



Faculty of Design

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Using systemic models in games and simulations for participatory planning

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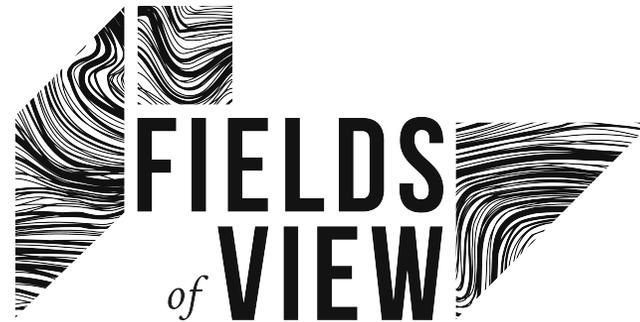
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USING SYSTEMIC MODELS IN GAMES AND SIMULATIONS TO FOR PARTICIPATORY PLANNING



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14th October 2020

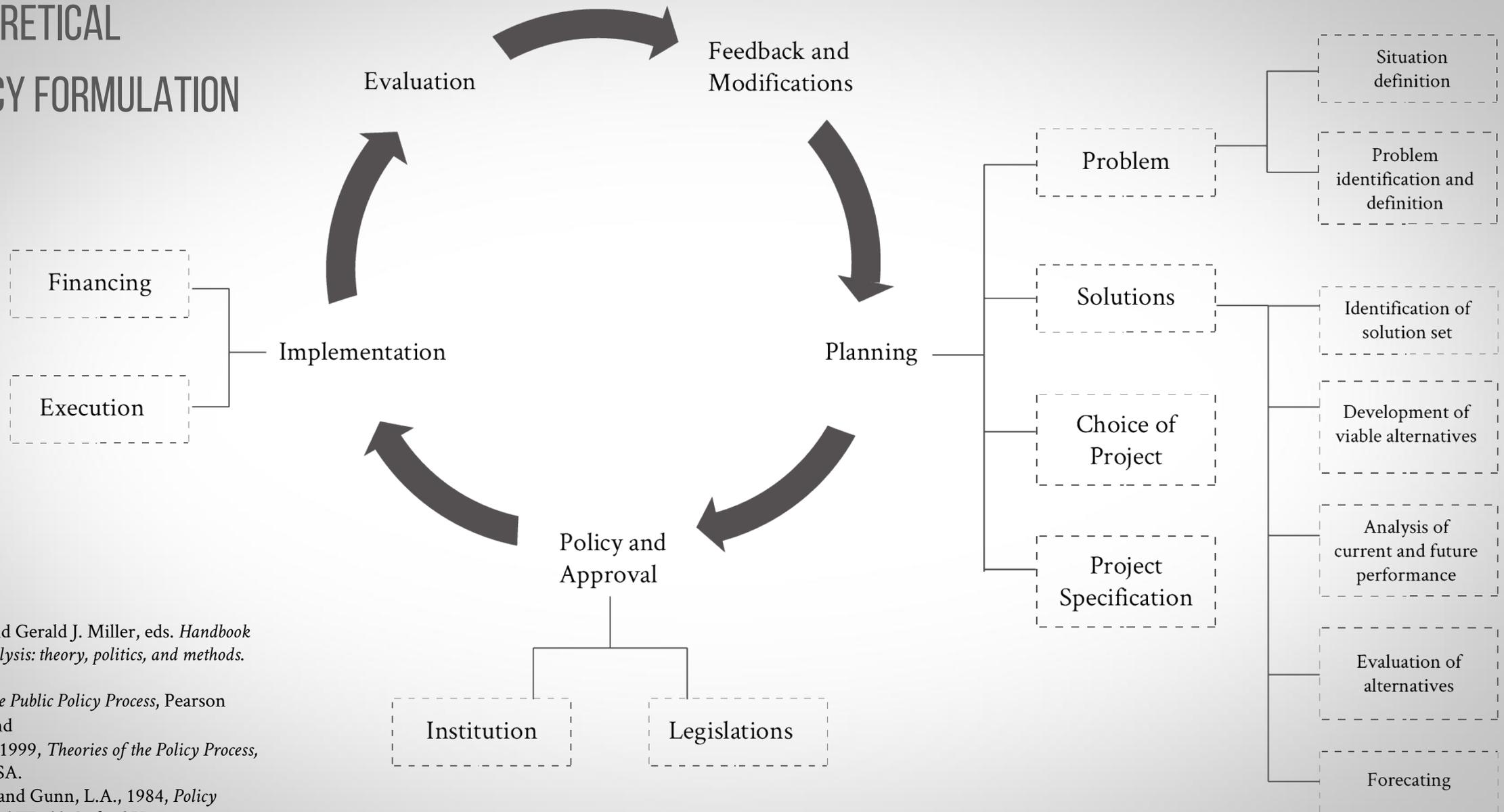
RSD9 Relating Systems Thinking & Design

Methodology, philosophy and theory of systemic design

RSD9 Systemic Design Association



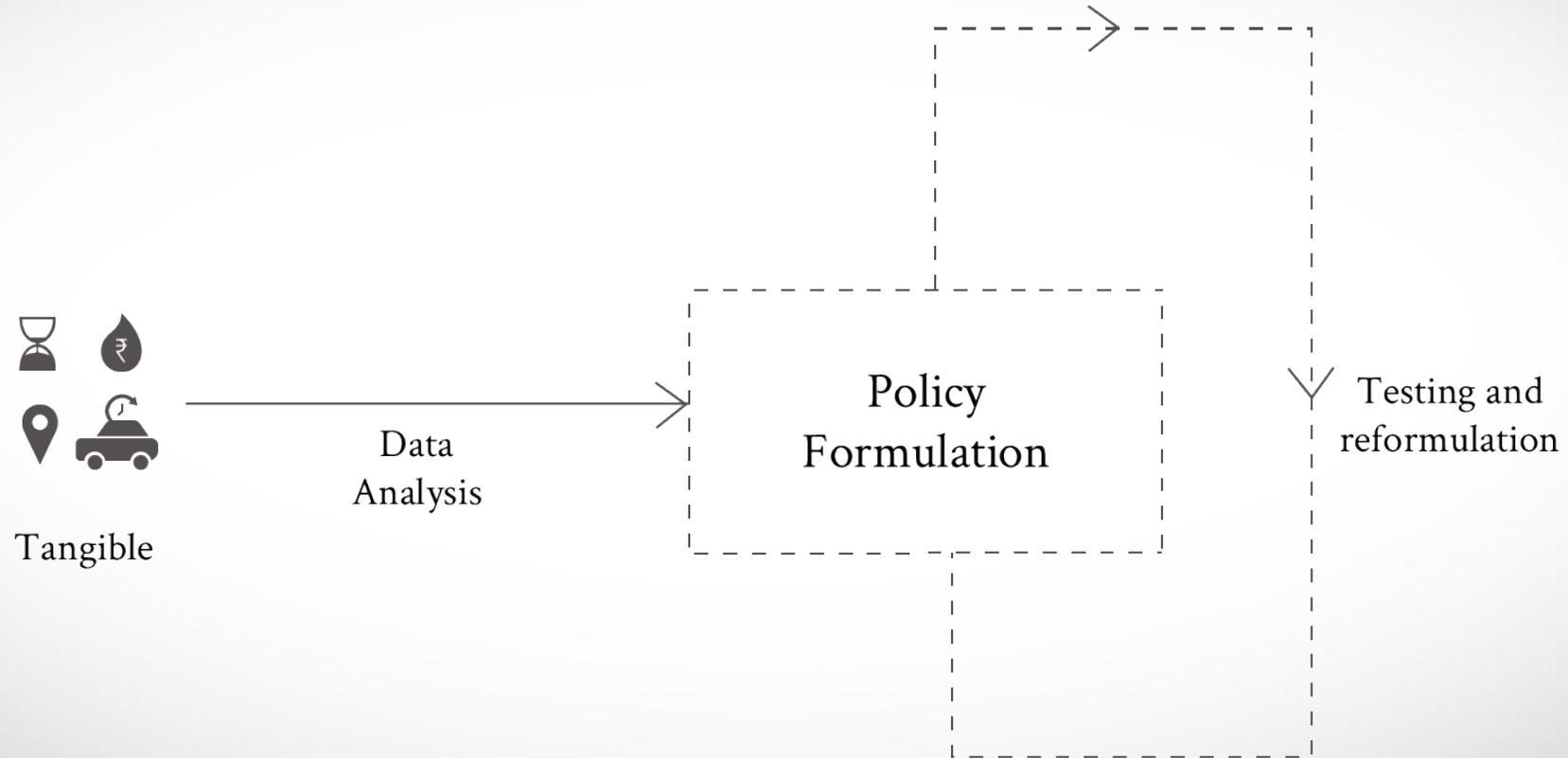
THEORETICAL POLICY FORMULATION

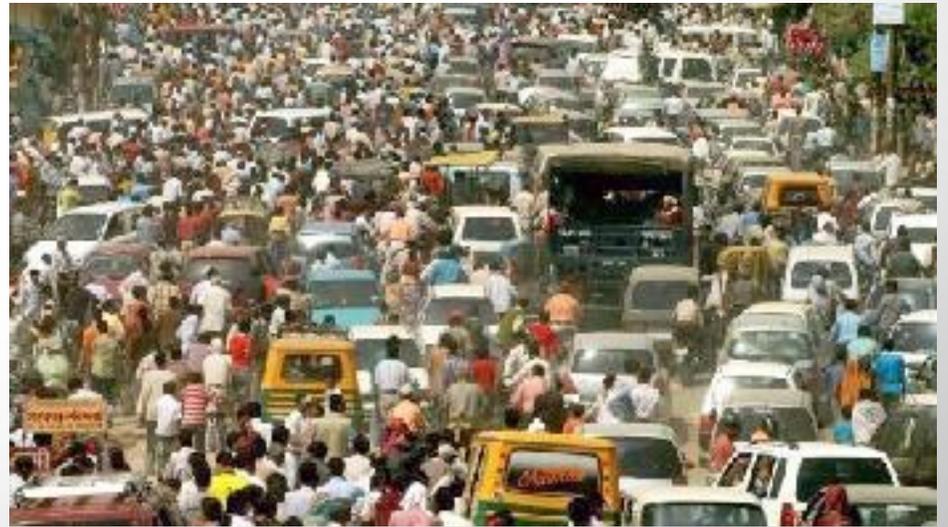


Adapted from,
 Fischer, Frank, and Gerald J. Miller, eds. *Handbook of public policy analysis: theory, politics, and methods*.
 crc Press, 2006.
 Hill, M., 2005, *The Public Policy Process*, Pearson Education, England
 Sabatier, P. (eds), 1999, *Theories of the Policy Process*, Westview Press, USA.
 Hogwood, B.W., and Gunn, L.A., 1984, *Policy Analysis for the Real World*, Oxford University Press.

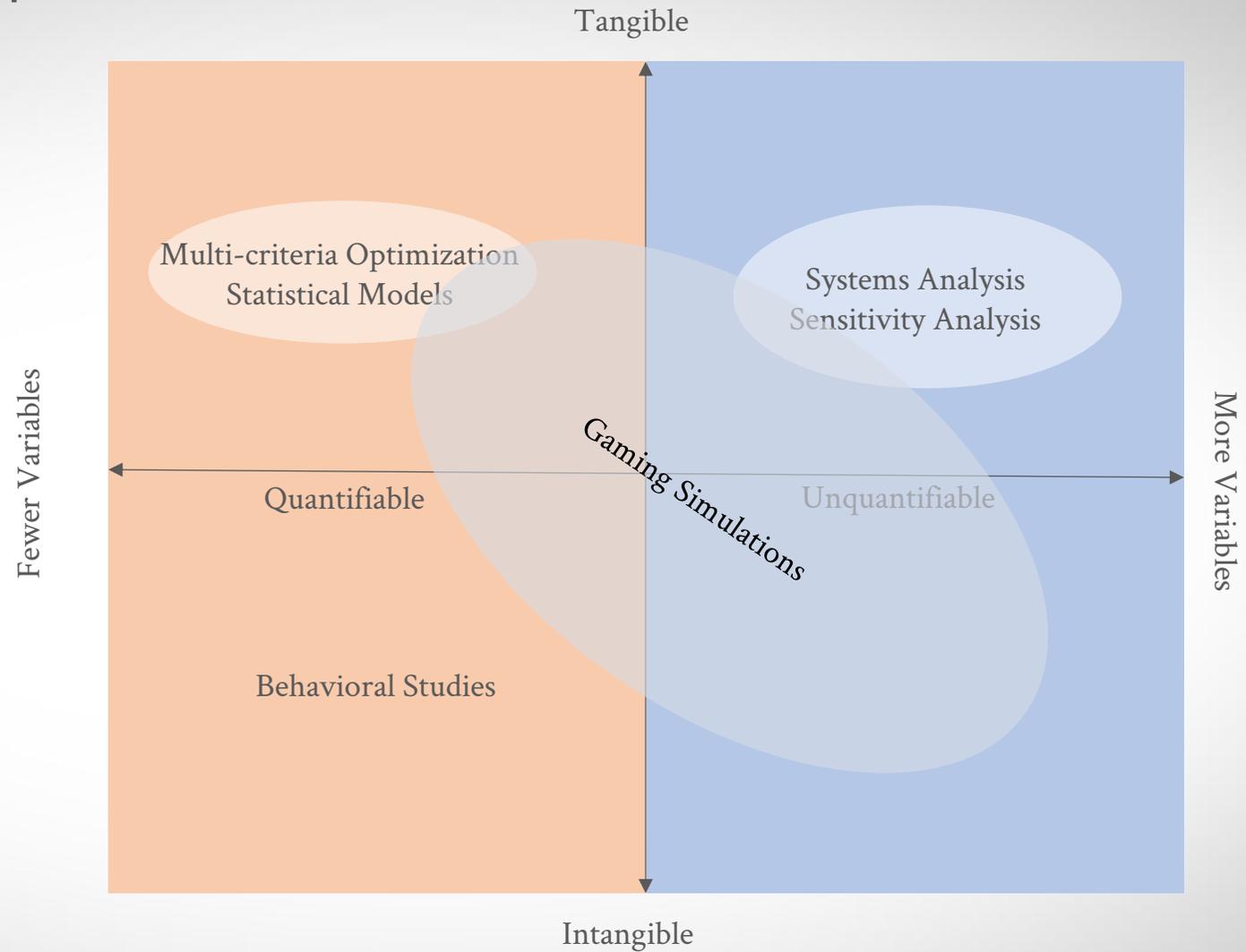


POLICY FORMULATION IN THE REAL WORLD



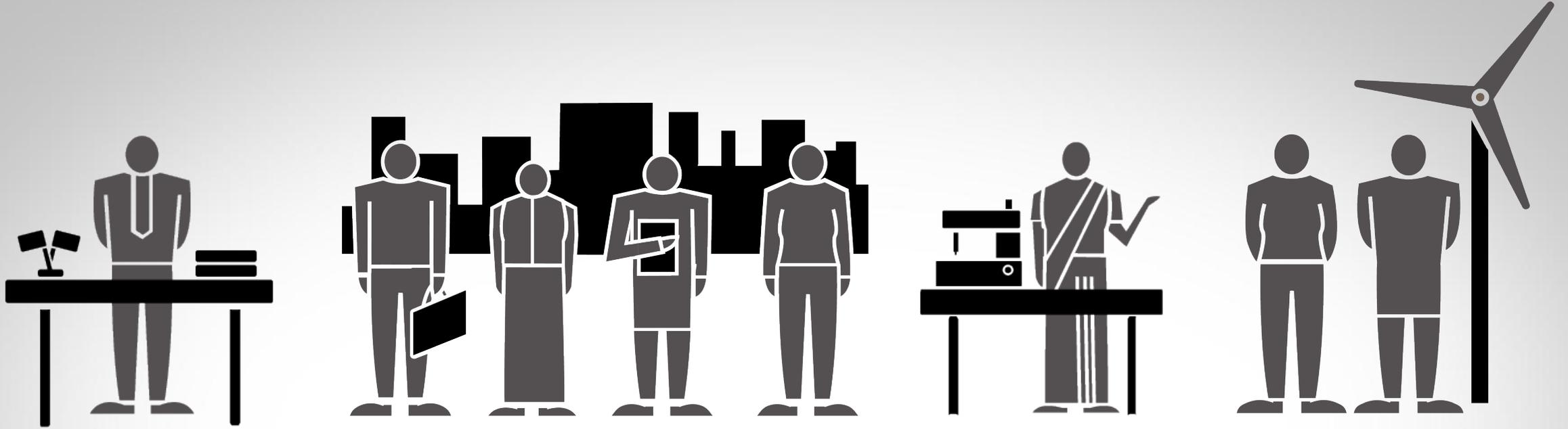


HOW - MODELLING APPROACHES?



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





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.



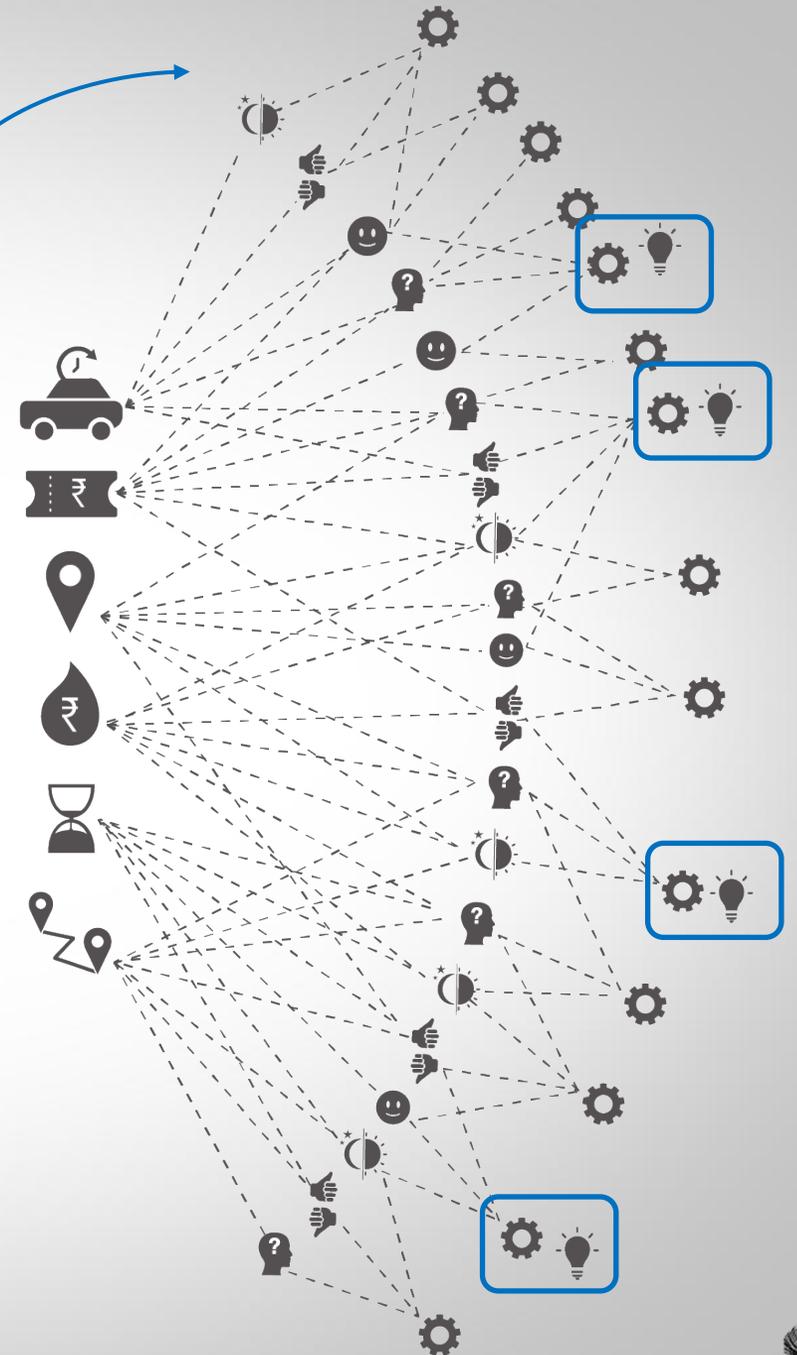
SIMULATION MODELS

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 | |

Unquantifiable, Intangible

Quantifiable, Tangible



Parker, Dawn C., et al. "Multi-agent systems for the simulation of land-use and land-cover change: A review." *Annals of the association of American Geographers* 93.2 (2003): 314-337.

Approach 2: Generative, Adaptive, etc.



COMPLEXITIES IN THE REAL WORLD

- Multi-scalar and multi-sectoral
- Inter-temporal effects
- Formal and Informal institutions
- Actors at various levels (Individuals, communities, organizations, etc.)
- Differing Objectives and desired future states
- Governance structures
- Changing interaction dynamics between State-Private-Civil Society actors
- Scale





NEGOTIATING FUTURES THROUGH A GAMING SIMULATION



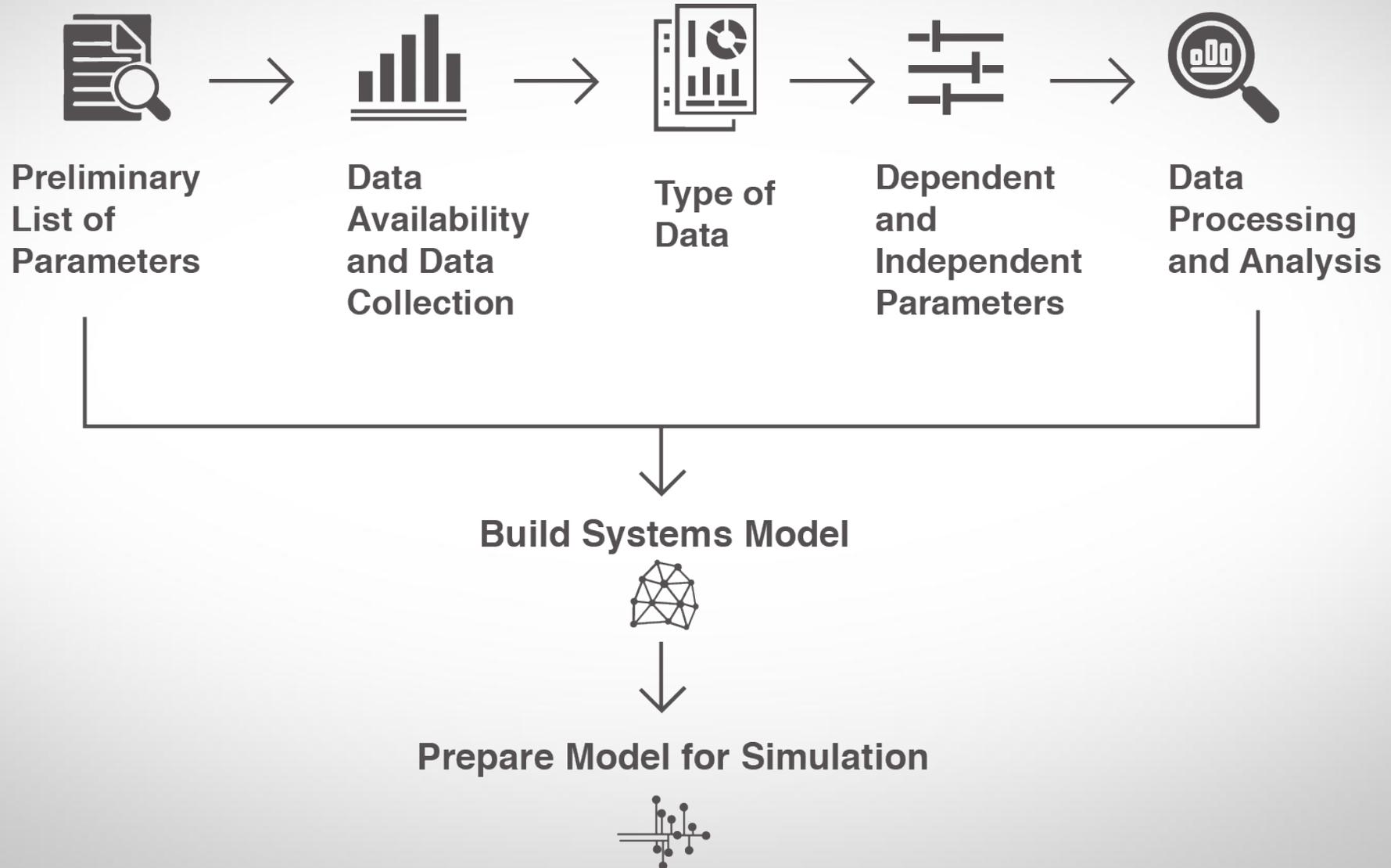
Evaluating simulation
outcomes and choosing
the trade-offs



HOW DO WE PLAN FOR CHENNAI'S FUTURE?



QUANTITATIVE RESEARCH



QUALITATIVE RESEARCH

Secondary data collection

Stakeholder interviews

Activity-based workshops

Follow-up interviews



MAPPING PROBLEMS TO THE POLICY-PLANNING AND IMPLEMENTATION CYCLE

PLANNING				POLICY AND APPROVAL		IMPLEMENTATION		EVALUATION	FEEDBACK AND MODIFICATION
Problem	Solutions	Choice of Project	Project specification	Institution	Legislation	Financing	Execution		
No water source/supply		Channelization of storm water into the water bodies					Non-maintenance of storm water drains/sewers		
Land boundary dispute		Carrying capacity of storm water drains					Illegal sewer connection into storm water drain		
Land encroachment		Rainwater harvesting arrangements					Storm water drainage network – proper disposal arrangements		
Lack of access to land		Land use for each allotment					Fogging in all water bodies and storm water drains		
Lack of land for housing Economic weaker sections/Low income groups"		Scientific land use planning					Disposal of rain water through inadequate Storm water drain causing inundation on the banks to avoid pollution		
Encroachments in water course, lakes, canals and government lands							Storm water drain blockage		
Water course encroachment							Illegal water dumping in rivers and vacant lands		
Public encroachment in government properties	Desilting, deepening of water bodies						Inadequate sewage treatment plant		

 Desilting, deepening of water bodies

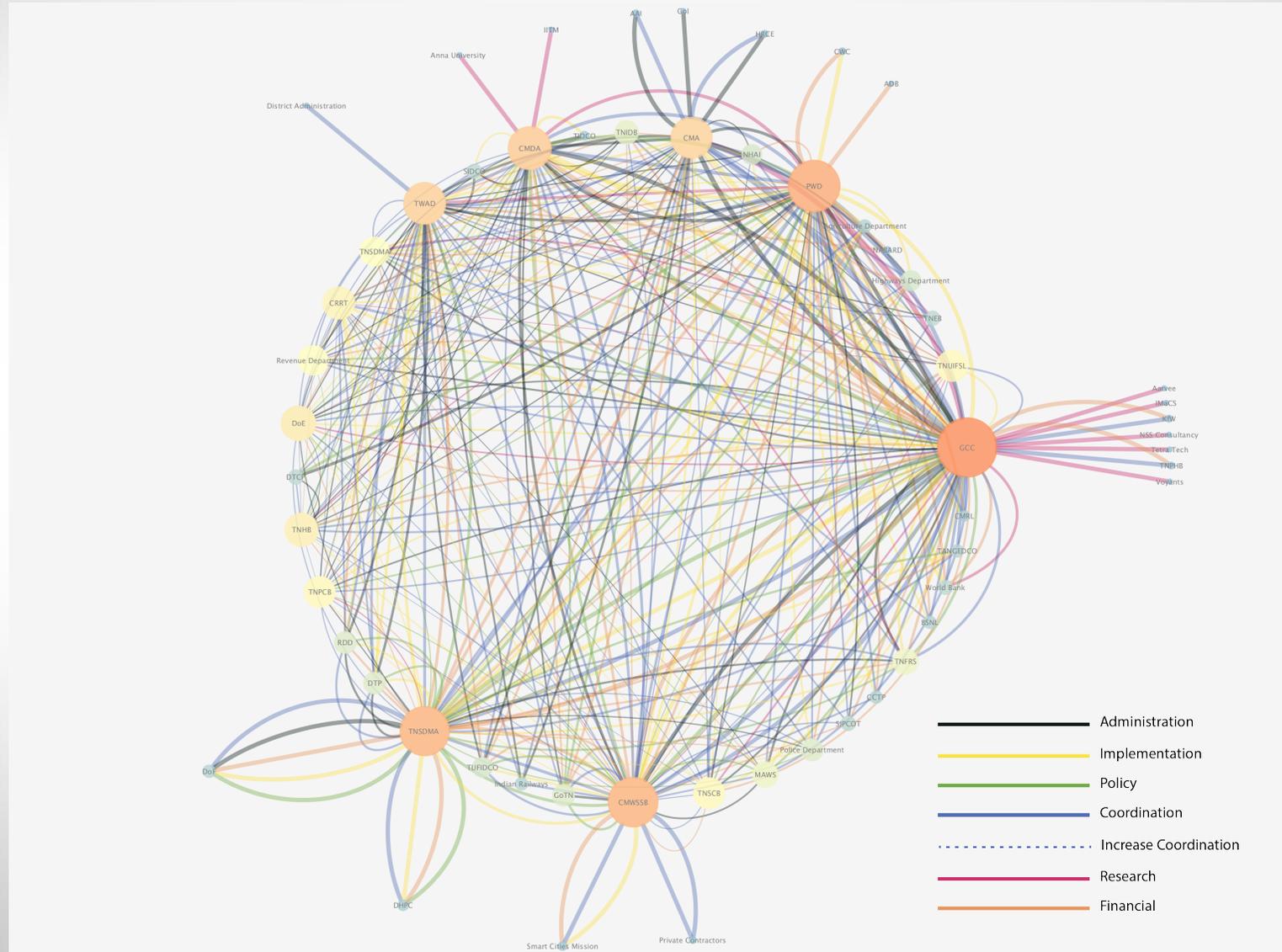
 Water bodies/Drains/Sewage/Storm water

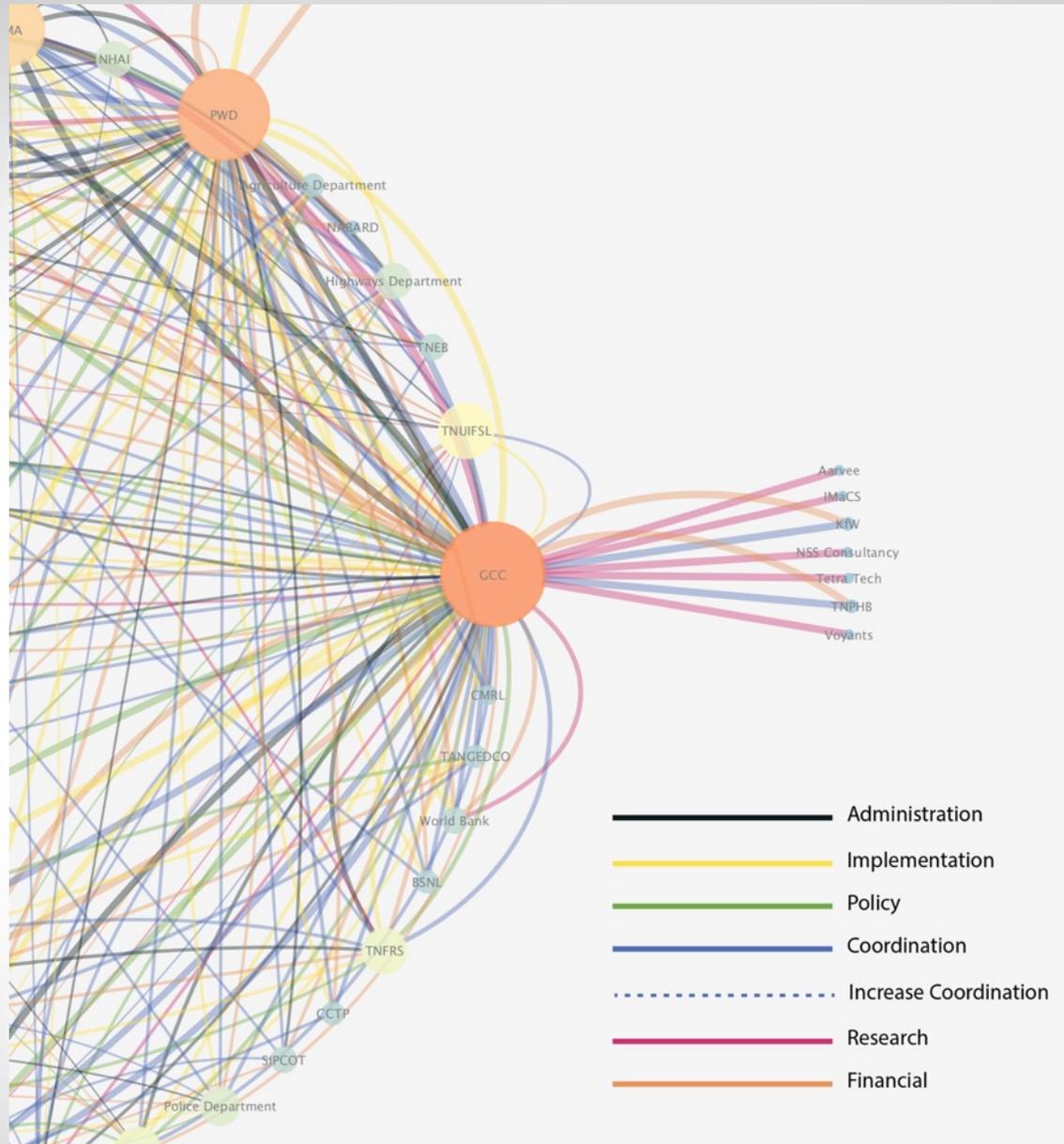
 Water Supply

 Land Use



MAP OF CHENNAI'S INSTITUTIONAL STRUCTURE

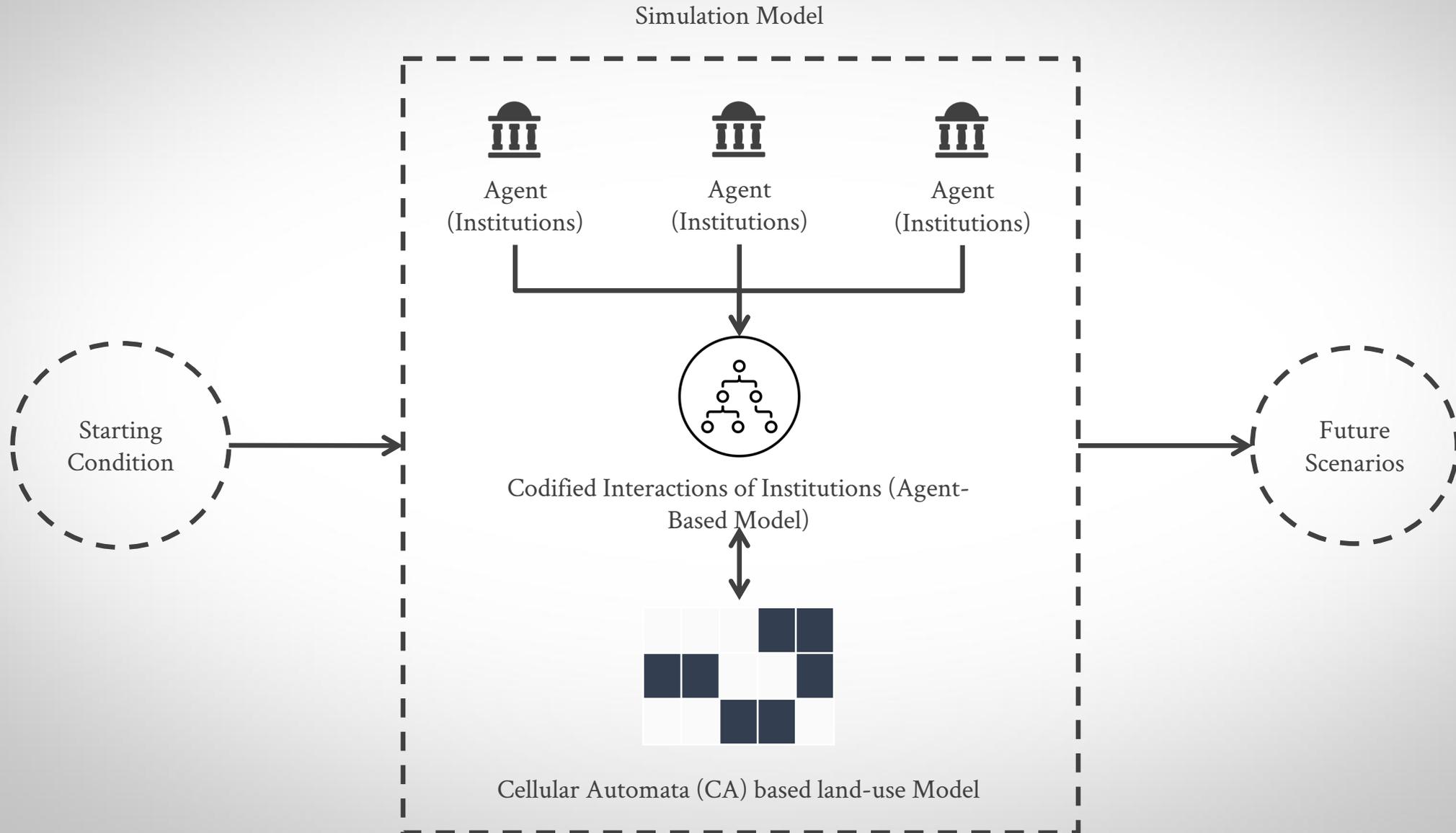




Institutional structure map generated on Cytoscape



MULTI-SCALE SIMULATION APPROACH



SCENARIO 2

Example:

Agency : CMWSSB

Scenario:

Scenarios emerging due to differential prioritization of capital intensive projects (e.g. desalination plants) vis-a vis improved maintenance of existing infrastructure.



SCENARIO 2

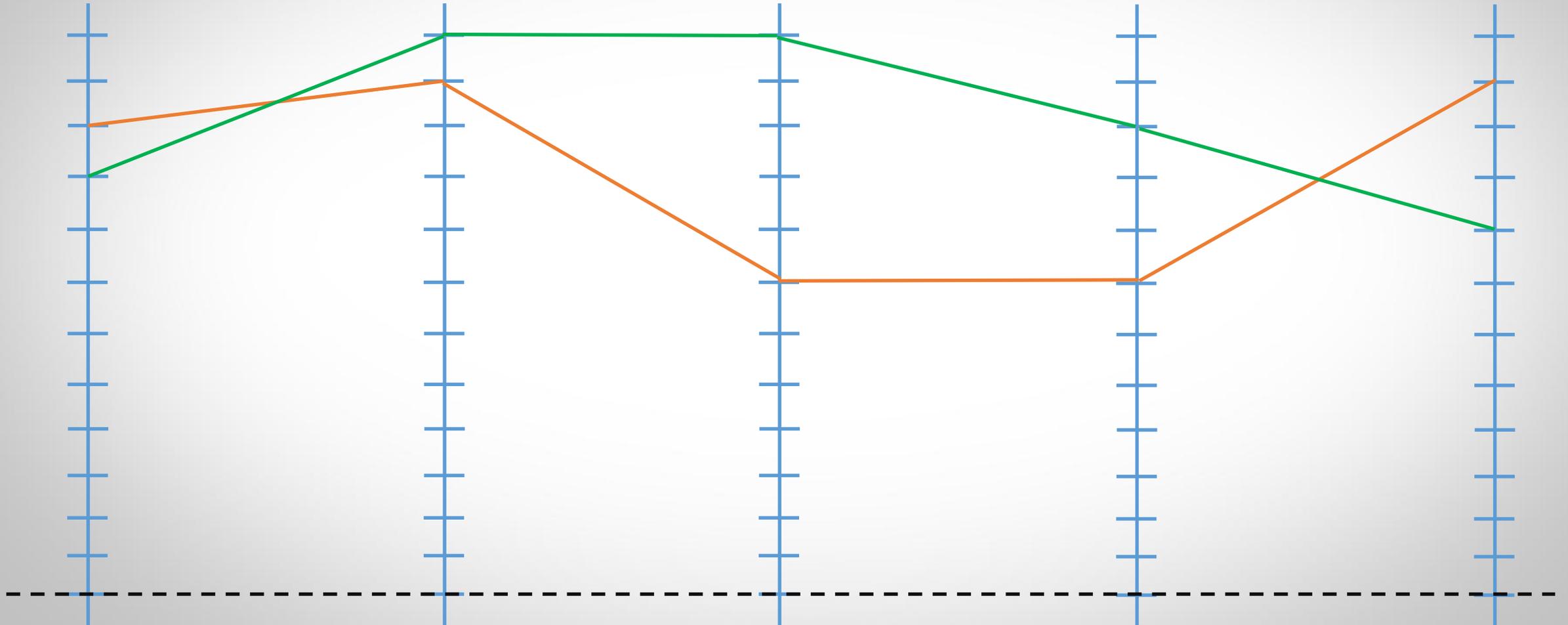
% change in residential area

% change in industrial area

No. of wells

No. of de-salination plants

Cost of maintenance of sewerage



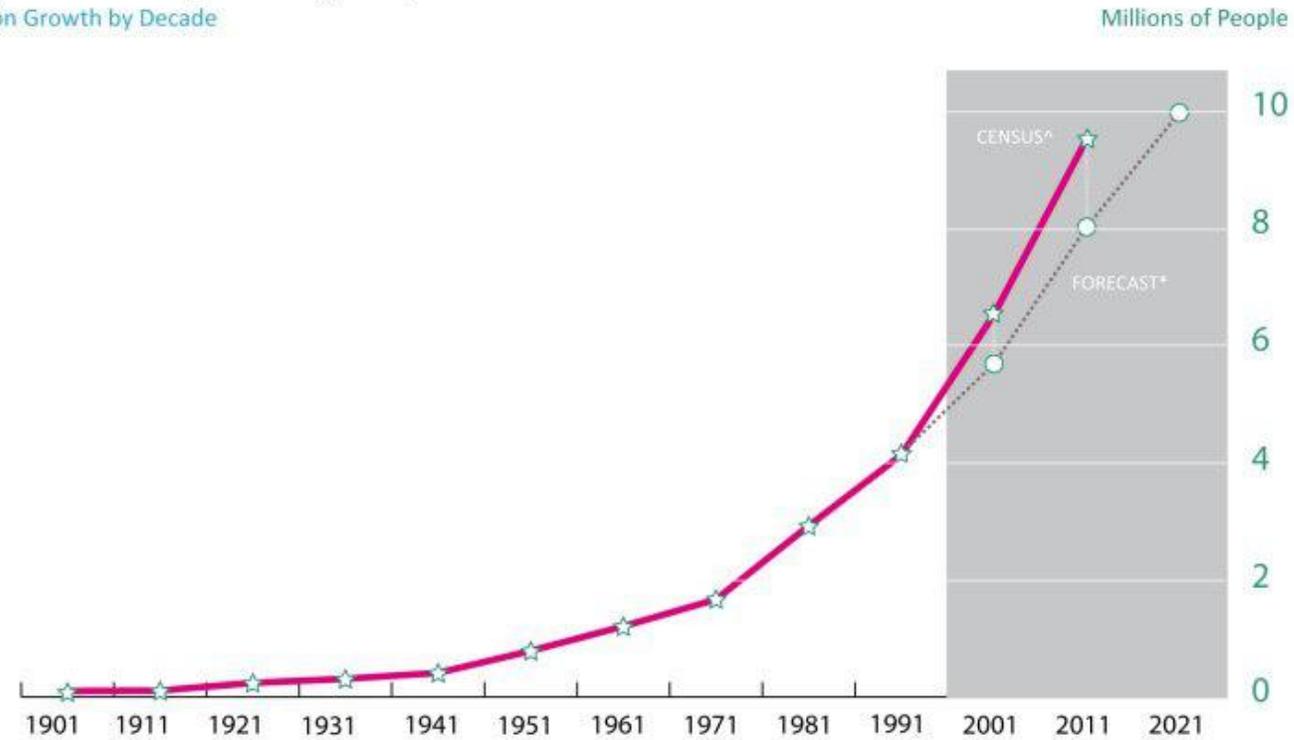
HOW DO WE OPERATE BANGALORE'S PUBLIC TRANSPORT?



BANGALORE'S POPULATION GROWTH

Bangalore's Exploding Population

Population Growth by Decade



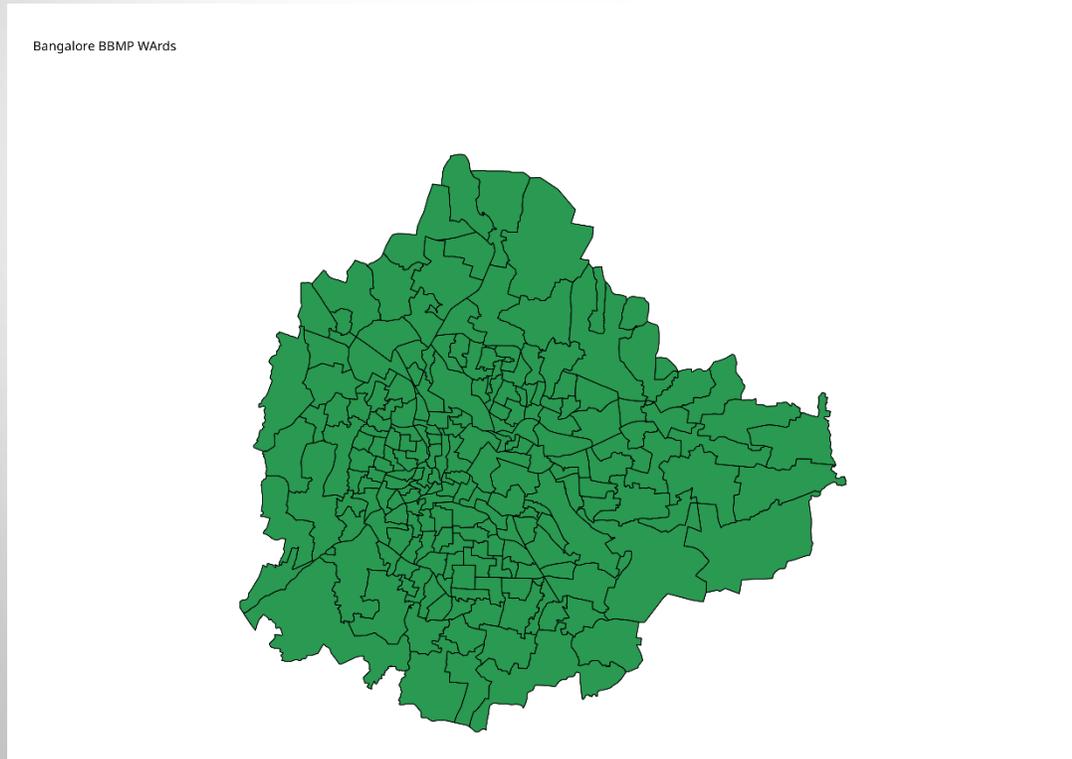
Source: Forecast*: BDA Draft Master Plans 2015 (Scenario Indicators)

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

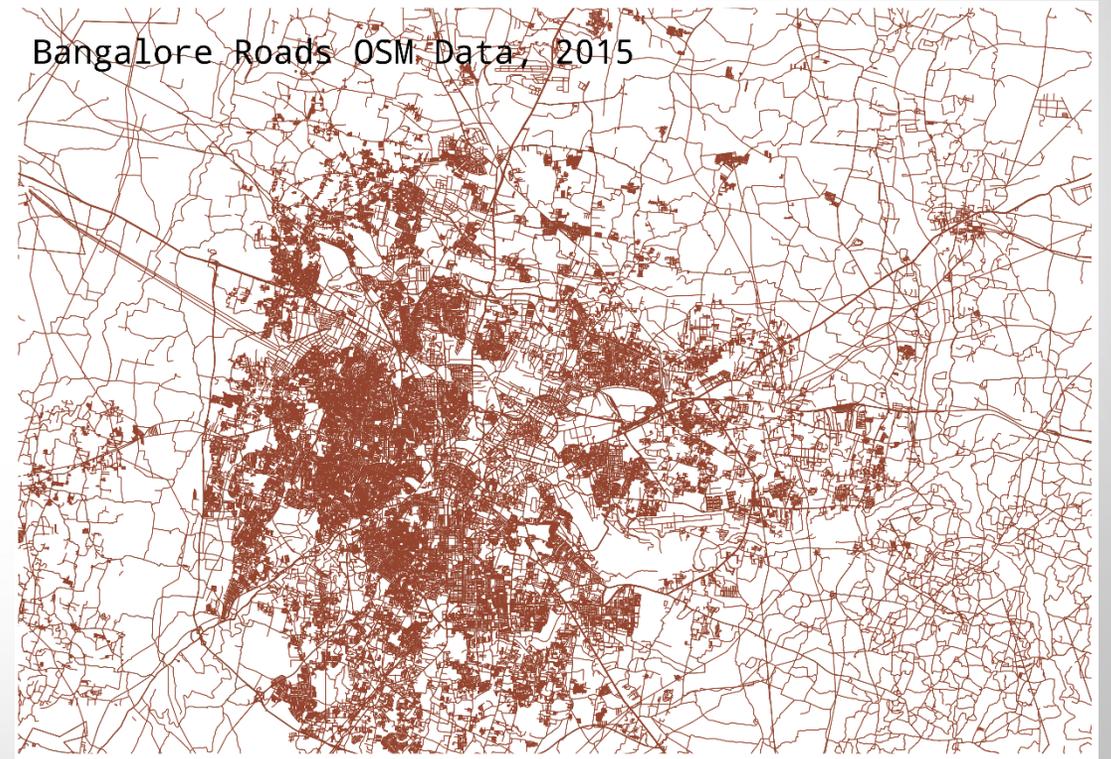


BANGALORE GEOGRAPHY

Bangalore Wards (BBMP Data 2015)



Bangalore Road Network (OSM, 2015)



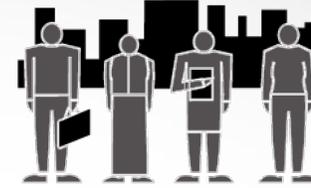
JOINT ROAD FORWARD



Commuters from
marginalized communities



Games
Joint Road Forward



Civil society



Transport decision makers
(Govt. of Karnataka)
Dept of Urban development and
Transport

Service provider and operations
(BMTc Finance - Transport dept,
KUIDFC, BMTc (Accounts))

Transport planners
(DULT, BMLTA, BBMP,
BMTc planning)



BANGALORE METROPOLITAN TRANSPORT CORPORATION (BMTCC) SERVICES



GENERAL SERVICE



BENGALURU ROUNDS



GENERAL SERVICE



VAYU VAJRA



METRO FEEDER SERVICE



VAJRA



CHAKRA



SAMPARKA SARIGE



GENERAL SERVICE



DEPLOYING A NEW ROUTE



Minimise costs

Demographics and Commuter preferences



Road network

Traffic density



Infrastructure

Enhance accessibility



Enhance network efficiency



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



INFORMATION SCREEN

SUMMARY/EXISTING STATUS

Please change the current year to check the changes in commuter, financial and structural parameters.

YEAR

2017

CURRENT STATUS OF COMMUTER PARAMETERS

ROUTES OPERATED

2500

Absolute

SCHEDULES OPERATED

6219

Absolute

BUS TRIPS

74292

Absolute

TOTAL RIDERSHIP

17922

People In Lakhs

AVG RIDERSHIP/DAY

49.1

People In Lakhs

FREQUENCY/ROUTE

2.57

Absolute

PASSENGER CAPACITY/TRIP

24124

Absolute

PER RIDERSHIP CAPITA TRIP RATE (PRCTR)

0.015

Rate

AVG TRIP LENGTH (ATL)/DAY/TRIP

15.50

km

RATE OF OVERCROWDING/ROUTE (MAX PASSENGER CAPACITY = 60)

0.47%

Percentage

RIDERSHIP TO TRIP RATIO

66.1

Rate

CURRENT STATUS OF FINANCIAL PARAMETERS

TICKET SALE REVENUE

162632

INR Lakh

NET WORTH

64428

INR Lakh

PROFIT/LOSS - TICKET SALE REVENUE

-39807

Lakh

PROFIT/LOSS - GROSS REVENUE

-14171

Lakh

PROFIT/LOSS PER KM

-3.7

INR

GROSS REVENUE

188268

INR Lakh

EPKM

48.9

INR

CPKM

52.6

INR

AVG TICKET SALE REVENUE/BUS

2528090

INR

AVG GROSS REVENUE/BUS

2926597

INR

MARGIN ON TICKET SALE REVENUE

Max 180000, Min 51000

MARGIN ON GROSS REVENUE

Max 201500, Min 60000

CURRENT STATUS OF STRUCTURAL PARAMETERS

FLEET STRENGTH

6433

Absolute

FUEL EFFICIENCY

3.7

km/l

RATE OF BREAKDOWNS/10000KM

0.070

Rate

RATE OF ACCIDENTS/1 LAKH KM

0.050

Rate

EFFECTIVE KM

4204

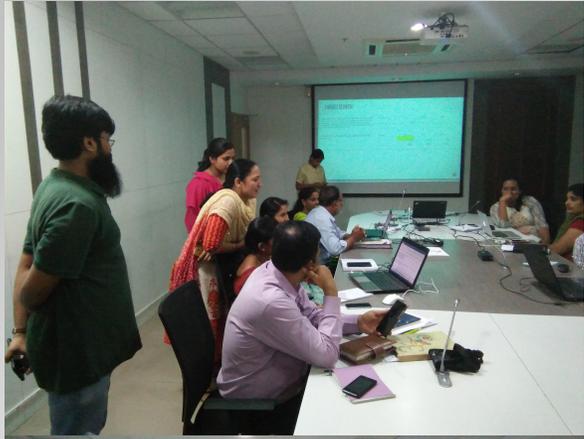
Lakh

EFFECTIVE KM/DAY

11.5

Lakh





GAME SESSIONS

BMTC

BBPV



INSIGHTS

- BMTC 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



THE RELATIONSHIP BETWEEN POLICYMAKERS AND MODELLERS



TRUST

DATA

SILOIZATION

INCLUSIVITY

TRADE-OFFS

TIMELINESS



IMPLICATIONS FOR THE LONG-TERM

- Does the principle of building institutional memory hold?
 - Caveats being applied to us as tool-builders and process-creators
- Working with institutions vis-a-vis individuals in the institution
- Role of the industry and tech-first approach
- What is the precedent set by using such methods and tools?





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