São Paulo School of Advanced Science on Smart Cities

From urban data flows and civic hacking to a smart city software ecosystem

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Centro de Informática

C E S A R

Instituto Nacional de Ciência e Tecnologia para a Engenharia de Software

INES


Brasil
Bolívia
Paraguai
Chile
PORTODIGITAL

http://www.bbc.com/future/story/20131016-brazil-tech-hubs-big-ambitions

A brief chronology of a mid-term/long-term strategy

Qualification of lecturers from Centro de Informática

The creation of an IT-centered hub to fight brain-drain

A movement that reconstructed a degraded area of the city

An economical foundation to generate more work and revenue for the city

Some “smartness" aspects of Recife

The setting: A typical brazilian metropolitan city immersed in urban problems

Some IT companies flourished on solutions being used nationwide:
Avantia, Cittati, Colab.re, Epitrack, InLoco Media, Serttel/Samba, etc

INES - An institute focused on Software Engineering for Smart Cities

INCITI - An institute focused on City Innovation

A few isolated smart initiatives from government

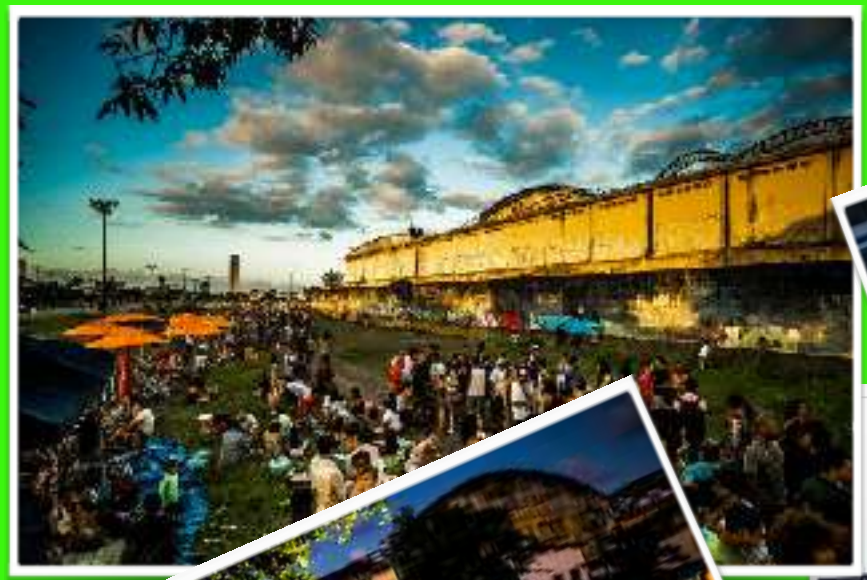
Still a **very** long way to go

but also,
strong **political engagement**
to
fight for the city


Tallest buildings on today`s Estelita skyline


Proposed project
(for the wealthy)

origin to a movement that in a sort of way resembled Turkey's **#occupygezi**



#OCUPE ESTELITA

Among you, who could share with us some story about similar development strategy or any fight for the city?

Going straight to the smart city subject...

The smart city concept is still very confusing

No consensus on a smart city definition

Several cities defining themselves smart using different perspectives

Green City

Virtual City

Wired city

Sustainable City

Digital City

Intelligent City

smart city

Ubiquitous City

Smart Community

Information City

Knowledge City

Learning City

Cocchia, Annalisa. "Smart and digital city: A systematic literature review." Smart city. Springer International Publishing, 2014. 13-43.

Google Imagens

smart cities

Masdar City

Initial steps (2012)

Project for 2025

New Songdo

How it was in 2013

Expected for 2020


WELCOME TO THE SMART CITY PLAZA


la ciudad


AYFN


6


FINLAND
SMART 24/7 CITY


A talking post? Sometimes, legends are true
PA system with public WI-FI


SiTecno
COMPLETE PLUG & PLAY SOLUTIONS
FOR SMART CITIES
SOLAR ENERGY KIT
SOLAR ENERGY KITS 250W to 100KW
On-grid, Off-grid & Hybrid
SOLAR STREET LIGHTING
STREET LIGHT LED 24 W to 140 W
3000 Lums to 19000 Lums


SMART CAFE


$mart
cities

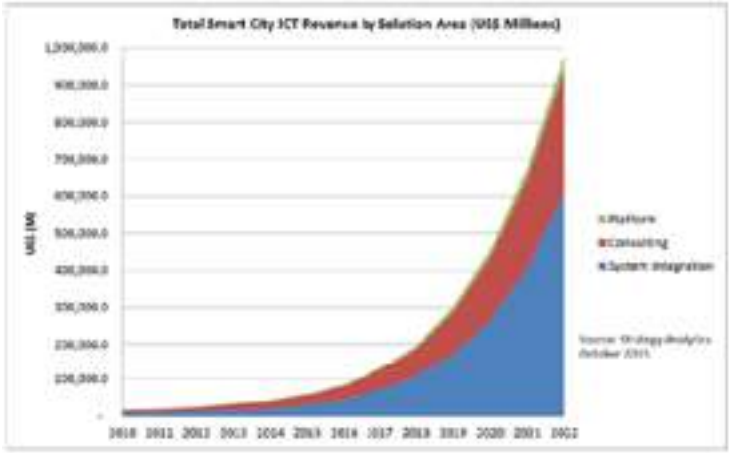
SIEMENS

Pictures of the Future

Why Cities are Getting Smarter

STRATEGY ANALYTICS

Strategy Analytics: Smart City ICT revenues are forecast to reach $977 Billion by 2022



Forbes / Autos

Free Webcast: 8 Billionaire Predictions For 2016

106,958 views

Smart Cities -- A $1.5 Trillion Market Opportunity

Egham, UK, March 18, 2015 View All Press Releases

Gartner Says Smart Cities Will Use 1.1 Billion Connected Things in 2015

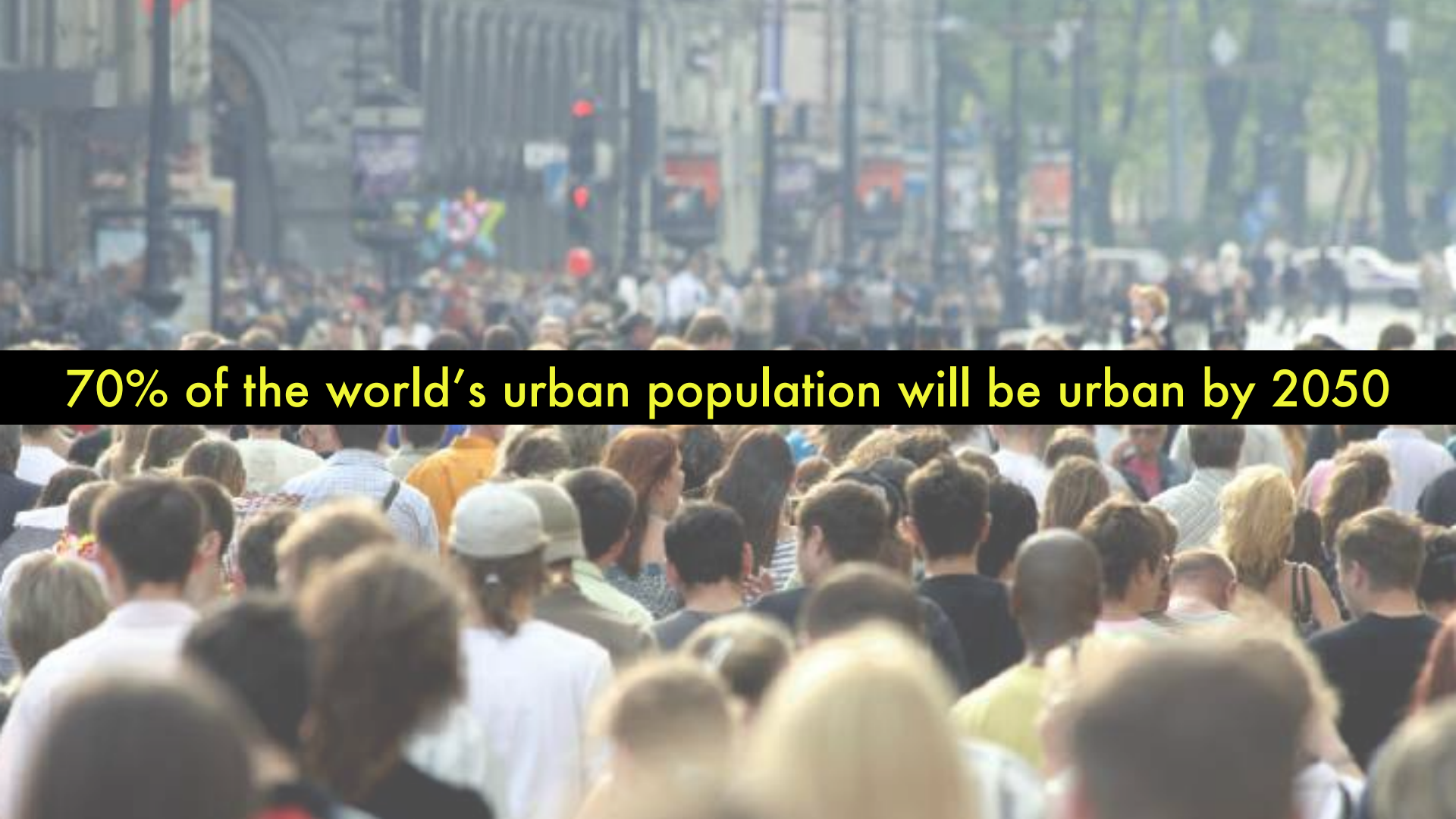
Egham, UK, December 7, 2015 View All Press Releases

Gartner Says Smart Cities Will Use 1.6 Billion Connected Things in 2016

Egham, U.K., February 7, 2017 View All Press Releases

Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016

Arguments from IT vendor based on United Nations data


70% of the world's urban population will be urban by 2050


84%
urban population in Brazil
2010

Photo: Henrique Boney

Photo: Business Insider

Photo: UOL

Photo: JC Online

SECURITY

EDUCATION

ENERGY

HEALTH

WASTE

WATER

Gather in groups of three, ideally from different countries (or at least different cities)

What are the most critical problems you can point out in your cities?

Any problem in common between your cities?

Are there solutions being developed/deployed?

Attempts to measure the "smartness"

Smart cities dimensions

SMART ECONOMY (Competitiveness)

- Innovative spirit
- Entrepreneurship
- Economic image & trademarks
- Productivity
- Flexibility of labour market
- International embeddedness
- *Ability to transform*

SMART PEOPLE (Social and Human Capital)

- Level of qualification
- Affinity to life long learning
- Social and ethnic plurality
- Flexibility
- Creativity
- Cosmopolitanism/Open-mindedness
- Participation in public life

SMART GOVERNANCE (Participation)

- Participation in decision-making
- Public and social services
- Transparent governance
- *Political strategies & perspectives*

SMART MOBILITY (Transport and ICT)

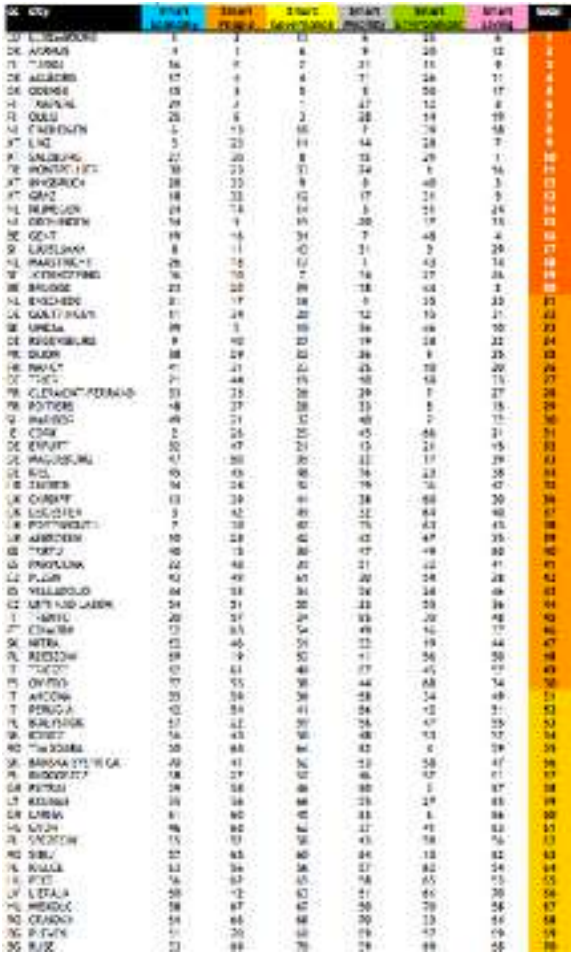
- Local accessibility
- (Inter)national accessibility
- Availability of ICT-infrastructure
- Sustainable, innovative and safe transport systems

SMART ENVIRONMENT (Natural resources)

- Attractivity of natural conditions
- Pollution
- Environmental protection
- Sustainable resource management

SMART LIVING (Quality of life)

- Cultural facilities
- Health conditions
- Individual safety
- Housing quality
- Education facilities
- Touristic attractivity
- Social cohesion



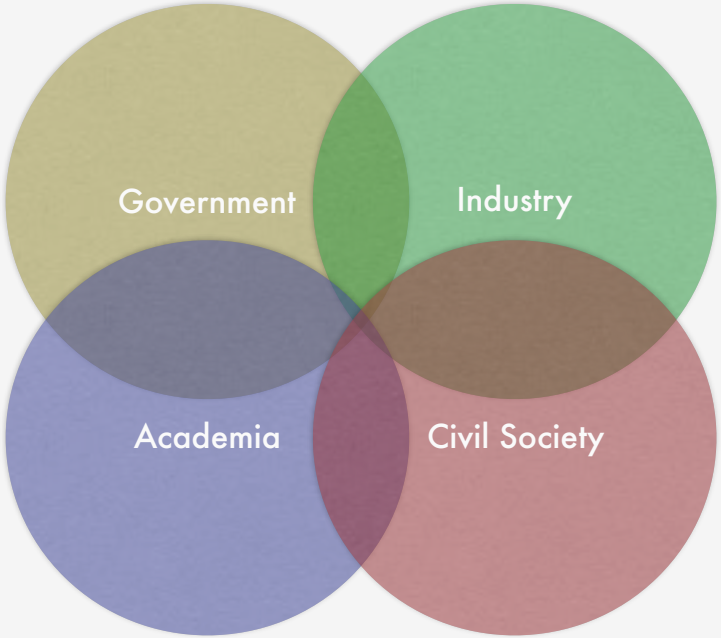
Giffinger, Rudolf, et al. "Smart cities. Ranking of European medium-sized cities, Final Report, Centre of Regional Science, Vienna UT." (2007): 303-320.

Dimension	Working Area	Indicator	Description
Environment			
Mobility			
Government			
Economy			
People			
Living			

Cohen, Boyd. The Smart Cities Wheel

Indicators clustered by 5 SC components:

- Smart Governance
- Smart Economy
- Smart Human Capital
- Smart Living
- Smart Environment



Lombardi, Patrizia, et al. "Modelling the smart city performance." Innovation: The European Journal of Social Science Research 25.2 (2012): 137-149.

System of systems: Having a holistic view is difficult

Photo: www.berries.com

Information silos:

- **Tool-centric**
- **Department-centric**
- **A reflex of institutional organization**


CENTRO DE OPERAÇÕES
PREFEITURA DO RIO

Vendor lock-in

too many promises

The Urban Panopticon

Urban Dynamics case in Portland

Generic system model of cities

3000+ equations describing the interaction of different city domains

The greatest revelation: Pro-bicycle policies would decline obesity

Townsend, Anthony M. *Smart cities: Big data, civic hackers, and the quest for a new utopia*. WW Norton & Company, 2013.

Chaordic Cities

chaos

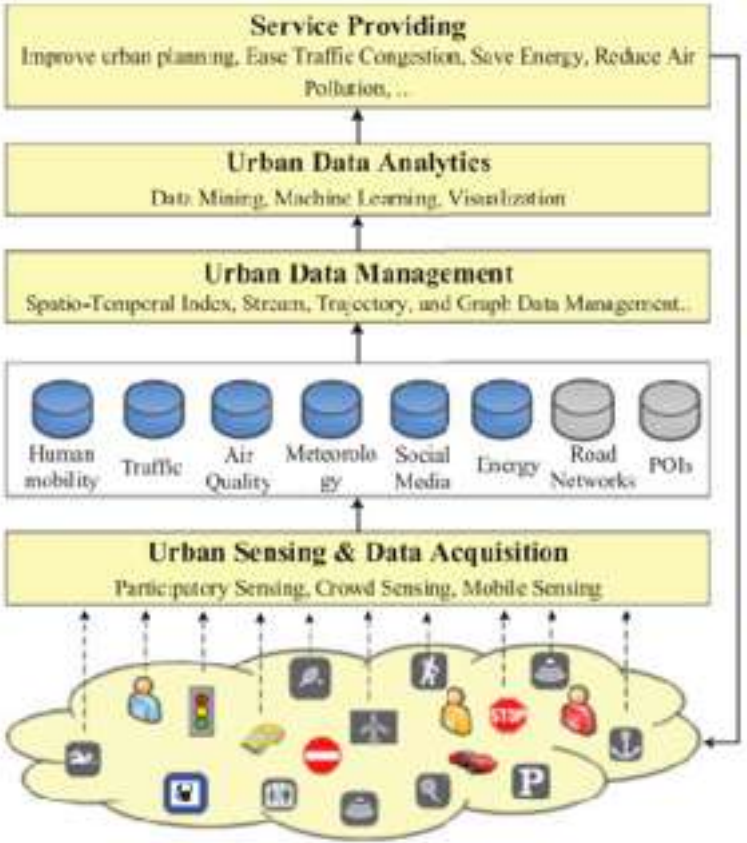
order

"...any self-organizing, adaptive, nonlinear complex system, whether physical, biological, or social, the behavior of which exhibits characteristics of both order and chaos"

Dee W. Hock (VISA founder)

Hock, Dee W. "The chaordic organization: Out of control and into order." World Business Academy Perspectives 9.1 (1995): 5-18.

Urban Computing and the promise of the magic box



Zheng, Yu, et al. "Urban computing: concepts, methodologies, and applications." *ACM Transactions on Intelligent Systems and Technology (TIST)* 5.3 (2014): 38.

Flows of information

Urban Sensing Systems
(LANE et al, 2008)

Participatory: Explicit user involvement

Opportunistic: Autonomous and Continuous

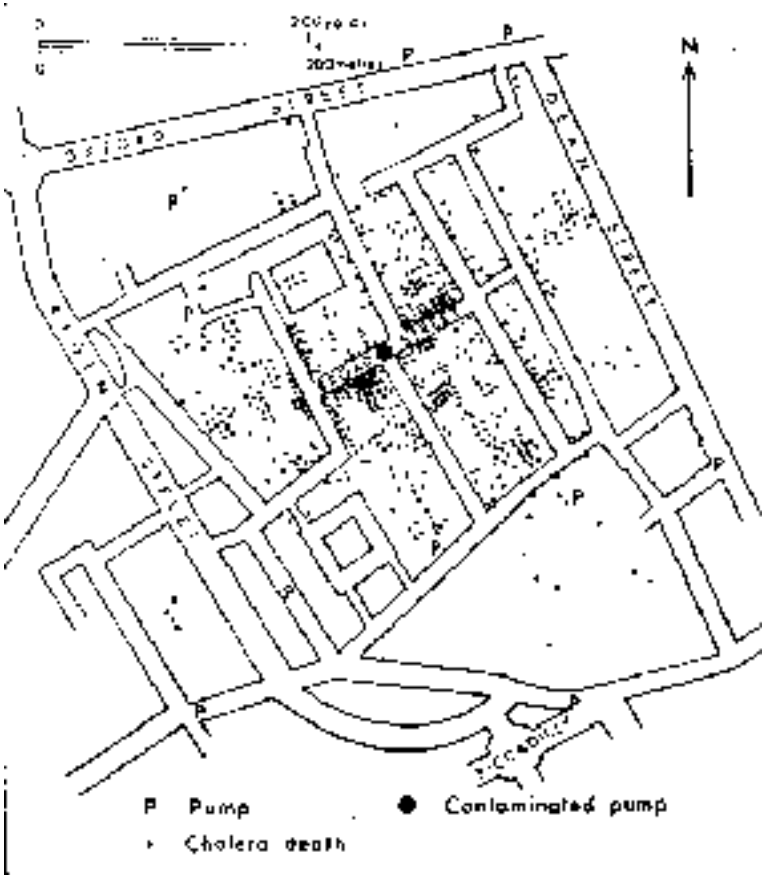
Mobile Crowdsensing Applications (MCS)
(GANTI et al, 2011)

MCS

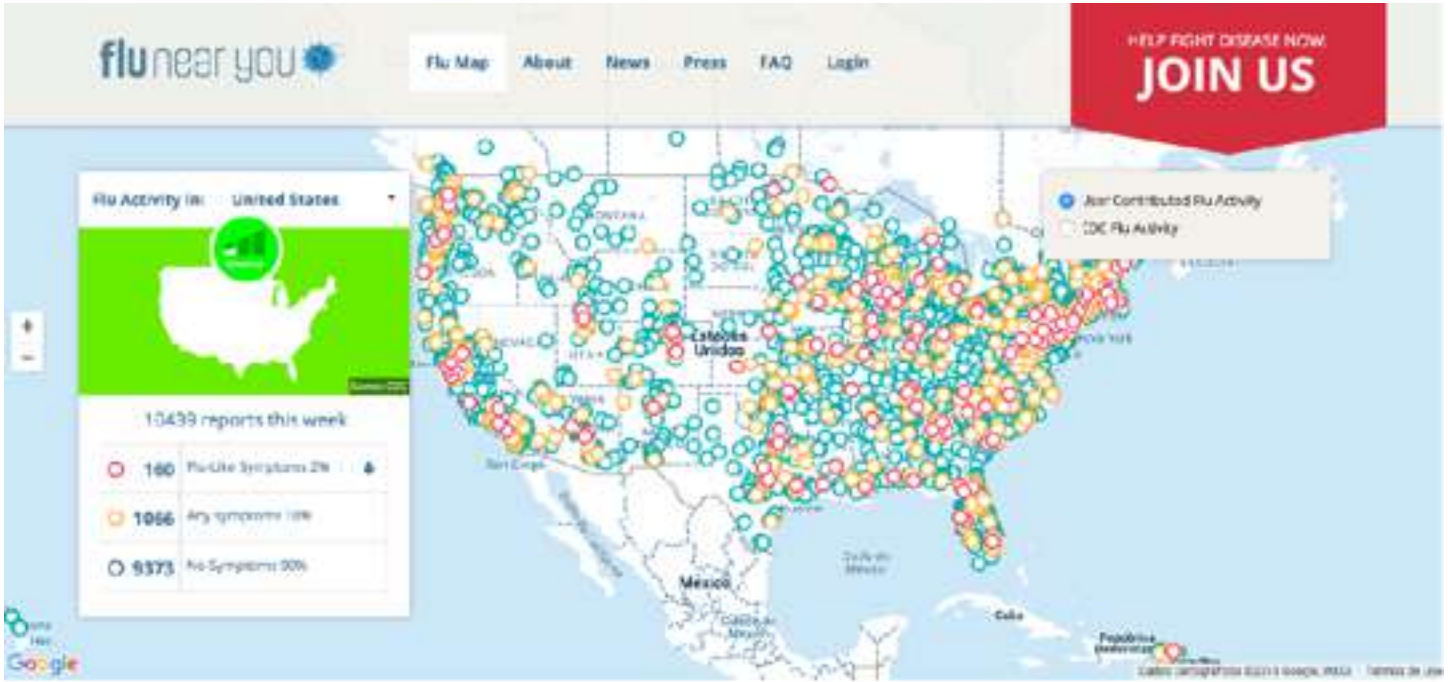
community sensing

Data of common interest, shared by smartphones

LANE, Nicholas D. et al. Urban sensing systems: opportunistic or participatory?. In: Proceedings of the 9th workshop on Mobile computing systems and applications. ACM, 2008. p. 11-16.

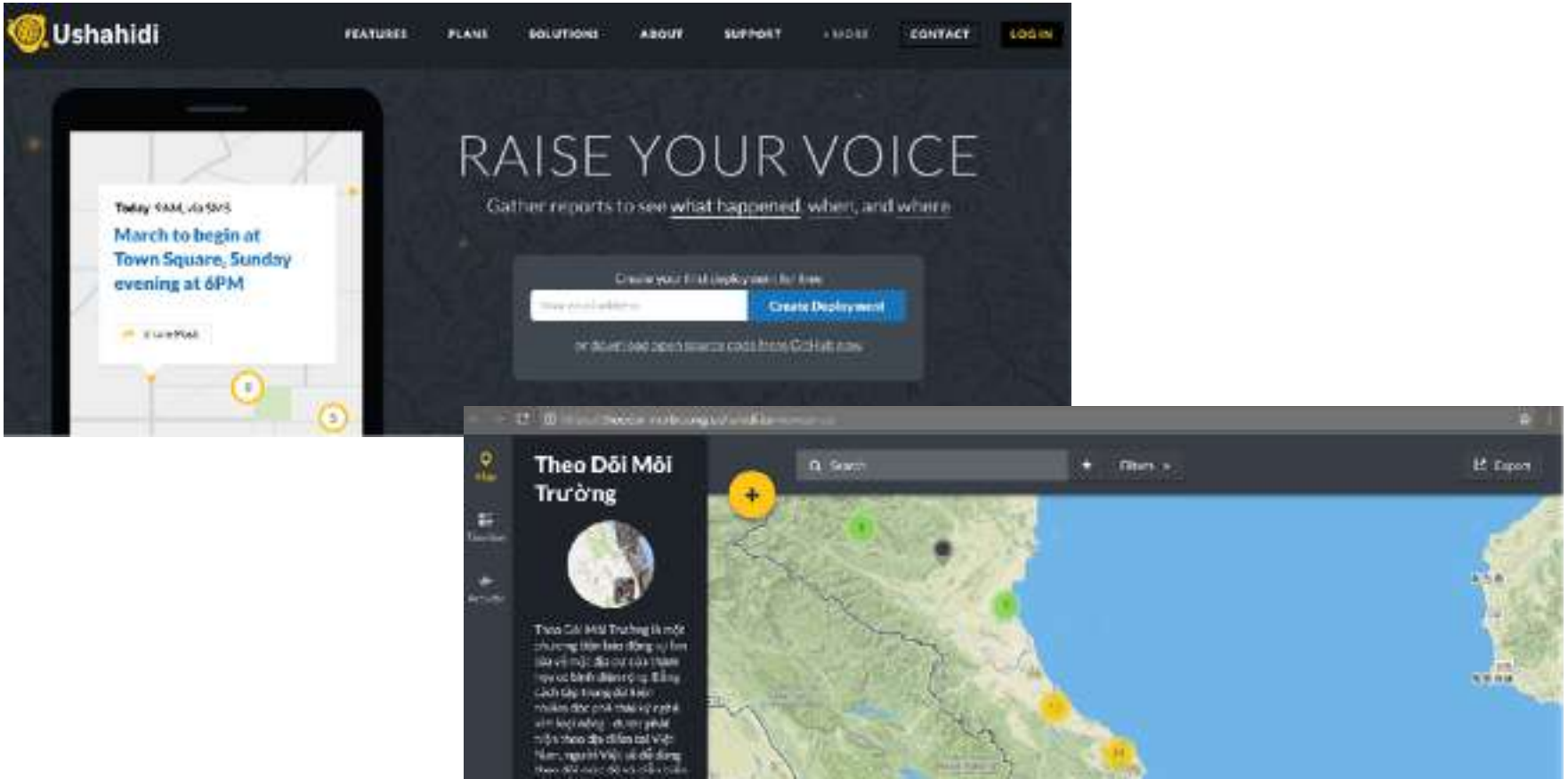


Cholera Mapping
London, 1854



made in Recife by Epitrack

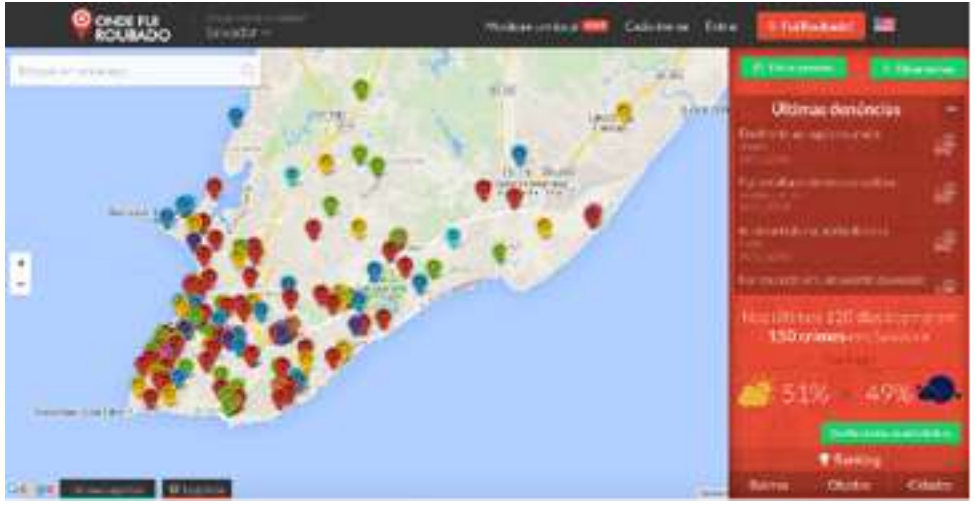
Platforms for Crowdsensing




PASADENA
City of Pasadena
PASADENA CITIZEN SERVICE CENTER
Citizens Connect
Recent Reports
My Reports
Favorite Reports
Tweets
Settings
About
BOS:311
New Report
Recent
My Reports
Favorites
Trash Alerts
My Info
How can we help?
Colab
Rede social para a cidadania

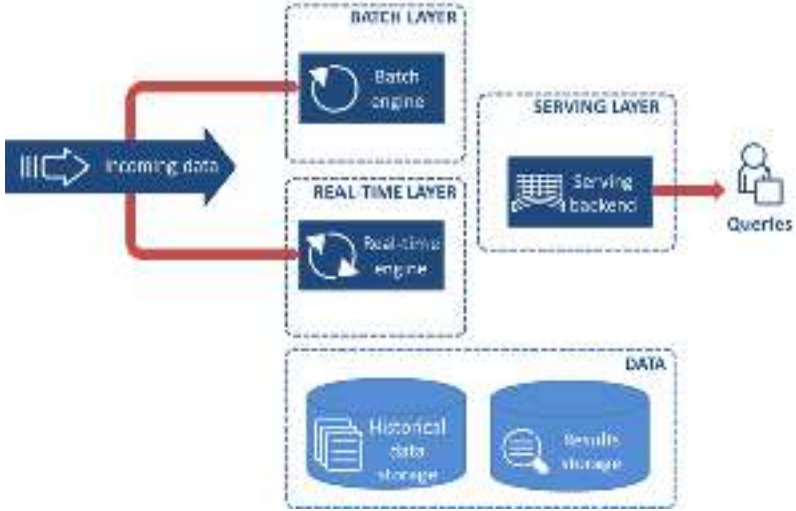
Challenges with the quality of crowdsensed data

Also: a limited and biased view of facts

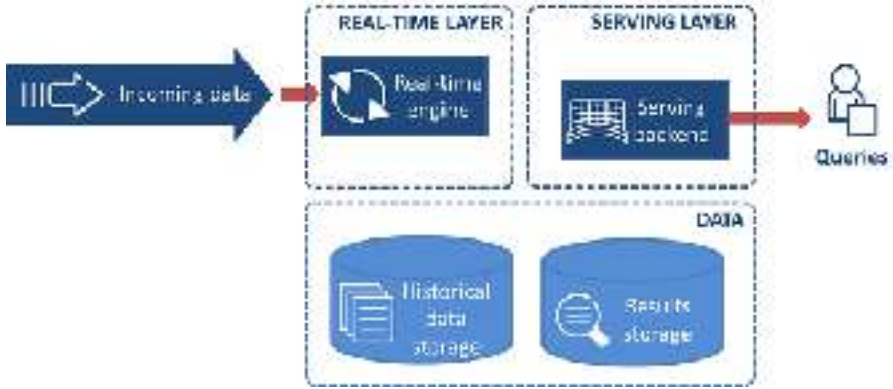


Architectures we are experimenting

Lambda



Kappa



https://www.ericsson.com/research-blog/data-processing-architectures-lambda-and-kappa/

How to make non-specialists deal with data from so many different flows?

Simplicity...

www.ifttt.com

Dealing with Complex Event Processing using programming styles:
SQL extensions, rule-based languages and imperative languages.

Esper's EPL

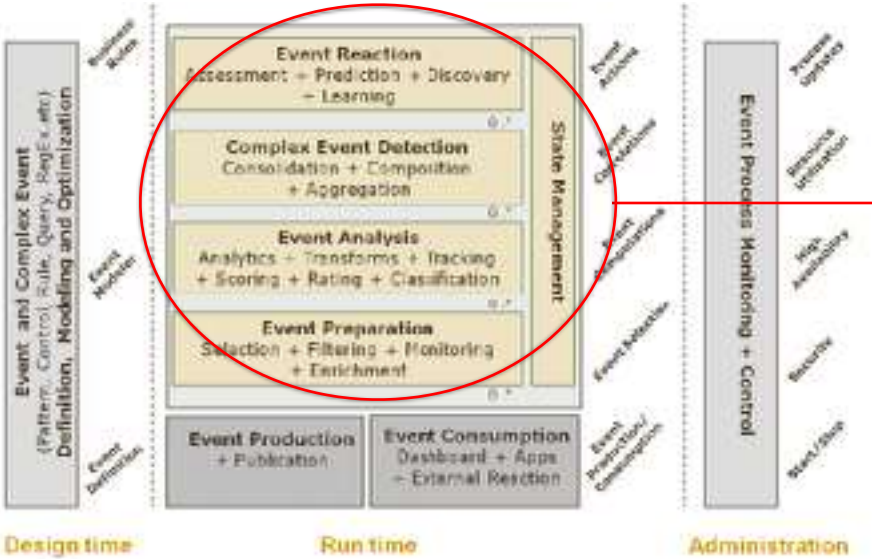
```
select * from TemperatureEvent
 match_recognize (
   measures A as temp1, B as temp2
   pattern (A B)
   define
     A as A.temperature > 400,
     B as B.temperature > 400)
```

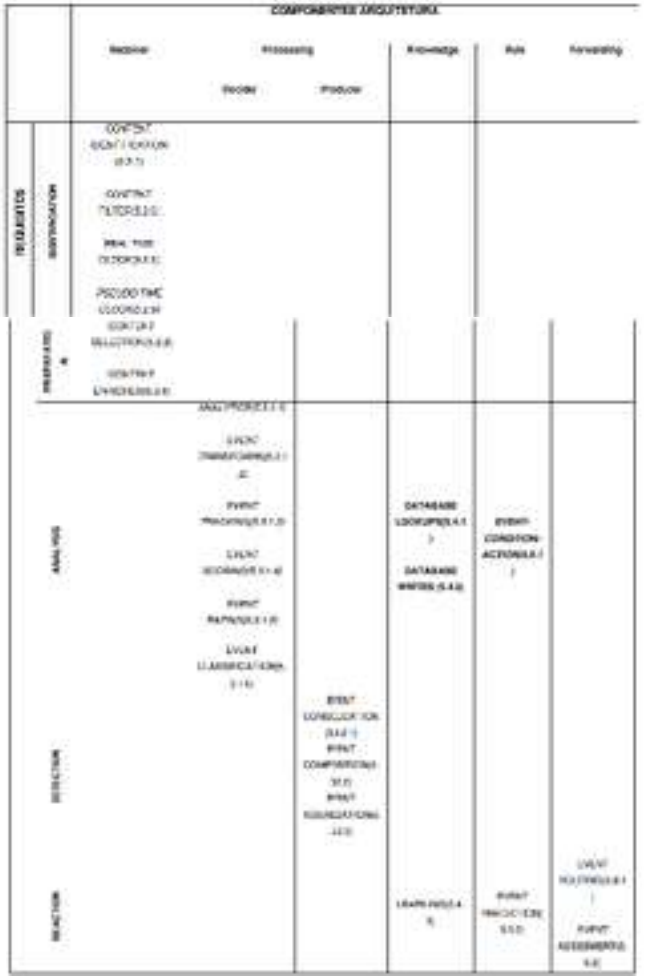
Drools Fusion

```
rule "Sound the alarm in case temperature rises above threshold"
when
    TemperatureThreshold( $max : max )
    Number( doubleValue > $max ) from accumulate(
        SensorReading( $temp : temperature ) over window:time( 10m ),
        average( $temp ) )
then
    // sound the alarm
end
```

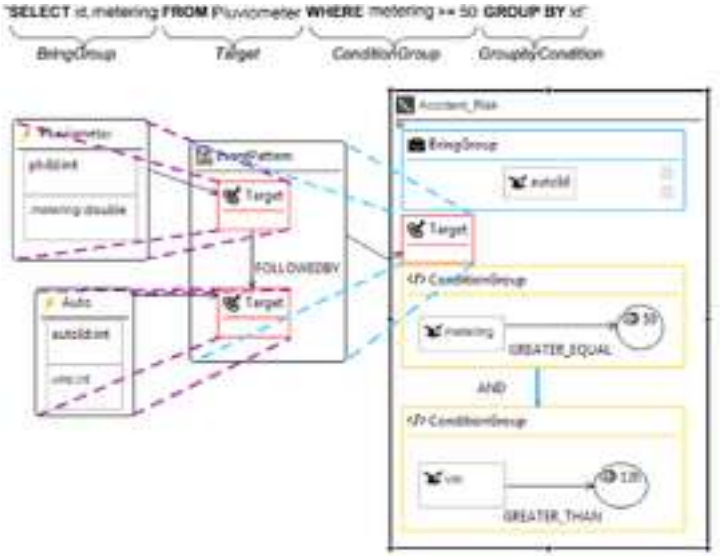
Apache Flink

```
Pattern<MonitoringEvent, ?> warningPattern =
Pattern.<MonitoringEvent>begin("First Event")
    .subtype(TemperatureEvent.class)
    .where(evt -> evt.getTemperature() >= TEMPERATURE_THRESHOLD)
    .next("Second Event")
    .subtype(TemperatureEvent.class)
    .where(evt -> evt.getTemperature() >= TEMPERATURE_THRESHOLD)
    .within(Time.seconds(10));
```





A catalog of design patterns inspired on
Hohpe & Woolf's Enterprise Integration Patterns



Herbertt Diniz (MSc) - Domain specific language for the abstraction of complex event processing solution
co-advisor: Robson Fidalgo

A set of Node-RED extensions for complex-event processing

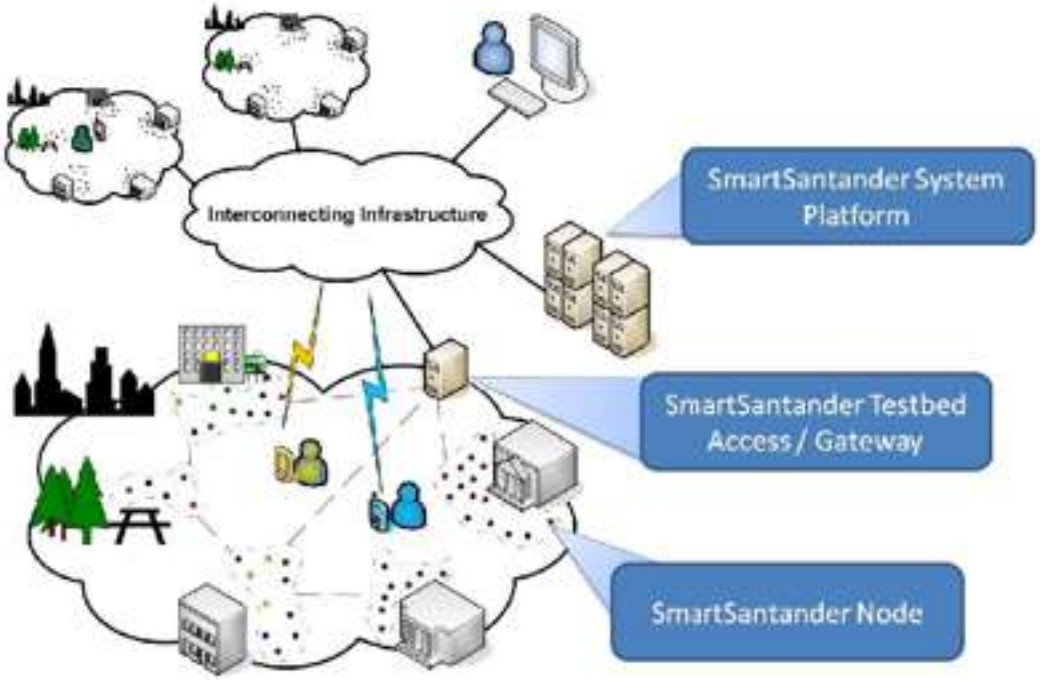
https://www.npmjs.com/package/node-red-contrib-cep

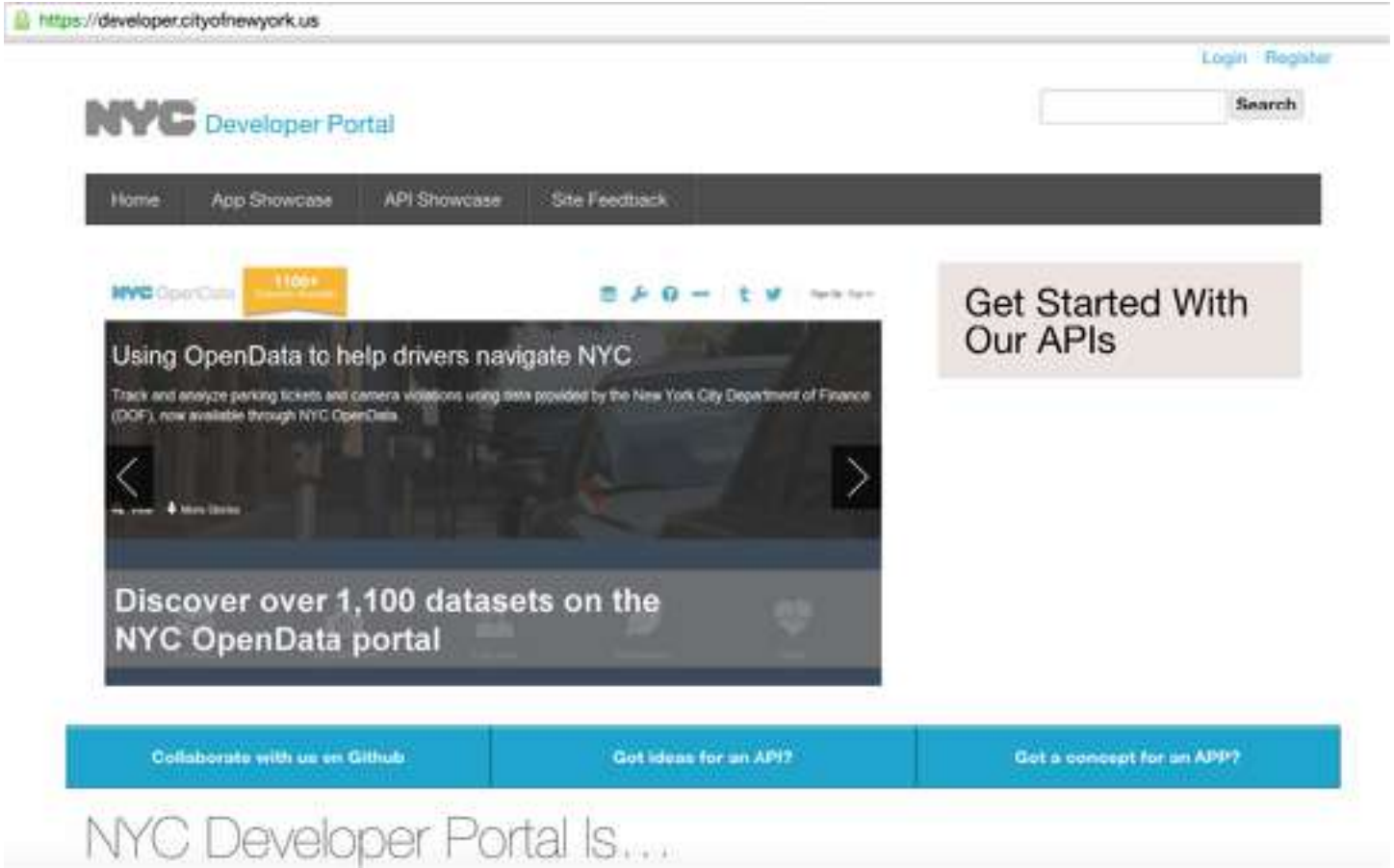
Integrating these flows
(some of which from the silos we discussed before)

SOA did not deliver what it promised

Instead, microservices took over

What if we "accessed" the City through an API?


Interconnecting Infrastructure
SmartSantander System Platform
SmartSantander Testbed Access / Gateway
SmartSantander Node


https://developer.cityofnewyork.us
Login Register
NYC Developer Portal
Search
Home
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API Showcase
Site Feedback
Using OpenData to help drivers navigate NYC
Track and analyze parking tickets and camera violations using data provided by the New York City Department of Finance (DOF), now available through NYC OpenData.
Discover over 1,100 datasets on the NYC OpenData portal
Get Started With Our APIs
Collaborate with us on Github
Got ideas for an API?
Got a concept for an APP?
NYC Developer Portal Is...

Top-down
x
Bottom-up

A “frugal" Smart City empirically raises as a collection of individual initiatives (bottom-up)

It may be non-holistic and lack strategic vision, but is pragmatic and cheaper.

The “evil side” of big technology suppliers remain trying to provide a top-down perspective to sell expensive products

smart cities

x

smart citizens


smart city expo
CITIES FOR CITIZENS
South Access


HUAWEI
World's First Visualized and Converged Command
Intelligent Operation Center


What do you expect from a smart city?
Stop talking about & Start taking action!
SAFER PEOPLE
Smart people
+ SCIENCE


Smart City: who is it for?

in a country of contrasts

Smart can’t be 100% technological

Many articles claim the importance of citizens being involved in smart cities solutions

We don’t see that much from us (IT people) talking about technology

[Multi|Inter|Trans]disciplinarity

In this path I had the opportunity to discuss and work with people from different backgrounds

Our IT knowledge and vision is not enough to tackle city problems

living lab

Important (although vague) concept for "human" smart cities

Conceive solutions for real problems

Technology as a possible means to an end

Citizens (users) involved in the process

Interdisciplinary approach

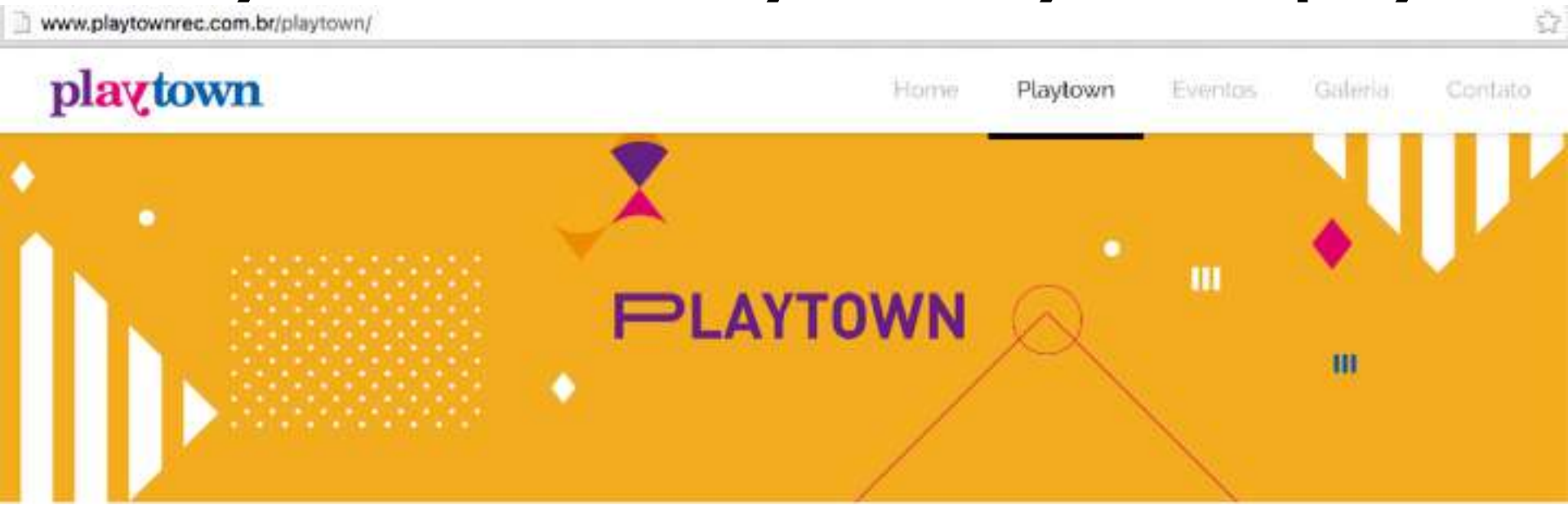
user-centered design

Implementation

Summer school

Empowering the Cart Haulers that collect recyclables

PlayTown: A ludic city where you can play



Open calls for citizen participation
Co-creation of ludic urban furniture together with citizens
Fab-lab infrastructure being used
Interdisciplinary approach to foster thinking “outside the box”
A different type of hackathon
As an immediate result, the transformation of the Recife Antigo neighbourhood
Potential incubation of winning projects

CESAR

RECIFE

Ministério do Turismo

GOVERNO FEDERAL BRASIL PÁTRIA EDUCADORA












playtown



Biblioteca de Troca


Intemporal


Urban Umbrella


Brincachão


Scaffolding Tile

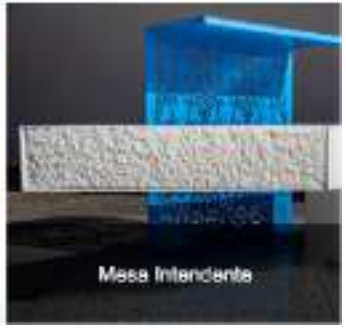

CONCURSO
FABLAB
IN
THE
CITY
OBRIGADO
PELA SUA
PARTICIPAÇÃO!


Kinematicity


Peças de Conversação


SitBIKE


Biocompostão no Largo


Mesa Intendente

Recife the Playable City

Intervenções urbanas

Interdisciplinaridade

Experiência lúdica

Interações pessoa-cidade


makerspaces
are key players in this setting

cultural obstacles

Photo: Guilherme Pinto

Assignment:

Thinking with a “bottom-up smart city" mindset, what problems did you see here or in your city could be overcome with the help of IT?
Who are the citizens that could benefit from that? What are their needs? (employ the techniques from Gemma’s workshop)
What resources are available (data, APIs)?
What can be made available through a possible solution?
Are there similar solutions ?
What professionals (from which disciplines) would be required to develop a solution in that context?
What obstacles would you have to overcome?