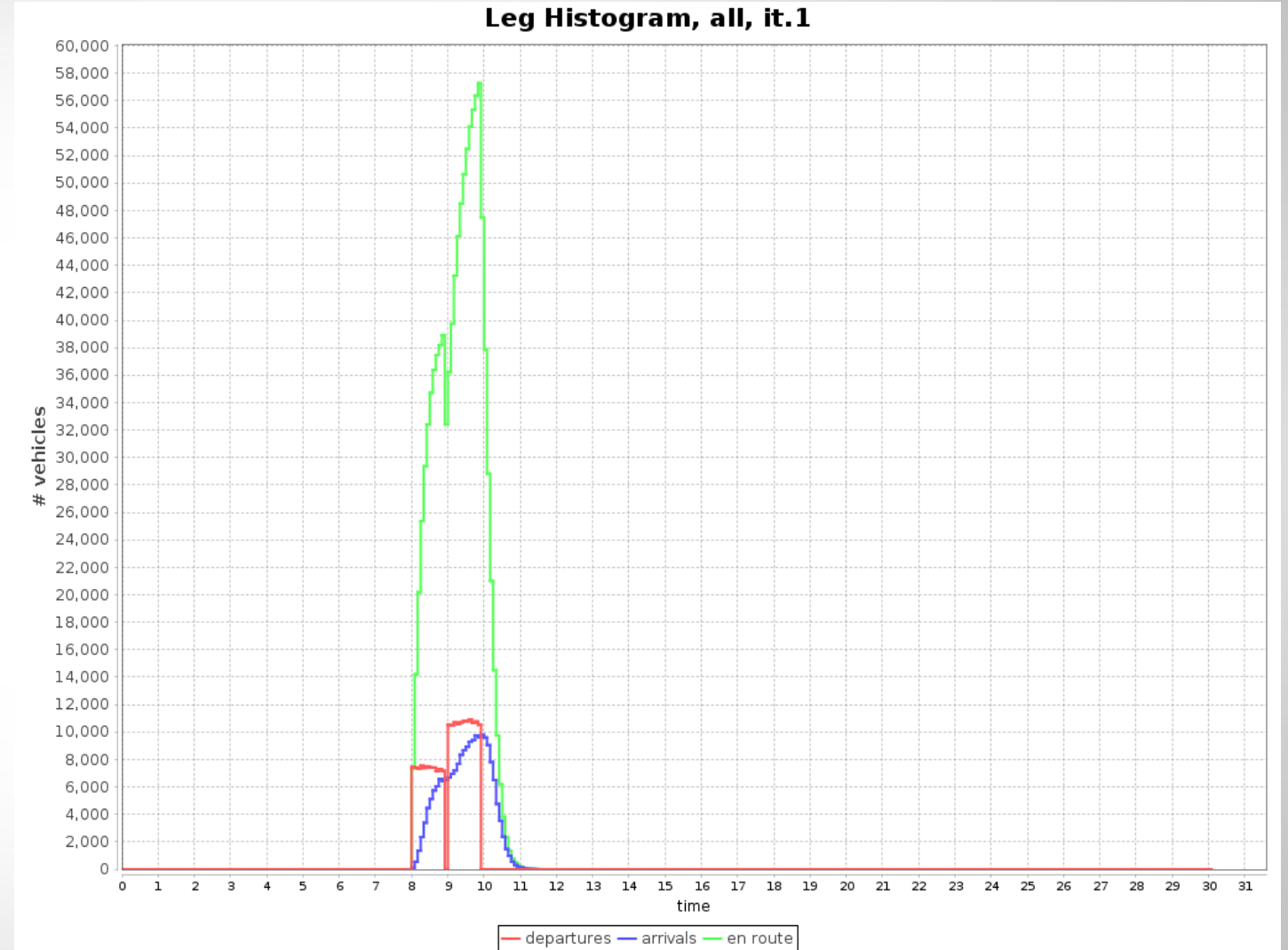


# Simulation Run

- PCU: Passenger car unit, a vehicle carrying 4 people
  - (Example: 2 Mopeds = 1 PCU)
- Input for simulation (Source: Comprehensive Traffic and Transportation Plan for Bangalore-June2011)
  - No of PCUs: 1,800,000 (1/3rd of total traffic observed in a day)
  - Road Capacity: 10,000 pcus/hour
  - Simulated Time: 8:00 to 10:00 (Morning Peak hour traffic)
- Simulation output
  - Average Travel Time: 1619s (26.8 minutes)
  - Average Trip Distance: 12697.42(12.6 km)
  - Trip Counts: 198460

# Simulation Run

- People leave for work from 8:00 AM to 10:00 AM.
- We observe a large peak due to congestion.
- Some people arrive late for work.



# route Frequency

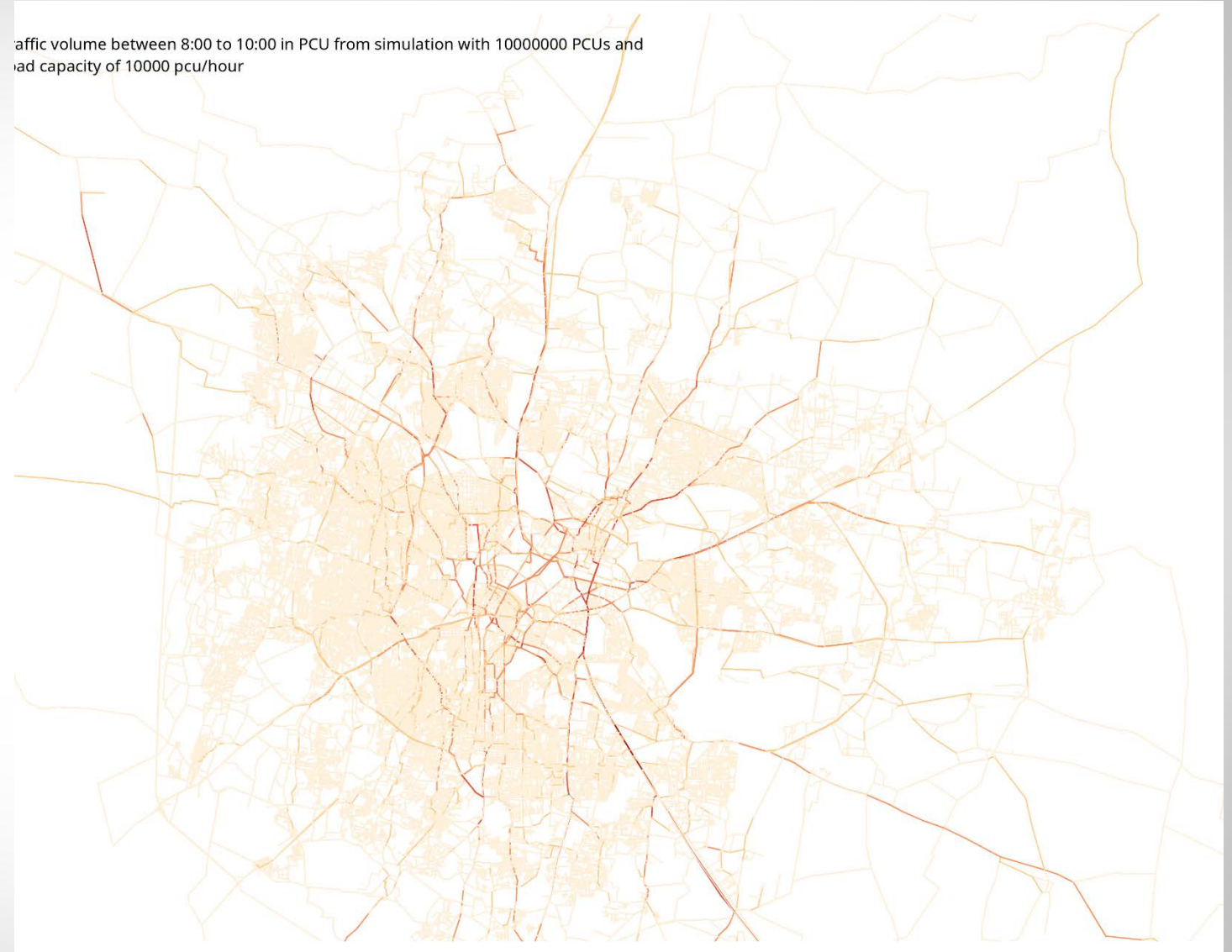
- No of cars using a given road segment (link).
- Most of the traffic is towards the centre of the city.

Frequency from a MATSIM simulation for Bangalore. 1000000 PCU with a link capacity of 10000 PCU per hour for morning peak hour traffic between 8:00 to 10:00



# Traffic Volume

- Number of cars on the road.
- Traffic volume is higher in the centre (validation from simulation).





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