



CIVITAS FORUM 2014

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SESSION 2 - EASY, SHARED AND WIDESPREAD CYCLING

A complete methodology for designing and dimensioning bike-sharing systems

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Casablanca (Morocco)

Mariano Pérez Miñano, SERTTEL LTDA. (Brazil)



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Bike Sharing Systems in Brazil - 2012

- Just five pilot projects throughout the country
 - Rio de Janeiro (1st) – 60 stations
 - Sorocaba (2nd) – 15 stations
 - São Paulo (3rd) – 100 stations
 - Porto Alegre (4th) – 40 stations
 - Santos (5th) – 14 stations
- These services were the first installations in Brazil
 - No experience
 - No knowledge
 - No mobility focus



The Challenge

To find the most suitable area, both in size and potential for uptake of cycling demand, for a bike sharing service in 2 of the world's biggest cities.

Analyze the expanding project for the existing services of Rio de Janeiro and São Paulo and create our own proposal

- New services size still way below the ideal
- Projects created without focus on mobility
- No experience about ideal area to install the service



Serttel standards for designing bike-sharing systems

Coverage Area

**NEED FOR A METHODOLOGY TO
IDENTIFY THE IDEAL COVERAGE
AREA**

Station Density

8 e 14 stations/km²

Bicycle Density

**8 e 15 bicycles/1.000 residents
Docks/bicycles = 2**

Station Location

Points of greatest demand, taking into account land use, the existence of cycling infrastructure, public transport and other facilities

Objective: identifying areas of cities with better conditions for the implementation of a public bicycle service.

- Definition of variables in direct correlation with the uptake of cycling demand
- Territorial divisions of the city
- Assignment of values to the variables in each zone
- Homogenization of the variables
- Assignment of weights and weighted sum
- Sensibility analysis and robustness of the model
- Heat map with the variable result of the weighted sum

The New Methodology

Variables

Population Density

Residents/km²

**Station/Stop
access*lines**

Public Transport

Employment Density

Jobs/km²

**Different Types
km/km²**

**Cycling
Infrastructure**

Business Density

Licences/km²

**Foreign
Photographies**

**Proximity tourist
attractions and
leisure**

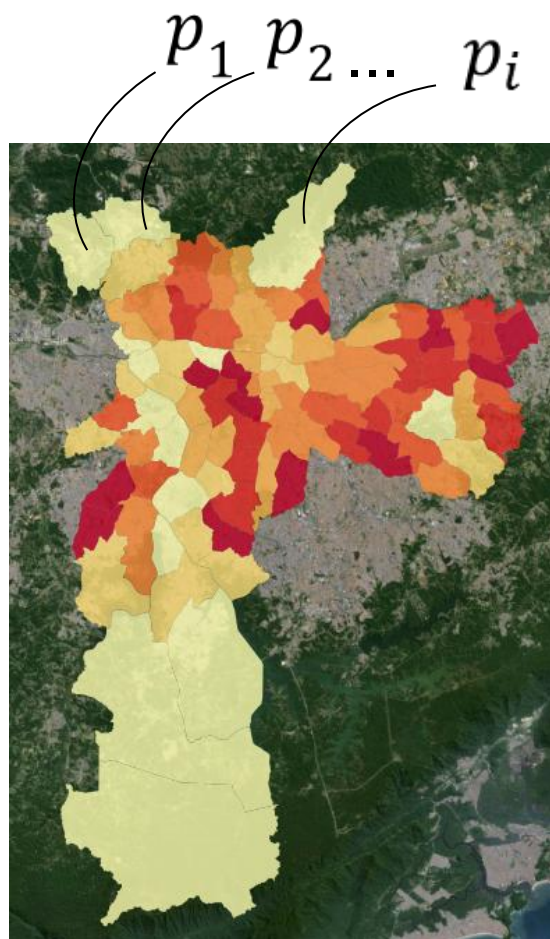
**Proximity to
Universities**

**University
places/km²**

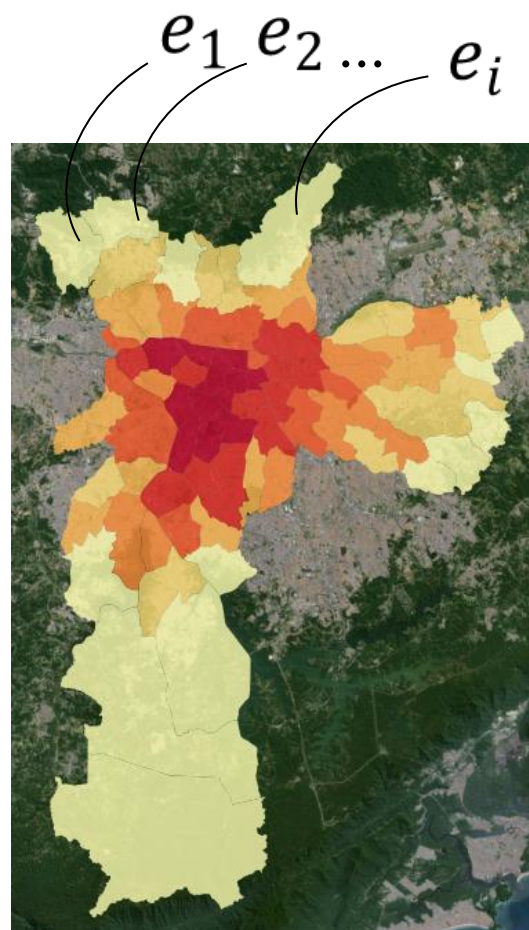
**(Out of model)
0 or 1**

Incline

Variable Assignment



Population Density



Employment Density

- Business
- Public transport
- ...
- Cycling infrastructure
- Tourist interest
- Incline

Homogenization PATTERN

$$Y = (1/n) + ((X-x)/\sum x)$$

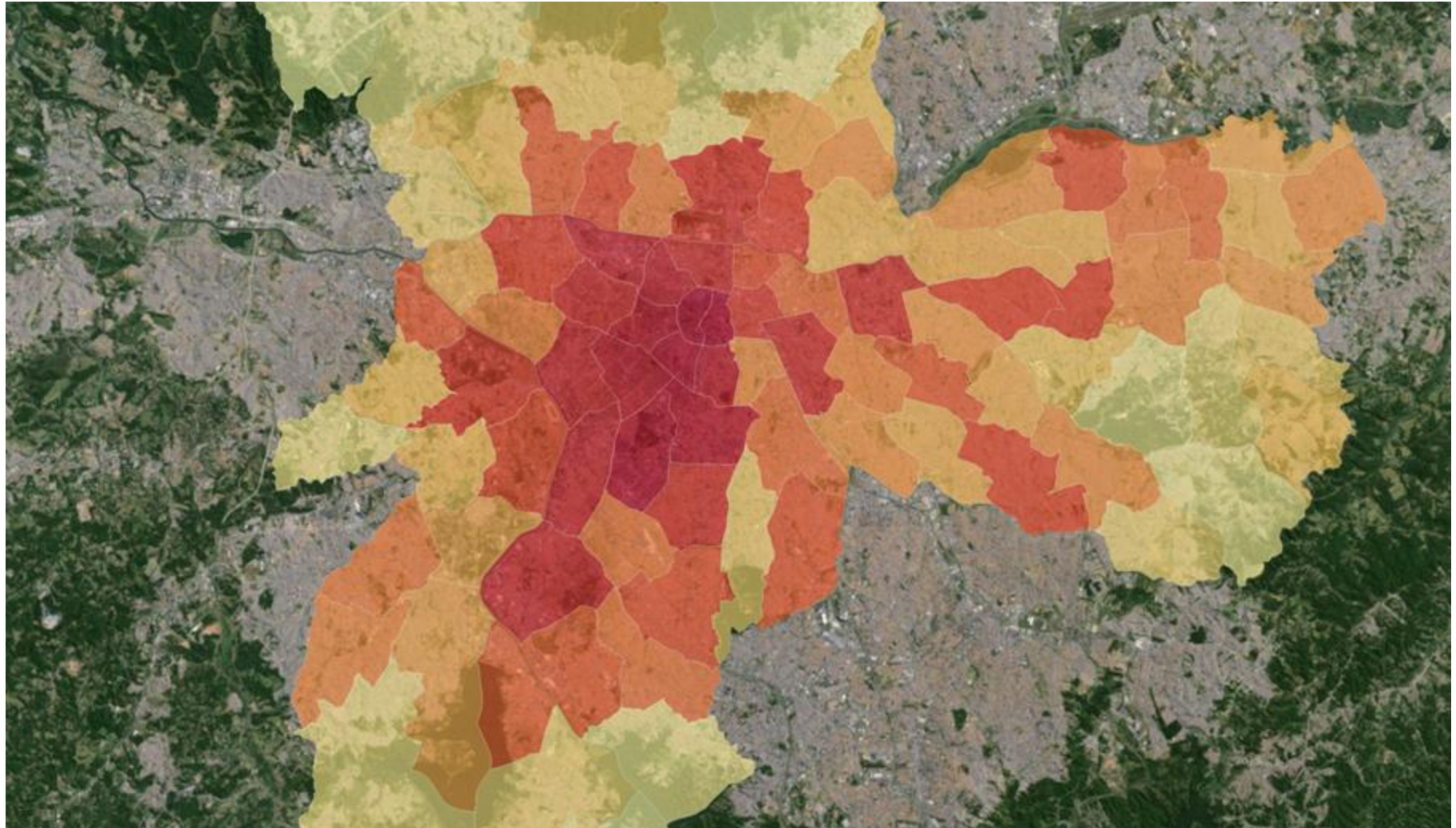


	p (Population)	e (Employments)		p-hom (Population)	e-hom (Employments)	
District 1	12.528	5.317	...	0,24	0,20	...
District 2	9.721	4.251	...	0,19	0,17	...
District 3	15.213	3.081	...	0,28	0,13	...
District 4	10.875	3.850	...	0,21	0,15	...
...
District n	6.345	7.133	...	0,14	0,26	...

$$\text{suitability district } X = w_p \cdot p_x + w_e \cdot e_x + w_b \cdot b_x + w_u \cdot u_x + w_{pt} \cdot pt_x + w_{ci} \cdot ci_x + w_t \cdot t_x$$

$$\sum w_i = 1$$

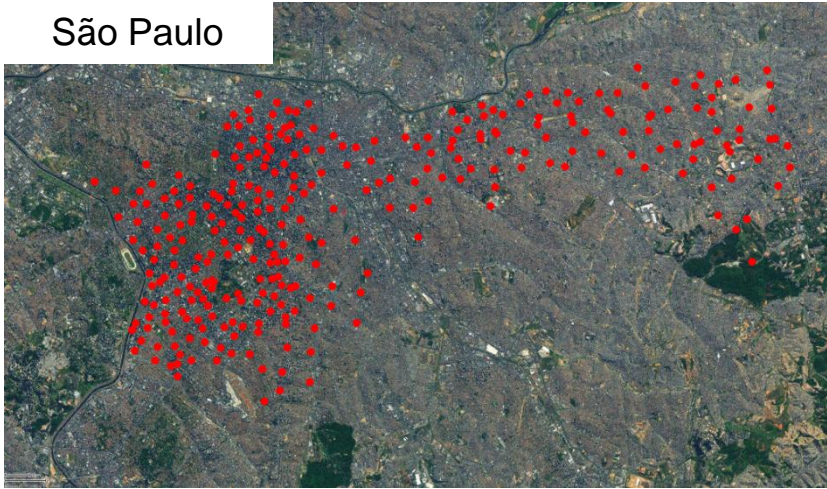
(*) Sensibility analysis and robustness of the model with different w_i



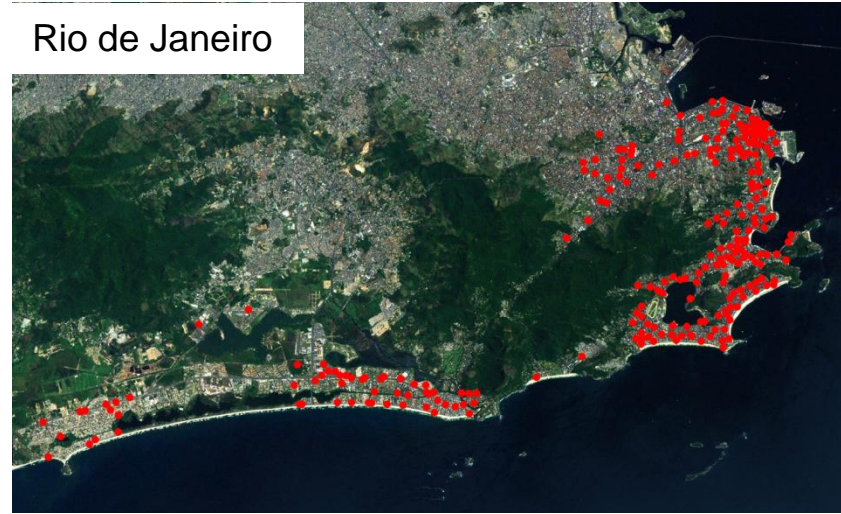
Example: São Paulo. (warmer color indicates greater suitability)

Results for system in São Paulo and Rio de Janeiro

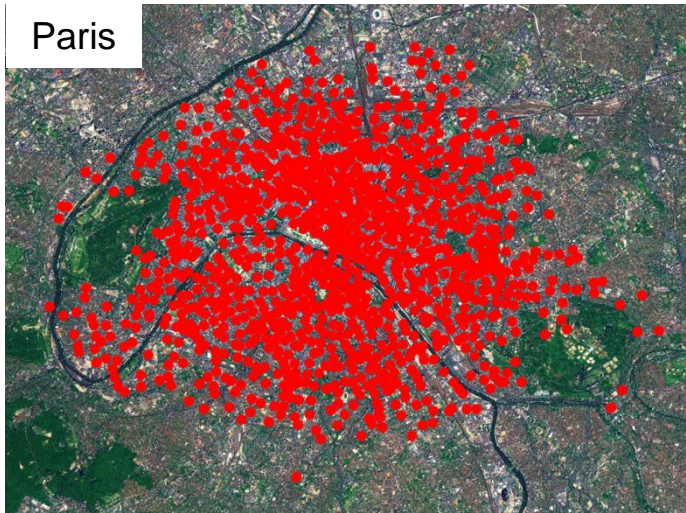
São Paulo



Rio de Janeiro



Paris



Barcelona



New York

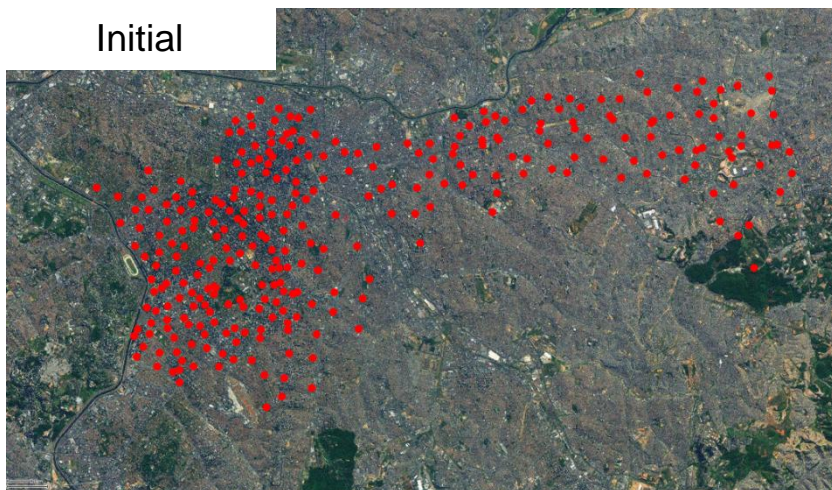


Results for system in São Paulo

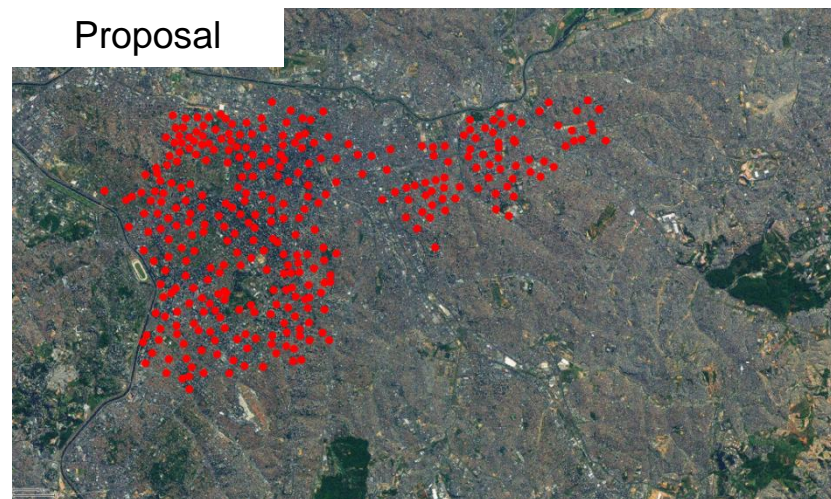
Proposal

Implement a service with a higher density of stations in more suitable areas

Initial



Proposal

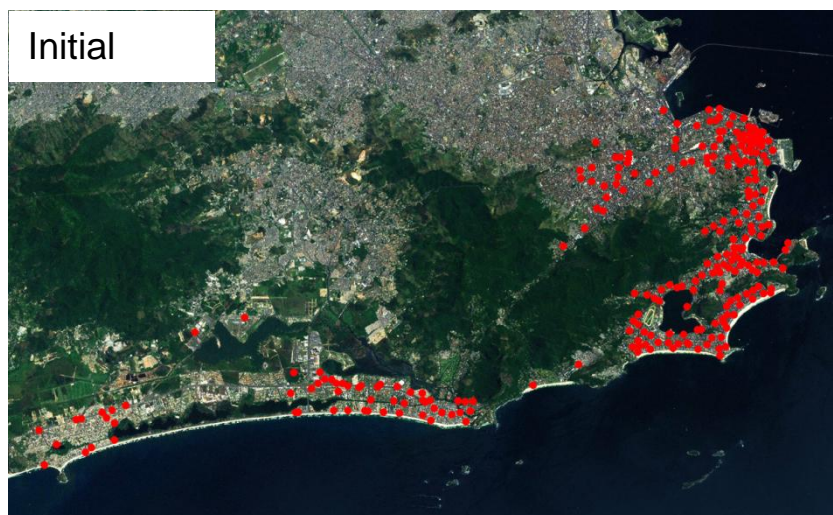


	Area (km ²)	Population	Stations	Bikes	Station/ km ²	Bikes/1.000 residents
São Paulo (initial)	224,30	2.574.515	300	3.000	1,34	1,17
São Paulo (proposal)	122,24	1.452.254	300	3.000	2,45	2,07

Results for system in Rio de Janeiro

Proposal

Implement a service with a higher density of stations in more suitable areas



	Area (km2)	Population	Station	Bikes	Station/ km2	Bikes/1.000 residents
Rio de Janeiro (Initial)	94,27	1.113.863	255	2550	2,71	2,29
Rio de Janeiro (Proposal)	44,47	899.297	255	2550	5,73	3,59

- To install services with size way below the ideal, the coverage area must ensure that the standards of density of bicycles and stations are maintained at high levels.
- Therefore, the objective of the design process should be to find the best area to install the service and choose the correct size inside to implement the services.

The methodology created allows identify areas of the city with the best conditions to install a public bicycle service through a simple multi-criteria decision analysis (MCDA).

This methodology is a very useful tool for urban planners because the model only takes into account variables with demonstrated correlation with the uptake of cycling demand, whose values can be found in any public database.

Bike Sharing Systems in Brazil - 2014

- Given the size of new services in Brazil, this methodology has been used in all of them
 - Rio de Janeiro/RJ – 260 stations
 - São Paulo/SP – 300 stations
 - Recife/PE – 80 stations
 - Salvador/BA – 40 stations
 - Porto Alegre/RS – 40 stations
 - Belo Horizonte/MG – 40 stations
 - Brasilia/DF – 40 stations
 - Aracaju/SE- 20 stations
 - Santos/SP – 37 stations
 - Sorocaba/SP – 19 stations
 - Petrolina/PE -10 stations



Thank you!

Mariano Pérez Miñano

Contact Details

SERTTEL LTDA.

Rua Poeta Carlos Drummond de Andrade. 500.
50.950-060 Várzea. Recife-PE. Brasil

mariano.perez@serttel.com.br

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