Data for public statistics:
Data Science, Big Data & Artificial Intelligence
20-21-22-23 May 2019
Brazilian Network Information Center – NIC.br
São Paulo, Brazil
Make Measurement Matter: Big Data and Artificial Intelligence for Monitoring and Promoting Sustainable Human Development

Emmanuel Letouzé, PhD
Director, Data-Pop Alliance | Director, OPAL Project
Visiting Scholar, MIT Media Lab | Connection Science Fellow, MIT

Eurostat New Techniques and Technologies for Statistics Conference
Brussels, March 14, 2019
Part 1:
Genesis, Context, Concepts and Questions of the 4th Industrial ‘Data’ Revolution

Part 2:
Statistical Measurement and Sustainable Development in the Age and Big Data and AI

Part 3:
Pillars and Pathways of a People-Centered, Data-Enabled Human Development Revolution: Towards and Human AI
Part 1: Genesis, Context, Concepts and Questions of the 4th Industrial ‘Data’ Revolution

Part 2: Statistical Measurement and Sustainable Development in the Age and Big Data and AI

Part 3: Pillars and Pathways of a People-Centered, Data-Enabled Human Development Revolution: Towards and Human AI
1. Are we ever going to be enslaved by AI-powered machines? Be discriminated by algorithms? Lose our jobs? Have a machine-driven war? Or all get paid to do no work? Hopefully and probably none of the above. But...

2. Can we envision and build a better world where humans and machines cooperate – and where measurements and facts matter for sustainable human development? a ”Human AI” or “human-machine ecology”? What would it feel like, look like, and take? Where are we now and can we go?
THE DATA REVOLUTION IS HERE!

The good news is we can now measure your poverty levels at amazing levels of geographic granularity in real time!

The bad news is we still can’t do anything about it.
HAL VARIAN PREDICTED: "THE SEXIEST JOB OF THE 21ST CENTURY WILL BE STATISTICIAN!"

Note that he didn't specify when in the 21st century.
SIRE! WE THINK YOU NEED BETTER DATA!

I THINK I NEED BETTER DATES..
A decade of “Data Revolution”; a decade until 2030: expectations, experimentations, controversies, slow changes…

“We are at the beginning of what I call The Industrial Revolution of Data.”
Joe Hellerstein, Nov. 2008

Fix Africa’s Statistics
By Marcelo Glugala

Off the map
Rich countries are deluged with data; developing ones are suffering from drought

The world’s most valuable resource
Data and the new rules of competition

AFRIQUE CONTEMPORAINE
La révolution des données est-elle en marche ?
Implications pour la statistique publique et la démocratie
Thomas Risa et Emmanuel Letouzé

PRINCIPLES for Digital Development

The data deluge
The Economist

D4D Challenge

BigData Challenge

The Datathon

Wired

The Economist

Why do we measure things? Does it matter? Why or why not? How can it matter more?
Statistiks “Science of the State”
invented here

GDP invented here
What about the SDGs?
### The (Big) Data Revolution, democracy, development and the Sustainable Development Goals

**DATA-POP ALLIANCE WORKING NOTE**

<table>
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<tr>
<th>No Poverty</th>
<th>Zero Hunger</th>
<th>Good Health and Well-being</th>
<th>Quality Education</th>
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<td>Industry, Innovation and Infrastructure</td>
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<td>Sustainable Cities and Communities</td>
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<td>Peace and Justice Strong Institutions</td>
<td>Partnerships for the Goals</td>
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**Reflections on Big Data & the Sustainable Development Goals:**

1. **How can (Big) Data help monitor the SDGs** by “filling data gaps” with more granular & disaggregated data—and what does measuring and monitoring something do to that something?

2. **How can (Big) Data help promote (or impede?) the SDGS** and their underlying human development vision and objectives—including towards and through lower (or higher?) inequalities?
# Big Data and AI’s relevance for SDG monitoring (from 2015)

Annex: Uses of Big Data for SDG monitoring

<table>
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<th>SDGs adopted by the OWG</th>
<th>Big data examples</th>
<th>What is monitored</th>
<th>How is monitored</th>
<th>Country(ies)</th>
<th>Year</th>
<th>Advantages of using big data</th>
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<td>Satellite data to estimate poverty</td>
<td>Poverty</td>
<td>Satellite images, night-lights</td>
<td>Global map</td>
<td>2009</td>
<td>International comparable data, which can be updated more frequently</td>
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<td>Estimating poverty maps with cell-phone records</td>
<td>Poverty</td>
<td>Cell phone records</td>
<td>Cote d’Ivoire</td>
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<td>Cheaper data available at higher frequencies</td>
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<td>Internet-based data to estimate consumer price index and poverty rates</td>
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<td>Cell phone records to predict socio-economic levels</td>
<td>Socio-economic levels</td>
<td>Cell phone records</td>
<td>“Major city in Latin America” (Actually Mexico City)</td>
<td>2011</td>
<td>Data available more regularly and cheaper than official data; informal economy better reflected</td>
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<tr>
<td>2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture</td>
<td>Mining Indonesian Tweets to understand food price crises</td>
<td>Food price crises</td>
<td>Tweets</td>
<td>Indonesia</td>
<td>2014</td>
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<td>Uses indicators derived from mobile phone data as a proxy for food security indicators</td>
<td>Food security</td>
<td>Cell phone data and airtime credit purchases</td>
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<td>Use of remote-sensing data for drought assessment and monitoring</td>
<td>Drought</td>
<td>Remote sensing</td>
<td>Afghanistan, India, Pakistan</td>
<td>2004</td>
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<td>3. Health</td>
<td>Internet-based data to identify influenza outbreaks</td>
<td>Influenza</td>
<td>Google search queries</td>
<td>US</td>
<td>2009</td>
<td>Real-time data; captures disease cases not officially recorded; data available earlier than official data</td>
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<td></td>
<td>Data from online searches to monitor influenza epidemics</td>
<td>Influenza</td>
<td>Online searches data</td>
<td>China</td>
<td>2013</td>
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<td>Detecting influenza epidemics using twitter</td>
<td>Influenza</td>
<td>Twitter</td>
<td>Japan</td>
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<td>Monitoring influenza outbreaks using twitter</td>
<td>Influenza</td>
<td>Twitter</td>
<td>US</td>
<td>2013</td>
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<td></td>
<td>Systems to monitor the activity of influenza-like-illness with the aid of volunteers via the internet</td>
<td>Influenza</td>
<td>Voluntary reporting through the internet</td>
<td>Belgium, Italy, Netherlands, Portugal, United Kingdom, United States</td>
<td>ongoing</td>
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<td>Cell phone data to model malaria</td>
<td>Malaria</td>
<td>Cell phone data</td>
<td>Kenya</td>
<td>2012</td>
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</tbody>
</table>
“...Big Data comes from things like location data off of your cell phone or credit card,

...the little data breadcrumbs that you leave behind you as you move around in the world...
Concepts: from big data to Big Data

Big Data is Not About the Data!

Gary King

“Big data [is] an ecosystem,” says @ManuLetouze of @datapopalliance, a global coalition that includes the @medianalab.
The C of crumbs—i.e. those “digital bread crumbs” or those “digital translations of human actions and interactions passively emitted and captured by digital devices”. At the center of our information societies is the production of massive amounts of data through connected platforms, social networks, and machines. This feature is important as it presides over a fundamental qualitative shift as much as a quantitative one and gives Big Data its deeply political nature.
The C of capacities—i.e. tools and methods to collect, aggregate and analyze data. Algorithms—to be defined and discussed below—fall squarely under capacities, and stand firmly at the center of this ecosystem, as both products and drivers of its expansion. Parallel computing is another key aspect without which Big Data would not exist as a techno-social phenomenon as it allows making computations in a fraction of the time—sometimes years—it would take to run them on one machine.
The **C of communities**—i.e. all those involved in generating, governing and using data, including data producers, end users, policymakers, experts, privacy advocates and civic hacker communities. Namely, groups. To date the two constituencies that have been the most active in leveraging algorithms to make decisions of not as the centerpiece of their business are large private companies and government agencies—notably those in charge of surveillance activities—with academia coming third and organized advocacy groups and networks (e.g. in the humanitarian space) coming fourth.
1. Big data (as data):
“Digital translations of human actions, interactions and transactions picked up by digital devices and services.”

2. Big Data (as a field of research and practice):
an ecosystem of the 3 Cs of Big Data as data ‘crumbs’, capacities (human and technical), and communities] producing and leveraging information to shape decisions.
Functions of Big Data

1. Descriptive
2. Predictive
   i. Forecasting
   ii. Nowcasting
3. Prescriptive
4. Discursive
Is this all really bad?

Data centers CO₂ emissions > entire airline industry

Computational Privacy
How human behavior bounds privacy and what we can do about it

The real digital divide is between families that limit screen time and those that don't

Is data a danger to the developing world?
By Kate Crawford
Nov 2 2015
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An illustrated introduction to predicting socioeconomic levels through cell-phone data.

Question: How is it possible to predict an area's socioeconomic level from the cell-phone data it emits?

Step 1: Fast forward to actual surveyed data. Hello, we are collecting an official survey. Are you poor or rich?

Step 2: Notice how cell phone users leave digital traces, day & night.

Telecom operator data center

And these CDRs will show differences in calling patterns between different areas...

Poor area

Rich area

Their "digital signature" will differ. And using computers and algorithms, we hope to find the strongest correlations between CDRs and survey data to build a predictive model.

Can then take CDRs from a later time in a different area and turn them into estimates of socioeconomic levels without a survey!
Scientific Prize and Ethics Mention: Construction of socio-demographic indicators with digital breadcrumbs
F. Bruckschen (1), T. Schmid (2), T. Zbiranski (1)

We show that socio-demographic indicators such as population, age, literacy, poverty, religion, ethnicity, electricity supply and others can be estimated in unprecedented detail and virtually ad-hoc using antennato antenna traffic data only. We offer a uniform approach that can be easily extended to other variables. Results are tested for spatio-temporal robustness and visualized as heat maps.

(1) Humboldt Universität Berlin, Germany - (2) Freie Universität Berlin, Germany
2013: Call for a “data revolution for sustainable development (...) to improve the quality of statistics and information available to people and governments”…

“Data are the lifeblood of decision-making and the raw material for accountability.

Governments, companies, researchers and citizen groups are in a ferment of experimentation, innovation and adaptation to the new world of data, a world in which data are bigger, faster and more detailed than ever before. This is the data revolution.”
Measurement ↔ Development?

Level of Development

HUMAN DEVELOPMENT INDEX (HDI) RANKS 2014

Top 5 Countries
1. Norway
2. Australia
3. Switzerland
4. Netherlands
5. United States

Bottom 5 Countries
1. Sierra Leone
2. Chad
3. Central African Republic
4. DR Congo
5. Niger

Quality of Development Measurement
Better Data ➔ Better Decisions ➔ Better Development?

Level of Development

Quality of Development Measurement
“Despite the many publications I think there are still many holes in our knowledge. There is a further need for empirical research on the lines of ‘political ethnography of indicators’.

Particularly is there a gap in theory and empirical studies on the line of causality from ‘data’ to ‘decisions’”

Morten Jerven, 2015

What does the evidence suggest?
Why?
Development vs. statistical capacity: a rather weak link
Development vs. statistical capacity: a rather weak link

So, what do we do?
Artificial intelligence—broadly-- is the simulation of human intelligence processes by computer systems, especially artificial neural networks (ANNs) inspired by the biological neural networks that constitute animal brains, which can "learn" (i.e. progressively improve performance on) through iterations and feedback. Basically it’s algorithms that learn to automate parts or all of tasks, and the machines they power. (It’s also what has not been invented yet)
The basics of AI is learning through *many* feedbacks

1. Try to guess / recognize. Right or Wrong?
2. Correct: +1. Reward!
4. Repeat and learn through a feedback loop.

⇒ (The) machine (is) learning!
From Big Data to AI: what can we learn?

1. It is at least 60+ years old.
2. It still generalizes poorly. It has no sense of context. **It is still pretty stupid.**
3. We are far from general AI.
4. **Humans are still in control** (for better or worse).

…it's neither new nor black magic…

…but…

1. The (good) magic / core of the current AI is the **credit assignment function** to encourage and reinforce neurons / functions that help the most achieve the goal (and reverse if not).
2. The key **difference and is data. Big Data.**
TOWARDS A HUMAN ARTIFICIAL INTELLIGENCE FOR HUMAN DEVELOPMENT

Emmanuel Letouzé¹, Alex Pentland²

¹Data-Pop Alliance, MIT Media Lab, and OPAL, ²MIT and Data-Pop Alliance, and OPAL

Abstract – This paper discusses the possibility of applying the key principles and tools of current artificial intelligence (AI) to design future human systems in ways that could make them more efficient, fair, responsive, and inclusive.

Keywords – Artificial intelligence, big data, human development, open algorithms, fourth industrial revolution
A positive vision: Towards “Human AI” ecologies

MIT Prof Alex ‘Sandy’ Pentland:

“The big question that I'm asking myself these days is how can we make a human artificial intelligence? (...) I don't want to think small—people talk about robots and stuff—I want this to be global. (...)

What would happen if you had a network of people where you could reinforce the ones that were helping and maybe discourage the ones that weren't? That begins to sound like a society or a company”.

The Human Strategy. www.thehumanstrategy.mit.edu
Main challenges to a Human AI

1. Powerful agents have an incentive for this not to work (e.g. economic and political elites benefit from status quo).
2. Most societies / countries currently lack appropriate data connections, capacities, and culture for this.
3. There is widespread digital and analog distrust, disdain, echo chambers, alternative facts narratives, hampering cooperation, consensus, compromise.

It is very hard for facts and measures to “matter”
“In this age of intense political conflict, we sense objective fact is growing less important. Experts are attacked as partisan, statistics and scientific findings are described as propaganda, and public debate devolves into personal assault. How did we get there and what can we do about it?”
Norway topped the ranking and North Korea came last.

**Top 10**
1. Norway
2. Iceland
3. Sweden
4. New Zealand
5. Denmark

**Bottom 10**
1. 158. Uzbekistan
2. T-159. DR Congo
3. T-159. Saudi Arabia
4. 161. Tajikistan
5. 162. Turkmenistan
6. Canada
7. 163. Equatorial Guinea
9. Switzerland
10. Finland

"Democracy is in trouble in the West, in the mature democracies of western Europe and the US, which are no longer obvious beacons for those striving for democracy in the nondemocratic world," the EIU said.
The US has been downgraded to a “flawed democracy,” but not just because of Trump.

![Graph showing US public trust in government from 1959 to 2014.](image)

**The Rich Get Richer**

Gap between top and bottom wage earners continues to widen.

- 10th Percentile of Earnings
- 90th Percentile of Earnings

![Graph showing weekly earnings of full-time workers from 1979 to 2016.](image)

Data, Statistics, Measurement, Development, and Democracy

Official statistics’ two main functions:
1) provide society with “knowledge of itself, on which to base its own choices and evaluate the effects of political decisions.”.
2) The second function of official statistics is provides a deliberative space where what is worth measuring, how it is measured, and for which purpose it is measured is freely and openly debated—to act as “a debated public institution”.

Statistics 2.0
The next level

By Enrico Giovannini

(2010)
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Part 3: Pillars and Pathways of a People-Centered, Data-Enabled Human Development Revolution: Towards and Human AI
There are reasons to be concerned…

Data centers CO₂ emissions > entire airline industry

Anonymousization
Privacy
Utility

Computational Privacy
How human behavior bounds privacy and what we can do about it

Is data a danger to the developing world?
By Kate Crawford
Nov 2 2015
But we can’t give up on (data) science and technology

Before the start of the demographic transition, life was short, births were many, growth was slow and the population was young.

How to ‘open’ private sector data safely, ethically, at scale?

On the privacy-conscientious use of mobile phone data

Yves-Alexandre de Montjoye, Sébastien Gambs, Vincent Blondel, Geoffrey Canright, Nicolas de Cordes, Sébastien Deletaille, Kenth Enge-Monsen, Manuel García-Herranz, Jake Kendall, Cameron Kerry, Gautier Krings, Emmanuel Letouzé, Miguel Luengo-Oroz, Nuria Oliver, Luc Rocher, Alex Rutherford, Zbigniew Smoreda, Jessica Steele, Erik Wetter, Alex “Sandy” Pentland & Linus Bengtsson

_Scientific Data_ 5, Article number: 180286 (2018) | Download Citation

Les Echos

Nos données peuvent-elles servir l'intérêt général ?

PROSPECTIVE - De plus en plus de voix s'élèvent pour demander que les données collectées par les entreprises privées soient mises au service de la collectivité.
“Open Algorithms” (OPAL): a revolutionary vision to make facts and measurements matter, and data, algorithms and AI ‘work’ for the majority and the SDGS

Elisabeth MEDOU BADANG, Porte-parole et directrice Afrique, Moyen-Orient, Orange Rabat, 2 juillet 2018


Open algorithms: A new paradigm for using private data for social good

By Thomas Roca, Emmanuel Letouzé | 18 July 2016

The Open Algorithm project: Developing indicators, capacity and trust

To address the complex challenge of data access, Orange, MIT Media Lab, Data-Pop Alliance, Imperial College London and the World Economic Forum — supported by Agence Française de Développement and the World Bank — are developing a platform to unleash the power of big data held by private companies for public good in a privacy-preserving, commercially sensible, stable, scalable and sustainable manner.

Mettre le Big Data privé au service du bien public

Le projet Open Algorithm vise à utiliser les données d’entreprises privées pour des actions de développement.
OPAL: Setting Human AI data systems and standards for sharing and using private data safely at scale

1. Partner private companies (here a telecom operator) allow OPAL to access its servers through a secured platform. The data never leave the servers.

2. Certified open algorithms developed by developers are sent and run on the servers of partner private companies, behind their firewalls.

3. A governance system including a Council for the Orientations of Development and Ethics (CODE) ensures that the algorithms and use cases are ethically sound, context relevant, etc.; users benefit from capacity building activities.

4. Key indicators derived from private sector data such as population density, poverty levels, or mobility patterns, feed into use cases in various public policy and economic domains. Data are safe, minimized, used (more) ethically.
OPAL is a unique case of a Public-Private-People Partnership piloted in Colombia and Senegal.
OPAL ambitions to radically change how data are shared and used to improve the state of the world

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<th>MVP Pilots 2017-18</th>
<th>Beta 2019-20</th>
<th>Scaling &amp; Expansion 2020-22</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
<td><img src="image3.png" alt="Image 3" /></td>
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### FEATURES

- **MVP Pilots 2017-18**
  1. Fully functional version of the core architecture
  2. Open code of the platform
  3. Three algorithms and indicators available
  4. Use cases

- **Beta 2019-20**
  1. Algorithm diversity (Bank/store)
  2. Easy monitoring/integration
  3. Enhanced security
  4. Friendly usability, SDK
  5. Representativeness and Stratification
  6. Upgraded capabilities
  7. Safe answer optimization
  8. Privacy research
  9. +1 new pilot

- **Scaling & Expansion 2020-22**
  1. Oversight and steering
  2. Legal and ethics (C.O.D.E.)
  3. Facilitating algorithm dev.
  4. User and developer support
  5. Knowledge and skills
  6. Research
  7. Business model & partner dev.
  8. New potential pilot countries

### NEW POTENTIAL PILOT COUNTRIES

- Chile
- El Salvador
- Haiti
- Mexico
- Ivory Coast
- Sierra Leone
- Kenya
- Moldova
- Jordan
- Tunisia

### NEW POTENTIAL INDUSTRIES

- Insurance
- Public Health
- Banking

### OPAL Becomes an Independent Legal Entity

“Other data sharing initiatives with private companies are also being worked on, including OPAL (...), to derive aggregated insights from a company’s data without data leaving the company’s server. If proven successful, this could be a powerful tool in unlocking private data for social causes.”

—McKinsey Global Institute “Applying AI for Social Good”, December 2018
OPAL will aim to query multiple data sources

First step
Level 1: Additive

1. Call algo on separate OPALs
2. Get individually aggregated results (current MIT OPAL demo)

OPAL’s vision
Level 2: Integrative

1. Call level 2-algo that runs across OPALs
2. Aggregate combined results
## Use cases in Senegal

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<th>Health</th>
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<td>Calibration and use of population density algorithm (with <em>Knuper</em>)</td>
<td>Granularity and explanatory factors of contagious diseases</td>
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<th><strong>Institut Pasteur</strong></th>
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<td>Analysis of monetary poverty</td>
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<td>Impact of road improvements on regional markets</td>
<td>Event detection</td>
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<th><strong>Urbanism</strong></th>
<th><strong>Agriculture</strong></th>
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<td>Analysis of mobility flows</td>
<td>Analysis of travel time and distance to regional markets</td>
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<th><strong>Migration and Stability</strong></th>
<th><strong>Agriculture</strong></th>
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<tr>
<td>Migrations and tensions between communities</td>
<td>Data Visualization and simulation tool</td>
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</table>

*Essec-Accenture*
Use case #1 in Senegal
How to build “data literacy”, connections, and “rational compassion” to make this work?

Building Literacy for the Data Generation
A unique opportunity exists to develop data literacy education for children born into a world shaped by big data.
Think about the need for ‘data literacy’ and reconsider as literacy in the age of data

"Writing is a strange thing. If my hypothesis is correct, the primary function of writing, as a means of communication, is to facilitate the enslavement of other human beings”.

If writing was not sufficient to spur knowledge, it may have been necessary to reaffirm domination structures. (…) The fight against illiteracy goes on par with an increase in the control of the Power over citizens.”

Avoid this with data to accelerate positive history
Think about the need for ‘data literacy’ and reconsider as literacy in the age of data

We define data literacy as the “the desire and ability to constructively engage in society through or about data”.

Building Literacy for the Data Generation

December 18, 2015

A unique opportunity exists to develop data literacy education for children born into a world shaped by big data.
Trainings Timeline

- **CAMBRIDGE, MA**
  - June 2016

- **BOGOTÁ, COLOMBIA**
  - December 2016
  - Learn more

- **SANTIAGO DE CHILE, CHILE**
  - March 2017

- **NAIROBI, KENYA**
  - June 2017
  - Learn more

- **SÃO PAULO, BRASIL**
  - September 2017
  - Learn more

- **MEXICO CITY, MEXICO**
  - October 2017
  - Learn more

- **DAKAR, SENEGAL**
  - March 2018

- **BANGKOK, THAILAND**
  - March 2018

- **CAMBRIDGE, MA (MIT)**
  - October 2018
  - Learn more

- **SANTO DOMINGO, DOMINICAN REPUBLIC**
  - April 2019
  - Learn more

- **TUNIS, TUNISIA**
  - April 2019
  - Learn more

- **BOGOTÁ, COLOMBIA**
  - May 2019
Data-Pop work and model (here example of LAC): Locally co-design and deploy regional research, training, and strategy programs and partnerships to leverage Big Data and AI for sustainable human development (including outside of LAC in Botswana, Togo, Turkey, Moldova, Turkey, Tunisia…)}
Why do we measure things? Does it matter? Why or why not? How can it matter more?

Measurement only matters when people care. Measurement is meant to signal and strengthen care about what gets measures; to turn codes into norms. Typically, in simple systems measurement becomes unnecessary once people care about what is measured. In complex system like human societies, the language, appetite for, skills and culture of measurement used and promoted wisely and with “rational compassion”, remains a very powerful tool to instill change.
Thank you

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