

Big data in smart cities: a model for Rio bus service

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LÍDERES
CARIOCAS





Problem

Why are we worried?

Forbes New Posts +15 Most Popular Lists Video 2 Free Issues of Forbes

BBC News Sport Weather Earth Future Shop

LE FIGARO · fr

Traffic in central London moves at the same speed as horse-drawn carriages

Michael Graham Richard (@Michael_GR)
Transportation / Cars
December 29, 2014

Share on Facebook



HANSOM CAB photographed in London in 1895.
Public Domain Smithsonian

100-km

Urban Mobility is a global issue

- Inefficient public transportation
- Massive use of private cars
- 2010-2050 - people living in urban areas will increase 80%

Why are we even more worried?

- In Rio, citizens prefer private cars
 - from 2001-2012 an increase of 120%
- Number of citizens that spend more than 2 hours to get to work increased 179% in the past ten years
- BRL 29 billion/year loss

TomTom Americas Traffic Index

1. Moscow: 74%
2. Istanbul: 62%
3. Rio de Janeiro: 55%
4. Mexico City: 54%
5. São Paulo: 46%
6. Palermo: 39%
7. Warsaw: 39%
8. Rome
9. Los A
10. Dublin



O GLOBO

RIO

COMENTAR

COMPARTILHAR

BUSCAR

CLIQUE E ASSINE

A um custo de R\$ 36,5 bilhões, 28 grandes projetos de infraestrutura mudam a cara do Rio

Enquanto isso, carioca enfrenta transformos, na expectativa de usufruir de cidade mais bonita quando tapumes forem retirados

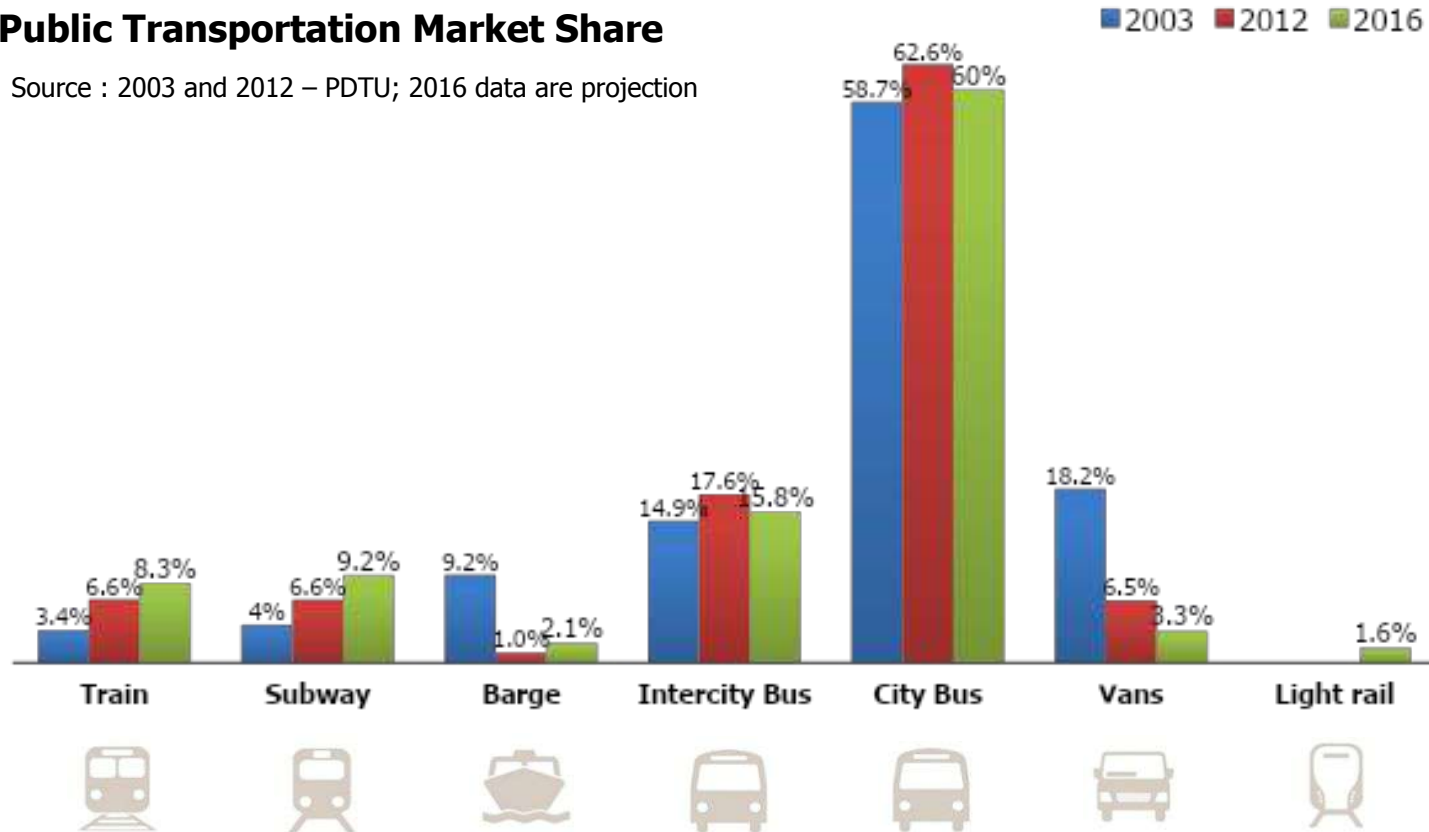
POR LUIZ ERNESTO MAGALHÃES

14/12/2014 10:00 / ATUALIZADO EM 15/12/2014 10:00

Why are we focusing bus service?

Public Transportation Market Share

Source : 2003 and 2012 – PDTU; 2016 data are projection



Bus transportation service in Rio

- Concession model since 2010
- 5 Regional Transportation Networks covering all city
- 4 consortia (Transcarioca, Intercarioca, Transcarioca and Santa Cruz) for the next 20 years
- Fleet of 8.718 vehicles, 697 drivers, 1.7 million passengers traveling more than 730 million kilometers
- Revenue of about BRL 1,7 billion
- Operating costs of BRL 1,6 billion
- 40.000 employees
- Contracts establishing the SLAs

04/12/2014 12h15 - Atualizado em 04/12/2014 13h06

Viagens não realizadas rendem até R\$ 1 milhão a empresas de ônibus

Valor é referente a 1 dia de serviço, diz auditoria.

Passageiros estariam sendo levados em menos coletivos que o contratado.

Our Proposal

- Using the concept of Big Data, propose a model to support the planning and operation of the public bus transportation service in the city of Rio de Janeiro.
- Support a proper service management and a fast decision-making, in ordinary or emergency situations, by providing means to predict scenarios and event analysis.



Big Data

Big Data Highlights

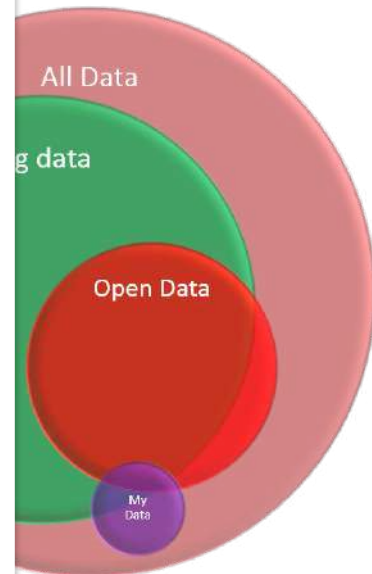
Big Data = Structured+Unstructured Data



The Digital Universe Is Growing By 7,600 PB / Day

Breitman, K., Big Data Overview, EMC Big Data Summer School, 2013, Rio de Janeiro

3V's



McKinsey Global Institute analysis



Big Data in Transportation

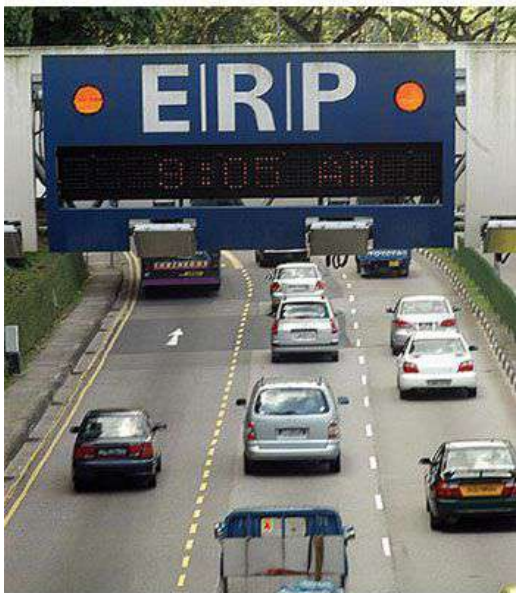
- New technologies and analytical tools
 - real-time data analysis
 - immediate solutions for transport challenges
 - development of policies to reduce congestion and improve infrastructure performance.
- Transport authorities can
 - understand commuters' behavior
 - predict scenarios and act
 - provide targeted information
 - identify policy interventions



The biggest gains from using big data may come from changing user and management behaviors.

Big Data in Transportation

- **Singapore** uses data on local traffic conditions in real-time to determine prices for road tolls.



Land Transport Authority, Singapore

- In **Sweden**, GPS data, radar sensor, weather and visibility data, along with other sources, provide information to the intelligent identification of current traffic conditions.



Workflow

- **Premises**

- Alignment to City Hall Strategic Plan
- Something really implementable

- **Scope Definition**

- Joining PENZA -Technical advice
- Urban Mobility Model
- Focus on Public Transportation
- Research and studies
- Specialists contact attempts

- **Technical Meetings**

- **SMTR**

- Expectations alignment
- Initial approach design
- 1st mental map
- N&Q to be answered
- Managers, data sources and attributes identification

- **PENZA**

- Data sources access strategies
- Effort dimensioning

- **Modeling**

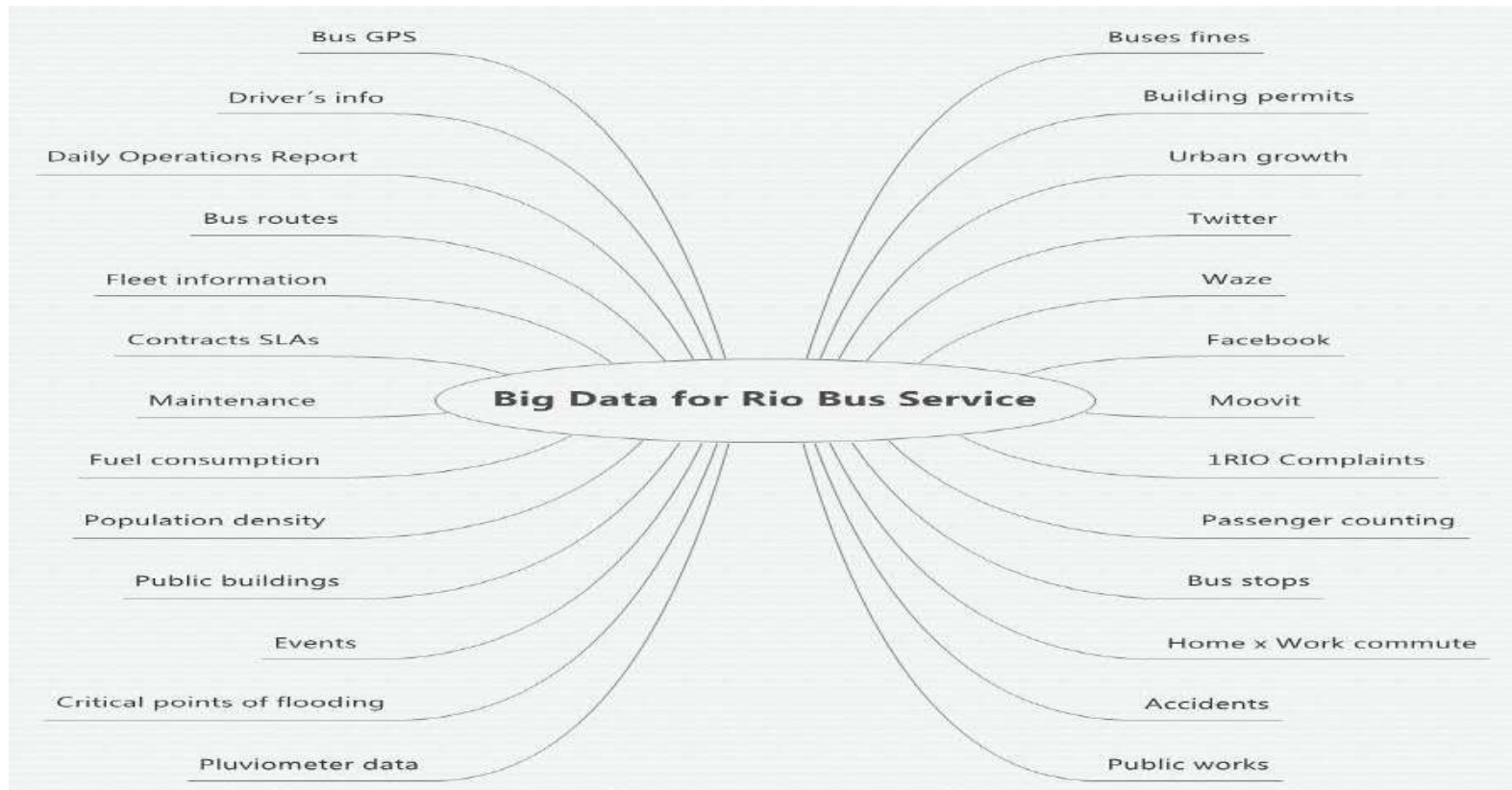
- Model refinement
- Databases, views, attributes detailing
- Questions X Data Sources analysis
- Sources availability survey
- Risk analysis

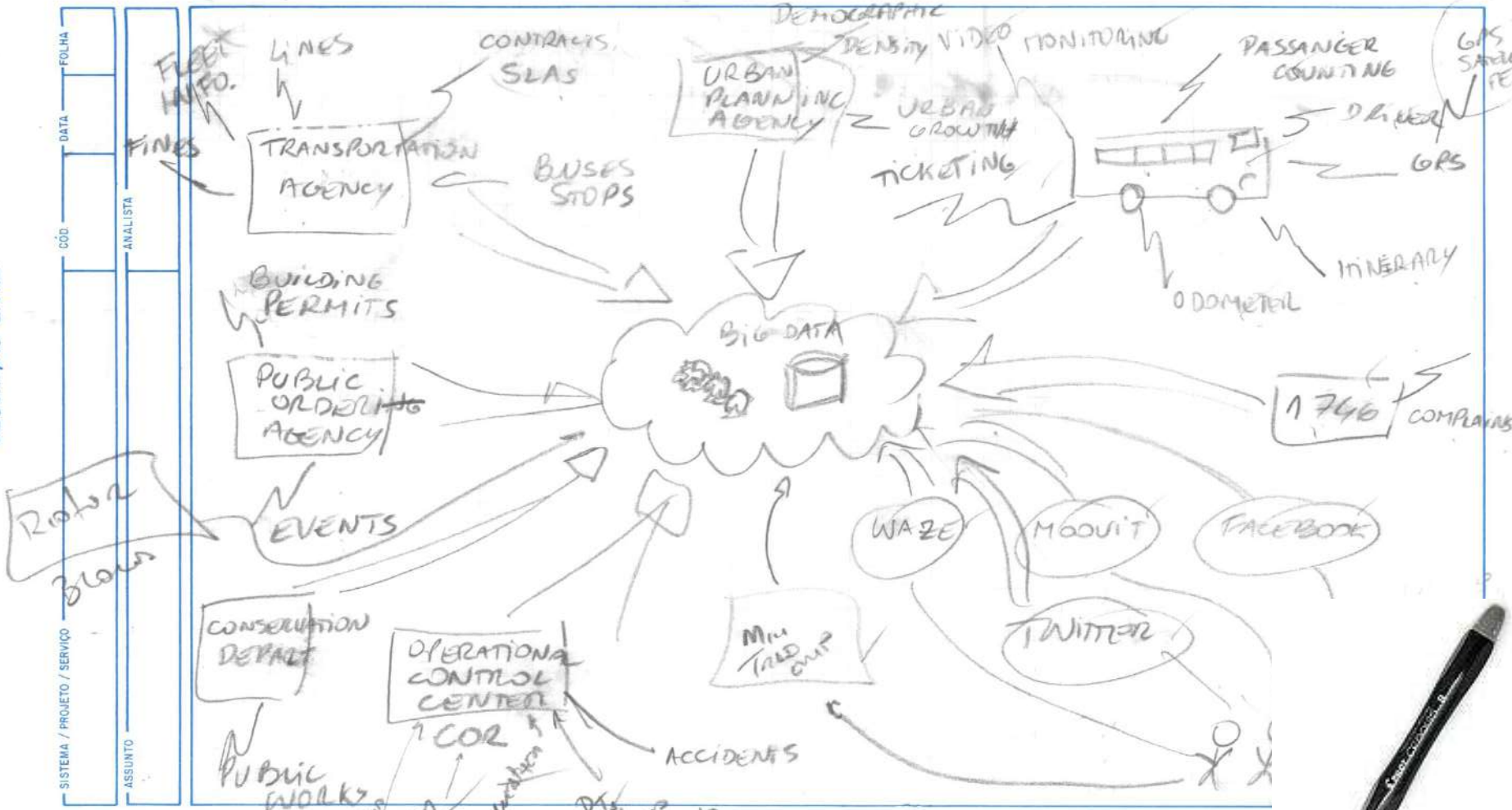
- **PoC**



Model

Data sources brainstorm





20/05/2018
 Dr. Carlos de Almeida

Inserir CIOCO (Estado)



Questions to be answered by the model

How long does the passengers wait for a given bus route at the bus stop?

Are the contracted Service Level Agreements being accomplished?

Are the contracted SLAs meeting the city needs?



Sources detailed Mapping

	Sources	Description	Information Provider	Database Location	IT System	Information owner		Update frequency	
						Agency	Name	Today	Desired
1	Bus GPS	All city buses have GPS equipments installed. These data are created by Rioonibus, that transmits in real time to a database located in City Hall Datacenter.	RIOONIBUS - Private company, the operates buses in Rio	City Hall Datacenter	GPS Base	Transportation Agency - SMTR	Alberto Nygaard	Real Time	Real Time
2	Daily Operations Report	This information is provided by Rioonibus, 40 days later, and it is summarized by day.	RIOONIBUS - Private company, the operates buses in Rio	City Hall Datacenter	Transportation BI	Transportation Agency - SMTR	Alberto Nygaard	Monthly	Real Time
3	Bus routes	Information on bus routes and their georeferenced itineraries	Transportation Agency - SMTR	City Hall Datacenter	SPPO	Transportation Agency - SMTR	Marcelo Estilac	Real Time	Real Time
4	Fleet information	Fleet information to analyze passenger comfort: air conditioner, wheelchair adapted, accessibility, bikes allowed etc.	Transportation Agency - SMTR	City Hall Datacenter	STU	Transportation Agency - SMTR	Lauro Silvestre	Real Time	Real Time
5	Contracts SLAs	The contracts are elaborated by Transportation Agency and are available in 2010. These contracts define all service level agreements that must be accomplished by the buses companies.	Transportation Agency - SMTR	There is no IT System					When a new SLA is established
6	Fleet Maintenance	These informations are provided monthly by Rioonibus. They are used, among other informations, to calculate an accurate fare.	Transportation Agency - SMTR	There is no IT System, the information is sent using electronic worksheets			Alberto Nygaard	Monthly	Monthly
7	Fuel Consumption	These informations are provided monthly by Rioonibus. They are used, among other informations, to calculate an accurate fare.	Transportation Agency - SMTR	There is no IT System, the information is sent using electronic worksheets			Alberto Nygaard	Monthly	Monthly
8	Demographic Density	Information about the Rio population such as territorial distribution, age structure, education, social and economic profile of the families etc.	Urban Planning Institute - IPP - using data from IBGE (Brazilian Institute of Geography and Statistics)	Urban Planning Institute - IPP	Data Storage - Armazém de Dados	Urban Planning Institute - IPP	Luiz Arueira	When a new research occurs	
9	Public Buildings	Public Buildings georeferenced such as schools, hospitals, sport equipments, police stations, administration buildings etc.	Urban Planning Institute - IPP	City Hall Datacenter	Arcgis Software	Urban Planning Institute - IPP	Luiz Arueira	When a new public equipment is created	
10	Events	Information about events organized in Rio that could impact public transportation system.	Public Ordering Agency -SEOP	There is no IT System. Operation Center has this information in its databases				When a new event is planned	

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26	Home x work commute	Ministry of Labor and Employment: information about place of residence, workplace and times of entry and exit of employees.	Ministry of labour and employment - TEM	There is no information available				Monthly	Monthly
27	Carnival	During Carnival is important to know the dates, times and locations of blocks to redesign the bus routes.	Tourism Agency - Riotur	There is no IT System				When Carnival is planned	When Carnival is planned
28	Drivers' information	Bus drivers' information	Transportation Agency - SMTR	City Hall Datacenter	STU	Transportation Agency	Lauro Silvestre	Real Time	Real Time

New Sources - soon

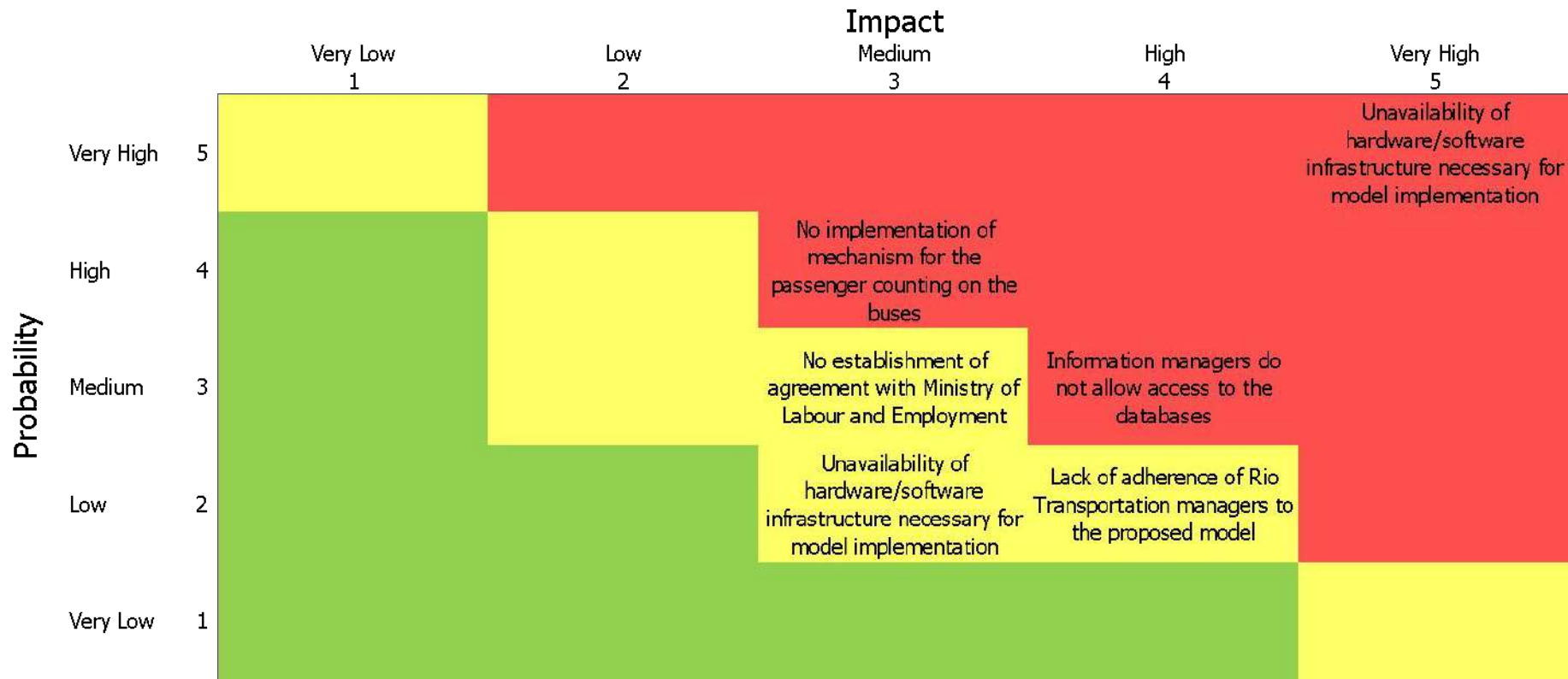
- Twitter and Facebook – necessary to establish agreement
- Passenger counting – the quantity of passengers traveling on the bus at a given period of time is completely unknown.
- Home x work commute – necessary to establish agreement with Ministry of Labor and Employment.

Restrictions

This model does not include:

- Passengers who were at bus stop and gave up taking the bus for any reason
- Users of private cars that would use the bus, if they realize any improvement in the quality of the service

Risks





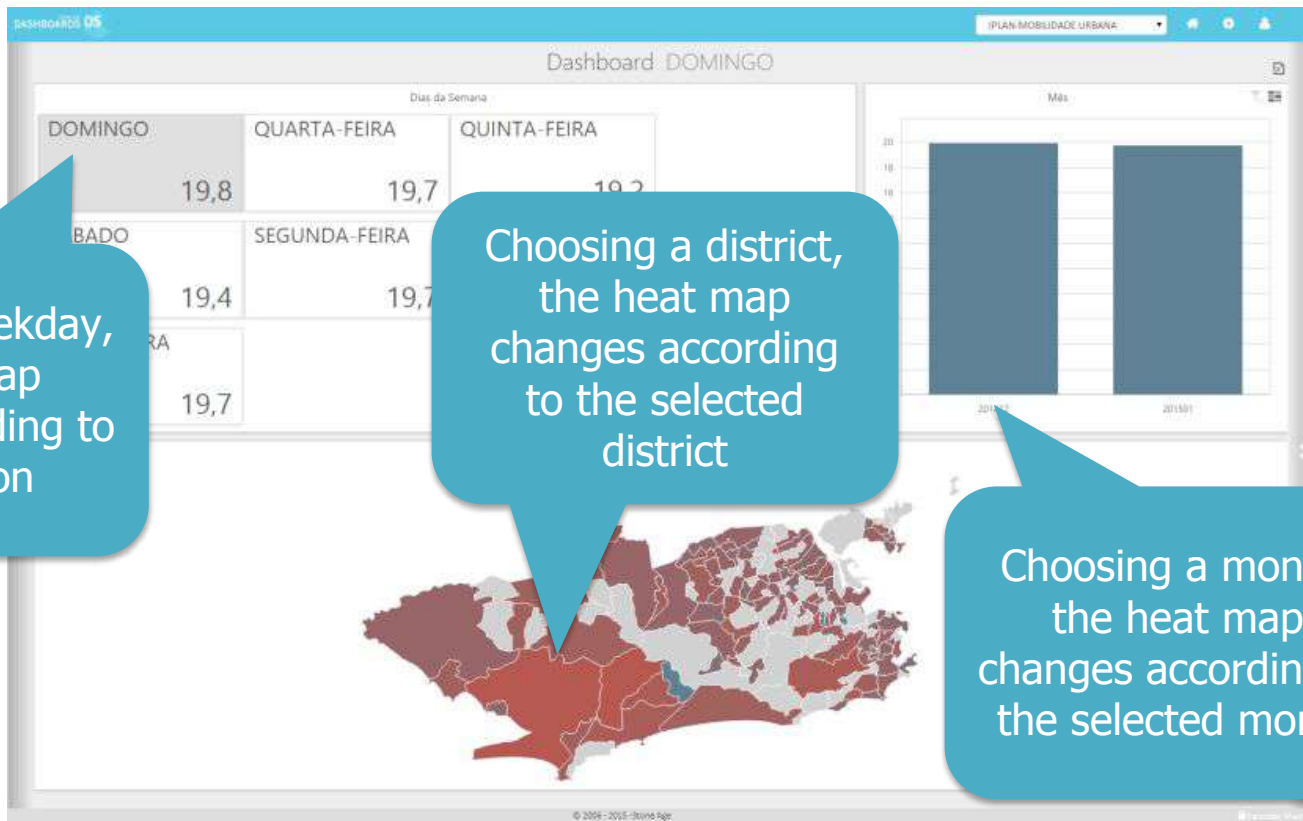
Bonus

Proof of Concept - PoC

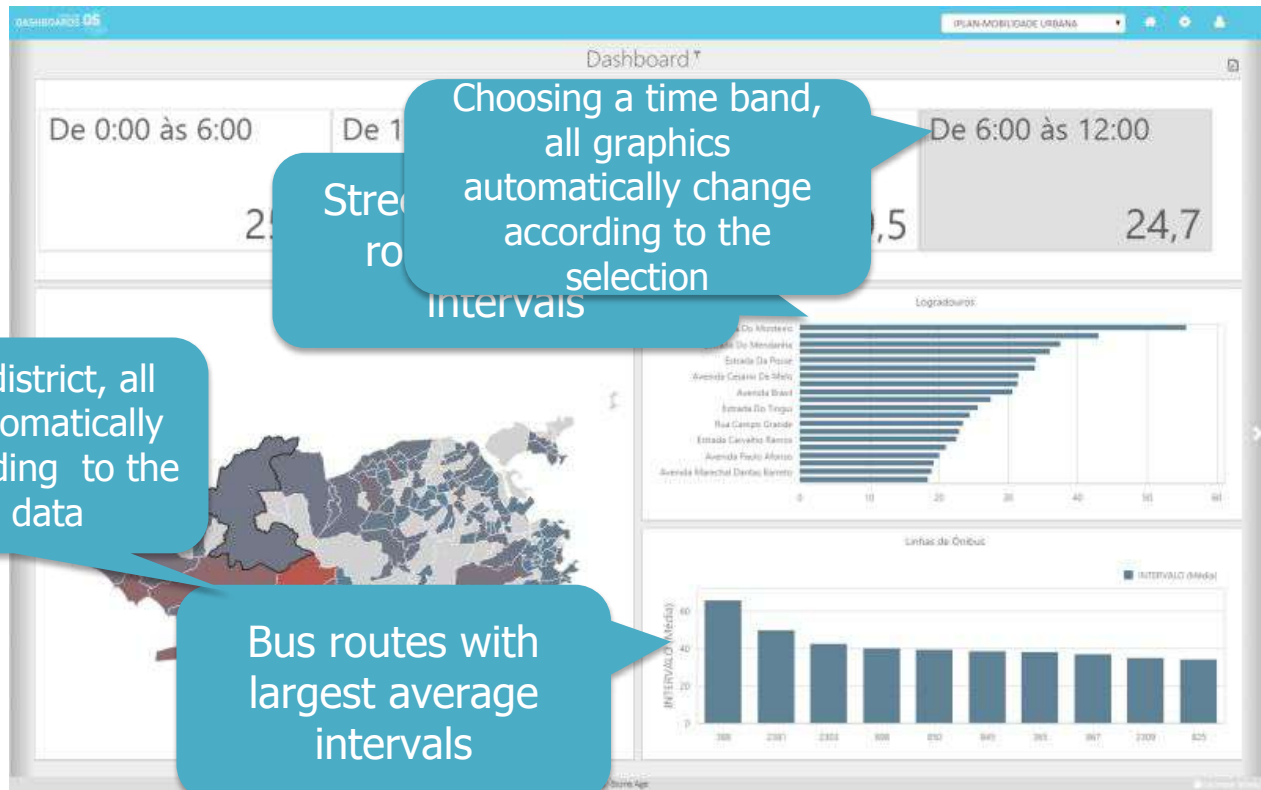
Focus in the analysis of city bus intervals, by time band, comparing to the contracted frequency (SLA).

Questions	Sources	Bus GPS	Driver's information	Daily Operations Report	Bus routes	Fleet information	Contracts SLAs	Maintenance	Fuel consumption	Demographic density	Public buildings	Events	Critical points of flooding	Bus fines	Building permits	Urban growth	Twitter	Facebook	Moovit	1RIO Complaints	Passenger counting	Bus stops	Home X Work Commute	Accidents	Public works	Pluviometer data	Waze	
Are the contracted SLAs meeting the city needs?																												
How long do the passengers wait for a given bus route at the bus stop?																												

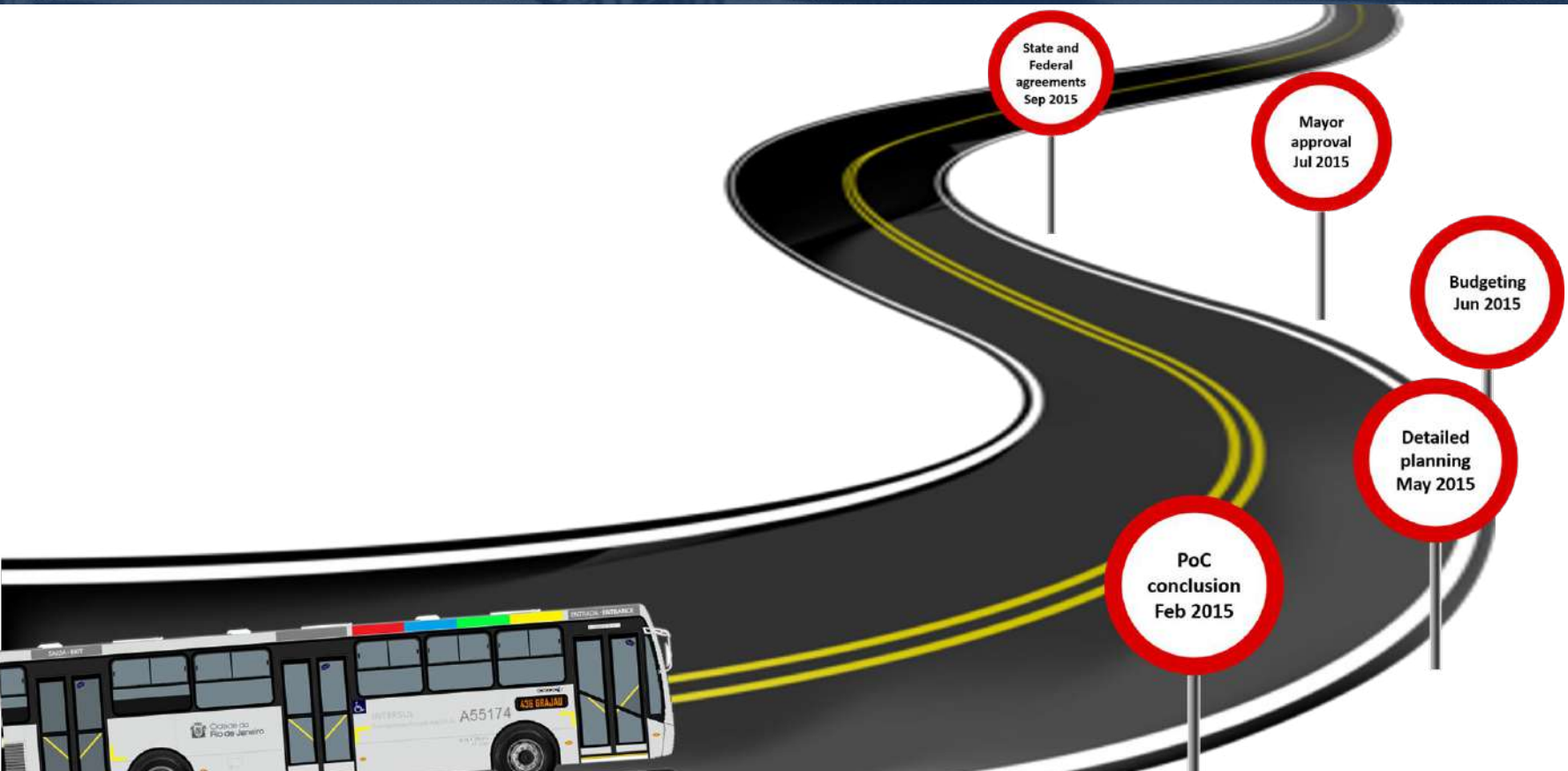
Dashboard – Heat map showing bus routes intervals



Dashboard - Time bands and routes average intervals



Project Timeline





Conclusions

Conclusions

- Establishing internal and external partnerships is a critical factor for a successful project implementation.
- The great part of sources used in our Big Data model is already available and the PoC has proved that it is feasible.
- The model can be used by other transportation agencies that have similar issues.
- The produced data may be made available to everyone who wishes (open data).
- Joining Big Data analytics and accountability can lead transportation management to a higher step in our city, improving the quality of life in Rio.

Thank you!!!

